Lexicon of Geologic Names Of the United States For 1936-1960

Part 2, G–O

GEOLOGICAL SURVEY BULLETIN 1200

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By GRACE C. KEROHER *and others*

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A compilation of the geologic names of the United States, its possessions, the Trust Territory of the Pacific Islands, and the Panama Canal Zone

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Gabbs Formation[1]

Upper Triassic: Southwestern Nevada.

Original reference: S. W. Muller and H. G. Ferguson, 1936, Geol. Soc. America Bull., v. 47, p. 241–252.

H. G. Ferguson, S. W. Muller, and S. H. Cathcart, 1954, U.S. Geol. Survey (geol.) Quad. Map GQ–45. Described in Mina quadrangle where it consists of sandy shale and limestone in upper part, brown shaly limestone in middle, and black carbonaceous shale with a few beds of black impure limestone, weathering purple, in lower part. Thickness at type locality 420 feet. Overlies Luning formation; underlies Sunrise formation.

Named for Gabbs Valley Range, where it is well exposed in New York area.

Gabilan Limestone[1]

Pre-Franciscan: Western California.

Original reference: G. F. Becker, 1888, U.S. Geol. Survey Mon. 13, p. 128, 181.

I. F. Wilson, 1943, California Jour. Mines and Geology, v. 39, no. 2, p. 193, 224 (fig. 3). Described as a white to bluish-gray, thoroughly recrystallized marble, commonly exhibiting faint banding. Occurs as isolated roof pendants in Santa Lucia granite and as fault breccia along San Andreas fault zone.

Occurs in San Francisco Bay region.

Gabilan Mesa Quartz Diorite

[Cretaceous]: Central western California.

G. H. Curtis, J. F. Evernden, and J. Lipson, 1958, California Div. Mines Spec. Rept. 54, p. 9. Discussed in paper dealing with potassium-argon age determinations. Age given as 83.8 million years.

Occurs in Gabilan Mesa, which covers an area of approximately 250 square miles east of Salinas Valley. Oldest sedimentary rock resting in depositional contact on flanks of mesa is Miocene in age. Dated specimen collected in sec. 29, T. 17 S., R. 7 E., on road to Pinnacles National Monument, 3.2 miles east of its junction with Metz Road.

Gaddes Basalt (in Ash Creek Group)

Precambrian (Yavapai Series): Central Arizona.

C. A. Anderson and S. C. Creasey, 1958, U.S. Geol. Survey Prof. Paper 308, p. 10–11, pl. 1. Forms black to dark-green outcrops. On unweathered surfaces basalt is dark green. Chiefly pillow lavas; local intercalated rhyolitic flows. Pyroclastic rocks of highly vesicular or amygdaloidal, irregular-shaped basaltic fragments resembling lapilli and small bombs appear in bodies of small size east of Mingus Mountain. Pillow structures range from 1 to 5 feet in length and average 1½ to 2 feet. Estimated thickness in Black Canyon, 2,000 to 2,500 feet. Underlies Buzzard rhyolite (new).

Good exposures in Gaddes Canyon, south of Mingus Mountain, and in Black Canyon, Jerome area, Yavapai County.

Gadsden Limestone (in Ocala Group)

Eocene, upper: Northwestern Florida (subsurface).

W. E. Moore, 1955, Florida Geol. Survey Bull. 37, p. 21 (table 1), 30, 42–44. Introduced for some limestones of Jackson age that occur in subsurface sections of southeastern Jackson County. Consists of those limestones that have no, or few, specimens of the larger Foraminifera such as *Lepidocyclina*, *Asterocyclina*, or *Operculinoides*. Underlain in Jackson County by Marianna limestone. Stratigraphic equivalent of Crystal River formation which includes the Bumpnose member. Grades laterally into Crystal River formation, and youngest Gadsden beds extend farthest to northwest. Depending upon where the Gadsden is encountered, it is underlain by the Crystal River formation or by older Eocene formations. Overlies Tallahassee limestone in well W–4 in Gadsden County. Thickness 0 to 180 feet in Jackson County. Gadsden is confined to area southeast of Cypress fault, and from fault it thickens to southeast at expense of Crystal River.

H. S. Puri, 1957, Florida Geol. Survey Bull. 38, p. 34–35. Appears to be a faunal facies of the Crystal River. Suggested that name be abandoned.

Named for occurrence in City of Quincy water well W–4, Gadsden County.

Gaffney Marble[1]

Gaffney Formation

Mississippian: Northwestern South Carolina and southern North Carolina.

Original reference: A. Keith and D. B. Sterrett, 1921, Limestones and marls of North Carolina, by G. F. Loughlin and others: North Carolina Geol. and Econ. Survey Bull. 28, p. 28, 72–75.

T. L. Kessler, 1944, Geol. Soc. America Bull., v. 55, no. 6, p. 756, 764, 776, 780. The quartzite, carbonate-silicate rocks, and crystalline limestone have been mapped as Cambrian (the Kings Mountain, Blacksburg, and Gaffney formations). Near Kings Mountain, mica schist and gneisses previously mapped as Carolina gneiss, and hornblende gneisses previously mapped as Roan gneiss actually constitute the metamorphosed upper part of the Gaffney; names Carolina and Roan, therefore, have lithologic but not stratigraphic significance.

U.S. Geological Survey currently designates the age of the Gaffney Marble as Mississippian on the basis of a study now in progress.

Named for exposures at Gaffney, Cherokee County, S.C.

Gage Shale Member (of Doyle Shale)

Gage Shale (in Chase Group)[1]

Permian: Southeastern Nebraska and eastern Kansas.

Original reference: G. E. Condra and J. E. Upp, 1931, Nebraska Geol. Survey Bull. 6, 2d ser., p. 45.

R. C. Moore and others, 1951, Kansas Geol. Survey Bull. 89, p. 44. As currently defined, consists mostly of clayey shale with calcareous fossiliferous shale and a minor amount of limestone in upper part; lower and middle parts are chiefly varicolored noncalcareous shale consisting of red, green, purple, and chocolate-colored zones interbedded with gray and yellow layers. Thickness approximately 45 feet. Overlies Towanda limestone member; underlies Stovall limestone member of Winfield limestone.

Type locality: Between 1 and 2 miles south of west side of Wymore, Gage County, Nebr.

Gaikema Sandstone (in Tuxedni Group)

Gaikema Sandstone Member (of Kialagvik Formation)

Gaikema Sandstone Member (of Tuxedni Formation)

Middle Jurassic: Central southern Alaska.

C. E. Kirschner and D. L. Minard, 1948, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 95 [1949]. Member of Kialagvik formation. Predominantly of resistant cliff-forming sandstone beds 1 to 10 feet thick; usually separated by thin laminae of siltstone. Pebble lenses common and several conglomerate beds present. Thickest conglomerate bed approximately 50 feet. Rocks are dark green in fresh exposure and dark brown in weathered exposures. Thickness ranges from 500 feet in southern part of outcrop area to about 970 feet in northern part. Overlies unnamed siltstone member; underlies Tuxedni formation. Lower Jurassic. Name credited to Kellum and Wedow (rept. in preparation).

R. W. Imlay, 1953, U.S. Geol. Survey Prof. Paper 249-B, table 5 facing p. 60. Assigned to Tuxedni formation. Lies between two unnamed siltstone members. Middle Jurassic.

U.S. Geological Survey currently classifies the Gaikema Sandstone as a formation in Tuxedni Group on the basis of a study now in progress.

Well exposed on Gaikema Creek, in northern part of Iniskin Peninsula.

Gailor Dolomite

Lower Ordovician: East-central New York.

D. W. Fisher and G. F. Hanson, 1951, Am. Jour. Sci., v. 249, no. 11, p. 797, 803 (fig. 3), 807–808, 811–812, 813. Because *Ophileta*, *Helicotoma*(?) *uniangulata*, and *Ectenoceras* are exclusive Canadian index fossils, the latter two indicative of the Lower Canadian, the age of the cherty dolomite above Mosherville sandstone (new) is established as lowermost Ordovician. Name Little Falls dolomite for these beds is in error, and name Skene dolomite (Wheeler, 1942) is not applicable because it was defined as Upper Cambrian. Hence, name Gailor dolomite is proposed for these beds. Thickness varies from about 80 feet in northern part of Amsterdam quadrangle to about 150 feet in Saratoga region. West of Petrified Sea Gardens, formation is capped by massive 6-foot gray chert bed which locally contains *Cryptozoon*. Underlies Tribes Hill limestone in western part of area and Amsterdam limestone in eastern part of area. Section at Rock City Falls shows 12 feet of Gailor dolomite below thin Lowville limestone. Mosherville sandstone also referred to as basal member of Gailor.

D. W. Fisher, 1954, Geol. Soc. America Bull., v. 65, no. 1, p. 85. Traced into Fort Johnson member (new) of Tribes Hill formation in Mohawk Valley. Debatable whether some of dolomite beneath the Fort Johnson in that area should be assigned to the Gailor.

Type locality: Gailor quarry at northern edge of city of Saratoga Springs, one-eighth mile west of U.S. Highway 9, Saratoga County.

Gaines Group

Gaines Stage

Upper Cretaceous (Chico): Northern California.

F. M. Anderson, 1937, (abs.) Am. Assoc. Petroleum Geologists Bull., v. 21, no. 12, p. 1612. Group in lower part of Chico series; embraces late Albian to Turonian. Thickness 5,300 feet. Underlies Panoche group.

F. M. Anderson, 1943, California Div. Mines Bull. 118, pt. 2, p. 185 (fig. 69) [preprint 1941]. Shown as a stage, based on a faunal assemblage, in Pioneer group.

Group present in western Shasta County.

†Gainesville[1]

Lower Cretaceous (Comanche Series): Northeastern Texas and southwestern Arkansas.

Original reference: F. W. Cragin, 1895, Am. Geologist, v. 16, p. 384–385.

Named for Gainesville, Cooke County, Tex.

Gainesville Sandstone Bed (in Blackjack Knob Member of Theodosia Formation)

Lower Ordovician: Southern Missouri and northern Arkansas.

J. S. Cullison, 1944, Missouri Univ. School Mines and Metallurgy Bull., Tech. Ser., v. 15, no. 2, p. 31, pl. 2. Fossiliferous sandstone at least 8 feet thick that occurs near the base of the Blackjack Knob.

Well exposed on Missouri Highway 80 just east of county seat [Gainesville] of Ozark County, Mo.

Gakona Formation[1]

Eocene, upper: Southeastern Alaska.

Original reference: W. C. Mendenhall, 1905, U.S. Geol. Survey Prof. Paper 41, p. 52, map.

Occurs east of Gakona Glacier, central Copper River district.

Galap Sub-Member (of Ngarsul Member of Aimeliik Formation)

Eocene: Caroline Islands (Palau).

U.S. Army Corps of Engineers, 1956, Military geology of Palau Islands, Caroline Islands: U.S. Army Corps of Engineers, Far East, p. 44, pl. 8. Andesitic-basaltic tuff intercalated with tuff breccia in lower part of Ngarsul member (new).

Occurs only in north part of Babelthuap Island on Arekalong Peninsula. Well exposed along coast north of village of Galap.

Galata Ash

[Recent]: Northwestern Montana, and Alberta, Canada.

Leland Horberg and R. A. Robie, 1955, Geol. Soc. America Bull., v. 66, p. 949–955. Volcanic ash layer that occurs in postglacial alluvium and colluvium at several localities. Stratigraphic relations and physical properties indicate a single episode of volcanic activity and possible correlation with an ash layer in southeastern Glacier Park assigned on basis of pollen analyses to postglacial Xerothermic period. If correlation with postglacial ash from Glacier Peak, Wash., is established by later studies, this name should be dropped and term Glacier Peak ash adopted.

Galatia Sandstone (in McLeansboro Formation)[1]

Pennsylvanian: Southeastern Illinois.

Original reference: G. H. Cady, 1926, Illinois State Acad. Sci. Trans., v. 19, p. 256–258.

Crops out about one-half mile north of Galatia, Saline County.

Galdog Beds

See Ngardok (Galdog) Beds.

Various spellings—Galdock, Goldock, Goldog, Garudokku.

Gale Sand[1]

Pleistocene (Wisconsin): Western Washington.

Original reference: B. Willis and G. O. Smith, 1899, U.S. Geol. Survey, Geol. Atlas, Folio 54.

Named for creek in Tacoma quadrangle, which flows across part of area covered by Gale sands, Puget Sound region.

Galena Dolomite[1]

Galena Group or Formation

Middle Ordovician: Northern Illinois, eastern Iowa, southern Minnesota, and southwestern Wisconsin.

Original reference: J. Hall, 1851, Rept. on geology of Lake Superior land district, by J. W. Foster and J. D. Whitney, pt. 2, p. 146–148.

C. R. Stauffer and G. A. Thiel, 1941, Minnesota Geol. Survey Bull. 29, p. 81, 82–90, measured sections. Formation, in southeastern Minnesota, comprises (ascending) Decorah shale, with Guttenberg and Ion submembers, Prosser, and Stewartville members. Overlies Spechts Ferry member of Platteville formation; underlies Dubuque member of Maquoketa formation. Mohawkian.

J. S. Templeton and H. B. Willman, 1952, Tri-State Geol. Soc. Guidebook 16th Ann. Field Conf., p. 6, fig. 3. Group, in Dixon-Oregon area, Illinois, comprises (ascending) Spechts Ferry (missing in some places), Guttenberg, Dunleith (new), Wise Lake (new), and Dubuque formations. Overlies Platteville group.

M. P. Weiss, 1955, Jour. Paleontology, v. 29, no. 5, p. 763–766. Formation, in southeastern Minnesota, comprises carbonate rocks that overlie Decorah shales and underlie limestones and shales of Dubuque formation. Thickness about 93 feet. Includes (ascending) Cummingsville (new), Prosser, and Stewartville members.

A. F. Agnew and others, 1956, U.S. Geol. Survey Prof. Paper 274–K, p. 255, 257, 259, 261–269, 296–300. In zinc-lead district, Galena dolomite is commonly coarsely crystalline massive vuggy dolomite or limestone divisible regionally into two units: a cherty lower unit 105 feet thick and a noncherty upper unit 120 feet thick. Cherty unit is divisible into four zones based primarily upon relative chert content and presence of *Receptaculites*. Noncherty unity unit is divided on basis of thinness of bedding and amount of interbedded shale into Dubuque, at top, and the more massive, less shaly Stewartville and zone P of the Prosser below; latter is divided less precisely on basis of *Receptaculites* which are abundant in the Stewartville but not in zone P below. Name Dubuque is applied much as it has been in past; name Stewartville is applied more or less as it has been in past; name Prosser includes the cherty unit and probably all of zone P overlying noncherty unit. Because of paleontologic deficiencies and because of distinct lithologic difference, the Galena in this report is subdivided into cherty and noncherty units rather than into Prosser, Stewartville, and Dubuque members of common, although not precise, usage. Overlies Decorah formation; underlies Maquoketa shale.

Named for exposures in bluffs of Mississippi River in vicinity of Galena, Jo Daviess County, Ill.

†Galena Series[1]

Middle Ordovician: Upper Mississippi Valley region.

Original reference: F. W. Sardeson, 1896, Am. Geologist, v. 18, p. 356–368.

Galesburg Shale (in Kansas City Group)[1]

Original reference: G. I. Adams, 1903, U.S. Geol. Survey, Bull. 211, p. 36.

Pennsylvanian (Missouri Series): Eastern Kansas, southwestern Iowa, northwestern Missouri, and southeastern Nebraska.

F. C. Greene and W. V. Searight, 1949, Missouri Geol. Survey and Water Resources Rept. Inv. 11, p. 11–12. Redefined to exclude Canville limestone and Stark shale formerly included in it by Missouri Geological Survey.

R. C. Moore and others, 1951, Kansas Geol. Survey Bull. 89, p. 87. Thickness 3 to 75 feet. In southern Kansas, includes Dodds Creek sandstone member. Overlies Swope limestone; underlies Dennis limestone. Southward from point where Swope limestone disappears, a few miles north of Oklahoma line, Galesburg is not separable as a unit and forms upper part of Coffeyville formation. In Bronson subgroup of Kansas City group.

T. L. Welp, L. A. Thomas, and H. R. Dixon, 1957, Iowa Acad. Sci. Proc., v. 65, p. 421. Thickness about 8 feet in Madison County, Iowa. Separates Swope formation below from Dennis formation above. Kansas City group.

Named for Galesburg, Neosho County, Kans.

Galesville Sandstone (in Dresbach Group)

Galesville Member[1] (of Dresbach Formation)

Upper Cambrian: Wisconsin, Iowa, and southern Minnesota.

Original reference: A. C. Trowbridge and G. I. Atwater, 1934, Geol. Soc. America Bull., v. 45, p. 45, 79.

W. H. Twenhofel, G. O. Raasch, and F. T. Thwaites, 1935, Geol. Soc. America Bull., v. 46, no. 11, p. 1696–1697. Uppermost member of Dresbach formation; overlies Eau Claire member; underlies Ironton member of Franconia formation.

R. R. Berg, 1954, Geol. Soc. America Bull., v. 65, no. 9, p. 861–862. Underlies Woodhill member of Franconia formation. Name Woodhill replaces term Ironton. Measured sections show thickness 13 to 60 feet.

U.S. Geological Survey currently classifies the Galesville as a formation in Dresbach Group on the basis of a study now in progress.

Named for exposures on bluff of Beaver Creek at mill dam at Galesville, Trempealeau County, Wis.

Galice Formation[1]

Upper urassic: Southwestern Oregon and northern California.

Original reference: J. S. Diller, 1907, Am. Jour. Sci., 4th, v. 23, p. 401–421.

N. L. Taliaferro, 1942, Geol. Soc. America Bull., v. 53, no. 1, p. 74, 81–83. Diller (1907) concluded that the Dothan was younger than the Galice and believed entire section, Galice, volcanics, and Dothan, was overturned. Present study indicates that Dothan sediments in type section are not overturned, except locally on drag folds; Dothan is older than Galice and, at type section at least, is separated from it by volcanics which grade downward into former and upward into latter; Dillard series lies unconformably on and overlaps Dothan and Galice.

F. G. Wells, P. E. Hotz, and F. W. Cater, Jr., 1949, Oregon Dept. Geology and Mineral Industries Bull. 40, p. 4–9. Described in Kerby quadrangle. Galice, as defined by Diller, included only slates and sandstones in type area; present mapping shows that volcanic rocks are intercalated with slates and sandstones and form part of a continuous cycle of deposition; they are here included in the formation. Consists of volcanic member and sedimentary member. Estimated thickness of sedimentary member 15,000 feet; volcanic member 10,000 feet. Unconformably overlies gneiss in northeastern part of quadrangle; in fault contact with similar gneiss in southwestern part of quadrangle; not in contact with Dothan.

F. G. Wells and F. W. Cater, Jr., 1950, California Div. Mines Bull. 134, pt. 1, chap. 2, p. 81. Geographically extended into northern California.

F. G. Wells and G. W. Walker, 1953, Geology of the Galice quadrangle, Oregon; U.S. Geol. Survey Geol. Quad. Map [GQ-25]. In Galice quadrangle, lies to east of Rogue formation (new).

F. W. Cater, Jr., and F. G. Wells, 1953, U.S. Geol. Survey Bull. 995-C, p. 79, 84 (chart), 86-92, pl. 11. Geographically extended into Gasquet quadrangle, California, where it includes a lower metavolcanic rock unit at least 7,000 feet thick, consisting of andesitic flows, breccias, and tuffs, and an upper sedimentary unit consisting of not less than 3,000 feet of slate and phyllite with interbedded tuffaceous sandstone. Contacts between Dothan and Galice have been destroyed by plutonic intrusions.

Well exposed at Galice, on Rogue River, and on Galice Creek, Josephine County, Oreg.

Galisteo Formation

Galisteo Sandstone[1]

Eocene-Oligocene(?): Central northern New Mexico.

Original reference: F. V. Hayden, 1869, U.S. Geol. and Geog. Survey Terr. 3d Ann. Rept., p. 40, 67, 90.

C. E. Stearns, 1943, Jour. Geology, v. 51, no. 5, p. 301-319. Referred to as formation. Consists of from 900 to at least 4,000 feet of sandstone, sand, and clay, variegated in color, together with minor amounts of conglomerate, fresh-water limestone, and water-laid tuff. Succeeded without interruption by deposition of Espinaso volcanics (new). Unconformably overlies Upper Cretaceous Mancos or Mesaverde. Fossil evidence indicates Duchesnean (late Eocene or early Oligocene).

Peter Robinson, 1957, Am. Assoc. Petroleum Geologists Bull., v. 41, no. 4, p. 757. Molar of *Coryphodon*, collected from red mudstone bed approximately 700 feet above base of formation in Santa Fe County, indicates lower Eocene (Wasatchian) age for lower part of formation.

A. E. Disbrow and W. C. Stoll, 1957, New Mexico Bur. Mines Mineral Resources Bull. 48, p. 5 (table 1), 10-11, pl. 1. Formation described in Cerrillos area where it is 1,200 to 3,000 feet thick and consists of sandstone, clay, conglomerate, with silicified wood. Includes strata lying between erosion surface that cuts Upper Cretaceous and top of first massive sandstone beneath Espinaso volcanics. Fossil evidence indicates deposition of Galisteo terminated in late Eocene or possibly early Oligocene.

Named for occurrence in valley of Galisteo Creek.

Galiuro Limestone[1]

Pennsylvanian: Southeastern Arizona.

Original reference: A. A. Stoyanow, 1936, Geol. Soc. America Bull., v. 47, no. 4, p. 517-521.

R. C. Moore and others, 1944, Geol. Soc. America Bull., v. 55, no. 6, chart 6 facing p. 706 (column 52b). Galiuro formation used on Pennsylvanian correlation chart.

Type section: In Galiuro Mountains at junction of Gila and San Pedro Rivers, about 45 miles northeast of Tucson and 6 miles east of Winkelman, south of Deer Creek coal field and Ash Creek, and at foot of Saddle Mountain, Gila Basin.

Galiuro Rhyolite[1]

Tertiary: Southeastern Arizona.

Original reference: W. P. Blake, 1902, Eng. and Mining Jour., v. 73, p. 546.

Galiuro Mountains.

Galkyoku Limestone

See Ngarekeukl Limestone.

Gallatin Limestone[1] or Formation

Gallatin Group

Upper Cambrian: Southern Montana and northwestern Wyoming.

Original references: A. C. Peale, 1893, U.S. Geol. Survey Bull. 110; 1896, U.S. Geol. Survey Geol. Atlas, Folio 24.

B. M. Miller, 1936, Jour. Geology, v. 44, no. 2, p. 124–127. In Wind River Mountains and Owl Creek-Bridger uplift, formation is subdivided to include Du Noir member (new).

Erling Dorf and Christina Lochman, 1938, Geol. Soc. America Proc. 1937, p. 275–276; 1940, Geol. Soc. America Bull., v. 51, no. 4, p. 541–555. Term Gallatin eliminated; its use in any sense other than original definition of Peale is invalid and confusing. Replaced by (ascending) Maurice, Snowy Range, and Grove Creek formations (all new).

Charles Deiss, 1938, Geol. Soc. America Bull., v. 49, no. 7, p. 1091–1105. Terms Du Noir and Gallatin not applicable to Wind River Canyon section which is herein divided into Depass formation and Boysen formation (new).

H. A. Tourtelot and R. M. Thompson, 1948, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 91. Formation, in Boysen area, Wyoming, consists of 455 feet of limestone and limestone-pebble conglomerate with lesser amounts of limy siltstone and shale. Contact between Gallatin and overlying Gros Ventre is placed at base of prominent cliff-forming limestone about 87 feet thick; the contact thus placed is approximately at base of Gallatin as used by Miller (1936) and is about 60 feet above contact between DePass and Boysen formations of Deiss (1938). Underlies Bighorn dolomite. In southern Big Horn Mountains, Gallatin underlies Madison formation.

A. B. Shaw and P. O. McGrew, 1954, Wyoming Geol. Assoc. Guidebook 9th Ann. Field Conf., chart 2. Rank raised to group. Includes (ascending) Du Noir limestone, Dry Creek shale, and Sage limestone. It should be noted that Dry Creek shale in most exposures is thin and rarely mappable and should be most commonly regarded as member of Sage limestone.

C. R. DeLand, 1954, (abs.) Geol. Soc. America Bull., v. 65, no. 12, pt. 2, p. 1374. Formation comprises three subdivisions (ascending): Du Noir limestone, Dry Creek shale, and Sage limestone:

A. B. Shaw and C. R. DeLand, 1955, Wyoming Geol. Assoc. Guidebook 10th Ann. Field Conf., p. 38, 39 (fig. 1), 40 (fig. 2), 41. Group in southwestern Wyoming, comprises (ascending) Du Noir limestone and Open Door limestone (new).

Named for typical occurrence in Gallatin Range, the southern extension of which is in northwestern corner of Yellowstone Park.

Gallatinian series[1]

Precambrian: Montana.

Original reference: C. R. Keyes, 1926, Pan-Am. Geologist, v. 46.

Gallaway Beds or Formation

Miocene: Northern California.

C. E. Weaver, 1943, California Div. Mines Bull., 118, p. 630–632. Alternating units of dark-gray and brown argillaceous shale, mudstones, and medium-grained sandstone interstratified with thick units of massive and bedded brownish-gray sandy shales. Beds strongly folded. Thickness 2,075 feet. Underlies Point Arena beds (new); overlies Skooner Gulch basalt (new).

C. E. Weaver, 1944, Washington [State] Univ. Pubs. in Geology, v. 6, no. 1, p. 4, 19, 20, 21, pl. 2. Described as a formation; overlies Skooner Gulch formation (redescribed); type section designated.

Type section: In sea cliffs from north side of Skooner Gulch northward to Abalone Cove for a distance of about 3,800 feet. Point Arena-Fort Ross area, Mendocino County.

Gallego Sandstone Member (of Gallup Sandstone)

Gallego Sandstone Member (of Miguel Formation)[1]

Upper Cretaceous: Southwestern New Mexico.

Original reference: D. E. Winchester, 1920, U.S. Geol. Survey Bull. 716–A.

C. A. Dane, A. A. Wanek, and J. B. Reeside, Jr., 1957, Am. Assoc. Petroleum Geologists Bull., v. 41, no. 2, p. 187, 188 (fig. 2). Cretaceous section in Alamosa Creek valley area, Catron and Socorro Counties, reinterpreted and stratigraphic names used in San Juan basin extended into valley. Name Gallego sandstone member retained but applied to upper sandstone member of Gallup standstone, and name Miguel formation abandoned. Underlies Dilco coal member of Crevasse Canyon formation; overlies D–Cross tongue (new) of Mancos shale.

Named for Gallego Creek, Socorro County.

Gallegos sandstone[1]

Pennsylvanian(?): Central northern New Mexico.

Original references; C. R. Keyes, 1915, Iowa Acad. Sci. Proc., v. 22, p. 257–259; 1915, Conspectus of geologic formations of New Mexico: Des Moines, Robert Henderson, State Printer, p. 3, 7.

Sandia Mountains.

Gallinas shale[1]

Cretaceous: New Mexico.

Original reference: C. R. Keyes, 1915, Conspectus of geologic formations of New Mexico: Des Moines, Robert Henderson, State Printer, p. 2, 7.

Well developed on Gallinas Creek, near Las Vegas, San Miguel County.

Gallitzin Limestone (in Conemaugh Formation)[1]

Pennsylvanian: Western Pennsylvania.

Original reference: J. P. Lesley, 1880, Pennsylvania 2d Geol. Survey Rept. H_5, p. 312.

Armstrong County.

Gallup Sandstone (in Mesaverde Group)

Gallup Sandstone Member (of Mesaverde Formation)[1]

Upper Cretaceous: Northwestern New Mexico.

Original reference: J. D. Sears, 1925, U.S. Geol. Survey Bull. 767.

W. S. Pike, Jr., 1947, Geol. Soc. America Mem. 24, p. 9, 39–35. Pescado tongue (new) of Mancos shale splits Gallup member of Mesaverde into upper and lower parts.

J. E. Allen and Robert Balk, 1954, New Mexico Bur. Mines Mineral Resources Bull. 36, p. 91. Rank raised to formation in Mesaverde group. In Fort Defiance-Tohatchi quadrangles, basal unit of group; underlies Crevasse Canyon formation (new).

E. C. Beaumont, C. H. Dane, and J. D. Sears, 1956, Am. Assoc. Petroleum Geologists Bull., v. 40, no. 9, p. 2156. Nomenclature of Mesaverde, in San Juan basin, revised. Gallup sandstone as a formation replaces Gallup sandstone member, and also, in its northward extension, replaces in its entirety Tocito sandstone lentil of Mancos shale.

C. H. Dane, A. A. Wanek, and J. B. Reeside, Jr., 1957, Am. Assoc. Petroleum Geologists Bull., v. 41, no. 2, p. 187, 188 (fig. 2), 190, 191. Cretaceous section in Alamosa Creek valley area, Catron and Socorro Counties, reinterpreted, and stratigraphic names used in San Juan basin extended into valley. Gallup sandstone is split into upper and lower units by D–Cross tongue (new) of Mancos shale. Name Gallego sandstone retained but applied to upper sandstone member of Gallup rather than to member of Miguel formation which is herein abandoned. Overlies Mancos shale; underlies Crevasse Canyon formation (Dilco coal member). Gallup as identified, correlated, and described in this report, corresponds with only the upper part of La Cruz Peak formation of Tonking (1955) which includes also the underlying part of the Mancos down to a sandstone identified by him as Tres Hermanos(?) sandstone member of Mancos.

Named for town of Gallup.

Galton facies (of Belt Series)

Precambrian: Northwestern Montana, and southern British Columbia, Canada.

C. L. Fenton and M. A. Fenton, 1937, Geol. Soc. America Bull., v. 48, no. 12, p. 1877. Within its northern basin, Belt series is divisible into facies that differ in lithology, stratigraphic sequence, thickness, recorded conditions of deposition, fauna, and flora. Galton facies is a transitional stage between Glacier Park and Purcell facies. Distinguished from former by more clastics in the Siyeh and Helena; from the latter by finer clastics below Siyeh and presence of Altyn siliceous dolomites.

In MacDonald-Galton Ranges.

Galton Series[1]

Precambrian: Northwestern Montana, and southeastern British Columbia. Canada.

Original reference: R. A. Daly, 1913, Canada Dept. Int., Rept. Chief Asst. 1910, v. 2, p. 97, pl. opposite p. 178.

Gallatin Range, Montana-British Columbia.

Galum Limestone Member (of Carbondale Formation)

Galum Limestone (in McLeansboro Group)

Galum Limestone Member (of McLeansboro Formation)[1]

Pennsylvanian: Southern Illinois.

Original reference: A. H. Bell, C. Ball, and L. McCabe, 1931, Illinois Geol. Survey Press Bull. 19.

C. L. Cooper, 1946, Illinois Geol. Survey Bull. 70, p. 16 (fig. 2). Shown on correlation chart as Galum limestone in McLeansboro group. Underlies Cutler limestone; overlies Bankston Fork limestone.

H. R. Wanless and Raymond Siever, 1956, Illinois Geol. Survey Circ. 217, p. 11. Correlation chart shows Galum limestone in Sparland cyclothem. Type locality given.

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 34, 48 (table 1), pl. 1. Reallocated to member status in Carbondale formation (redefined). Occurs above Allenby coal member (new) and below Danville (No. 7) coal member. Presentation of new rock-stratigraphic classification of Pennsylvanian stata in Illinois.

Type locality: North center sec. 13, T. 6 S., R. 4 W., Perry County. Well exposed along Galum Creek near Pinckneyville.

Galveston Sand

Recent: Eastern North Carolina.

W. B. Wells, 1944, Elisha Mitchell Sci. Soc. Jour., v. 60, no. 2, p. 132, pls. 63, 64. Vertical cliff exposes four layers (or horizons) which show progressively decreasing consolidation upward; each lies unconformably on the preceding. Maximum thickness of exposure a little more than 9 feet. Galveston sand is a thin top stratum representing recent wind deposited sand from adjacent strand. Overlies Pine sand (new).

Exposure between Kure's Beach fishing pier and Ethyl Dow Bromine Plant on lower Cape Fear Peninsula.

Galway Formation[1]

Upper Cambrian: East-central New York.

Original reference: J. M. Clarke, 1910, New York State Mus. Bull. 140, p. 11–12, map.

D. W. Fisher and G. F. Hanson, 1951, Am. Jour. Sci., v. 249, no. 11, p. 802, 803 (fig. 2), 810. Name Galway formation substituted for beds previously termed "Theresa" in Saratoga Springs area. Formation redefined to comprise sandy dolomites, dolomitic sandstones, and calcareous sandstones lying below the Hoyt limestone and above the Potsdam sandstone. Formation has total thickness of 125 feet in area, and top lies 12 feet below *Cryptozoon proliferum* reef of Hoyt limestone; strata formerly classed as lower Hoyt are now included in the Galway. Embraces beds of lower Franconia through Trempealeau age. In area of Mosherville, unconformably underlies Mosherville sandstone (new). Type locality designated.

Type locality: Two railroad cuts and roadcut along New York State Highway 9–K, 3 miles northwest of Saratoga Springs. Named for Galway, Saratoga County.

Gamboa Formation

Oligocene(?): Panamá.

Karl Sapper, 1905, Petermanns Mitt. Erganzungsbd. 32, no. 151, p. 38, 39. Terms Gesteine von Gamboa, Gamboa formation, and Gamboagesteinen used in text discussion.

W. P. Woodring, 1960, *in* R. Hoffstetter and others, Lexique Strat. Internat., v. 5, Amérique Latine, fasc. 2a, p. 335–336. Name has not been used in recent literature but is available as a name to include Bas Obispo formation and Las Cascadas agglomerate.

Game Lodge Granite

Precambrian: Western South Dakota.

G. L. Taylor, 1935, Am. Jour. Sci., 5th ser., v. 29, no. 171, p. 281–282. Fine-grained gray biotite-granite which consists essentially of quartz, feldspars, and biotite. More compact and darker than most of Harney Peak granite which intrudes it. Occurs as intrusive masses into Precambrian sediments. Field evidence did not indicate relative ages of Game Lodge to Little Elk gneissoid granite (new), Harney Peak granite, or igneous amphibolites.

Exposed west of Game Lodge Hotel, which is in valley of Galena Creek, vicinity of Custer, Black Hills.

Gamerco Formation

Recent: Northwestern New Mexico.

L. B. Leopold and C. T. Snyder, 1951, U.S. Geol. Survey Water-Supply Paper 1110–A, p. 6–9. At type locality, consists of (ascending) 1 to 2 feet of fine gravel partly cemented with caliche; about 2 feet of brown compact silty sand with white mottling of caliche; 2 feet of reddish- to reddish-brown silty fine compact sand containing hard calcareous concretions. Disconformably underlies Nakaibito formation (new); disconformably overlies shale and sandstone of Gibson coal member of Mesaverde.

Type locality: In outskirts of Gallup about 300 yards east of El Rancho Hotel. Crops out in gully wall of Puerco River. Name derived from Gamerco, a suburb of Gallup, McKinley County. Most exposures occur where bedrock, the Mesaverde formation, crops out in gully channel.

Game Refuge Formation (in Jackfork Group)

Mississippian (Chesterian): Southeastern Oklahoma.

B. H. Harlton, 1959, *in* The geology of the Ouachita Mountains—a symposium: Dallas, Tex., Dallas Geol. Soc. and Ardmore Geol. Soc., p. 131 (fig. 1), 135–136. Replaces name Union Valley sandstone extended into this area (Harlton, 1938). Consists of approximately 250 to 350 feet of gray to dark-gray shale and intercalated massive and thin-bedded fine to medium subangular sandstone. Intercalations of fine to medium-coarse fossiliferous limonitic sandstones with abundance of crinoid columnals and plant remains present in upper half of formation. Overlies Wesley shale; underlies unit referred to as Johns Valley shale of published reports. Included in Pushmataha series considered to be of Carboniferous age.

L. M. Cline and O. B. Shelburne, 1959, *in* The geology of the Ouachita Mountains—a symposium: Dallas, Tex., Dallas Geol. Soc. and Ardmore Geol. Soc., p. 179 (table 1), 190 (table 2), 192–193. Referred to as Game Refuge sandstone. Approximately 350 to 400 feet thick in western Ouachitas; thins northward in frontal Ouachitas and disappears north of Ti Valley fault. Underlies Johns Valley shale. Mississippian (Chesterian).

Name derived from State Game Refuge at Jerusalem Hollow in western Kiamichi Range in secs. 28 and 29, T. 1 S., R. 18 E., about 6 to 7 miles southwest of Clayton, Pushmataha County. [Referred to as type locality by Cline and Shelburne.] Best exposures are in Round Prairie syncline in sec. 2, T. 2 S., R. 12 E., along Campbell Creek, but name Campbell Creek is preoccupied.

Gammon Ferruginous Member (of Pierre Shale)[1]

Upper Cretaceous: Northeastern Wyoming, southeastern Montana, and northwestern South Dakota.

Original reference: W. W. Rubey, 1930, U.S. Geol. Survey Prof. Paper 165–A.

W. A. Cobban, 1952, Billings Geol. Soc. Guidebook 3d Ann. Field Conf., p. 87. Well exposed in common corner of Montana, Wyoming, and South Dakota, where it is about 800 feet thick and divisible into three units. Lower consists of 600 feet of gray mudstone that is slightly calcareous in basal 150 feet; middle unit is Groat sandstone bed, about 50 feet thick; and upper is 150 feet of gray mudstone with ferruginous and calcareous concretions. Underlies Mitten black shale member.

C. S. Robinson, W. J. Mapel, and W. A. Cobban, 1959, Am. Assoc. Petroleum Geologists Bull., v. 43, no. 1, p. 104–107, measured sections. Traced across northern end of Black Hills and along western side as far south as Beaver Creek, which is a few miles southeast of Osage, Weston County, Wyo. Pedro bentonite beds crops out at base of member near Osage. Groat sandstone bed present about 150 feet below top of member. Thickness 700 to 800 feet in vicinity of Osage. Underlies Mitten black shale member; overlies Niobrara formation.

Named for exposures along Gammon Creek, T. 57 N., Rs. 67 and 68 W., Crook County, Wyo.

Gamsetu (Gamusetsu) Agglomerate

Eocene: Caroline Islands (Babelthuap)

Risaburo Tayama, 1939, Brief report on the geology and ore resources of Babelthuap Island (Palau Island proper): Tropical Industry Inst., Palau, South Sea Islands Bull. 3 [English translation in library of U.S. Geol. Survey, p. 15, 18]; 1952, Coral reefs in the South Seas: Japan Hydrog. Office Bull., v. 11, p. 64, table 4 [English translation in library of U.S. Geol. Survey, p. 75–76]. Group of rocks resembling quartz trachyte. Lower member greenish breccia; upper member a liparite agglomerate. Underlies Babelthuap agglomerate.

Typically developed at Gamusetsu on north shore of Ngatpang (Gasupan) Bay.

Ganado Series[1]

Tertiary or Pleistocene: Northeastern Arizona.

Original reference: A. B. Reagan, 1932, Kansas Acad. Sci. Trans., v. 35, p. 253–258.

Caps an irregularly shaped mesa north of Ganado, Apache County.

Gander Run Shale Member[1] (of Mahantango Formation)

Middle Devonian: South-central Pennsylvania.

Original references: Bradford Willard, 1935, Geol. Soc. America Proc. 1934, p. 361; 1935, Geol. Soc. America Bull., v. 46, no. 8, p. 1279, 1282.

G. A. Cooper and others, 1942, Geol. Soc. America Bull., v. 53, no. 12, pt. 1, chart 4. Gander Run shale listed on correlation chart at base of Mahantango formation, and below Chaneysville sandstone, and above Marcellus shale. Middle Devonian.

Named for stream occupying valley underlain by these strata 6 to 8 miles north of Chaneysville, Bedford County.

Gannett Group[1]

Lower Cretaceous: Southeastern Idaho and southwestern Wyoming.

Original reference: G. R. Mansfield and P. V. Roundy, 1916, U.S. Geol. Survey Prof. Paper 98–G, p. 76, 82, 83.

L. S. Gardner, 1944, U.S. Geol. Survey. Bull. 944–A, p. 7. In Irwin quadrangle, where Draney limestone is top of group, underlies Bear River formation. Overlies Stump sandstone. Thickness 940 feet.

G. R. Mansfield, 1952, U.S. Geol. Survey Prof. Paper 238, p. 39, 43, pl. 1. In Paradise Valley quadrangle, Idaho, Ephraim conglomerate is only representative of group. In Ammon quadrangle, group comprises Ephraim conglomerate, Peterson limestone, and Bechler conglomerate. Underlies Wayan formation.

C. A. Moritz, 1953, Intermountain Assoc. Petroleum Geologists [Guidebook] 4th Ann. Field Conf., p. 63–68. Restricted to exclude Tygee sandstone which is here included in overlying Bear River formation. Uppermost unit of group is unnamed discontinuous redbed unit above Draney limestone. Lower Cretaceous.

H. R. Wanless, R. L. Belknap, and Helen Foster, 1955, Geol. Soc. America Mem. 63, p. 53–57. Described in Jackson Hole area where all formations —(ascending) Ephraim conglomerate, Peterson limestone, Bechler conglomerate, Draney limestone, and Tygee sandstone—are recognized. Here group is much thinner than in type area, nearly 100 miles southwest, and cannot be divided into separate formations as conveniently. Lower Cretaceous.

Named for Gannett Hills, in Bannock County, Idaho, and Lincoln County, Wyo., in eastern part of Wayan quadrangle, where all of its formations are well exposed.

Gannett Peak Stage

Gannett Peak Stage

Recent: Rocky Mountain region.

G. M. Richmond, 1953, Friends of the Pleistocene Rocky Mountain Sec. [Guidebook] 2d Ann. Field Trip, Oct. 4–5, correlation chart. In proposed time-stratigraphic standard for Rocky Mountains, the Recent epoch includes (ascending) Castle Valley, Temple Lake, Spanish Valley, and Gannett Peak stages.

G. M. Richmond, 1957, Internat. Assoc. for Quaternary Research, 5th Cong., Madrid, p. 157. Two stages of Recent glaciation recognized in Rocky Mountain region, an early Recent stage, Temple Lake, and a late Recent stage, Gannett Peak. Unweathered moraines of the Gannett Peak occur in front of existing glaciers or in recently evacuated cirques.

Gano Shale (in Wabaunsee Group)

Pennsylvanian (Virgil Series): Northeastern Oklahoma.

C. C. Branson, 1956, Oklahoma Geology Notes, v. 16, no. 11, p. 122–123, 124–126. Name applied to shale, limestone, and sandstone sequence between top of Emporia limestone and base of Wood Siding formation; base of Wood Siding is at base of Nebraska City limestone member in Osage County, at base of Grayhorse limestone member southward to T. 15 N., and at base of Brownville limestone member in southern Lincoln County. Thickness about 62 feet.

P. B. Greig, 1959, Oklahoma Geol. Survey Bull. 83, p. 61–62. First recognizable keybed above Elmont limestone in Pawnee County is "Grayhorse" limestone. Between the Elmont and "Grayhorse" is shale-sandstone sequence which in Kansas is subdivided into more than a dozen stratigraphic units on basis of persistent limestones which occur in section there. All of these limestones pinch out north of Pawnee County; consequently there is no basis for subdivision of Pawnee County section. Branson (1956) applied name Gano shale to this shale-sandstone sequence. Upper limit is lowermost recognizable key bed in Wood Siding formation. As result of southward pinchout of progressively higher key beds in lower part of Wood Siding, the Gano-Wood Siding boundary migrates upward in the section toward south. In Pawnee County, this boundary is base of "Grayhorse" limestone. Thickness 35 to 50 feet in Pawnee County.

Type section: Exposed in hills northeast of Gano, a refinery village northeast of Cushing, Wayne County.

Gansevoort[1]

Gansevoort Shale Member (of Canajoharie Shale)

Middle Ordovician: Eastern New York.

Original reference: Rudolf Ruedemann and G. H. Chadwick, 1935, Science, new ser., v. 81, no. 2104, p. 400.

Rudolf Ruedemann, 1947, Geol. Soc. America Mem. 19, p. 118. Referred to as Gansevoort shale member of Canajoharie. Overlies Chuctenunda shale member; underlies Sprakers shale member.

Type locality and derivation of name not given, but may have been named for Gansevoort, Saratoga County.

†Gant Bed[1]

†Gant Limestone[1]

Silurian (Niagaran): West-central Tennessee.

Original reference: A. F. Foerste, 1903, Jour. Geology, v. 11, p. 576, 582–583.

C. W. Wilson, Jr., 1949, Tennessee Div. Geology Bull. 56, p. 262. Foerste named Gant limestone and Gant bed from exposures in Wayne County. Gant limestone included 30 feet of limestone and is equivalent to Bob limestone as recognized by Miser, Jewell, Wilson, and Pate and Bassler at some localities. If name Bob had not become so well established, it would be recommended here that Bob limestone be dropped in preference to Gant.

Named for A. B. Gant homestead, about 1 mile northeast of Martin's Mill, Wayne County.

†Gap Latite[1]

Miocene: Southwestern Colorado.

Original reference: E. S. Larsen, 1917, Colorado Geol. Survey Bull. 13.

Platoro-Summitville region.

Gap Sandstone Member (of Tallant Formation)

Gap Sandstone Member (of Nelagoney Formation)[1]

Pennsylvanian (Missouri Series): Northeastern Oklahoma.

Original reference: M. I. Goldman, 1920, U.S. Geol. Survey Bull. 686–W, p. 330, 333.

W. F. Tanner, 1956, Oklahoma Geol. Survey Circ. 40, p. 38. Reallocated to Tallant formation. Goldman (1920) correlated this lenticular member with the Revard sandstone; present study indicates that unit is northward continuation of Bigheart sandstone, except south of Caney River, where it falls at top of or above the Revard sandstone member.

Named for occurrence at top of Gap Ridge, in SW cor. T. 29 N., R. 13 E., in northwest corner of Washington County.

Gap Ridge Sandstone Member (of Stanley Shale)

Pennsylvanian: Southwestern Arkansas.

N. H. Stearn *in* J. M. Hansell and J. C. Reed, 1935, Am. Inst. Mining Metall. Engineers Trans., v. 115, p. 245. Consists of (ascending) a 300-foot sandy zone, a 200-foot shaly zone, and a 100-foot sandy zone. Occurs about 1,000 feet below top of Stanley shale and about 700 feet above the Parker Hill sandstone member (new).

J. C. Reed and F. G. Wells, 1938, U.S. Geol. Survey Bull. 886–C, p. 25, pls. 2, 3. Stratigraphically restricted to the lower 300-foot sandstone.

Named from Gap Ridge mine, an important mining development in that horizon. Mine is in sec. 11, T. 7 S., R. 26 W., Pike County.

Gaps Flow or Tongue (of Clayton Basalt)

Late Cenozoic: Northeastern New Mexico.

Brewster Baldwin and W. R. Muehlberger, 1959, New Mexico Bur. Mines Mineral Resources Bull. 63, p. 112, 133, 134, 143 (fig. 20). East of type locality, Clayton basalt consists of many long tongues. For purpose of this report, these tongues have been named, from south to north, the Carrizo, Herringa, Clayton Mesa, Apache, Seneca, Gaps, and Van Cleve flows. All basalts rest on sand and gravel of Ogallala-like material in ancient valleys. Vents that gave rise to these basalts are unknown.

Well exposed along east side of Sand Gap, eastern Union County.

Gaptank Formation[1]

Pennsylvanian: Western Texas.

Original reference: J. A. Udden, C. L. Baker, and E. Böse, 1916, Texas Univ. Bur. Econ. Geology and Tech. Bull. 44, p. 47.

P. B. King, 1937, U.S. Geol. Survey Prof. Paper 187, p. 73–92. Gaptank, as originally defined, evidently included strata now known as Wolfcamp formation. Later the Gaptank was restricted to exclude *Uddenites* zone which Böse believed to be of Permian age. Further knowledge of fossils near Pennsylvanian-Permian boundary obtained in recent years has led to conclusion that *Uddenites* zone is of Pennsylvanian age, and top of Gaptank is now placed above this zone. West of Marathon are exposures of strata, here considered to be part of Gaptank formation, which were variously placed in Tesnus (Baker and Bowman, 1917, Texas Univ. Bull. 1753), Haymond (Böse, 1917, Texas Univ. Bull. 1762) and Gaptank by Baker, Böse, and Udden. Term Dugout beds (Baker, 1928, Am. Assoc. Petroleum Geologists Bull., v. 12, no. 11) has also been proposed for them. Gaptank formation crops out only in northern part of Marathon basin [this report]. Type area of Gaptank lies north of region of this report, but problematic strata exposed on Dugout Creek and here considered to be part of Gaptank formation crop out over wide area in northwestern part of Monument Spring quadrangle. Thickness at type locality about 1,800 feet; overlies Haymond formation; underlies Wolfcamp formation. In most places the Gaptank is separated from Wolfcamp by strong angular unconformity.

R. C. Moore and M. L. Thompson, 1949, Am. Assoc. Petroleum Geologists Bull., v. 33, no. 3, p. 289 (fig. 1). Desmoinesian, Oklan series.

C. A. Ross, 1959, Washington Acad. Sci. Jour., v. 49, no. 9, p. 299, 300 (fig. 1). Discussion of Wolfcamp series (Permian) and new species of fusulinids, Glass Mountains, Tex. Nealranch formation (new) overlies Gaptank formation, which, according to chart, contains "grey limestone" included in Wolfcamp formation by King (1937) and *Uddenites* shales. Boundary between Pennsylvanian and Permian is taken at unconformity at top of "grey limestone."

Occurs at Gaptank, 24 miles northeast of Marathon, Brewster County. Named for tank, sometimes locally called Gap Tank, located in a gap locally called Stockton Gap and Marathon Gap.

Garanon Member (of Santa Rosa Island Formation)

Pleistocene, upper: Santa Rosa Island, California.

P. C. Orr, 1960, Geol. Soc. America Bull., v. 71, no. 7, p. 1113, 1115. Consists of a basal marine facies and upper terrestrial facies. Thickness about 25 feet. Marine facies is commonly a light-gray calcareous clay containing fossil bones of whale, sea lion, sea otter, shore birds, and occasional dwarf mammoth as well as organic remains and quantities of "rotted" asphalt. Thickness at least 2 feet except for a few erosional channels.

Garanon platform and member exposed along sea cliffs between Jaw Gulch on west and Tecolote Canyon on east. Present locally between Survey Point and Arlington Canyon.

Garber Sandstone[1]

Permian: Northwestern, central, and south-central Oklahoma.

Original reference: F. L. Aurin, H. G. Officer, and C. N. Gould, 1926, Am. Assoc. Petroleum Geologists Bull., v. 10, p. 786–799.

C. C. Branson, 1954, Shale Shaker, v. 4, no. 6, p. 7, 12. Thick sequence of deep-pink sandstones and intervening red shales. Overlies Wellington formation; underlies Hennessey shale. Leonardian.

H. D. Miser and others, 1954, Geologic map of Oklahoma (1:500,000): U.S. Geol. Survey. Mapped in northwestern, central, and south-central parts of State.

Named for exposures at Garber, Garfield County.

Garceno Sandstone Member (of Cook Mountain Formation)

Eocene (Claiborne): Western Texas.

J. M. Patterson, 1942, Am. Assoc. Petroleum Geologists Bull., v. 26, no. 2, p. 259 (fig. 2), 261–262. Name applied to basal sandstone member of formation. With exception of a 50-foot dark-colored marine shale about 150 feet above the base, member is composed of glauconitic marine sandstone beds that are highly fossiliferous. Thickness approximately 500 feet. Underlies Veleno member (new); overlies Mount Selman formation.

Name is taken from Garceno ranchhouse, located on an outcrop of the sandstone, 9 miles northwest of Zapata, Mexico. Ranchhouse is on American side of Rio Grande.

Garcia Formation (in Armendaris Group)

Pennsylvanian (Des Moines Series): Central New Mexico.

M. L. Thompson, 1942, New Mexico Bur. Mines Mineral Resources Bull. 17, p. 27 (table 2), 42–43 (fig. 4), 50–51. Name introduced for all sediments between top of Whiskey Canyon limestone (new) below and base of Bolander group (new). Type section is composed of about 213 feet of rocks, including essentially pure highly fossiliferous limestone, argillaceous to slightly arenaceous and cherty limestones, several thin gray to red shales, and a 50-foot bed of highly conglomeratic sandstone at its base. Formation is wide spread and varies considerably lithologically.

Type locality: East of westernmost box canyon of Whiskey Canyon in northern part of Mud Springs Mountains, sec. 1, T. 13 S., R. 5 W., Sierra County. Name derived from Garcia Road, 4 or 5 miles west of Mud Springs Mountain.

Gardeau Shale Member (of West Falls Formation)

Gardeau Shale Member (of Portage Formation)[1]

Gardeau Shale or Formation

Upper Devonian: Western and west-central New York.

Original reference: J. Hall, 1840, New York Geol. Survey 4th Rept., p. 390–392, 452–455.

J. F. Pepper and Wallace de Witt, Jr., 1950, U.S. Geol. Survey Oil and Gas Inv. Prelim. Chart 37. Gardeau shale and overlying Nunda sandstone make up sedimentary cycle which begins as series of silty gray shales containing a few thin siltstones and grades upward through flaggy siltstones and a few silty shales into massive siltstone and shale at top. The Gardeau is predominantly shale, silty shale, and various amounts of intercalated siltstones. Locally some massive siltstones occur in the Gardeau, and member or formation names have been given to them, for example, Table Rock sandstone (Chadwick, 1933). Naming of such beds serves little purpose because they cannot be positively identified beyond their type exposure.

R. G. Sutton, 1951, Rochester Acad. Sci. Proc., v. 9, nos. 5–6, p. 393–394. Formation, in Batavia quadrangle, overlies Grimes sandstone and underlies Nunda sandstone. Table Rock sandstone not present in this area. Thickness 200 to 550 feet, thinning is westward.

J. F. Pepper, Wallace de Witt, Jr., and G. W. Colton, 1956, U.S. Geol. Survey Oil and Gas Inv. Map OC–55. Hall proposed name Gardeau for sequence of rocks between top of Cashaqua shale and base of his Portage group, later called Nunda group, which crops out along gorge of Genesee River in area that is now Letchworth Park. Gardeau is herein designated shale member of West Falls formation (new). In this report, Gardeau shale along gorge of Genesee River in Letchworth Park area includes rocks between top of Rhinestreet shale member and base of West Hill member. In Naples-Hammondsport area, overlies Grimes siltstone member. In westernmost outcrops, Gardeau intertonques with Angola shale member, and base is not sharply marked. Thickness 12 feet in western Wyoming County; 525 feet in vicinity of Letchworth Park; 350 feet at Naples.

Extensively exposed along Gardeau Reservation, Livingston and Wyoming Counties.

Gardena Intraglacial Substage

Pleistocene (Wisconsin): North-central United States.

M. M. Leighton, 1960, Jour. Geology, v. 68, no. 5, p. 549. Name applied to Iowan-Tazewell intraglacial substage. Radiocarbon dates show deposition of Iowan loess was completed about 1,700 years before advent of Tazewell glacier.

Name derived from village of Gardena, Tazewell County, Ill.

Garden City Formation

Garden City Limestone[1]

Lower and Middle Ordovician : Northern Utah and southeastern Idaho.

Original reference: G. B. Richardson, 1913, Am. Jour. Sci., 4th, v. 36, p. 407, 408.

G. B. Richardson, 1941, U.S. Geol. Survey Bull., 923, p. 13, 14, 16. As originally defined, included succession of thick and thin beds of gray limestone approximately 1,000 feet thick lying between St. Charles limestone and Swan Peak quartzite. St. Charles is restricted to lower 400 feet (approximately) as defined by Walcott, and upper 900 feet (approximately) is included in Garden City limestone. Thickness of expanded Garden City 1,900 feet.

J. S. Williams, 1948, Geol. Soc. America Bull., v. 59, no. 11, p. 1135–1136. Thickness in Green Canyon, northeast of Logan, Utah, 1,400 feet. Deiss (1938) erred in attempt to redefine St. Charles formation in Blacksmith Fork section; the 258 feet of limestones and intercalated and intraformational conglomerates which he included at top of St. Charles is basal Garden City and contains Ordovician fossils.

R. J. Ross, Jr., 1949, Am. Jour. Sci., v. 247, no. 7, p. 472–491. Formation divided into two members: lower comprising approximately two-thirds of formation is composed of numerous alternations of interbedded and interlensed intraformational conglomerates, and crystalline, aphanitic and muddy limestones; and upper characterized by high content of chert nodules, stringers, and interbeds occurring for the most part in irregularly laminated limestone and dolomitic limestone. Thickness 1,200 feet on east to 1,800 feet on northwest of Logan quadrangle.

J. K. Rigby, 1958, Utah Geol. Soc. Guidebook 13, p. 26–30. Term extended into Stansbury Mountains where it is used for sequence of argillaceous limestones and dolomites that occur above Ajax limestone and below Fish Haven and Kanosh formations. Four units recognized (ascending): interbedded series of cherty limestone and dolomite; well-bedded medium-gray argillaceous limestone; interbedded, evenly bedded argillaceous limestone and shale or shaly limestone; and very cherty and sandy limestone. Thickness 1,100 to 1,300 feet.

U.S. Geological Survey currently designates the age of the Garden City Formation as Lower and Middle Ordovician.

Named for exposures in Garden City Canyon, Rich County, Utah.

Garden Creek Phyllite[1]

Cambrian(?) : Southern central Idaho.

Original reference: C. P. Ross, 1932 (Idaho correlation chart compiled by M. G. Wilmarth).

C. P. Ross, 1937, U.S. Geol. Survey Bull. 877, p. 11, 12, pl. 1. Composed exclusively of dark-gray or nearly black phyllite with silvery sericite on cleavage surfaces. Thickness several hundred feet; base not exposed. Underlies Bayhorse dolomite.

L. L. Sloss and C. A. Moritz, 1951, Am. Assoc. Petroleum Geologists Bull., v. 35, no. 10, p. 2140 (fig. 5). Middle Cambrian age shown on chart.

Named for Garden Creek on which Challis is located.

Garden Gulch Member (of Green River Formation)[1]

Eocene: Northwestern Colorado and northeastern Utah.

Original reference: W. H. Bradley, 1931, U.S. Geol. Survey Prof. Paper 168.

D. C. Duncan and N. M. Denson, 1949, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map. 94. Described in Garfield County, Colo., where it is essentially gray marlstone with some gray and brown shale and a few thin shales. Thickness 630 to 720 feet. Underlies Parachute Creek member; overlies Douglas Creek member. Parachute Creek, Garden Gulch, and Douglas Creek members interfinger with unit referred to as lower sandy member of Green River.

M. D. Williams, 1950, Utah Geol. Soc. Guidebook 5, p. 102, 107–108. In this report, the Green River is considered to be middle Eocene in age.

F. M. Swain, 1956, Intermountain Assoc. Petroleum Geologists [Guidebook] 7th Ann. Field Conf., p. 130. Garden Gulch, where it is developed in Piceance Creek and eastern Unita Basin, is herein considered to represent lower part of Green River; Douglas Creek member is referred to unit termed Colton-Green River transition beds.

Named for exposures in buffs near mouth of Garden Gulch a tributary of Parachute Creek, in secs. 7 and 8, T. 6 S., R. 96 W., Garfield County, Colo.

Garden Island Formation

Lower Devonian: Northeastern Michigan.

G. M. Ehlers *in* K. K. Landes, G. M. Ehlers, and G. M. Stanley, 1945, Michigan Dept. Conserv. Geol. Survey Div. Pub. 44, Geol. Ser. 37, p. 34, 35 (table 1), 73–80. Proposed for a dolomite and dolomitic limestone which occupies a position between Upper Silurian St. Ignace formation (new) and Middle Devonian Bois Blanc formation (new). Thickness at type locality probably not more than 3 feet; maximum thickness probably not more than 25 feet, and average thickness not more than 15 feet. Included in Deerpark group.

Type locality: On Garden Island, which is north of Beaver Island, in Lake Michigan. Underlies narrow belt of land having east-northeast trend across the island.

Garden Valley Formation

Permian: Central Nevada.

T. B. Nolan, C. W. Merriam, and J. S. Williams, 1956, U.S. Geol. Survey Prof. Paper 276, p. 67–68. Consists of four unnamed members: (1) a basal limestone; (2) one made up of conglomerate, sandstone, and shale; (3) a resistant siliceous conglomerate; and (4) a sequence of purple and red shales and conglomerates. Maximum thickness is about 3,000 feet. Overlies Vinini formation with angular unconformity. Permian (?).

U. S. Geological Survey currently considers this unit to be of Permian age.

Described from occurrence along east side of Garden Valley on western slope of Sulphur Spring Range, vicinity of Eureka, Eureka County.

Gardiner River Rhyolite-Basalt Complex

Tertiary: Northwestern Wyoming.

R. E. Wilcox, 1944, Geol. Soc. America Bull., v. 55, no. 9, p. 1047–1052, pls. 2, 3. Term applied to complex that is part of the lava filling of a valley eroded in main mass of Yellowstone Plateau rhyolites. Includes Lodgepole rhyolite and Cataract basalt (both new). Younger than Meadow rhyolitic tuff (new); older than Elkhorn basalt and Sheepeaters basalt (both new).

Main body of complex lies 5 miles south of Mammoth Hot Springs and three-quarters mile down stream from Sevenmile Bridge at point where Gardiner River begins to descend its canyon on north side of plateau, Yellowstone Park.

Gardiners Clay[1]

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).

Original reference: M. L. Fuller, 1905, Geol. Soc. America Bull., v. 16, p. 367–390.

K. E. Lohman, 1939, U.S. Geol. Survey Prof. Paper 189–H, p. 229–235. Discussion of Pleistocene diatoms from Long Island. Because all species, with one exception, are represented in living floras in about the same latitude, an age no older than some interglacial stage of Pleistocene is indicated. Similarity of floras suggests contemporaneous deposition, and tentative correlation of Gardiners clay with Cape May formation of New Jersey is proposed.

Lawrence Weiss, 1954, U.S. Geol. Survey Prof. Paper 254–G, p. 143–163. Gardiners clay in eastern Long Island is variable in thickness, lithology and fossil content. Foraminferal assemblage in clay is indicative of shallow water, probably brackish-water deposition and suggests a depositional environment similar to bays that fringe southern shore of Long Island today. Most abundant Foraminifera—those which might possibly be used as guide fossils—are *Elphidium clavatum* and *E. florentinae.* Clay, in western part of Long Island, overlies Jameco gravel; in eastern part, lies directly above Upper Cretaceous deposits (Magothy?). Described as bluish clay in central part of Long Island and as red and green clay near eastern end of island. At type locality, a succession of black, green, and red clays, 28 feet thick, merging upward into Jacob sand. Gardiners clay underlying Brookhaven area is a green-gray silty clay 10 to 20 feet thick. In general, zones of true clay are fossiliferous, and sand and gravel are not. Samples from wells of Riverhead Water District, about 10 miles northeast of Brookhaven Laboratory, reveal 11 feet of greenish fossiliferous Gardiners clay lying beneath 7 feet of fossiliferous sand and gravel and above 10 feet of fossiliferous sand and gravel. Microfaunal assemblage of the clay is almost identical with that of the two zones of sand. Surface of this predominantly coarse-grained fossiliferous zone in Riverhead is 70 feet below sea level. It is overlain by about 45 feet of unfossiliferous gray and brown clay which is overlain by about 50 feet of typical glacial sand. Many sections of the clay contain gravel, and some contain sand lenses. Fuller (1914, U.S. Geol. Survey Prof. Paper 82) reported outcrops of Gardiners clay beneath Jacob sand on north shore of Long Island at Roanoke Point and Jacobs Hill, 3 miles north of Riverhead.

Recent evidence indicates that Gardiners clay is 70 feet below sea level 3 miles south of Roanoke Point and Jacobs Hill. Because Gardiners clay seems to thin toward north and to grade into a shoreline sand and gravel facies, it is believed that clays described by Fuller are not part of Gardiners clay but are equivalent to 45-foot section of unfossiliferous clay that overlies the Gardiners in Riverhead area. Most recent work on Gardiners Island shows that beds called the interglacial Gardiners clay actually consist of two clays of entirely different origin. The upper part (probably red clay referred to by Fuller) is reddish-brown varved glacial clay, and lower part is predominantly green fossiliferous interglacial clay. The reddish-brown varved clay on Gardiners Island and the gray-brown clays at Roanoke Point and Jacobs Hill both grade upward into Jacob sand; perhaps these clays are correlative, as Fuller suggested. They are not part of the interglacial Gardiners clay but a younger glacial deposit.

Named for Gardiners Island, at east end of Long Island.

Gardison Limestone

Lower Mississippian : Central Utah.

M. D. Crittenden, Jr., 1959, Intermountain Assoc. Petroleum Geologists Guidebook 10th Ann. Field Conf., p. 63, 65, 69 (fig. 3). Basal beds, which are conformable with underlying Fitchville formation (new), consist of 20 to 50 feet of coarse-grained, crossbedded black clastic dolomite; these are overlain by 200 to 250 feet of banded rock consisting of blue-gray fine-grained fossiliferous limestone in beds 2 to 4 inches thick with ¼ to ½ inch partings of tan to brownish-gray-weathering silty dolomite; upper part of unit consists of massive cliff forming beds of dolomite and limestone containing pods and lenses of white chert increasing in abundance upwards. Conformably underlies Deseret limestone; contact drawn at base of a black carbonaceous shale. Name credited to Morris and Lovering who applied name in East Tintic Mountains to body of dark limestone, most of which was originally included in Gardner dolomite and which in Wasatch Mountains has commonly been called Madison.

In Provo area, formation is well exposed in American Fork Canyon at several places along road between Timpanogos Cave National Monument and mouth of South Fork. Type locality and derivation of name not stated.

†Gardner Dolomite[1]

Lower Mississippian : Central northern Utah.

Original reference : G. F. Loughlin, 1919, U.S. Geol. Survey Prof. Paper 107.

T. S. Lovering and others, 1951, (abs.) Geol. Soc. America Bull., v. 62, no. 12, pt. 2, p. 1506. Restricted to exclude beds now known to contain an Upper Devonian fauna. These beds are included in underlying Pinyon Peak limestone. The restricted Gardner is about 535 feet thick and contains lower Mississippian fossils in its basal bed.

H. T. Morris, 1957, Utah Geol. Soc. Guidebook 12, p. 14. Name Madison limestone is preferred to name Gardner dolomite for rocks of Lower Mississippian age in East Tintic Mountains inasmuch as Gardner dolomite, as originally defined by Loughlin (1919), erroneously included some beds of Late Devonian age, and name was essentially restricted in its usage to East Tintic Mountains. Term Madison will be used as group name to include two new formations in report currently being prepared.

Names have not been officially adopted by U.S. Geological Survey, and, hence, are not used in present report.

J. K. Rigby, 1958, Utah Geol. Soc. Guidebook 13, p. 38 (fig. 5), 40–43. Described in Stansbury Mountains, Tooele County, where it consists of a lower member 200 to 650 feet thick and an upper member 475 to 1,110 feet thick. Underlies Pine Canyon formation; overlies Pinyon Peak limestone. Report states that U.S. Geological Survey has revised Mississippian nomenclature in Tintic district, but because names have not been officially proposed term Gardner is used in essentially same sense as applied by Lovering and others (1949, Econ. Geology Mon. 1). Gardner, as used in present report, includes all the Madison group of Morris (1957) except the upper cherty beds, which are mapped separately as basal unit of Pine Canyon formation.

H. J. Bissell, 1959, Utah Geol. Soc. Guidebook 14, p. 38–43, 46 (fig. 10), 155–157, pl. 1. Described in southern Oquirrh Mountains where it is about 812 feet thick and consists of two members: lower, 344 feet thick, chiefly dolomite; and upper, 468 feet, chiefly limestone with some chert at top. Lower member includes Gilluly's (1932, U.S. Geol. Survey Prof. Paper 173) Jefferson(?) dolomite; upper member includes approximately lower half of Gilluly's (1932) Madison. Disconformably overlies Opex formatiom (upper part of Lynch of Gilluly); stratigraphically above Stansbury formation; underlies Pine Canyon limestone which here includes some of upper strata of what Gilluly mapped as Madison. Described and mapped in Fivemile Pass and North Boulter Mountains quadrangles where it consists of lower and upper member. Name is used in preference to Madison.

First described in Tintic district where fossils were collected on spur west of Gardner Canyon.

Garfield Formation[1]

Precambrian: Southwestern South Dakota.

Original reference: J. O. Hosted and L. B. Wright, 1923, Eng. and Mining Jour.-Press, v. 115, p. 793–799, 836–843, maps.

R. J. Berg, 1946, South Dakota Geol. Survey Rept. Inv. 52, p. 6, 14, geol. map. Discussion of Galena-Roubaix district. In north and northwest parts of district, rocks which are described and mapped as Garfield and Northwestern formations, strike northwestward toward outcrops of Garfield and Northwestern formations in Lead district. They cannot be traced directly into Lead district because of Cambrian and Tertiary igneous cover. Formation characterized by graphitic slates. Overlies Northwestern formation; underlies Pluma formation. In Lead system.

Occurs in Lead district, Lawrence County.

Garfield Formation[1]

Pennsylvanian: Central Colorado.

Original reference: R. D. Crawford, 1913, Colorado Geol. Survey Bull. 4, p. 66.

R. L. Langenheim, Jr., 1952, Am. Assoc. Petroleum Geologists Bull., v. 36, no. 4, p. 559. Crawford's (1913) Garfield formation includes Belden, Gothic, and possibly some Maroon, and is defined in an area of rather intense metamorphism. These factors make its interpretation uncertain and its usage undesirable.

Named for Garfield, Chaffee County.

Garfield Member (of Muldoon Formation)

Upper Mississippian : Central and eastern Idaho.

M. R. Thomasson, 1959, Dissert. Abs., v. 20, no. 3, p. 999. Underlies Iron Mine member (new) ; overlies Copper Creek member (new).

Deposited in Muldoon trough, aligned N. 30° W.

Garfield Sandstone (in Chester Group)[1]

Mississippian : Western central Kentucky.

Original reference: A. F. Foerste, 1910, Kentucky Geol. Survey Rept. Prog. 1908 and 1909, p. 79, 84.

Named for Garfield, Breckinridge County.

Garim Limestone

Pleistocene : Caroline Islands (Garim, island off Yap)

Risaburo Tayama, 1935, Topography, geology, and coral reefs of the Yap Islands: Tohoku Univ. Inst. Geology and Paleontology Contr. in Japanese Language, no. 19, p. 27–29 [English translation in library of U.S. Geol. Survey, p. 24–25] ; 1952, Coral reefs in the South Seas: Japan Hydrog. Office Bull., v. 11, p. 63, table 4 [English translation in library of U.S. Geol. Survey, p. 74]. Hard white limestone that resembles Mariana limestone. Primarily coral limestone and secondarily *Halimeda* limestone. Believed to overlap Tomil agglomerate nonconformably, though contact not observed.

Constitutes Garim Island and Irikku Island at southern extremity of Yap proper.

†Garland Conglomerate (in Pottsville Formation)[1]

Pennsylvanian : Northwestern Pennsylvania.

Original reference: J. F. Carll, 1875, Pennsylvania 2d Geol. Survey Rept. I, p. 38, 45–46.

At Garland quarries, about 1 mile northwest of Garland, Warren County.

Garland Peak Syenite

Carboniferous (?) : East-central New Hampshire.

Alonzo Quinn, 1937, Geol. Soc. America Bull., v. 48, no. 3, p. 377, 389, 400. A small pluglike body of light- to dark-gray, yellow-weathering syenite. Contains many needlelike grains of amphibole, increasing in quantity toward margin causing darker appearance. Irregular texture. Belongs to White Mountain magma series.

Best exposed on Garland Peak, a hill on east side of Red Hill, Carroll County. Also crops out in area southwest of the peak.

Garley Canyon Sandstone Member (of Mancos Shale)[1]

Upper Cretaceous : Central eastern Utah.

Original reference: E. M. Spieker and J. B. Reeside, Jr., 1925, Geol. Soc. America Bull., v. 36, no. 3, p. 438.

W. A. Cobban and J. B. Reeside, Jr., 1952, Geol. Soc. America Bull., v. 63, no. 10, chart 10b (column 38). As shown on correlation chart, occurs near middle of formation stratigraphically above Ferron sandstone member and below Emery sandstone member.

Named for exposures in Garley Canyon, Carbon County.

Garlock Series

Permian: Southern California.

T. W. Dibblee, Jr., 1952, California Div. Mines Bull. 160, p. 12 (fig. 1), 15–19, pls. 1, 2, 3. Thick series of slightly metamorphosed Paleozoic sediments and volcanics, in part if not all of Permian age. About 22,000 feet of section exposed; possibility of repetition by isoclinal folding within the section, or even by strike faulting, should not be overlooked. Occurs as a large inclusion within a granitic batholith. Shown on columnar section as underlying unnamed quartzite conglomerate and hornfels below newly defined Goler formation and overlying newly named Mesquite schist.

Crops out in northeastern part of El Paso Mountains, Saltdale quadrangle, Kern County. Exposed continuously from Mesquite Canyon northeastward, striking about N. 20° W., across mountains and dipping steeply to the northwest.

Garnavillo Member (of Guttenberg Formation)

Middle Ordovician: Northern Illinois.

J. S. Templeton and H. B. Willman, 1952, Tri-State Geol. Soc. Guidebook 16th Ann. Field Conf., figs. 3, 9. Shown on columnar section as basal member of Guttenberg formation. Underlies Glenhaven member (new); overlies Spechts Ferry formation or where Spechts Ferry is absent, the Strawbridge member (new) of Quimbys Mill formation.

In copy of guidebook used by compiler, in fig. 3, the name Glenhaven had been crossed out and the name Garnet written in. However, in figure 9, the name Garnet had been used to replace the name Garnavillo. Since compiler had no way to determine what changes, if any, had been made in other copies of the guidebook, it was impossible to be certain which names should be retained.

Occurs in Dixon-Oregon area.

Garner Formation (in Strawn Group)[1]

Garner Formation (in Lone Camp Group)

Middle Pennsylvanian: North-central Texas.

Original reference: E. H. Sellards, 1933, Texas Univ. Bull. 3232, p. 106, 108.

M. G. Cheney, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 1, p. 66 (fig. 1). Reallocated to Lone Camp group (new).

R. J. Cordell and others, 1954, Abilene Geol. Soc. Guidebook, Field Trip Nov. 19–20, p. 6 (fig. 2). Suggested revision on basis of faunal break in Brazos River sandstone member; upper part of Brazos River sandstone reallocated to base of East Mountain shale.

Leo Hendricks, 1957, Texas Univ. Bur. Econ. Geology Pub. 5724, p. 20, fig. 3, pl. 1. Underlies East Mountain formation; overlies Grindstone Creek formation. Type section established; section is chosen where the best and most nearly continuous exposure occurs; approximately basal 45 feet of formation not exposed at type section, and section does not exhibit a thin coal seam or lensing limestones present in other localities. Rank designations suggested by Cheney (1940) are accepted in this paper.

Type section: Along the Millsap to Mineral Wells Highway as it ascends scarp 2½ miles west of Millsap, Parker County. Name derived from town of Garner.

Garnet Member (of Guttenberg Formation)

See Glenhaven Member and Garnavillo Member of Guttenberg Formation.

Garner Mountain Andesite

Pliocene: Northern California.

H. A. Powers, 1932, Am. Mineralogist, v. 17, no. 7, p. 261–262. Dark-colored fine-grained porphyry in which glassy plagioclase phenocrysts are only easily determined component.

Occurs on Garner Mountain in Modoc Lava-Bed quadrangle.

Garnet Canyon Tongue (of Sanup Plateau Member of Muav Formation)

Lower and (or) Middle Cambrian: Northwestern Arizona.

E. D. McKee, 1945, Carnegie Inst. Washington Pub. 563, p. 14 (fig. 1), 29, 92. Rusty-brown or snuff-colored dolomite unit. Grades laterally into limestone to the west and into clastic sediments toward the east. Thickness averages about 12 feet. Older than Lava Falls tongue (new); younger than Elves Chasm tongue (new).

Upper of two very conspicuous dolomite units which form low but persistent cliffs from Garnet Canyon to Hermit Creek in eastern Grand Canyon.

Garnet Mountain Andesite

Probably lapsus for Garner Mountain Andesite.

Garnet Range Formation[1]
Garnet Range Quartzite } (in Missoula Group)

Precambrian (Belt Series): Central western Montana.

Original reference: C. H. Clapp and C. F. Deiss, 1921, Geol. Soc. America Bull., v. 42, p. 681, figs. 2, 3.

D. A. Andrews, G. S. Lambert, and G. W. Stose, 1944, U.S. Geol. Survey Oil and Gas Inv. Prelim, Map 25, Sheet 1, Formation underlies Sheep Mountain quartzite and overlies McNamara formation, all in Missoula group.

W. H. Nelson and J. P. Dobell, 1959, U.S. Geol. Survey Misc. Geol. Inv. Map I–296. In Bonner quadrangle Montana, Garnet Range quartzite overlies McNamara argillite and underlies Pilcher quartzite (new).

Type locality: On north side of Blackfoot Canyon from Johnson Gulch 2 miles east of Bonner eastward to 1 mile from mouth of West Twin Creek. Blackfoot Canyon forms northwest boundary of Garnet Range, the western part of which is composed largely of rocks of Garnet Range formation, Missoula to Helena region.

Garnett Limestone[1]

Pennsylvanian: Eastern Kansas.

Original reference: E. Haworth and M. Z. Kirk, 1894, Kansas Univ. Quart., v. 2, p. 110, 120–121.

Named for Garnett, Anderson County.

Garnuan series[1]

Precambrian: New Mexico.

Original reference: C. R. Keyes, 1915, Conspectus of geologic formations of New Mexico: Des Moines, Robert Henderson, State Printer, p. 4, 7.

Garo Sandstone

Jurassic(?): Central Colorado.

D. B. Gould and others, 1947, Rocky Mountain Assoc. Geologists Guidebook Field Conf., June 16–19, p. 39 (road log). Name applied to yellow sandstone that underlies Morrison; has been mapped as Dakota sandstone by some workers.

J. T. Stark and others, 1949, Geol. Soc. America Mem. 33, p. 47–48, 160, pl. 1. Except for basal beds, which are coarse and in a few localities conglomeratic, consists of medium- to fine-grained sandstone. Color varies from red, pink, white, cream, gray, to brownish gray; generally red to the north and lighter to the south. Beds massive; crossbedding on large scale is especially characteristic. Thickness varies: 409 feet at Badger Spring near type locality; 132 feet at Red Hill; 85 feet west of Hartsel; 10 to 12 feet southeast of Hartsel. Unconformably overlies Maroon formation but locally overlaps on Precambrian; separated by unconformity from Morrison, generally regarded as Upper Jurassic. Nonfossiliferous.

Named from exposures in sec. 36, T. 11 S., R. 76 W., near town of Garo, Park County. Also present in fault block north of Hartsel.

Garrard Sandstone (in Eden Group)[1]

Garrard Sandstone Member (of Eden Formation)

Garrard Siltstone Member (of Maysville Formation)

Upper Ordovician: Central Kentucky.

Original reference: M. R. Campbell, 1898, U.S. Geol. Survey Geol. Atlas, Folio 46, p. 2.

D. K. Hamilton, 1950, Kentucky Geol. Survey, ser. 9, Bull. 5, p. 17. Garrard sandstone member present in upper part of Eden formation in southern Fayette and Jessamine Counties.

J. L. Rich, 1951, Geol. Soc. America Bull., v. 62, no. 1, p. 18. Referred to as Garrard siltstone member of Maysville formation.

W. H. Twenhofel and others, 1954, Geol. Soc America Bull., v. 65, no. 3, chart 2 (column 44). Shown on correlation chart as Garrard siltstone.

Named for Garrard County.

Garren Group

Tertiary: Western Texas.

Hugh Hay-Roe, 1957, Texas Univ. Bur. Econ. Geology Geol. Quad. Map 21. Term proposed to embrace Tertiary extrusive rocks of the area (Wylie Mountains and vicinity) which consist of up to 2,500 feet of lava rock and tuff. Consists of seven formations (ascending): Hogeye tuff, Pantera trachyte porphyry, Moon trachyte, Fairbury trachyte, Means trachyte, Zopilote breccia, and Bell Valley andesite (all new). Lies with marked angular unconformity upon unevenly eroded Cretaceous and Permiun strata; overlain by bolson deposits.

Group constitutes eroded northwest portion of Davis Mountains volcanic field in Wylie Mountains, Culberson and Jeff Davis Counties. Name taken from Guy Garren Ranch, on which all but the youngest formation are exposed.

Garrett conglomerate[1]

Lower Cretaceous (Comanche Series) : Northeastern New Mexico.

Original references: C. R. Keyes, 1915, Iowa Acad. Sci. Proc., v. 22, p. 257–259; 1915, Conspectus of geologic formations of New Mexico: Des Moines, Robert Henderson, State Printer, p. 2, 7.

Derivation of name not stated.

Garrett Mill Sandstone Member (of Warsaw Formation)[1]

Upper Mississippian: North-central Tennessee and southeastern Kentucky.

Original reference: C. Butts, 1922, Kentucky Geol. Survey, ser. 6, v. 7, p. 89, 107, 122.

P. B. Stockdale, 1939, Geol. Soc. America Spec. Paper 22, p. 15, 16, 212, 227, pl. 6. Throughout Kentucky belt, Butts (1922) identified three members of the Warsaw (ascending) : Wildie sandstone, Somerset shale, and Garrett Mill sandstone. Wildie sandstone of Butts is included in Wildie siltstone member of Muldraugh formation (new) ; Somerset shale is member of Salem formation; Garrett Mill sandstone of Butts is in upper part of Salem.

Named for exposures at Garrett Mill, on Eagle Creek, 3 miles north-northeast of Livingston, Overton County, Tenn.

Garrett Ranch Volcanic Group

Oligocene (?) : East-central Nevada.

W. M. Winfrey, Jr., 1958, Am. Assoc. Petroleum Geologists Rocky Mountain Sec., Geol. Rec., p. 77–78, 79 (fig. 2). Unconformably overlies Eocene Sheep Pass formation (new). Consists of basal conglomerate followed by volcanics (welded tuff and flows).

Egan Range, White Pine County.

†Garrison Shale (in Council Grove Group)[1]

Permian: Eastern Kansas, southeastern Nebraska, and northern Oklahoma.

Original reference: C. S. Prosser, 1902, Jour. Geology, v. 10, p. 712.

R. C. Moore, 1936, Kansas Geol. Survey Bull. 22, p. 50 (fig. 12). In diagram showing comparison of old and revised classification of beds referred to lower part of Big Blue series of "Permian" age, Garrison shale is replaced by (ascending) Beattie limestone (includes Florena and Morrill limestone members), Stearns shale, Bader limestone (includes Eiss limestone, Hooser shale, and Middleburg limestone members), Easly Creek shale, Bigelow limestone (includes Crouse limestone, Blue Rapids shale, and Funston limestone members), and Speiser shale.

P. B. Greig, 1959, Oklahoma Geol. Survey Bull. 83, p. 103–105. As used in this report, Garrison shale is top unit of Council Grove group. Includes beds upward from top of Cottonwood limestone to base of Wreford limestone. Name was discarded by Moore (1936) who raised various members of Garrison formation to formation rank. Formations constituting Garrison section in Kansas cannot be identified in Pawnee County, and general term Garrison shale has been retained. Interval consists of poorly exposed heterogeneous sequence of red shales and red to tan lenticular sandstones. Thickness difficult to determine. About 140 feet in subsurface, slightly west of outcrop.

Named for exposures at Garrison, Pottawatomie County, Kans.

Gartra Grit Member (of Ankareh Formation)

Gartra Grit Member (of Stanaker Formation)

Upper Triassic: Northeastern Utah and northwestern Colorado.

H. D. Thomas and M. L. Krueger, 1946, Am. Assoc. Petroleum Geologists Bull., v. 30, no. 8, pt. 1, p. 1260 (fig. 2), 1271–1274. Name applied to basal conglomerate of Stanaker formation (new). Along south flank of Uinta Mountains, from Weber River to Skull Creek, and at Vermillion Creek, member is gray, poorly sorted coarse-grained felspathic quartz grit with sporadic quartz pebbles as large as 1 inch in diameter. At Manila, on north flank of mountains, consists of lenses of purplish-red crossbedded sandstone. Thickness 18 to 88 feet. At type locality, overlies Woodside shale.

Bernhard Kummel, 1954, U.S. Geol. Survey Prof. Paper 254–H, p. 166 (fig. 8), 180. Reallocated to member status in Ankareh formation. Overlies Mahogany member (new); underlies Stanaker member.

W. F. Scott, 1959, Intermountain Assoc. Petroleum Geologists Guidebook 10th Ann. Field Conf., p. 101–104. Discussion of Triassic sequence in Wasatch and Uinta Mountains. Names Gartra and Stanaker considered unnecessary. Terms Shinarump(?) and Chinle preferred.

S. S. Oriel and L. C. Craig, 1960, Guide to the geology of Colorado: Rocky Mountain Assoc. Geologists, p. 43, 48. Because Shinarump member of Chinle formation is now known to be of far more limited extent than formerly believed, name is not applied to rocks in northwestern Colorado. Name Gartra grit seems more suitable. Not determined whether name should be given member or formation status because status of name Ankareh in northwestern Colorado is not yet settled.

Type section: At point where Vernal-Manila Highway crosses Brush Creek, about 10 miles north of Vernal, in north part of sec. 5, T. 3 S., R. 22 E., Uintah County, Utah. Name derived from Gartra Spring, sec. 11, T. 2 S., R. 21 E.

Garukiyoku Limestone

See Ngarekeukl Limestone.

Garzas Beds, Sandstone, or Formation (in Orestimba Group)

Upper Cretaceous: California.

F. M. Anderson, 1937, (abs.) Am. Assoc. Petroleum Geologists Bull., v. 21, no. 12, p. 1612. Moreno group is faunally and lithologically divisible into Moreno beds below and Garas [Garzas] beds above. Chico series.

A. S. Huey, 1937, (abs.) Geol. Soc. America Proc. 1936, p. 335. Cretaceous in Tesla quadrangle consists of Upper Horsetown, Chico, Panoche, Moreno, and Garzas. The Garzas formation is fossiliferous sandstone differentiated from top of Moreno.

F. M. Anderson, 1940, 6th Pacific Sci. Cong. Proc., v. 1, p. 395 [1939]. Orestimba group begins with stratigraphic unit of unique character as described by Anderson and Pack (1915) who termed it "Moreno formation." Its sediments are largely organic. This shaly unit has thickness of 2,000 feet, which in district of Orestimba Creek is overlain by 3,000 feet or more of sandy formation, termed Garzas from next important stream south of the Orestimba.

F. M. Anderson, 1943, California Div. Mines Bull. 118, pt. 2, p. 185 (fig. 69), 186 [preprint 1941]. Moreno group, highest division of Chico series, is 5,000 feet or more thick on west side of San Joaquin Valley, and includes three stages, Moreno, Quinto, and Garzas. Garzas member, highest part of Moreno group, is near top of Cretaceous succession.

L. I. Briggs, Jr., 1953, California Univ. Pub. Geol. Sci., v. 29, no. 8, p. 421. In eastern part of Diablo Range, the Upper Cretaceous sequence (Chico series) has been subdivided into two formations: Panoche at base and Moreno shale at top. North of Pacheco Pass, a third unit, Garzas sandstone, overlies the Moreno, and this formation can be traced for some 20 miles.

Named for exposures on Garzas Creek, Stanislaus and Merced Counties.

Gasconade Dolomite[1]

Lower Ordovician: Eastern and central Missouri.

Original reference: F. L. Nason, 1892, Missouri Geol. Survey, v. 2, p. vii, 12, 93, 114–115, pl. 3.

O. R. Grawe, 1954, Missouri Geol. Survey and Water Resources, 2d ser., v. 30, p. 52 (fig. 2), 55–57. Basal part of formation contains pebbles of chert and sometimes of Precambrian igneous rocks derived from older formation, but commonly it is marked by sandstone or sandy dolomite, 15 to 25 feet thick. This basal zone is known as Gunter. It is overlain by 80 to 125 feet of thin- to medium-bedded cherty dolomite which in some Missouri Survey reports is referred to as Van Buren formation, and this in turn is overlain by massively bedded cherty dolomite, 141 to 200 feet thick. In those reports in which term Van Buren formation is used, term Gasconade is restricted to this upper cherty dolomite. In present report, term Gasconade is used in its earlier unrestricted sense to include all strata between the Eminence and the Roubidoux.

R. D. Knight, 1954, Missouri Geol. Survey and Water Resources Rept. Inv. 17, p. 57. Includes Gunter member at base. Term Van Buren not used. Lower Ordovician.

Named for exposures on Gasconade River, central Missouri.

Gasconadian Series or Stage

Ordovician (Canadian): North America.

R. H. Flower, 1957, New Mexico Bur. Mines Mineral Resources Mem. 2, p. 18. Divisions within Canadian system favor natural division into four major units: Gasconadian, Demingian, Jeffersonian, and Cassinian. Gasconadian includes equivalents of the Van Buren and Gasconade of Ozark region, and their equivalents. Recognizable in general are: (1) an initial phase, often restricted geographically, with rather local faunas: (2) widespread beds of Gasconade in restricted sense; (3) late beds comprising *Kainella* zone, known as yet only from Cordilleran region. This division is late Ozarkian of Ulrich, with reservation that the Gasconade and Tribes Hill are equivalents and not successive intervals of deposition. Classification based principally on cephalopod distribution.

Marshall Kay, 1960, Internat. Geol. Cong., 21st, Copenhagen, pt. 7, p. 28–32. Canadian series includes Gasconadian, Demingian, Jeffersonian, and Cassinian stages.

†Gasper Formation or Oolite (in Chester Group)[1]

Upper Mississippian: Kentucky, northern Alabama, northwestern Georgia, and southwestern Virginia.

Original reference: C. Butts, 1917, Mississippian formations of western Kentucky: Kentucky Geol. Survey, pt. 1, p. 64–84.

Charles Butts, 1940, Virginia Geol. Survey Bull. 52, pt. 1, p. 374–381. In Virginia, the Gasper limestone lies between Ste. Genevieve limestone below and Glen Dean limestone or Bluefield shale above, as along northwest belt of Appalachian Valley, or between Ste. Genevieve limestone and Fido limestone, as in Greendale syncline. Thickness 1,025 feet northwest of Greendale, Washington County; 515 feet northeast of Bluefield, W. Va.

J. M. Weller and A. H. Sutton, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 5, p. 828. From Todd County to Grayson County, Ky., Bethel sandstone is absent, and Renault and Paint Creek formations together form limestone unit that cannot be easily subdivided. Name Gasper has been used for this limestone, but persistent miscorrelation has resulted in such confusion that name is no longer useful. These beds are now known as Girkin limestone.

B. N. Cooper, 1944, Virginia Geol. Survey Bull. 60, p. 164–169. Butts (1917) named Gasper limestone from exposures in Warren County, Ky. Sutton and Weller stated that Gasper is unsuitable formation name because it was never adequately defined nor was its type locality clearly indicated. In this report [Burkes Garden quadrangle], name Gasper is used in tentative sense for limestones above the "Ste. Genevieve" and below Bluefield shale. Average thickness 425 feet. Chester series.

Charles Butts, 1948, Georgia Geol. Survey Bull. 54, p. 42, 46–47. Geographically extended into northwestern Georgia where, at north end of Lookout Mountain, it is about 100 feet thick and consists of a thick-bedded gray, rather coarsely crystalline limestone. Overlies Ste. Genevieve limestone; underlies Golconda limestone.

J. M. Weller and others, 1948, Geol. Soc. America Bull., v. 59, no. 2, p. 163, chart 5. Type Gasper appears to consist of both Renault and Paint Creek strata; type Ohara consists of the Levias member of the Ste. Genevieve and the Renault formation; thus the two names overlap.

S. W. Welch, 1958, U.S. Geol. Survey Oil and Gas Inv. Chart OC–58. Wagnon member of Pride Mountain formation (both new) includes the lower part of the strata referred to by Butts (1926, Alabama Geol. Survey Spec. Rept. 14) as Gasper formation.

Named for exposures in bluffs along Gasper River, Warren County, Ky.

Gasport Limestone Member (of Lockport Dolomite)[1]

Gasport Limestone (in Lockport Group)

Middle Silurian: Western New York, and Ontario, Canada.

Original reference: E. M. Kindle, 1913, U.S. Geol. Survey Geol. Atlas, Folio 190.

E. R. Cumings, 1939, Geologie der Erde, North America, v. 1, p. 596 (fig. 7), 597. Basal member of Lockport. Underlies Suspension Bridge member (new); overlies Decew. Thickness 15 feet.

B. F. Howell and J. T. Sanford, 1947, Wagner Free Inst. Sci. Bull., v. 22, no. 4, p. 34. Member of Lockport formation. Overlies DeCew waterlime member; underlies Goat Island member (replaces preoccupied name Suspension Bridge).

D. W. Fisher, 1959, New York State Mus. Sci. Service Geol. Survey Map and Chart Ser. 1. Basal formation in Lockport group. Underlies Goat Island limestone; overlies Decew dolomite. Lockportian stage. Middle Silurian.

Named for exposures at Gasport, Niagara County, N.Y.

Gasport shaly channel[1] (in Lockport Limestone)

Silurian: Western New York.

Original reference: R. Ruedemann, 1925, New York State Mus. Bull. 265, p. 5–14.

Gassaway Member (of Chattanooga Shale)

Gassaway Formation (in Chattanooga Shale)

Upper Devonian: Northern Tennessee, north-central Alabama, and central southern Kentucky.

Guy Campbell, 1946, Geol. Soc. America Bull., v. 57, no. 9, p. 881, 884, 886, pl. 2. Hard slaty fissile black shale with conspicuous joints, abundant *Lingula melie*, conodonts, and small fish scales; contains conspicuous phosphatic nodules at different levels. Thickness varies from 9 to 13½ feet north and east of the basin, except in Macon County where it is 5 feet; here total thickness of Chattanooga is only 13 feet. Includes Bransford sandstone member (new) at base. Underlies Eulie shale (new); overlies Dowelltown formation (new); at type section underlies Maury shale which in this area is about 8 inches thick. Mississippian.

S. W. Maher, 1954, (abs.) Geol. Soc. America Bull., v. 65, no. 12, pt. 2, p. 1363. Referred to as upper member of Chattanooga shale. Contains numerous sandstone beds and a series of thinly laminated siltstones.

W. H. Hass, 1956, U.S. Geol. Survey Prof. Paper 286, p. 20–23. Member is chiefly a thin-bedded grayish-black shale, though along part of Eastern Highland Rim it can be subdivided into two black shale units and an intervening thin zone consisting of gray mudstone and black shale. Thickness between 12 to 21 feet along Eastern Highland Rim; thinner in south-central Tennessee and north-central Alabama; about 46 feet in Pulaski, Ky. Overlies Dowelltown member. Contains two distinct conodont faunas. Upper Devonian.

Type locality: On Highway 63, 5 miles south of Gassaway, Cannon County, Tenn.

Gassetts Schist[1]

Upper Cambrian (?): Southeastern Vermont.

Original reference: C. H. Richardson, 1929, Vermont State Geologist 16th Rept., p. 210, 225.

Crops out at Gassetts, Ludlow quadrangle, in northern part of Chester Township, Windsor County.

Gastineau Volcanic Group[1]

Upper Triassic: Southeastern Alaska.

Original reference: G. C. Martin, 1926, U.S. Geol. Survey Bull. 776, p. 92, 247, chart opposite p. 120.

Named for Gastineau Peak, Juneau region.

Gatecliff Formation

Silurian: Central Nevada.

Marshall Kay, 1960, Internat. Geol. Cong., 21st, Copenhagen, pt. 12, p. 97 (fig. 3), 98 (fig. 4). Named on cross section and structure section in report on Paleozoic continental margin in central Nevada. Overlies Perkins Canyon formation (new), Pogonip formation, or Caesar Canyon formation (new); underlies Masket formation (new).

Toquima Range, Nye County.

Gates Limestone[1]

Silurian: Western New York.

Original reference: G. H. Chadwick, 1918, Geol. Soc. America Bull., v. 29, p. 335, 356, 358, 359, 360, 361, 364.

H. L. Alling, 1946, Rochester Acad. Sci. Proc., v. 9, no. 1, p. 52–53. Term Gates, in sense proposed by Chadwick, is a formation, for he says it is separated from the Rochester [restricted] below. Gates is a rock facies, and the retention of the name as a formation or a member of the Rochester is deemed inadvisable.

Named for town in Monroe County.

Gatesburg Formation[1]

Upper Cambrian: Central Pennsylvania.

Original reference: Charles Butts, 1918, Am. Jour. Sci., 4th, v. 46, p. 527, 534, 537.

J. L. Wilson, 1952, Geol. Soc. America Bull., v. 63, no. 3, p. 281–303. Stratigraphically expanded upward to include Mines dolomite (Butts, 1918) as uppermost member. As thus expanded, includes (ascending) Stacy dolomite member, lower sandy member, Ore Hill dolomite member, upper sandy member, and Mines dolomite member. Thickness about 1,700 to 1,800 feet. Overlies Warrior limestone; relation to overlying beds is obscure because upper contact of Mines member is not exposed but probably unconformably underlies Ordovician Larke dolomite or its limestone facies, the Stonehenge formation. Gatesburg rock types grade southeastward into the Conococheague-type limestone over a distance of about 40 miles; younger sediments cover the transition beds except in a small area along axis of a reverse-faulted anticline in Fulton County.

H. H. Arndt and others, 1959, Geol. Soc. America Guidebook Field Trips Pittsburgh Mtg., p. 8. Thick-bedded bluish, coarsely crystalline dolomite, with interbedded quartzite layers up to 10 feet thick. Includes Stacy dolomite member at base and Ore Hill limestone member near middle. Underlies Mines formation. Overlies Warrior formation.

Named for Gatesburg Ridge, Centre County.

Gatesville Formation (in Fredericksburg Group)[1]

Lower Cretaceous (Comanche Series): North-central Texas.

Original reference: S. A. Thompson, 1935, Am. Assoc. Petroleum Geologists Bull., v. 19, no. 10, p. 1508, 1530, 1531–1533, 1536.

F. E. Lozo and others, 1959, Texas Univ. Bur. Econ. Geology Pub. 5905, p. 3 (fig. 2), 5–6. Formation mentioned in symposium on Edwards limestone in central Texas.

Type locality: Near State Training School for Boys, north of Gatesville, Coryell County.

Gateway Formation[1]

Precambrian (Belt Series): Northwestern Montana, and southern British Columbia, Canada.

Original reference: R. A. Daly, 1912, Canada Geol. Survey Dept. Mines Mem. 38, maps 2, 3, 4.

C. L. Fenton and M. A. Fenton, 1937, Geol. Soc. America Bull., v. 48, no. 12, p. 1899. Discussion of Belt series in Glacier Park region. In MacDonald and Galton Ranges of British Columbia, Daly describes 2,025 feet of Gateway (equivalent to Sheppard) strata, which the writers [Fenton and

Fenton] group into two members as follows: sandstone, 125 feet; and siliceous thin-bedded light-gray to greenish-gray argillite, 1,850 feet.

Named for exposures on heights east of Gateway, Mont.

Gateway Granodiorite

[Cretaceous]: Eastern California.

J. F. Everden, G. H. Curtis, and J. Lipson, 1957, Am. Assoc. Petroleum Geologists Bull., v. 41, no. 9, p. 2123 (fig. 2). Shown on map in paper dealing with potassium-argon dating of igneous rocks. Age shown on map legend as 92.9 millions of years. Younger than Arch Rock granite; older than El Capitan granite. [Calkins (1930, U.S. Geol. Survey Prof. Paper 160) referred to granodiorite at the Gateway. Compiler was unable to locate reference to Gateway granodiorite.]

Occurs in Yosemite National Park.

Gateway Canyon Member (of Muav Formation)

Lower and (or) Middle Cambrian: Northwestern Arizona.

E. D. McKee, 1945, Carnegie Inst. Washington Pub. 563, p. 14 (fig. 1), 29, 105–109. At type locality, consists of thin beds of mottled, aphanitic limestone separated by parting planes of yellow-brown siltstone. Thickness 137 feet. Base determined by weak zone which everywhere forms bench at top of Kanab Canyon member. Upper limit indicated by flat-pebble conglomerate zone at bottom of overlying cliff. Westward from type locality to and beyond Granite Park, member fairly constant in character; beds become thicker, and silt partings less numerous, but total thickness remains about the same. From Diamond Creek westward, however, marker beds at base are absent, and member cannot be differentiated from lithologically similar underlying units. Eastward from Gateway Canyon, member is progressively less massive, contains more clastic materials, and is thinner bedded. Older than Havasu member (new); younger than Kanab Canyon member (new).

Type locality: At mouth of Gateway Canyon in east-central Grand Canyon.

Gatún Formation[1]

Miocene, middle and upper: Panamá.

Original reference: E. Howe, 1907, Isthmian Canal Comm. Rept., app. E., p. 113–114.

H. N. Coryell and Suzanna Fields, 1937, Am. Mus. Novitates no. 956, p. 1. At Cativa, includes Cativa marl (new) in lower part.

W. P. Woodring, 1957, U.S. Geol. Survey Prof. Paper 306–A, p. 42–47, 51 (fig. 4), pl. 1. Chiefly massive medium to very fine grained sandstone and siltstone. Estimated thickness at least 500 meters. On faunal basis, divided into lower, middle, and upper parts; lower part not represented at type region; middle part includes best known strata. Overlies Caimito formation with contact covered by waters of Gatún Lake; farther east, overlaps Caimito and lies directly on Cretaceous(?) basement; underlies Chagres sandstone. Lower and middle Miocene. Gatún formation was named by Howe (1907). Hill (1898, Harvard Coll. Mus. Comp. Zool. Bull., v. 28, no. 5) had used names Monkey Hill formation and Mindi Hill beds. Howe used both Gatún formation and Monkey Hill formation in structure section, and in later publication (1908, Am. Jour. Sci., 4th ser., v. 26, p. 228) used only Monkey Hill formation. MacDonald's usage (1913, Isthmian Canal Comm. Ann. Rept., 1913, app. S., p. 530) apparently established preference of Howe's name. Howe (1907) excluded oldest strata near Garun from Gatún formation and grouped them into Bohió formation. It is now known that oldest outcropping part of formation is not represented in type region.

Type area: From Gatún to Mount Hope (Monkey Hill of Howe's time), C.Z.

Gatuna Formation

Pleistocene: Southeastern New Mexico.

W. B. Lang, 1938, *in* T. W. Robinson and W. B. Lang, New Mexico State Engineer 12th–13th Bienn. Rept., p. 84–85 [1939]. Name given to an assemblage of rocks of various kinds that were laid down in Pecos Valley in post-High Plains time and apparently after completion of maximum cycle of erosion. Terrestrial; fine red sand dominant; conglomerates, stream gravels, gypsum, limestone also present; gray, purplish, and red. Mantles many places to depth of only a few feet; more than 100 feet in Pierce Canyon; may exceed 300 feet at head of Cedar Canyon. Overlies Rustler formation.

Name derived from Gatuna Canyon, northeastern Eddy County, N. Mex.

Gatuncillo Formation

Gatuncillo Shale

Eocene, middle and upper: Panamá.

T. F. Thompson, 1944, Geological explorations in the vicinity of Rio Quebrancha for the Panamá Cement Company: Panamá Spec. Eng. Div., p. 12–13. Gatuncillo shale consists of thick sequence of soft, finely bedded, uniformly fine, and even grained yellowish-gray or buff-colored shales and impure bentonite beds with occasional thin siltstone layers. Overlies basement complex. Older than Quebrancha limestone (new). Many forms of microfossils are related to those identified from the so-called Tranquilla shales of upper Eocene age, which formerly cropped out within Madden Reservoir basin now inundated.

W. P. Woodring and T. F. Thompson, 1949, Am. Assoc. Petroleum Geologists Bull., v. 33, no. 2, p. 227–228, 246 (fig. 2). Gatuncillo formation, in type region, consists chiefly of mudstone, siltstone, impure bentonite, and thin lenses of limestone. Unless it is duplicated by faults, which would be difficult to detect, its thickness is as much as 3,000 feet. Unconformably overlies basement complex; underlies Bohío formation. Upper Eocene. Name Tranquilla shale was proposed for late Eocene strata in Madden basin (Coryell and Embich, 1937). That name was inadequately defined and specified type locality is now flooded by Madden Lake.

W. P. Woodring, 1957, U.S. Geol. Survey Prof. Paper 306–A, p. 13–22, 51, 56, 148. Middle and upper Eocene.

Type region: Quebrancha syncline.

Gavilan Peak Gabbro

Jurassic(?): Southern California.

E. F. Osborn, 1939, Geol. Soc. America Bull., v. 50, no. 6, p. 1925–1926. Dark, massive, medium to coarse grained, and hypidiomorphic. Intrudes schist believed to be Triassic.

W. J. Miller, 1946, Geol. Soc. America Bull., v. 57, no. 5, p. 481, table 4. Listed as oldest of late Mesozoic plutonics in Riverside-Elsinore-Coahuila area. Older than Virginia quartz norite.

Occurs in Perris fault block, Riverside County.

Gaviota Formation[1]

Gaviota Stage

Eocene or Oligocene: Southern California.

Original reference: W. L. Effinger, 1935, Pan-Am. Geologist, v. 65, no. 1, p. 75.

B. L. Clark and H. E. Vokes, 1936, Geol. Soc. America Bull., v. 47, no. 6, p. 853 (fig. 1), 868–871. Defined as a stage based on faunal assemblages. Covers an interval at top of marine Eocene sequence above Tejon stage.

R. M. Kleinpell, 1938, Miocene stratigraphy of California: Tulsa, Okla., Am. Assoc. Petroleum Geologists, fig. 14. Gaviota formation shown in Refugian stage (Oligocene).

F. R. Kelley, 1943, Am. Assoc. Petroleum Geologists Bull., v. 27, no. 1, p. 3 (fig. 2), 6. In Canada de Santa Anita area, Santa Ynez Mountains, overlies Sacate formation (new).

T. W. Dibblee, Jr., 1950, California Div. Mines Bull. 150, p. 29–30, 38 (fig. 2), pls. 1–6. Type Gaviota formation (west of Las Cruces) is about 1,600 feet thick and consists of three members, each about 500 feet thick. Lower member is a massive soft gray siltstone; middle member is light-buff thick-bedded well-sorted fine- to medium-grained concretionary sandstone; upper member a gray sandy siltstone with some interbedded fine-grained sandstone. Conformably underlies Sacate formation; conformably overlies Alegria formation (new). Oligocene.

Type locality: Canada de Santa Anita west of Gaviota Pass, Santa Barbara County.

Gay Hill terrace deposit

Pleistocene: Southern Texas.

A. W. Weeks, 1941, (abs.) Am. Assoc. Petroleum Geologists Program 26th Ann. Mtg., p. 20; 1945, Am. Assoc. Petroleum Geologists Bull., v. 29, no. 12, p. 1695 (fig. 1), 1697 (fig. 2), 1703, 1717 (fig. 16). Quaternary section of Texas Coastal Plain between Brazos River and Rio Grande is divided into 11 terraces and terrace deposits. Name Gay Hill is proposed for a terrace and terrace deposit of siliceous gravel at elevation of 372 feet in Fayette County. Younger than the Willis (herein considered to be Pleistocene); older than Bastrop Park (new) terrace deposit.

Named from Gay Hill cemetery. Exposed north of Colorado River, 6 miles northeast of Colorado County line, and along La Grange-Columbus Highway.

Gaylord Mountain Basalt or Flow (in Clayton Basalt)

Late Cenozoic: Northeastern New Mexico.

Brewster Baldwin and W. R. Muehlberger, 1959, New Mexico Bur. Mines Mineral Resources Bull. 63, p. 126, pl. 1–b, 11. Ten basalt flows in what is termed Folsom sequence of Clayton basalt are named and mapped. Stratigraphic position of six of these basalts has been determined, but stratigraphic position of Gaylord Mountain, Sierra Grande, Purvine Mesa, and Dunchee Hill is not known. Gaylord Mountain is younger than Purvine Mesa.

Gaylord Mountain (also known as Carr Mountain) is an irregularly eroded cone, 4 miles east of Folsom, Union County.

Gaysport cyclothem

Pennsylvanian (Conemaugh Series): Southeastern Ohio.

M. T. Sturgeon and others, 1958, Ohio Geol. Survey Bull. 57, p. 94 (table 11), 140–143. Embraces interval between Ames cyclothem (new) below and Duquesne cyclothem (new) above. An incomplete cyclothem. Includes (ascending) Gaysport shale and (or) sandstone and Gaysport limestone members. Thickness about 13 feet. In area of this report, the Conemaugh series is discussed on a cyclothemic basis; 15 cyclothems are named. [For sequence see Mahoning cyclothem.]

Present in Athens County.

Gaysport Member (of Conemaugh Formation)[1]

Gaysport limestone member

Pennsylvanian: Southeastern Ohio.

Original reference: W. Stout, 1918, Ohio Geol. Survey, 4th ser., Bull. 21, p. 258.

R. E. Lamborn, 1951, Ohio Geol. Survey, 4th ser., Bull. 49, p. 29, 32. In this report, the Conemaugh is considered a series, and the Gaysport is referred to both as a limestone and a member.

D. L. Norling, 1958, Ohio Geol. Survey Bull. 56, p. 55–56. Gaysport is a thin sandy limestone which is discontinuous in Morgan County [this report]. Average thickness about 4 inches. Occurs from 16 to 23 feet above Ames limestone and about 10 to 15 feet below Skelley limestone. Interval between Gaysport and Skelley is the position of Duquesne shale, clay, and coal member of geologic column of Ohio. Conemaugh series.

M. T. Sturgeon and others, 1958. Ohio Geol. Survey Bull. 57, p. 94 (table 11), 142–143, 144. Gaysport limestone included in Gaysport cyclothem (new). Separated from underlying Ames limestone by unit referred to as Gaysport shale and (or) sandstone member of cyclothem. Gaysport limestone as used in this report [Athens County] may be a split from Ames limestone. Conemaugh series.

Well developed in vicinity of Gaysport, Bluerock Township, Muskingum County.

Gazelle Formation

Silurian and Lower Devonian: Northern California.

F. G. Wells, G. W. Walker, and C. W. Merriam, 1959, Geol. Soc. America Bull., v. 70, no. 5, p. 646–649. Name applied to a sequence of clastic rocks with included limestone reefs. Consists essentially of hard fine-grained siliceous graywacke, dark-gray to black siltstone and mudstone, and siliceous and feldspathic grit; also contains appreciable quantities of chert, conglomerate, limestone, and limestone conglomerate. Five members have been distinguished (ascending): dark-gray to black siliceous mudstone—600 feet; graywacke—1,000 feet; black siliceous mudstone and green shale—300 feet; limestone lenses in chert conglomerate—500 feet; and siltstone, sandstone, and volcanic debris—200 feet. In most places in continuous exposures, one or more of these members is lacking or poorly exposed, and all vary markedly in thickness. Total thickness exceeds 2,400 feet. Formation is in fault contact with older Duzel formation (new) on the north, south, and west sides; on the east side, locally overlain by Devonian sedimentary and volcanic rocks and has been intruded by diorite and peridotite.

Michael Churkin, Jr., and R L. Langenheim, Jr., 1960, Am. Jour. Sci., v. 258, no. 4, p. 259 (fig. 1), 260–266. Described in Yreka quadrangle, Siskiyou County, where it is 85 to 713 feet thick and subdivided to include Payton Ranch limestone member at top. Member is 75 to 188 feet thick. Some outcrops of formation west of Payton Ranch limestone exposures are possibly younger than the member. Formation is interbedded sequence of shale, sandstone, bedded chert, conglomerate, limestone, and tuff; shale and sandstone predominate, but lateral gradation from one lithologic type to another is widespread; bedded chert, conglomerate, and limestone occur abundantly as discontinuous lenses and layers; one outcrop of andesitic lapilli tuff is only evidence of volcanic rock noted in formation in area. Base unexposed; folded thrust fault brings metamorphic rocks into contact with Gazelle. Contains trilobite and brachiopod fauna. Formation crops out in central part of area and forms east-west trending ridge between North and Middle Branches of Willow Creek.

U.S. Geological Survey designates the age of the Gazelle Formation as Silurian and Lower Devonian on the basis of a study now in progress.

Crops out in Siskiyou County in valley of East Fork of Scott River, across the Gazelle Mountain, and throughout northern part of valley of Willow Creek, and area of about 60 square miles.

Gazley Creek Sands and Clays[1]

Eocene: Southern central Texas.

Original reference: W. A. Price and K. V. W. Palmer, 1928, Jour. Paleontology, v. 2, p. 22.

Occurs on south bank of Colorado River at mouth of Gazley Creek, in western edge of Smithville, Bastrop County.

†Gebo Formation[1]

Upper Cretaceous: Northwestern Wyoming.

Original reference: D. F. Hewett, 1914, U.S. Geol. Survey Bull. 541, p. 91, 100.

Named for Gebo, near Thermopolis, Park County.

Geddes Limestone

Middle Cambrian: Eastern Nevada.

H. E. Wheeler and D. M. Lemmon, 1939, Nevada Univ. Bull., Geology and Mining ser., no. 31, p. 13, 20–23, fig. 3. Proposed for flaggy limestone beds between Eldorado dolomite and overlying paper shale of Secret Canyon formation; both contacts sharp. Bluish gray, moderately fine grained. Where unweathered, rock is black owing to carbonaceous impurities. Beds vary from ½ inch to 12 inches in thickness, most being 2 to 6 inches. Thickness about 335 feet. Unit complicated by faulting. Tentatively assigned to early Middle Cambrian.

T. B. Nolan, C. W. Merriam, and J. S. Williams, 1956, U.S. Geol. Survey Prof. Paper 276, p. 11–12, pl. 2. Described in stratigraphic section in vicinity of Eureka. Contact with Eldorado dolomite appears to be gradational, although in places this may result from folding or faulting rather than interlayering. On northwest nose of Prospect Ridge, the two formations interfinger; here a bed of massive limestone 10 or more feet thick and resembling beds of Eldorado can be mapped within Geddes near its base. Upper contact not well exposed, but appears to be sharp. Wheeler and Lemmon (1939) section referred to as type locality.

Type locality: Geddes and Bertrand mine, in Secret Canyon. Exposed as band of variable width east of outcrop of Eldorado dolomite, from south end of Secret Canyon, north along east side of Prospect Ridge as far as Diamond Tunnel of Diamond mine; occurs in two bands on either side of Mineral Hill from Eureka Tunnel at head of Goodwin Canyon nearly to Ruby Hill.

Geers Corners Gabbro

Precambrian: Northeastern New York.

A. F. Buddington, 1936, 16th Internat. Geol. Cong. Rept., v. 1, p. 348; 1939, Geol. Soc. America Mem. 7, p. 57, 59, 61. Banded gabbro that varies from place to place in composition and texture. Locally, there are repeated composite bands about 1 inch thick consisting successively, from bottom to top, of pyroxenite, gabbro, and anorthosite. The banding, as well as the foliation of surrounding country rock, indicate the nose of a syncline pitching west and having steep limbs.

Occurs at Geers Corners, 2½ miles north-northwest of Harrisville, Lake Bonaparte quadrangle, Lewis County.

Geertson Formation

Oligocene, upper, or Miocene, lower: Eastern central Idaho.

A. L. Anderson, 1957, Idaho Bur. Mines and Geology Pamph. 112, p. 13, 14, 17–18, pl. 1. Consists of light-colored shaly beds with some intercalated bentonite, sandy shales, sandstones, and pebble conglomerate and locally thin beds of impure lignite. Beds of pebble conglomerate are thin, discontinuous, but rather numerous and widespread in formation northeast of Lemhi River. No such pebble beds observed southwest of river. Thickness is some hundreds of feet. Rests unconformably on each of the other Tertiary formations described in Baker quadrangle and is overlain unconformably by Carmen formation.

A. L. Anderson, 1959, Idaho Bur. Mines and Geology Pamph. 118, p. 26–27. Thickness about 800 feet in North Fork quadrangle, Lemhi County. In area of this report, formation is almost entirely conglomerate with minor thin partings of sandy shale. Formation passes unconformably under Kirtley formation (new name to replace preoccupied Carmen) and spreads unconformably over eroded surface of Kriley (new) and Kenney formations and Challis volcanics. Late Oligocene or early Miocene.

Named for Geertson Creek along which more or less typical exposures are to be found. Confined to Lemhi Valley, Lemhi County.

Geiser Quarry Member (of Dutchtown Formation)

Lower Ordovician: Southeastern Missouri.

H. S. McQueen, 1937, Missouri Geol. Survey and Water Resources 59th Bienn. Rept., app. 1, p. 18–19. Name applied to middle member of formation; lower and upper members unnamed. Consists of dark-brown to black argillaceous limestone; calcareous hard platy and fissile shale; calcareous siltstone; locally contains light-colored finely crystalline limestone with fine but distinct granular texture. Thickness about 10 feet.

Well exposed in abandoned quarry on Arnold Geiser Farm in southeast portion of U.S. Survey 214, approximately SW cor. NW¼NW¼ sec. 20, T. 30 N., R. 13 E., Cape Girardeau County.

Gem Hill Formation (in Tropico Group)

Miocene(?) : Southern California.

T. W. Dibblee, Jr., 1958, Am. Assoc. Petroleum Geologists Bull., v. 42, no. 1, p. 138 (fig. 2), 140. Name applied to lower unit of group in Rosamond district. Consists mainly of stratified light-colored rhyolitic lithic tuff, tuff-breccia, tuffaceous sandstone, volcanic agglomerate, and some conglomerates of both volcanic and granitic clasts; locally, thin basalt flows at or near the top. Thickness at Gem Hill 1,250 feet; at Antelope Buttes about 1,200 feet; thinner elsewhere. Overlies quartz monzonite; underlies Fiss fanglomerate (new), contact gradational at Gem Hill and sharp, locally unconformable contact elsewhere. In Soledad Mountains, includes Bobtail quartz latite member (new) at base.

Type locality: Gem Hill, in S½ sec. 25, SE¼ sec. 26, and NE¼ sec. 35, T. 10 N., R. 13 W., San Bernardino Base and Meridan, 5½ miles northwest of Rosamond, Rosamond quadrangle, Kern County. Exposed nearly continuously from Gem Hill southeastward 7 miles to Red Hill; other exposures at Little Buttes, Middle Buttes, Soledad Mountain, and ridge north of Bissell.

Gemini Limestone[1]

Ordovician : Central northern Utah.

Original reference: G. W. Crane, 1915, Am. Inst. Mining Engrs. Bull. 106, p. 2149–2151.

Probably named for Gemini mine, Tintic district.

Gemuk Group

Carboniferous(?) to Lower Cretaceous : Southwestern Alaska.

W. M. Cady and others, 1955, U.S. Geol. Survey Prof. Paper 268, p. 21 (table), 27–34, pl. 1. Chiefly dense dark massive siltstone, with which are interbedded smaller amounts of chert and volcanic rock, and thin interbeds of limestone, graywacke, and breccia. Siltstone and breccia beds made up of fragments unsorted as to size. Volcanic rocks chiefly of andesitic lava. Exposed part estimated to be 15,000 to 25.000 feet thick. A good section favorable for determinations of thickness occurs along Cinnabar Creek, comprises chiefly massive siltstone, 10,000 to 15,000 feet thick above and between 5,000 to 10,000 feet of thinly bedded siltstone below. Conformably underlies Kuskokwim group (new). Carboniferous(?), Permian(?), Triassic, and Lower Cretaceous.

J. M. Hoare and W. L. Coonrad, 1959, U.S. Geol. Survey Misc. Geol. Inv. Map I–285. Rocks of Gemuk group in lower Kuskokwim region have yielded sparse fossil collections ranging in age from Mississippian(?) to Early Cretaceous. Thickness 15,000 to 25,000 feet. Map bracket shows age Carboniferous(?) to Cretaceous.

Type locality and also most favorable exposures lie north of lower middle course of Gemuk River. Rocks crop out in several irregular areas near axis of Kuskokwim Mountains southwest of Kuskokwim River. Largest mapped area of group extends northward about 15 miles from northwest side of Gemuk River valley into drainage basins of Atsaksovluk and Chikululnuk Creeks, and thence northeastward about 15 miles into headwater area of main fork of Holokuk River.

Gene Autry Shale

Pennsylvanian (Morrow Series) : South-central Olahoma.

M. K. Elias, 1956, *in* Ardmore Geol. Soc., Petroleum Geology of Southern Oklahoma—a symposium, v. 1: Tulsa, Okla., Am. Assoc. Petroleum Geologists, p. 70 (table 2), 99–101. Uniformly soft clayey shale, gray to light gray; yellow-brown to red and maroon ferruginous concretions along bedding planes; contains one fossiliferous concretionary lentil, 2 or 3 feet thick, about 105 feet below what is considered top of formation. Thickness at type locality about 700 feet; dip almost vertical. Overlies Primrose sandstone; top is taken as base of concretionary fossiliferous lentil which is correlated with Jolliff formation.

Type section: North and west of center of NW¼ sec. 34, T. 3 S., R. 4 E., Carter County. Exposed in a series of ravines on both sides of Santa Fe Railroad track, about 2 miles north of town of Gene Autry.

Genesee Formation

Genesee Group[1]

Genesee Member (of Jennings Formation)

Middle and Upper Devonian: New York, Maryland, Pennsylvania, and West Virginia.

Original reference: L. Vanuxem, 1842, Geology of New York, pt. 3, p. 168–169.

W. H. Bradley and J. F. Pepper, 1938, U.S. Geol. Survey Bull. 899–A, pl. 3. Columnar section shows Genesee group comprises (ascending) Geneseo shale with Genundewa limestone lentil, Standish flagstone, and West River shale. Overlies Tully limestone of Hamilton group; underlies Middlesex shale.

R. L. Bates, 1939, Virginia Geol. Survey Bull. 51–B. p. 41 (table 1), 62–63, pl. 6. In Lee County, entire Genesee formation consists of fissile coal black shale. Thickness about 200 feet. Overlies Helderberg formation; underlies Portage formation.

H. P. Woodward, 1943, West Virginia Geol. Survey, v. 15, p. 385, 390. Genesee group not now recognized in outcrop area. Unit previously called "Genesee black shale" appears to be southwestern extension of Harrell shale of central Pennsylvania, and this term is considered appropriate for outcrops in West Virginia.

W. L. Grossman, 1944, Geol. Soc. America Bull., v. 55, no. 1, p. 41–76. Group, traced westward from Lake Erie, changes facies in central Finger Lakes region. In western New York, Geneseo and West River shales form lower and upper units. Sherburne-type rocks penetrate the West River of Finger Lakes region, and intertonguing units are named Penn Yan and Milo tongues of West River and Starkey tongue of the Sherburne. Term Genundewa is abandoned. Name Sherburne includes rocks between top of Penn Yan tongue and base of Middle Middlesex remnant in Cayuga Valley. Term Genesee group is used to include interval from base of Geneseo shale to base of Middlesex shale from Lake Erie to Cayuga Lake. To the east, the formational divisions do not correspond to those of western New York, and for all practical purposes Genesee group ends at Cayuga Lake. Overlies Tully limestone. Group is in Senecan series. An attempt to apply Caster's (1934, Bulls. Am. Paleontology, v. 21, no. 71) system of facies classification to Genesee rocks was not wholly successful.

Ernst Cloos, 1951, Maryland Dept. Geology, Mines and Water Resources Washington County [Rept. 14], p. 90, 99 (table 4). Member of Jennings formation. Consists of black fissile argillaceous shale. Thickness 90 to 100 feet, west of Wills Mountain near Cumberland; thins eastward and disappears before it reaches Washington County. Underlies Woodmont member; overlies Romney formation.

R. G. Sutton, 1951, Rochester Acad. Sci. Proc., v. 9, nos. 5–6, p. 381–386, pl. 1. In Batavia quadrangle, Genesee group comprises Geneseo formation and West River shale. Overlies Leicester marcasite member (new) of Moscow formation; underlies Middlesex black shale of Naples group.

Wallace de Witt, Jr., and G. W. Colton, 1959, Am. Assoc. Petroleum Geologists Bull., v. 43, no. 12, p. 2810–2828. Genesee group of Chadwick (1935) is here called Genesee formation. Includes all rocks between top of Tully limestone—or top of Moscow shale of Hamilton group where the Tully is absent—and base of Middlesex member of Sonyea formation in western half of New York. Formation is composed of seven intertonguing facies which are designated as members. In vicinity of Canandaigua Lake and Genesee River valley, formation consists of (ascending) Geneseo shale, Penn Yan shale, Genundewa limestone, and West River shale members. At Cayuga Lake, 30 miles east, comprises (ascending) Geneseo shale, Penn Yan shale, Sherburne flagstone, Renwick shale, Ithaca, and West River shale members. Top of formation is about 600 feet higher stratigraphically than top of Genesee group of previous workers. Thickness at reference section (herein designated) 125 feet; 850 to 940 feet near Ithaca; 595 feet near Sheldrake Creek on west side Cayuga Lake.

W. H. Hass, 1959, (abs.) Geol. Soc. America Bull., v. 70, no. 12, pt. 2, p. 1615. Discussion of conodont faunas from Devonian of New York and Pennsylvania. Parts of Geneseo shale [member of Genesee] placed in Middle Devonian. Leicester marcasite regarded as transgressive basal bed of Genesee formation; Leicester oldest east of Canandaigua where de Witt, Colton, and writer [Hass] found it above Tully limestone and youngest in western New York, where on Eighteen Mile Creek, Erie County, it includes Hinde's (1879, [Geol. Soc. London Quart. Jour., v. 35]) "Conondont bed"; its fauna there is mixture of high Middle and low Upper Devonian (pre-Genundewa and Genundewa) conodonts.

Reference section: At Beards Creek, near Leicester, western Livingston County. Named for exposures along Genesee River and valley, New York, especially in gorge of Genesee River below Portage.

Genesee Valley Limestone and Shales[1]

Triassic: Northern California.

Original reference: J. P. Smith, 1910, Jour. Geology, v. 18, chart opposite p. 220.

Name probably derived from occurrence in Genesee Valley, east of Genesee, Plumas County.

Geneseo Shale Member (of Genesee Formation)

Geneseo Shale (in Genesee Group)[1]

Middle and Upper Devonian: New York.

Original reference: G. H. Chadwick, 1920, Geol. Soc. America Bull., v. 31, p. 118.

W. L. Grossman, 1944, Geol. Soc. America Bull., v. 55, no. 1, p. 47 (fig. 2), 54–59. Basal formation of Genesee group. Extends from Lake Erie to

Cayuga Lake, beyond which its black shale facies is recognized as far as Chenango Valley. East of Cayuga Lake, upper part of the Geneseo grades laterally into the coarser facies characterizing the higher beds; the black shale facies thins and disappears a short distance east of Chenango Valley. Formation thickens from a 2-inch sliver at Lake Erie to 125 feet at Cayuga Lake; thins eastward from this meridian to 40 feet at Cayuga Lake. Underlies Penn Yan tongue (new) of West River shale. Overlies Tully limestone.

Wallace de Witt, Jr., and G. W. Colton, 1959, Am. Asso. Petroleum Geologists Bull., v. 43, no. 12, p. 2814 (fig. 3), 2815, 2816–2818, 2820. The 44 feet of black shale that overlies Moscow shale of Hamilton group in Menteth Gully, on west side of Canandaigua Lake 14 miles north of Naples, comprises Geneseo shale member of Genesee formation as defined in this paper. At reference section, herein designated, consists of homogeneous black shale and brownish-black shale containing a few layers of argillaceous limestone concretions 7 inches to 3 feet in diameter. Name Geneseo shale was proposed by Chadwick for exposures of about 82 feet of very dark gray calcareous mudrock and irregularly fissile shale containing some beds of black shale, many limestone concretions, and layers of nodular limestone in vicinity of Fall Brook. The Geneseo member is herein restricted at Fall Brook locality to a 5-foot tongue of black shale at the base and a 5-foot tongue of black shale 26 to 31 feet above the base of the 82-foot sequence. The lighter colored and less fissile rocks, which were originally included in the Geneseo by Chadwick, are herein placed in lower part of Penn Yan shale between and above tongues of the Geneseo shale member. The two tongues of black shale that comprise the Geneseo member at Fall Brook thicken eastward and coalesce near Hemlock Lake about 10 miles east of Geneseo. Member thins westward from about 45 feet at Canandaigua Lake to feather-edge in eastern Erie County. Thickness 113 to 135 feet at Cayuga Lake. Overlies Tully limestone.

W. H. Hass, 1959, (abs.) Geol. Soc. America Bull., v. 70, no. 12, pt. 2, p. 1615. Discussion of conodont faunas from Devonian of New York and part of Geneseo shale [member of Genesee formation] placed in Middle Devonian. Determination made on basis of conodont faunas.

Reference section: In Menteth Gully, on west side of Canandaigua Lake 14 miles north of Naples, Ontario County. Named for exposures at Fall Brook, 1½ miles south of Geneseo, Livingston County.

Geneva Limestone[1] **or Dolomite**

Middle Devonian: Central and southeastern Indiana.

Original reference: J. Collette, 1882, Indiana Dept. Geology and Nat. History 11th Ann. Rept., p. 63, 81, 82.

D. G. Sutton and A. H. Sutton, 1937, Jour. Geology, v. 45, no. 3, p. 331. Geneva is northward facies of Jeffersonville formation of Onondaga age as shown by Onondaga faunules of Jeffersonville which continue into Geneva at same horizons and by lateral transition from dolomitic Geneva to purer Jeffersonville limestone. Term Jeffersonville is synonym of Geneva, and by custom of priority latter name should be applied to all Indiana rocks of Onondaga age.

G. A. Cooper and others, 1942, Geol. Soc. America Bull., v. 53, no. 12, pt. 1, chart 4. Lower or Middle Devonian.

J. B. Patton and T. A. Dawson *in* H. H. Murray, 1955, Indiana Geol. Survey Field Conf. Guidebook 8, p. 37–38, pl. 1. Indiana Geological Survey uses name Geneva dolomite. Consists of buff to chocolate-brown granular thin-bedded to massive dolomite and contains white crystalline calcite masses that range from a fraction of an inch to more than 1 foot in cross section; carbonaceous material present in bands and partings. From Shelby, Rush, and Bartholomew Counties, where maximum thickness is 35 feet, Geneva thins regularly southward to its pinchout in northern Clark County. In most places, overlies Louisville limestone but locally overlies Waldron shale or Laurel limestone; throughout southern Indiana, outcrop underlies Jeffersonville limestone; relationship to lower Jeffersonville not clear from Jennings County northward, but recent data prove that middle and upper Jeffersonville maintain their characteristics throughout this area and overlie the Geneva.

Named for Geneva, Shelby County.

†Geneva Quartzite[1]

Lower Ordovician: Northeastern Utah.

Original reference: E. Blackwelder, 1910, Geol. Soc. America Bull., v. 21, p. 519, 526–527, 542.

Well exposed in northern part of Wasatch Range.

†Geneva Sands[1]

Pleistocene: Southeastern Alabama and Georgia.

Original reference: E. A. Smith, 1894, Alabama Geol. Survey geol. map of Alabama, explanatory chart.

Probably named for Geneva or Geneva County, southeastern Alabama.

†Genevieve Group[1]

Mississippian: Missouri.

Original reference: H. S. Williams, 1891, U.S. Geol. Survey Bull. 80, p. 169.

Named for exposures in Ste. Genevieve County.

Gennet Creek Formation (in Chester Group)[1]

Mississippian: Southwestern Indiana.

Original reference: M. A. Harrell, 1935, Indiana Dept. Conserv. Pub. no. 133, p. 78.

J. M. Weller and A. H. Sutton, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 5, p. 839. In Indiana, the Clore limestone is known as Gennet Creek formation and consists of 10 to 35 feet of predominantly shaly beds.

C. A. Malott, 1952, Stratigraphy of Ste. Genevieve and Chester formations of southern Indiana: Ann Arbor, Mich., The Edwards Letter Shop, p. 6. Name Clore limestone extended into Indiana and applied to shale and limestone interval underlying Degonia sandstone and overlying Palestine sandstone. [This appears to be interval to which name Gennet Creek was applied].

Type locality and derivation of name not given.

Genoa Member (of Oneota Formation)

Lower Ordovician: Southwestern Wisconsin.

G. O. Raasch, 1952, Illinois Acad. Sci. Trans., v. 45, p. 88–90, 91–92. Comprises two divisions, the lower of which is light buff, or buffy mottled dolomite commonly in beds 2 to 3 feet thick. Beds are dull in lustre, compact, homogeneous, and generally finely crystalline. Many of the strata studded with globose, nut-size cavities, horizontal burrows conspicuous in many beds, and chert nodules, in rows parallel to bedding at a few localities. Ripple marks at one locality. Thickness ranges from 8 feet in north to 29 feet in south. Upper division of white, dull, homogeneous, and finely crystalline dolomite, which readily breaks to flagstone slabs 2 to 6 inches thick. Nut-sized cavities generally present. Thickness ranges from 3 feet in north to more than 8 feet in south. Thickness of member ranges from 11 feet in northeast to 46 feet in southwest part of quadrangle. Underlies Stoddard member (new) with transitional contact; overlies Mount Ridge member (new).

Type section: Quarry and Mississippi bluff in NE¼SE¼ sec. 32, T. 13 N., R. 7 W., Stoddard quadrangle, 1 mile south of Genoa, Vernon County.

Genshaw Formation[1] (in Traverse Group)

Middle Devonian: Northeastern Michigan.

Original reference: A. S. Warthin, Jr., and G. A. Cooper, 1935, Washington Acad. Sci., Jour., v. 25, no. 12, p. 524–526.

A. S. Warthin and G. A. Cooper *in* G. A. Cooper and others. 1942, Geol. Soc. America Bull., v. 53, no. 12, pt. 1, p. 1762, chart 4. Originally proposed for thin limestones and shales between Ferron Point formation and Killians limestone. Recent work has shown that black limestone of Killians facies appears in the Genshaw. Therefore, Genshaw is redefined to include the Killians and lower 15 feet of Alpena limestone which contains many Genshaw species.

A. S. Warthin, Jr., and G. A. Cooper, 1943, Am. Assoc. Petroleum Geologists Bull., v. 27, no. 5, p. 579 (fig. 3), 582–584. Redefined Genshaw described in Thunder Bay region where composite section shows thickness of 116 feet. Killians limestone is excellent horizon marker in region and is here considered a named member of the Genshaw. Underlies Newton Creek limestone; overlies Ferron Point formation. Included in Traverse group.

W. A. Kelly and G. W. Smith, 1947, Am. Assoc. Petroleum Geologists, Bull., v. 31, no. 3, p. 448 (fig. 1), 451–453. Described in Afton-Onaway area where top is represented by Killians black limestone member. Separated from overlying Koehler limestone (new) by an interval which includes a buff limestone referable, possibly to the Newton Creek. Six faunal zones recognized in formation in area. Overlies Ferron Point formation.

Type locality: NE¼ T. 32 N., R. 8 E., Alpena County. Name derived from Genshaw School in SE¼ sec. 13.

Gent facies[1] (of Carwood Formation)

Lower Mississippian: Southern Indiana.

Original reference: P. B. Stockdale, 1931, Indiana Dept. Conserv., Div. Geology Pub. 98, p. 77, 178–184.

J. M. Weller and others, 1948, Geol. Soc. America Bull., v. 59, no. 2, p. 127–128, pl. 2. Mississippian facies nomenclature discussed. Correlation chart lists Gent facies of Carwood formation. Includes Lampkins sandstone member of Carwood.

Named from an old inland post office, Gent, located on a now abandoned part of Bloomington-Brownstown Road at middle of east line of NE¼ sec. 27, T. 8 N., R. 1 E., 9 miles east of Bloomington, Monroe County.

Gentile Valley Group[1]

Tertiary, upper, or Pleistocene: Southwestern Idaho.

Original reference: A. C. Peale, 1879, U.S. Geol. and Geog. Survey Terr. 11th Ann. Rept., p. 612, 642, map.

In Portneuf Canyon, on east side of Cache Valley, and in Gentile Valley.

Gentry Coal Member (of Caseyville Formation)

Pennsylvanian: Southeastern Illinois.

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 29, 44 (table 1), 61, pl. 1. Name applied to member of Caseyville (redefined). Overlies Sellers limestone member; underlies Pounds sandstone member. Thickness 2 feet in type section of Caseyville. Owen (1856) termed this Battery Rock coal, but Battery Rock has been more widely used for the sandstone and is so restricted in this report. Presentation of new rock-stratigraphic classification of Pennsylvanian of Illinois. Cyclical classification is retained but is entirely independent of rock-stratigraphic classification.

Type locality: Sec. 26, T. 11 S., R. 10 E., southwestern Hardin County.

Genundewa Limestone Member (of Genesee Formation)

Genundewa Limestone Lentil (of Geneseo Shale)[1]

Genundewa Limestone Member (of Geneseo Formation)

Upper Devonian: Western and west-central New York.

Original reference; J. M. Clarke, 1897, New York State Geologist 15th Ann. Rept.

W. H. Bradley and J. F. Pepper, 1938, U.S. Geol. Survey Bull. 899–A, p. 9, 10, pl. 3. Limestone lentil at top of Geneseo shale. Underlies West River shale. A bed of black, very dark gray limestone, in most places less than 1 foot thick. At Firtree Point, on west shore of Seneca Lake, abnormally thick.

W. L. Grossman, 1944, Geol. Soc. America Bull., v. 55, no. 1, p. 45. Term Genundewa abandoned because beds to which it refers are not considered a formation but rather a discontinuous shell limestone facies of the West River. These lenses are referred to as the *Styliolina* or pteropod facies of the West River. Impure limestone layers overlying the Geneseo in Seneca-Cayuga Lake region have been called Genundewa. They differ in lithology from the *Styliolina* beds to west and are discussed as limy facies of Penn Yan tongue (new) of West River.

R. G. Sutton, 1951, Rochester Acad. Sci. Proc., v. 9, nos. 5–6, p. 384. Referred to as limestone member of Geneseo formation.

Wallace de Witt, Jr., and G. W. Colton, 1959, Am. Assoc. Petroleum Geologists Bull., v. 43, no. 12, p. 2814 (fig. 3), 2815 2816, 2817 (fig. 4), 2818–2819, 2827. Redefined as member of Genesee formation. In type area, composed of about 12 feet of nodular layers of dark-gray fossiliferous limestone 1 to 10 inches thick interbedded with dark-gray calcareous shale. A few thin beds of black shale present. Thins toward west and locally absent near Lake Erie; thins toward east and grades laterally into Crosby sandstone in southeastern Ontario County. Overlies Penn

Yan shale member and underlies West River shale member at reference section of Genesee; thickness 3 feet. The Genundewa at Canandaigua Lake is lateral equivalent of Crosby sandstone of Torrey and others (1932) at Keuka Lake and is tentatively correlated with Williams Brook coquinite of Caster (1933) at Williams Brook near south end of Cayuga Lake.

Typically exposed at Genundewa Point, locally spelled Genundewah, on east side of Canandaigua Lake, about 9 miles north of Naples.

Geode Creek Basalt

Miocene and (or) Pliocene: Northwestern Wyoming.

A. D. Howard, 1937, Geol. Soc. America Spec. Paper 6, p. 19–21, 78 (table 9), pl. 4. Olivine basalt, with labradorite and augite. Characteristically massive, but locally may be highly vesicular. Weathers into stubby plates, up to 1 foot in length. Contains no secondary silica. Gray color and fine texture in contrast to color and texture of Crescent Hill basalt (new). Northern exposure about 60 feet high. Lies unconformably on unnamed breccia.

Exposed in two small patches, one east of Geode Creek and other about 1 mile northwest of Crescent Hill, Yellowstone National Park. The southern patch, the higher of the two, reaches elevation between 7,300 and 7,400 feet.

Georges Fork Sandstone Member (of Atoka Formation)[1]

Middle Pennsylvanian: Eastern Oklahoma.

Original reference: C. W. Wilson, Jr., 1935, Am. Assoc. Petroleum Geologists Bull., v. 19, no. 4, p. 503–520.

C. W. Wilson, Jr., and N. D. Newell, 1937, Oklahoma Geol. Survey Bull. 57, p. 29. Composed of thin to massively bedded sandstone. Thickness 35 feet at type locality. Separated by unnamed shale intervals from underlying Pope Chapel member and overlying Dirty Creek member.

Named for exposure east of Georges Fork, in secs. 24 and 25, T. 22 N., R. 19 E., Muskogee County.

Georgetown Limestone (in Washita Group)[1]

Georgetown Group or Subgroup

Lower Cretaceous (Comanche Series): Central and southern Texas.

Original reference: T. W. Vaughan, 1900, U.S. Geol. Survey Geol. Atlas, Folio 64.

T. L. Bailey, F. G. Evans, and W. S. Adkins, 1945, Am. Assoc. Petroleum Geologists Bull., v. 29, no. 2, p. 172–173. Washita group in Tyler basin is divided into eight stratigraphic units which can be traced in the subsurface. Except for Maness shale, which is not known at outcrop, and the Buda, which has been found at surface only as far north as southern Denton County, outcrop belts of each of the units in northeast Texas are readily mappable. Each unit is given formational rank, following Adkins and others (1933, Texas Univ. Bull. 3232). Lower five units are lumped into the Georgetown, which is here recognized as a subgroup. In central Texas where it is only 60 to 100 feet thick and where most of marls that separate the interval into mappable units are missing, it becomes an undifferentiated subgroup or formation and is called Georgetown limestone. Subgroup comprises (ascending) Duck Creek formation, Fort

Worth limestone, Denton shale, Weno formation, Pawpaw formation, and Main Street limestone.

Elliot Gillerman, 1953, U.S. Geol. Survey Bull. 987, p. 11 (table 1), 25–26, 27. In Eagle Mountains area, formation consists of interbedded blue-gray shales and black limestone at least 800 feet thick. Overlies Kiamichi formation; underlies Carpenter limestone member (new) of Grayson formation.

F. E. Lozo and others, 1959, Texas Univ. Bur. Econ. Geology Pub. 5909, p. 3–4, 15–18, 122–130. Discussed in symposium on Edwards limestone. Formation includes (ascending) Duck Creek, Fort Worth, Denton, Weno, Pawpaw, and Main Street members. Overlies Kiamichi formation; underlies Grayson formation.

Named for Georgetown, Williamson County.

Georgia Slate[1]

Lower Ordovician: Northwestern Vermont.

Original reference: Edward Hitchcock, 1861, Vermont Geologist Rept., v. 1, p. 357-386.

Charles Schuchert, 1937, Geol. Soc. America Bull., v. 48, no. 7, p. 1014, 1021, 1025, 1045, 1052. Overlies Rockledge breccia (new). Upper Cambrian.

A. B. Shaw, 1958, Geol. Soc. America Bull., v. 69, no. 5, p. 550. In previous publications, names Georgia slate, Corliss breccia, Grandge slate, and upper Gorge formation have been used for Ordovician rocks in St. Albans area. In present report, name Georgia slate is abandoned because Walcott's name for Lower and Upper Cambrian rocks should not be extended to lower Ordovician.

Named for town of Georgia, Franklin County.

†Georgian Series[1] or Epoch[1]

Lower Cambrian: North America.

Original reference: C. D. Walcott, 1891, U.S. Geol. Survey Bull. 81, p. 360.

A. B. Shaw, 1954, Geol. Soc. America Bull., v. 65, no. 11, p. 1046. Walcott (1891, U.S. Geol. Survey 10th Ann. Rept., pt. 1) used name *Olenellus* zone essentially in sense of series term after he had established correct relative positions of *Olenellus* and *Paradoxides* faunas. Later, he (1891) applied name Georgian series to Lower Cambrian, referring to standard section described by him (1886, U.S. Geol. Survey Bull. 30) west of Georgia Center, Vt. Name Georgian was replaced by Waucoban series (Walcott, 1912) because Georgian was at that time also used for a formation, Georgia slate. Section at Waucoba has been studied recently. Believed that, in view of present state of knowledge, the Waucoba section is not a satisfactory standard. Term Georgian should be reinstated for the following reasons: (1) Georgia section, as opposed to that at Waucoba Springs, is well known, and its contained fossils are properly located stratigraphically. (2) Fauna of Georgia section, and especially of Parker slate, is varied and abundant. Fossils are not common and do not seem to be so varied in most of Waucoba section. (3) Name Georgian is no longer used for any other stratigraphic unit. [Georgia slate abandoned in this report.]

Named for section at west of Georgia Center, Vt.

Gering Formation[1] **or Sandstone** (in Arikaree Group)

Gering facies (of Monroe Creek Formation)

Miocene: Western Nebraska and southeastern Wyoming.

Original reference: N. H. Darton, 1898, U.S. Geol. Survey 19th Ann. Rept., pt. 4, p. 735, 747–755.

C. B. Schultz, 1938, Am. Jour. Sci., 5th ser., v. 35, no. 210, p. 441–444. Arikaree group redefined to include Gering formation as basal unit. Underlies Monroe Creek formation.

C. B. Schultz and T. M. Stout, 1941, Guide for a field conference on the Tertiary and Pleistocene of Nebraska: Nebraska Univ. State Mus. Spec. Pub., p. 28. In most places, formation is disconformable on upper Oligocene Whitney member of Brule formation, and change in lithology from massive clay to gray or grayish-blue sand is commonly quite pronounced.

L. K. Wenzel, R. C. Cady, and H. A. Waite, 1946, U.S. Geol. Survey Water-Supply Paper 943, p. 70–72, pl. 2. Formation described in Scotts Bluff County where it is primarily a fine soft gray sandstone, strongly laminated and locally crossbedded. Occupies channel cut in upper surface of Brule formation. Maximum thickness about 200 feet, 6 miles south-southwest of Gering; thins toward the south and southwest and toward the north and northeast. Overlying Monroe Creek and Harrison formations cannot be distinguished in this area.

R. C. Cady and O. J. Scherer, 1946, U.S. Geol. Survey Water-Supply Paper 969, p. 20. Referred to as Gering sandstone.

P. O. McGrew, 1953, Wyoming Geol. Soc. Assoc. Guidebook 8th Ann. Field Conf., p. 62 (chart), 63. Geographically extended into southeastern Wyoming.

C. B. Schultz and T. M. Stout, 1955, Nebraska Univ. State Mus. Bull., v. 4, no. 2, p. 46, fig. 10. Bayard paleosol complex caps top of Whitney member of Brule formation and extends into Gering formation in Castle Rock section near Bayard.

S. G. Collins, 1960, Geology of the Patricia quadrangle (1:62,500): South Dakota Geol. Survey. Monroe Creek formation includes two mappable facies tentatively correlated with Gering channel sand and Mellette limestone.

Well developed southwest of Gering, Scotts Bluff County, Nebr.

†Gerlane Formation[1]

Pleistocene: South-central Kansas.

Original reference: G. L. Knight, 1934, Geol. Soc. America Proc. 1933, p. 91.

J. C. Frye, 1945, Jour. Geology, v. 53, no. 2, p. 91–92. Term Gerlane formation has been applied to Pleistocene beds only in Barber County. These deposits underlie floor of lowland surface that extends westward as far as eastern Meade County: topographically below Tertiary-capped upland to north. Deposits similar to the Gerlane occur in Clark County and eastern Meade County, Kans., and in Beaver and Harper Counties, Okla. These deposits, loosely referred to as Ashland-Englewood terrace beds, are shown by their physiographic relations and fauna to be late Pleistocene in age, but their exact correlation with named formations in Meade Basin and elsewhere in central and western Kansas is unknown. Age and stratigraphic relations of Gerlane formation and associated beds are problems for further study.

J. C. Frye and A. B. Leonard, 1952, Kansas Geol. Survey Bull. 99, p. 110. Name appears in list of units that consist in part or entirely of deposits known to be of Illinoian or younger age and that are properly classed, at least in part, as Sanborn formation.

Type locality: Near Gerlane, Barber County.

Germania Formation (in Chadakoin Group)

Germania Formation (in Conneaut Group)

Germania Member (of Chadakoin Formation)

Upper Devonian: Northwestern Pennsylvania and southwestern New York.

J. G. Woodruff, 1942, New York State Mus. Bull. 326, p. 17 (fig. 1), 47–50. Uppermost formation in Conneaut group. Overlies Whitesville formation (new); underlies Wolf Creek member of Cattaraugus formation. Thickness about 70 feet. Consists of thin green sandstones interbedded with red shales, with the "Catskill" crossbedded sandstone and conglomerate beds at different horizons, varying with the locality. Base of formation is recognized by the red color of the soil marking the earliest appearance of the real reds of the "Catskill."

I. H. Tesmer, 1955, New York State Mus. Sci. Service Circ. 42, p. 10 (fig. 1), 15. Upper member of Chadakoin formation. Overlies Whitesville member; underlies basal Wolf Creek (Panama) member of Cattaraugus formation.

L. V. Rickard, 1957, New York State Geol. Assoc. [Guidebook] 29th Ann, Mtg., p. 17 (table 2), 19. Uppermost formation in Chadakoin group. Inasmuch as Upper Devonian strata are still not thoroughly understood, a more or less permanent classification satisfactory to a majority of workers may not be obtained for some time.

Type outcrop: On south flank of Marshfield anticline, near Germania, Potter County, Pa. Can be traced over most of Wellsville quadrangle, Allegany County, N.Y.

Germer Tuffaceous Member (of Challis Volcanics)[1]

Oligocene, upper, or Miocene, lower: Southern central Idaho.

Original reference: C. P. Ross, 1932, Idaho correlation chart compiled by M. G. Wilmarth.

A. L. Anderson [1949], Idaho Bur. Mines and Geology Pamph. 83, p. 9. In most places, Germer member is interbedded with and overlies the flows of the basal latite-andesite member, but in Yankee Fork district it is in part stratigraphically equivalent to the flows and in part older.

Named for Germer Basin, on south side of Salmon River, nearly opposite mouth of Bayhorse Creek, Custer County.

Gerome Andesite[1]

Oligocene: Northeastern Washington.

Original reference: C. E. Weaver, 1920, Washington Geol. Survey Bull. 20, p. 98, map.

U.S. Geological Survey currently considers the Gerome Andesite to be Oligocene in age.

Named for exposures near town of Gerome, Stevens County.

†Geronimo Series[1]

Pennsylvanian(?): Southwestern Oklahoma.

Original reference: H. F. Bain, 1900, Geol. Soc. America Bull., v. 11, p. 135, 140–141.

C. C. Branson, 1957, Oklahoma Geology Notes, v. 17, no. 11, p. 101. Abandoned by Oklahoma Geological Survey. Named for Apache chief and thus not a geographic name.

Sequence occurs in Wichita Mountain region.

Gerster Formation[1] **or Limestone** (in Park City Group)

Permian: Western Utah.

Original references: T. B. Nolan, 1930, Washington Acad. Sci. Jour., v. 20, no. 17, p. 421–432; 1935, U.S. Geol. Survey Prof. Paper 177, p. 39–41.

R. K. Hose and C. A. Repenning, 1959, Am. Assoc. Petroleum Geologists Bull., v. 43, no. 9, p. 2183 (fig. 5), 2184–2185. Termed Gerster limestone. Assigned to Park City group in Confusion Range where it is highest Permian unit. Overlies Plympton formation (new); underlies Thaynes formation. Consists almost entirely of resistant ledge-forming light-brownish-gray limestone interbedded with slope-forming yellowish-gray or rusty-brown argillaceous limestone; most limestone beds bioclastic. Aggregate thickness about 1,100 feet.

Grant Steele, 1960, Intermountain Assoc. Petroleum Geologists Guidebook 11th Ann. Field Conf., p. 91–113. Nolan (1935) placed lower contact of the Gerster at top of "Oquirrh formation," and upper contact at base of overlying Triassic limestone and shales. As determined in present study, lower 170 feet of Nolan's Gerster formation is lithologically equivalent to Kaibab formation. Would seem appropriate to restrict the Gerster to those limestones above gray cherty carbonates of the Kaibab. The Gerster appears to grade laterally into shales and cherts of the Phosphoria as the unit is traced north and northwest to Leach Mountains and Burnt Canyon Range. At several localities west of Gold Hill, upper contact of the Gerster is placed at base of a chert pebble conglomerate sequence believed to correlate with third member of Nolan's Garden Valley formation. Upper Guadalupian.

Named for exposures in Gerster Gulch, in northwestern corner Gold Hill quadrangle, Tooele County.

Gerty Sand[1]

Pleistocene: Southeastern Oklahoma.

Original reference: J. A. Taff, 1899, U.S. Geol. Survey 19th Ann. Rept., pt. 3, p. 439.

H. D. Miser and others, 1954, Geologic map of Oklahoma (1:500,000): U.S. Geol. Survey. Pleistocene.

O. D. Weaver, Jr., 1954, Oklahoma Geol. Survey Bull. 70, p. 85–88. Averages 35 feet thick across Hughes County. Typically reaches maximum of 40 feet in central parts of its outcrop. Overlies Pennsylvanian sandstones and shales.

W. F. Tanner, 1956, Oklahoma Geol. Survey Bull. 74, p. 115. Validity of the Gerty, as anything more than a terrace level in Seminole County, questioned. Farther to southeast, geomorphic evidence lends support to Gerty concept.

Named for Gerty (formerly spelled Guertie), Hughes County.

Getaway Limestone Member (of Cherry Canyon Formation)

Permian (Guadalupe Series): Western Texas.

P. B. King *in* A. K. Miller and W. M. Furnish, 1940, Geol. Soc. America Spec. Paper 26, p. 9. Incidental mention.

P. B. King, 1942, Am. Assoc. Petroleum Geologists Bull., v. 26, no. 4, p. 580, 585 (fig. 7), pl. 2; 1948, U.S. Geol. Survey Prof. Paper 215, p. 35–36, pl. 3 [1949]. Consists of black or dark-gray limestone, with some lighter gray granular very fossiliferous limestone and some sandstone partings. Locally 200 feet thick; in some areas, feathers out. Lies 100 to 200 feet above base of formation: lies below South Wells limestone member which in turn lies about 600 feet above base of formation.

Type locality: Getaway Gap, 6 miles southeast of Guadalupe Peak and 6 miles southeast of El Capitan, Culberson County.

Getmuna Rhyolite Group

Paleocene(?) to Miocene(?): Southwestern Alaska.

W. M. Cady and others, 1955, U.S. Geol. Survey Prof. Paper 268, p. 21 (table), 50–53, pl. 1. Tuff comprises major part of formation though some lava crops out in small tract of about 3 square miles at southwest end of area in which group is exposed. Tuff beds and lava flows are rhyolitic. Lava is light purplish brown; weathered surface is buff colored. Tuff is mottled with contrasting light and dark shades of the fragmental materials; weathered surface is more uniform buff color. At least 500 feet thick. Maximum thickness estimated to be about 1,500 feet. Believed to cover folded and dissected Kuskokwim group (new) and to postdate Iditarod basalt (new). Probably older and extends beneath Holokuk basalt (new) exposed nearby.

Named for Getmuna Creek in central Kuskokwim region. Occupies elongate area, about 15 square miles north of Horn Mountains, that trends northeast across middle course of Getmuna Creek, a southwestern tributary of Crooked Creek.

Getsuyoto Beds or Formation

See Getuyoto Beds or Formation.

Gettysburg Shale (in Newark Group)[1]

Gettysburg sandstone lithofacies

Upper Triassic: Southern Pennsylvania and central Maryland.

Original reference: A. I. Jonas, 1926, Pennsylvania Geol. Survey Topog. and Geol. Atlas 178, p. 17, New Holland sheet.

G. W. Stose and A. I. Jonas, 1939, Pennsylvania Geol. Survey, ser. 4, Bull. C–67, p. 115–120. Gettysburg shale, upper formation of Newark group, consists of red shale and red sandstone, with lenticular zone near base containing thick beds of conglomerate herein named Conewago conglomerate member, a series of hard gray sandstone near middle, called Heidlersburg member, and beds of limestone and conglomerate and quartzose fanglomerate at top. Thickness 15,500 to 18,100 feet. Overlies New Oxford formation.

A. J. Stose and G. W. Stose, 1946, Maryland Dept. Geology, Mines and Water Resources Carroll and Frederick Counties Rept. Geographically extended to Maryland.

D. B. McLaughlin and R. C. Gerhard, 1953, Pennsylvania Acad. Sci. Proc., v. 27, p. 136, 137. Termed sandstone lithofacies in Lebanon and Lancaster Counties, southeastern Pennsylvania. Includes Furnace Ridge conglomerate (new) in lower part, sandstone units at bottom, middle, and top, and a second conglomerate unit below the top sandstone. Conspicuous changes in lithology along strike. Interfingers with New Oxford subarkosic lithofacies and is the northern and generally overlying unit; transition marked by extensive interbedding of feldspathic and nonfeldspathic sandstones.

M. E. Kauffman, 1960, Pennsylvania Geologists Guidebook 25th Ann. Field Conf., Oct. 22–23, p. 23. Formation comprises Elizabeth Furnace conglomerate member at base and shale member at top. Upper Triassic.

Named for exposures at Gettysburg, Adams County, Pa.

Getuyoto Beds or Formation

Miocene: Caroline Islands (Truk).

Risaburo Tayama, 1952, Coral reefs in the South Seas: Japan Hydrog. Office Bull., v. 11, p. 69, table 5 [English translation in library of U.S. Geol. Survey, p. 84]; S. Hanzawa *in* Jacques Avias and others, 1956, Lexique Strat. Internat., v. 6, Océanie, fasc. 2, p. 29. Getuyoto (Getsuyoto) beds (formation) of Truk are included in East Caroline beds (formation).

†Geuda salt measures (in Sumner Group)[1]

Permian: Eastern Kansas.

Original reference: F. W. Cragin, 1896, Colorado Coll. Studies, v. 6, p. 1–48.

Named for town of Geuda Springs, Sumner County.

Geuda Springs Shale Member (of Wellington Formation)

Permian: Central Kansas.

W. A. Ver Wiebe, 1937, Wichita Municipal Univ. Bull., v. 12, no. 5, p. 5, 12–14. Thick sequence of drab and bluish-grey shales and clays and anhydrite. Not well exposed; only a few feet at any one place. Thickness 230 feet (based on core sample). Includes three claystone layers which occasionally become limestones and can be traced for some distance along the strike; these are here named Prairie Creek, Sanitorium, and Udall limestone lentils. Underlies Annelly gypsum member (new); overlies Hollenberg limestone member (new).

Type locality: At sanitorium half a mile east of Geuda Springs, sec. 7, T. 34 S., R. 3 E.

Geyser Bentonite Bed (in Colorado Formation)

Cretaceous: Southwestern Montana.

Great Northern Railway Co. Mineral Research and Development Department, 1960, Great Northern Railway Co. Mineral Research and Devel. Dept. Rept. 12, pt. 2, p. 33–38, 41. Bed divided into two parts: lower bentonite member 3 to 16 feet thick, displaying "popcorn" bloom, overlying hard black shale; and upper hard siliceous shale member, 10 to 30 feet thick, weathering to a white outcrop. About 500 feet above base of Colorado formation; about 250 feet below Greenhorn bentonite bed (new).

Thirty miles of outcrop traced within distance of about 45 miles between Geyser and Windham, Judith Basin County.

Giannonatti facies

See **Cannonball Member** and **Ludlow Member** (of Fort Union Formation).

Giants Range Granite[1]

Precambrian: Northeastern Minnesota.

Original reference: J. E. Spurr, 1894, Minnesota Geol. Nat. Hist. Survey 22d Ann. Rept., p. 119–124.

F. F. Grout and others, 1951, Geol. Soc. America Bull., v. 62, no. 9, p. 1039, 1042. Giants Range granite is a batholith about 100 miles long and as much as 15 miles wide. Has several facies. Intrudes Knife Lake group. In some areas lies beneath Pokegama quartzite.

Forms core of Giants Range, Vermilion and Mesabi districts.

Gibbons Conglomerate Lentil (in Marble Falls Formation)

Gibbons Conglomerate Member (of Big Saline Formation)

Lower Pennsylvanian (Bend Series): Central Texas.

F. B. Plummer, 1945, Texas Univ. Bur. Econ. Geology Pub. 4401, p. 65–66. A basal conglomerate that marks the contact of the Marble Falls and the Barnett formation in some places. Consists of a dark-gray coarse fossiliferous glauconitic sand containing numerous subrounded cobbles from a fraction of an inch up to 10 inches in diameter; conglomerate grades upward into a coarse sandstone layer about 1 foot thick. Lentil is about 30 feet long east and west, 1 foot thick at each end and about 4 feet in the middle.

F. B. Plummer, 1947. Jour. Geology. v. 55, no. 3, pt. 2, p.196 (table 2), 197. Rank raised to member status in Big Saline formation. East of Ridge Cavern, underlies Aylor member; west of Ridge Cavern, underlies Brook Ranch member.

F. B. Plummer, 1950, Texas Univ. Bur. Econ. Geology Pub. 4329, p. 61–62, 63. At type section, the Gibbons is thin pebble conglomerate 6 to 12 inches thick.

Type section: One-fourth mile north of San Saba-Brady Road on the Gibbons Ranch 2½ miles south of Hall, San Saba County.

Gibson Coal Member (of Crevasse Canyon Formation)

Gibson Coal Member (of Mesaverde Formation)[1]

Upper Cretaceous: Northwestern New Mexico.

Original reference: J. D. Sears, 1925, U.S. Geol. Survey Bull. 767.

L. B. Leopold and C. T. Snyder, 1951, U.S. Geol. Survey Water-Supply Paper 1110–A, p. 6–9. Disconformably underlies Gramerco formation (new).

J. E. Allen and Robert Balk, 1954, New Mexico Bur. Mines Mineral Resources Bull. 36, p. 90, 92, 93, p. 1. Lower Gibson reallocated to member status in Crevasse Canyon formation (new). Overlies Dalton sandstone member; underlies Hosta tongue of Point Lookout sandstone.

E. C. Beaumont, C. H. Dane, and J. D. Sears, 1956, Am. Assoc. Petroleum Geologists Bull., v. 40, no. 9, p. 2157. Coal-bearing zone, originally named Gibson, is split into lower and upper part northeast of Gallup by wedging in of Point Lookout (formerly Hosta) sandstone. By newly adjusted terminology of Measaverde, lower and upper parts become respectively uppermost member of Crevasse Canyon and, in San Juan basin, lowest member of Menefee formation. Name Gibson coal member is restricted to lower split zone, and upper zone is here named Cleary coal member of Menefee formation. Southwest of point where Point Lookout (formerly

Hosta) sandstone wedges out, Cleary coal member and restricted Gibson coal member of Crevasse Canyon are in direct contact.

Named for village of Gibson, McKinley County.

Gibson Limestone Member (of Grindstone Creek Formation)

Pennsylvanian (Strawn) : North-central Texas.

H. T. Mann *in* R. J. Cordell, H. J. Fitzgeorge, and J. B. Sparks, 1954, Abilene Geol. Soc. Guidebook Nov. 19–20, p. 22, 25 (fig. 16). Name applied to member of Grindstone Creek. Lies below Goen limestone member and above Santo limestone member. Unit had been mapped as Santo by Plummer and Hornberger (1936, Texas Univ. Bull. 3534) and as Goen by Nickell (1939, Texas Univ. Bur. Econ. Geology Mineral Resources Survey Circ. 26).

Named for exposures along Gibson Creek, Erath County.

Gila Conglomerate[1] or Group

Tertiary, middle(?) to Pleistocene: Southeastern Arizona and southwestern New Mexico.

Original reference: C. K. Gilbert, 1875, U.S. Geog. and Geol. Survey 100th Mer., v. 3, p. 540–541.

L. A. Heindl, 1954, (abs.) Geol. Soc. America Bull., v. 65, no. 12, pt. 2, p. 1262. Reexamination of type section areas shows that term Gila conglomerate is unsatisfactory because it includes large proportion of deposits other than conglomerates; it suggests that deposits in separate basins are identical; its use masks sequences of alluvial deposits within individual basins; and it oversimplifies a complex Cenozoic history. Suggested that these deposits be separated into two major divisions wherever possible: an upper division consisting of conformable units and a lower division of older Cenozoic alluvial deposits. Upper division Pliocene to Pleistocene; lower division Oligocene(?) to Miocene(?).

James Gilluly, 1956, U.S. Geol. Survey Prof. Paper 281, p. 8–9 (table), 118–120, pl. 5. Described in central Cochise County, Ariz., where it is essentially conglomerate, sandstone, silt, and clay several hundred feet thick; in southern Dragoon Mountains unconformable above S O volcanics (new) and in Sulphur Spring Valley unconformable above Pearce volcanics (new). Pliocene.

P. A. Wood, 1959, Arizona Geol. Soc. Guidebook 2, p. 60. Three units distinguished in Gila conglomerate in Safford Valley area, Arizona. Bonita beds (lowest), Solomonsville beds, and Frye Mesa beds. Pliocene and Pleistocene.

U.S. Geological Survey currently designates the age of the Gila Conglomerate or Group as middle(?) Tertiary to Pleistocene.

Well exposed along gorges of upper Gila River and its tributaries.

Gila cyclothem (in McLeansboro Group)

Gila cyclothem (in Mattoon Formation)

Pennsylvanian: Southeastern Illinois.

W. A. Newton and J. M. Weller, 1937, Illinois Geol. Survey Rept. Inv. 45, p. 9, 27–28; J. M. Weller, 1942, Illinois Acad. Sci. Trans., v. 35, no. 2, p. 145 (table 1). Lies below the Woodbury cyclothem (new) and above the Greenup cyclothem (new). Thickness at type locality about 20 feet; thins northeastward. Includes Gila limestone.

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 52 (table 2), 55 (table 3), pl. 1. In Mattoon formation (new). Above Greenup cyclothem and below Woodbury cyclothem. Presentation of new rock-stratigraphic classification of Pennsylvanian strata in Illinois; cyclical classification is independent of rock-stratigraphic classification.

Type locality: Along Mint Creek in sec. 31, southeast of Gila, Jasper County.

Gila Limestone Member (of Mattoon Formation)

Gila Limestone (in McLeansboro Group)

Pennsylvanian: Southeastern Illinois.

W. A. Newton and J. M. Weller, 1937, Illinois Geol. Survey Rept. Inv. 45, p. 28. Dense fine-grained brittle limestone that contains small fragments of carbonaceous material; medium-gray, weathers nearly white. Thickness 1 to 4 inches. Included in Gila cyclothem.

H. R. Wanless and Raymond Siever, 1956, Illinois Geol. Survey Circ. 217, p. 12, pl. 1. Correlation chart shows Gila limestone in McLeansboro group below Woodbury limestone and above Greenup limestone. Gives type locality same as Gila cyclothem.

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 40, 51 (table 1), pl. 1. Reallocated to member status in Mattoon formation (new). Occurs above Greenup limestone member and below Woodbury limestone member. Presentation of new rock-stratigraphic classification of Pennsylvanian of Illinois.

Type locality Mint Creek, NE¼SW¼ sec. 31, T. 8 N., R. 9 E., Jasper County.

Gilbert Andesite

Pliocene: Southwestern Nevada.

H. G. Ferguson, S. W. Muller, and S. H. Cathcart, 1953, Geology of the Coaldale quadrangle. Nevada: U.S. Geol. Survey Geol. Quad. Map [GQ–23]. Flows and agglomerates, dominantly andesitic but also containing basalt, cover crest of Monte Cristo Range. Typically dark porphyritic lava. Few flows of hornblende andesite and hypersthene and olivine basalt. Locally sandstone, conglomerate, and fanglomerate between flows; andesite agglomerates widespread in adjacent Mina quadrangle. Also small intrusive masses of hornblende andesite. Between 500 and 1,000 feet thick in Monte Cristo Range.

H. G. Ferguson and S. H. Cathcart, 1954, U.S. Geol. Survey Geol. Quad. Map GQ–40. In Round Mountain quadrangle, underlies Toyabe quartz latite (new).

Type locality: Southern part of Gilbert district, Monte Cristo Range.

Gilbert Limestone (in McMillan Formation[1] or Group)

Upper Ordovician: Central Kentucky.

Original reference: A. F. Foerste, 1912, Denison Univ. Sci. Lab. Bull. 17, p. 18, 23.

A. C. McFarlan, 1943, Geology of Kentucky: Lexington, Ky., Kentucky Univ., p. 26, 27. In southern Blue Grass region, McMillan group includes (ascending) Tate formation, Gilbert limestone, and Mount Auburn formation. Gilbert is a zone of dove to grey fine-grained to dense hard limestone that grades into Mount Auburn; fossiliferous. Thickness 0 to 20 feet.

Probably named for Gilbert, Lincoln County.

Gilbert Sandstone (in Kanawha Formation[1] or Group)

Pennsylvanian (Pottsville Series) : Southern West Virginia.

Original reference: R. V. Hennen and D. B. Reger, 1914, West Virginia Geol. Survey Rept. Logan and Mingo Counties, p. 217–219.

P. H. Price and E. T. Heck, 1939, West Virginia Geol. Survey Greenbrier County, p. 215, 221. Lower Gilbert sandstone of Hennen and Reger (1914) is massive, grayish-white, coarse grained, and 30 to 80 feet thick. Overlies Gilbert shale. New River group, Pottsville series. Upper Gilbert sandstone not present in county.

Named for Gilbert, Mingo County.

Gilbert Shale[1]

Pennsylvanian(?) : Northeastern Arkansas.

Original reference: D. D. Owen, 1858, First report geol. reconn. northern counties of Arkansas, p. 68–69.

Exposed 3 miles northwest of Searcy, White County, at "bald point," in vicinity of Widow Gilbert's Farm.

Gilbert Shale (in Kanawha Formation[1] or Group)

Pennsylvanian (Pottsville Series) : Southern West Virginia.

Original reference: R. V. Hennen and R. M. Gawthrop, 1915, West Virginia Geol. Survey Rept. Wyoming and McDowell Counties, p. 168.

P. H. Price and E. T. Heck, 1939, West Virginia Geol. Survey Greenbrier County, p. 221. Shale in Kanawha group, Pottsville series.

First described in connection with Gilbert A coal in Wyoming County.

Gilboa Formation[1]

Upper Devonian: East-central New York.

Original reference: G. A. Cooper, 1934, Am. Jour. Sci., 5th ser., v. 27, p. 1–12.

J. M. Berdan, 1950, New York State Water Power and Control Comm. Bull. GW–22, p. 10, 19. Further described as gray medium- to fine-grained sandstone, thin-bedded siltstone, and dark-gray shale in Schoharie County.

Type section: In west face of Reed Hill, Schoharie Valley. Best section at Intake Building and along road from this building which connects with road to Hardenburg Falls and Grand Gorge [near southern end of Schoharie-Delaware County line]. [Probably named for Gilboa, Schoharie County, or Gilboa Reservoir.]

Gilboy Sandstone Member (of Monongahela Formation)[1]

Gilboy Sandstone (in Monongahela Group)

Gilboy sandstone and shale member

Upper Pennsylvanian: Northern West Virginia, eastern Ohio, and southwestern Pennsylvania.

Original reference: I. C. White, 1903, West Virginia Geol. Survey, v. 2, p. 150.

W. O. Hickok 4th and F. T. Moyer, 1940, Pennsylvania Geol. Survey, 4th ser., Bull. C–26, p. 100, 124 (fig. 29), 126. Lies below Waynesburg coal, which is considered top of Monongahela group; separated from underlying Waynesburg limestone by Little Waynesburg coal. Thickness as much as 20 feet in Fayette County.

D. L. Norling, 1958, Ohio Geol. Survey Bull. 56, p. 10 (fig. 3), 86, geol. map. In Morgan County, Gilboy sandstone and shale member (Monongahela series) consists of 13 to 20 feet of sandstone and sandy shales, with some gray to red shales. Where overlying Waynesburg (No. 11) coal is not present, sandstone section extends upward so that demarcation of Pennsylvanian-Permian contact is not possible.

M. T. Sturgeon and others, 1958, Ohio Geol. Survey Bull. 57, p. 158 (table 13), 188. Lowest member of Waynesburg cyclothem in report on Athens County. In many sections, member is in part a gray massive medium-grained sandstone very resistant to weathering. These zones give way laterally and vertically to less resistant lithologies, as fine- to medium-grained, thin- to medium-bedded sandstone or shaly sandstone interbedded with sandy platy shale. Average interval from top of Gilboy to Waynesburg coal bed is 9 feet, but this is variable because upper part grades laterally into redbeds; this results in thickening and thinning of both Gilboy sandstone member and redbed member (Waynesburg redbed member). Thickness of Gilboy 8 to 40 feet; average 11. In some areas, thick sandstone sequence begins at stratigraphic position of Gilboy and is continuous vertically to Waynesburg sandstone, with which member it is coalesced. When coalesced, the two sandstones cannot be separated or distinguished.

Named for exposure in Gilboy cut on Baltimore & Ohio Railroad east of Mannington, Marion County, W. Va.

Gilchrist Shale (in Carbondale Formation)

Gilchrist Shale (in Pottsville Formation)[1]

Pennsylvanian: Northwestern Illinois.

Original reference: H. R. Wanless, 1929, Illinois Geol. Survey Bull. 57, p. 49, 73, 83, 88, 122, 142.

H. R. Wanless, 1939, Geol. Soc. America Spec. Paper 17, p. 84. In Carbondale formation, a little below Colchester (No. 2) coal.

Exposed in shale pits north of Gilchrist, Mercer County.

Gile Mountain Formation

Gile Mountain Schists

Devonian: East-central Vermont and northwestern and west-central New Hampshire.

C. G. Doll, [1944]. Vermont State Geologist 24th Rept. 1943–1944, p. 18–19, pl. 3, 4. Light- to dark-gray chiefly quartz-mica schists. Less abundant are thin beds of massive and sheared quartzite, occasional coarse feldspathic schists, calcareous beds, and some graphic layers. Becomes more highly metamorphosed toward western part of outcrop belt where predominantly coarse amphibolites are prevalent. Thickness (excluding Meetinghouse slates) estimated about 6,500 feet. Meetinghouse slates, which are gradational westward into the schists, are the upper member of unit. Lower Devonian.

W. S. White and M. P. Billings, 1951, Geol. Soc. America Bull., v. 62, no. 6, p. 654–656, 662, pl. 1. Formation restricted to exclude rocks exposed in southeast corner of Strafford quadrangle, east of Ammonoosuc thrust, which Doll mapped as Gile Mountain schist[s]. Tentatively assigned to Middle Ordovician.

M. P. Billings, 1955, Geologic map of New Hampshire (1:250,000) : U.S. Geol. Survey. Geographically extended to New Hampshire. Middle Ordovician(?).

J. G. Dennis, 1956, Vermont Geol. Survey Bull. 8, p. 19–22, pl. 1. Discussion of gradational relationship with underlying Waits River formation. Included in St. Francis group. Lower to Middle Devonian.

M. P. Billings, 1956, The geology of New Hampshire, pt. 2, bedrock geology: Concord, New Hampshire State Plan. Devel. Comm., p. 10–11, 94–98, geol. map. Correlation chart shows Gile Mountain formation stratigraphically above Standing Pond volcanics and below Meetinghouse slate. Waits River, Standing Pond, Gile Mountain, and Meetinghouse formations are probably Middle Ordovician; may possibly be Silurian and (or) Devonian. Map bracket shows Gile Mountain as Middle Ordovician(?).

V. R. Murthy, 1958, Jour. Geology, v. 66, no. 3, p. 276–287. If structural interpretation given in present paper is correct, the calcareous rocks in East Barre quadrangle, here termed "Waits River formation" are youngest in Vermont sequence. Westmore and Gile Mountain formations, in all probability, are one and the same, being repeated on limbs of a syncline.

L. M. Hall, 1959, Vermont Geol. Survey Bull. 13, p. 28–34, 36–40. Formation described in St. Johnsbury quadrangle where it consists mainly of 5,000 feet of interbedded quartz-mica schist, micaceous quartzite, and minor amounts of feldspathic granulite and calc-silicate rock. Overlies Waits River formation; underlies Meetinghouse slate. Most workers agree age is Silurian and (or) Devonian. Discussion of age relations of rocks in Vermont sequence. According to one theory, Waits River and Gile Mountain could be equivalent in age, but, according to another theory, the Gile Mountain could be older than Waits River.

W. M. Cady, 1960, Geol. Soc. America Bull., v. 71, no. 5, p. 576, pl. 3. Formation of northeast Vermont is believed to be in section stratigraphically above Ammonoosuc volcanic rocks in west limb of Boundary Mountain anticlinorium. Billings (1956) suggests that Gile Mountain may be in higher stratigraphic position than the Ammonoosuc, although in an earlier interpretation (1955, map) he had tentatively placed the Gile Mountain in a stratigraphic position well beneath the Ammonoosuc. In northernmost Vermont, the Gile Mountain is continuous westward in Connecticut Valley-Gaspe synclinorium with identical slate, graywacke, and quartzite referred to Westmore formation (Doll, 1951), although farther south in Vermont belts of silty limestone are included in such terrane. Where this occurs, the belts of limestone are variously referred to as Waits River formation (Dennis, 1956; White and Jahns, 1950), or Barton River formation (Doll, 1951), or both (Murthy, 1957, Vermont Geol. Survey Bull. 10). Similar rocks with limestone interbeds crop out east of Gile Mountain formation in northern New Hampshire, where they have been referred to Waits River formation (Billings, 1955; 1956). Devonian.

Named for exposures on Gile Mountain in southern part of Strafford quadrangle, Vermont.

Giles Formation[1]

Silurian and Lower Devonian: Southwestern Virginia and southeastern West Virginia.

Original references: M. R. Campbell, 1894, Geol. Soc. America Bull., v. 5, p. 171, 177, pl. 4; 1896, U.S. Geol. Survey Geol. Atlas, Folio 26, p. 2.

Named for Giles County, Va.

Gilford Gabbro[1]

Devonian or Carboniferous: East-central New Hampshire.

David Modell, 1936, Geol. Soc. America Bull., v. 47, no. 12, p. 1895, 1898–1899, pl. 1. Dark gabbro with an unusual texture. Groundmass is a diabasic intergrowth of feldspar and greenish augite; in this are set large black clotlike hornblende spheroids each of which is a single crystal but poikilitically encloses numerous feldspar crystals similar to those in the matrix. Hornblende stands out in relief on weathered surfaces. Older than Endicott diorite; younger than Moat volcanics. Contacts not exposed. Assigned to White Mountain magma series.

Crops out one-fourth mile east of Gilford Station in northwestern corner of Belknap Mountains area. Best exposures found at 600-foot elevation on small bench which forms westernmost spur of Locke's Hill.

Gill Breccia (in Vieja Group)

Tertiary: Southwestern Texas.

R. K. DeFord, 1958, Texas Jour. Sci., v. 10, no. 1, p. 13, 14–17. Name proposed for a series of flow breccias consisting of three rock types: medium gray fragments in a grayish-red matrix; mottled fragments (pink, green, yellow, gray, and brown) in a dark-greenish-gray to orange-pink matrix; brecciated to massive light-olive-green to greenish-gray fine-grained rock. Contains blocks of massive Lower Cretaceous limestone, some of them as large as a three-story building. Maximum thickness 300 feet in type section. In most exposures, Gill breccia is concordant with underlying Jeff conglomerate; where Jeff conglomerate is absent or difficult to detect, the Gill forms the basal unit of the group; upper surface of Gill appears to form buried hills under the Colmena tuff (new).

Type section: Colmena Canyon (Gill Canyon) in the Rim Rock country, Presidio County.

†Gillespie Formation (in Trinity Group)[1]

Lower Cretaceous (Comanche Series): Central Texas.

Original reference: R. T. Hill and T. W. Vaughan, 1898, U.S. Geol. Survey 18th Ann. Rept., pt. 2, p. 221.

V. E. Barnes, 1941, (abs.) Geol. Soc. America Bull., v. 52, no. 12, pt. 2, p. 1955. Used in a quote sense and described as red beds occurring locally within Travis Peak formation. They are derived from red Cambrian sandstones and are at different stratigraphic levels, depending upon location of sandstone from which they were derived.

Probably named for Gillespie County.

Gilliam Limestone

Gilliam Thin-Bedded Member (of Capitan Limestone)[1]

Permian (Guadalupe Series) : Western Texas.

Original reference: J. A. Udden, C. L. Baker, and E. Böse, 1916, Texas Univ. Bur. Econ. Geology and Tech. Bull. 44, p. 52.

P. B. King, 1942, Am. Assoc. Petroleum Geologists Bull., v. 26, no. 4, p. 654–656, pl. 2. All beds of upper Guadalupe age have been placed in Capitan limestone, a chronologic unit that included Altuda, Vidrio, and Gilliam members. Capitan is herein restricted to that part of former Vidrio member, or reef facies, that is upper Guadalupe (post-Word) in age; both Altuda and Gilliam are given formational rank. Altuda, in western part of Glass Mountains, consists of siliceous shales and thin limestones that were laid down near margins of Delaware Basin; Capitan, in central part of mountains, is reef deposit, and Gilliam, in eastern part, a back-reef (shelf) deposit. Each formation grades into the other, and all are approximately of same age.

Exposed in Gilliam Canyon, Glass Mountains, Marathon region, Brewster County.

Gilman Quartzite[1]

Lower Cambrian : Southern Quebec, Canada, and northwestern Vermont.

Original reference: T. H. Clark, 1934, Geol. Soc. America Bull., v. 45, no. 1, p. 6, 10.

T. H. Clark, 1936, Royal Canadian Inst. Trans., v. 21, pt. 1, p. 137, 144–146. Light-gray or buff quartzite which weathers to a lighter color. At base is a coarse grit; beds of conglomerate occur near top. Thickness 3,000 feet. Underlies Dunham dolomite conformably; overlies West Sutton slate. Type locality cited.

V. H. Booth, 1950, Geol. Soc. America Bull., v. 61, no. 10, p. 1135, 1136, 1148–1149. Geographic extension into northwestern Vermont.

A. B. Shaw, 1958, Geol. Soc. America Bull., v. 69, no. 5, p. 523–525, 532 (fig. 5), pl. 1. Thickness about 500 feet in St. Albans area, Vermont. Base not exposed. Underlies Dunham dolomite. Lower Cambrian (Georgian series). Unit has been called Brigham Hill graywacke by Jacobs (1935), but this name has not been generally adopted.

Type locality: Oak Hill, Sutton quadrangle, Quebec. Named for Gilman, 3 miles east of Sweetsburg.

Gilman Sandstone Member (of Leadville Dolomite)

Lower Mississippian : West-central Colorado.

Ogden Tweto and T. S. Lovering, 1947, Colorado Mineral Resource [Bull], p. 380, (chart). Gray sandstone, black cherty dolomite, and breccia containing much black clay. Thickness 20 to 50 feet.

Ogden Tweto, 1949, Colorado Sci. Soc. Proc., v. 15, no. 4, p. 152 (table 1), 177–184. Reproposed for sandstone and associated breccia at base of Leadville limestone (or dolomite). Consists of lenticular beds of sandstone, dolomitic sandstone, or local quartzite, at base, overlain by sandy and locally cherty dolomite which at most places is interbedded with and overlain by breccia of dolomite and chert; sandstone is yellow, buff, or light gray, medium to coarse grained, and slightly arkosic; individual sandstone beds 2 to 24 inches thick; sandy dolomite is dense, dark, and weathers light; typically brecciated and contains chert in fragments, nodules, and lenticles. Thickness commonly 10 to 20 feet; range from 5 to 50 feet observed. Underlies massive gray dolomite member; in most places, contact is a few feet of fine-grained structureless soft dark-brownish-gray dolomite; separated from underlying Chaffee formation (Dyer dolomite member); by unconformity.

L. R. Litsey, 1958, Geol. Soc. America Bull., v. 69, no. 9, p. 1157. Noted at Wellsville and Calcite, Fremont County.

Named for exposures on cliffs of Eagle Canyon at Gilman, Pando area, Eagle County.

Gilmanton Monzodiorite[1]

Devonian or Carboniferous: East-central New Hampshire.

David Modell, 1936, Geol. Soc. America Bull., v. 47, no. 12, p. 1902–1903, pl. 1. Monzodiorite with striking differences in texture and composition of ferromagnesian minerals. Most characteristic type is equigranular to subporphyritic, yellow to pinkish. Feldspar is main constituent. Darker colored and medium grained with an even granular texture on Piper Mountain; biotite is chief dark mineral. Light colored and distinctly subporphyritic on Goat Pasture Hill; oblong phenocrysts of white feldspar are set in matrix of anhedral finer grained feldspar, and augite and hornblende are often concentrated along phenocryst borders. Intrudes older schists of the area. Older than Albany quartz syenite and Belknap syenite. Assigned to White Mountain magma series.

Named from township of Gilmanton, Belknap County. Occupies broad band along southwestern edge of Belknap complex extending from Piper Mountain on the northwest to Goat Pasture Hill on southeast.

Gilmer Schist

See Hurricane Graywacke.

Gilmore Limestone

Gilmore Limestone (in Greene Formation)[1]

Permian: Northern West Virginia.

Original reference: R. V. Hennen, 1909, West Virginia Geol. Survey Rept. Marshall, Wetzel, and Tyler Counties, p. 173.

Thomas Arkle, Jr., 1959, Geol. Soc. America Guidebook Pittsburgh Mtg., p. 118 (table 1). Table of classification and nomenclature lists Gilmore in Greene series above Upper Rockport limestone and below Gilmore coal.

Probably named for association with Gilmore coal.

Gilmore Sandstone Member (of Greene Formation)[1]

Permian: Southwestern Pennsylvania, eastern Ohio, and northern West Virginia.

Original reference: J. J. Stevenson, 1876, Pennsylvania 2d Geol. Survey Rept. K, p. 38–39.

Thomas Arkle, Jr., 1959, Geol. Soc. America Guidebook Pittsburgh Mtg., p. 118 (table 1). Table of classification and nomenclature lists Gilmore sandstone in Greene series above Gilmore coal and below Windy Gap coal.

Named for exposures in Gilmore Township, Greene County, Pa.

Gilmore City Limestone[1]

Gilmore City Limestone (in Easley Group)

Mississippian (Kinderhook Series) : North-central Iowa.

Original reference: F. M. Van Tuyl, 1925, Iowa Geol. Survey, v. 30, p. 113–114.

J. M. Weller, 1948, Geol. Soc. America Bull., v. 59, no. 2, p. 101, 146, 150, chart 5. Shown on standard Mississippian stratigraphic section as uppermost formation in Easley group (new) underlying Fern Glen formation and overlying Sedalia formation. In Iowa overlies Iowa Falls dolomite. Also termed Alden formation.

L. A. Thomas, 1960, Tri-State Geol. Soc. Guidebook 24th Ann. Field Conf., p. [3–5, 17–18]. Van Tuyl (1925) considered that there was an erosional surface of about 75 feet of relief upon Iowa Falls dolomite and that Gilmore City limestone was decidedly younger than Iowa Falls dolomite. Present study suggests that Iowa Falls dolomite is in part a dolomitized lateral equivalent of Gilmore City limestone.

Exposed in Gilmore Portland Cement Co.'s quarry, 1½ miles northwest of Gilmore City, Pocahontas County.

Gilmore Gulch Formation[1]

Miocene, pre-upper (?) : Central Nevada.

Original reference: H. G. Ferguson, 1933, Nevada Univ. Bull., v. 27, no. 3, p. 21.

Named for exposures in Gilmore Gulch, Tybo district, Nye County.

Gimlet cyclothem[1] (in McLeansboro Group)

Gimlet cyclothem (in Modesto Formation)

Pennsylvanian : Northern, western, and southern Illinois.

Original reference: H. R. Wanless, 1931, Illinois Geol. Survey Bull. 60, p. 182, 192.

H. R. Wanless, 1957, Illinois Geol. Survey Bull. 82, p. 50 (fig. 22), 60, 116–117, 193, 194, pls. 2, 5. Thickness of cyclothem 15 to 85 feet. Includes (ascending) Gimlet sandstone, Gimlet coal, and Lonsdale limestone. Gimlet sandstone has maximum thickness of 50 to 60 feet but is locally absent in some localities where higher Gimlet beds rest on Farmington shale; sandstone fills channels that cut from 50 feet above coal No. 7 to about 5 feet above Brereton limestone. Cyclothem is separated by erosional unconformities from Sparland cyclothem below and Trivoli and Exline cyclothems above. Derivation of name given.

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 52 (table 2), 55 (table 3). In Modesto formation (new). Presentation of new rock-stratigraphic classification of Pennsylvanian strata in Illinois; cyclical classification is independent of rock-stratigraphic classification.

Named for exposure on Gimlet Creek in SE¼ sec. 16, T. 12 N., R. 9 E., Marshall County.

Gimlet Limestone[1] (in McLeansboro Formation)

Pennsylvanian : Central western Illinois.

Original reference: H. R. Wanless, 1931, Illinois Geol. Survey Bull. 60, p. 179–193.

Derivation of name not stated.

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Gimlet Sandstone Member (of Modesto Formation)

Gimlet Sandstone (in McLeansboro Group)

Pennsylvanian: Western northern Illinois.

H. R. Wanless, 1957, Illinois Geol. Survey Bull. 82, p. 50 (fig. 22), 60, 116–117. Gimlet sandstone has maximum thickness of 50 to 60 feet but is locally absent. Fills channels that cut from 50 feet above coal No. 7 to about 5 feet above Brereton limestone. Unconformable on Farmington shale. In Gimlet cyclothem, McLeansboro group.

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 38, 49 (table 1). Included in Modesto formation (new). Occurs above Farmington shale member and below Lonsdale limestone member. Type locality stated. Presentation of new rock-stratigraphic classification of Pennsylvanian strata in Illinois; cyclical classification is independent of rock-stratigraphic classification.

Type locality: On Gimlet Creek in SE¼ sec. 16 T. 12 N., R. 9 E., Marshall county.

Ginseng Siltstone Member (of Brodhead Formation)

Lower Mississippian: Central Kentucky.

P. B. Stockdale, 1939, Geol. Soc. America Spec. Paper 22, p. 76, 151–152. Lower member of Brodhead formation, Athertonville facies (new). Massive slightly calcareous buff drab siltstone 35 feet thick. In type area, underlies Rolling Fork limestone member (new), Athertonville facies (new), and overlies New Providence formation, Junction City facies (new).

Type section: Along road leading up hill west of old Ginseng post office, southeastern LaRue County.

Girard Shale Member (of Chemung Formation)[1]

Girard Formation (in Conneaut Group)

Upper Devonian: Northwestern Pennsylvania and southwestern New York.

Original reference: I. C. White, 1881, Pennsylvania 2d Geol. Survey Rept. Q_4, p. 118–119, 251.

Bradford Willard, 1937, Pennsylvania Acad. Sci. Proc., v. 11, p. 32. Generalized succession for marine Upper Devonian of northwestern Pennsylvania and southwestern New York listed. Girard formation (I. C. White's Girard shale) is shown in Conneaut group. Includes Cuba sandstone.

I. H. Tesmer, 1955, New York State Mus. Sci. Service Circ. 42, p. 17. Girard shale is here included in Northeast shale member of Canadaway formation.

Carlyle Gray and others, 1960, Geologic map of Pennsylvania (1:250,000): Pennsylvania Geol. Survey, 4th ser. As mapped, Conneaut group includes "pink rock" of drillers and "Chemung" and "Girard" formations of northwestern Pennsylvania.

Well exposed along Elk Creek above Girard, Erie County, Pa.

Girardeau Limestone[1]

Lower Silurian: Southeastern Missouri and southwestern Illinois

Original reference: G. C. Swallow, 1855, Missouri Geol. Survey 2d Ann. Rept., pt. 1, p. 109.

J. M. Weller, 1939, Kansas Geol. Soc. Guidebook 13th Ann. Field Conf., p. 56. Girardeau limestone normally overlies Orchard Creek shale, which is considered to be southward continuation of some part of Maquoketa shale generally conceded to be Upper Ordovician in age. There is no sharp break between the Girardeau and Orchard Creek. It it possible that Girardeau limestone should also be referred to Ordovician.

C. K. Swartz and others, 1942, Geol. Soc. America Bull., v. 53, no. 4, chart 3. Shown on correlation chart in Alexandrian group, Albion series. Underlies Edgewood limestone.

W. H. Twenhofel and others, 1954, Geol. Soc. America Bull., v. 65, no. 3, p. 260, chart 2. Shown on correlation chart as Ordovician, Cincinnatian. Age of Thebes sandstone, Orchard Creek shale, and Girardeau limestone is still under study. They may belong at base of Silurian.

Named for outcrops 1½ to 2 miles above Cape Girardeau, Cape Girardeau County, Mo.

Gird[1] (shales)

Lower Cretaceous: Montana.

Original reference: C. R. Keyes, 1926, Pan-Am. Geologist, v. 46.

Derivation of name not stated.

Girkin Formation[1]

Girkin Limestone

Upper Mississippian: Western Kentucky and northern Alabama.

Original reference: A. H. Sutton and J. M. Weller, 1932, Jour. Geology, v. 40, no. 5, p. 430, 440, 441.

J. M. Weller and A. H. Sutton, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 5, p. 766 (fig. 1), 828. From Todd County to Grayson County, Ky., the Bethel sandstone is absent and Renault and Paint Creek formations together form a limestone that cannot be easily subdivided. Name Gasper has been used for this limestone, but persistent miscorrelation has resulted in such confusion that name is no longer useful. Hence, beds are now known as Girkin limestone. The Girkin consists almost entirely of massive light-gray limestone which cannot be distinguished from underlying Ste. Genevieve except by fossil content. Chester series.

Well exposed in hills that nearly surround village of Girkin, Warren County, Ky.

Gizzard Formation (in Lee Group)[1]

Gizzard Member (of Lookout Sandstone)

Gizzard Group

Gizzard Member (of Lee Formation)

Lower Pennsylvanian: Eastern Tennessee and northern Georgia.

Original reference: J. M. Safford, 1869, Geology of Tennessee, p. 369–370.

H. R. Wanless, 1939, (abs.) Geol. Soc. America Bull., v. 50, no. 12, p. 1941. Listed as member of Lee formation.

V. H. Johnson, 1946, Coal deposits on Sand and Lookout Mountains, Dade and Walker Counties, Georgia: U.S. Geol. Survey Prelim. Map. Geographically extended into northern Georgia where it is reduced to member status in Lookout sandstone. Consists of gray shales and fine-grained sandstone; on Lookout Mountains, shale is minor part of member; in Cole City area, a silty saccharoidal carbonaceous sandstone as much as 150 feet thick occurs 30 to 50 feet below Sewanee member.

C. W. Wilson, Jr., J. W. Jewell, and E. T. Luther, 1956, Pennsylvanian geology of the Cumberland Plateau: Tennessee Div. Geology [folio], p. 1, 4, 19, pls. 2, 3, 4. Rank raised to group. Includes all strata between top of Mississippian and base of Sewanee conglomerate. Thickness as much as 700 feet; at type locality 224 feet. Includes (ascending) Raccoon Mountain formation (new), Warren Point sandstone, and Signal Point shale (new); group is so subdivided on basis of wide distribution of Warren Point sandstone. Pottsville series. Type locality stated.

Type section: In gorge of Big Fiery Gizzard Creek (Gizzard Cove), about 2 miles south of Tracy City, Grundy County, Tenn.; geographic names used here are those on White City quadrangle, rather than "Little Fiery Gizzard" of Stafford.

Glacier Park facies (of Belt Series)

Precambrian: Western Montana, and southern Alberta and southern British Columbia, Canada.

C. L. Fenton and M. A. Fenton, 1937, Geol. Soc. America Bull., v. 48, no. 12, p. 1877. Within its northern basin, Belt series is divisible into facies that differ in lithology, stratigraphic sequence. thickness, recorded conditions of deposition, fauna, and flora. Glacier Park facies is the development of the series in Glacier National Park, Mont., Waterton Lakes National Park, Alberta, and westward to the Flathead trough. Grades into the dominantly clastic Purcell facies.

In Glacier-Waterton Parks.

Glacier Peak Volcanics[1]

Quaternary: Washington.

Original reference: H. C. Culver, 1936, Washington Div. Geology Bull. 32, p. 21.

Glacier Peak, Snohomish County.

Glacier Point Glaciation

Glacier Point glacial stage[1]

Pleistocene: Eastern California.

Original reference: F. E. Matthes, 1929, Science, new ser., v. 70, p. 75–76.

Ernst Antevs, 1945, Am. Jour. Sci., v. 243A, table 2. Correlated with McGee glaciation.

Change of name from stage to glaciation made in accordance with adoption of stratigraphic code, June 1961.

Named for occurrence of erratic boulders above Glacier Point, Yosemite National Park.

Glacier Ridge Agglomerate

Quaternary: Southwestern Alaska.

G. C. Kennedy and H. H. Waldron, 1947, U.S. Geol. Survey Alaskan Volcano Inv. Rept. 2, pt. 2, pl. 2. Name appears on geologic map legend.

Mapped on south flank of Pavlof Volcano, Alaska Peninsula.

Glacier Ridge Andesite

Quaternary: Southwestern Alaska.

G. C. Kennedy and H. H. Waldron, 1947, U.S. Geol. Survey Alaskan Volcano Inv. Rept. 2, pt. 2, pl. 2. Name appears on geologic map legend.

Mapped on south flank of Pavlof Volcano, Alaska Peninsula.

†Glade Sandstone[1]

Devonian or Carboniferous: Northwestern Pennsylvania.

Original reference: K. E. Caster, 1933, Geol. Soc. America Bull., v. 44, no. 1, p. 202.

Gladeville Sandstone

Gladeville Sandstone (in Pottsville Group)[1]

Middle Pennsylvanian: Southwestern Virginia and southeastern Kentucky.

Original reference: M. R. Campbell, 1893, U.S. Geol. Survey Bull. 111, p. 28, 33.

H. R. Wanless, 1946, Geol. Soc. America Mem. 13, p. 141. Sandstone between the Wise (above) and Norton formations.

U.S. Geological Survey does not use the term Pottsville Group in Kentucky.

Named for Gladeville (now called Wise), Wise County, Va.

Glady Fork Sandstone[1] (in Bluestone Group)

Glady Fork Sandstone Member (of Bluestone Formation)

Mississippian (Chesterian): Southwestern Virginia and southeastern West Virginia.

Original reference: D. B. Reger, 1926, West Virginia Geol. Survey Rept. Mercer, Monroe, and Summers Counties, p. 294, 321.

B. N. Cooper, 1944, Virginia Geol. Survey Bull. 60, p. 182–183, p. 15. Geographically extended into Virginia and redefined as member of Bluestone formation. Overlies Pipestem shale member; underlies Mud Fork member. Thickness 25 to 40 feet. In Chester series.

Type locality: In end of ridge between Brush Creek and Glady Fork, southeast of Princeton, Mercer County, W. Va.

Glance Conglomerate[1] (in Bisbee Group)

Lower Cretaceous (Comanche Series): Southeastern Arizona.

Original reference: F. L. Ransome, 1904, U.S. Geol. Survey Prof. Paper 21, p. 56, 57.

James Gilluly, 1956, U.S. Geol. Survey Prof. Paper 281, p. 71, pl. 5. Described in central Cochise County. Thickness varies rapidly in short distances owing to irregularities in surface of unconformity beneath. Thickness of several thousand feet reported at Bisbee. Unconformable above older rocks; locally overlies Pinal schist; underlies Morita formation.

Named for Glance, on El Paso and SW Railroad near Glance mine, Bisbee quadrangle.

Glasco Limestone

Glasco Limestone Lentil (of Rondout Waterlime)

Upper Silurian: Southeastern New York.

G. H. Chadwick, 1944, New York State Mus. Bull. 336, p. 44, 46, 47, 51 [1946]. Name proposed for limestone lentil near top of Rondout. Maximum thickness 10 feet.

D. W. Fisher, 1959, New York State Mus. Sci. Service Geol. Survey Map and Chart Ser. 1. Glasco and Cobleskill limestones appear to be youngest fossil-bearing Silurian in New York. Name Glasco is preferred to that of Le Fever because the latter has never been adequately described. Chart shows Glasco above Rosendale waterlime and below Whiteport waterlime.

Type exposure on West Wood Farm, Route 9–W, west of Glasco, Ulster County.

Glassboro Gravel[1]

Glassboro phase (of Bridgeton Formation)

Pleistocene: New Jersey and southeastern Pennsylvania.

Original reference: H. C. Lewis, 1881, Philadelphia Acad. Nat. Sci. Proc., v. 32, p. 296–309.

J. C. Martens, 1956, Rutgers Univ. Bur. Mineral Research Bull. 6, p. 72–74. Glassboro phase of Bridgeton (Salisbury and Knapp, 1917, New Jersey Geol. Survey, v. 8) occurs south and west of line drawn from Berlin down Mullica River to Atlantic Coast. Phase includes greater part of formation and consists of fine sand and gravel with a few boulders and some clay.

Probably named for occurrence at Glassboro, Gloucester County, N.J.

Glass Buttes Series[1]

Miocene: Central southern Oregon.

Original reference: A. Waters, 1927, Jour. Geology, v. 35, p. 442–452.

Forms main part of Glass Butte Range, Lake County.

†Glass Mountain Formation (in Cimarron Group)[1]

Permian: Southern Kansas and northwestern Oklahoma.

Original reference: F. W. Cragin, 1897, Am. Geologist, v. 19, p. 353, 355.

C. C. Branson, 1957, Oklahoma Geology Notes, v. 17, no. 11, p. 101. Abandoned by Oklahoma Geological Survey. An indefinite Permian unit.

Exposed in Glass Mountains of Major County, Okla.

Glass Mountain Lava

Recent: Northern California.

C. A. Anderson, 1941, California Univ. Dept. Geol. Sci. Bull., v. 25, no. 7, p. 374, 375–376. Name applied to lava of recent eruptions at Glass Mountain. Material is mostly rhyolite pumice and obsidian. Flows mark close of volcanic history in area.

Occurs in Medicine Lake Highland, approximately in center of Modoc Lava Bed quadrangle.

†Glass Mountains Formation[1]

Permian: Western Texas.

Original reference: P. B. King, 1933, Historical Geology, by R. C. Moore, p. 325.

Glass Mountains.

Glastonbury Formation

Glastonbury Granite Gneiss[1]

Paleozoic (pre-Pennsylvanian? or Ordovician?) Central Connecticut and southern Massachusetts.

Original reference: H. E. Gregory, 1906, Connecticut Geol. Nat. History Survey Bull. 6, p. 114, 115, map.

W. G. Foye, 1949, Connecticut Geol. Nat. History Survey Bull. 74, p. 51. Mapped as Monson orthogneiss.

G. E. Collins, 1954, Connecticut Geol. Nat. History Survey Quad. Rept. 4, p. 9–14, 26. Gneiss recognized in Ellington quadrangle as a unit separate from the belt of Monson gneiss which occurs east of Bolton formation exposures. Follows nomenclature of Gregory (1906). Eastern part of unit, here discussed, is light gray; western part is darker. Grades eastward into Bolton garnet-muscovite schist, and westward into a hornblende schist. Pre-Mississippian.

Norman Herz, 1955, Connecticut Geol. Nat. History Survey Quad. Rept. 5, p. 8–16. Areal variation in relative amounts of constituent minerals and degree of foliation and lineation. Four facies described in Glastonbury quadrangle: schistose, porphyroblastic, flaser gneiss, and highly felsic eastern border. Aplite dikes and pegmatites common. Devonian (?).

J. M. Aitken, 1955, Connecticut Geol. Nat. History Survey Quad. Rept. 6, p. 5–6, 15–16. Termed a formation.

John Rodgers and others, 1956, Preliminary geological map of Connecticut (1:253,440): Connecticut Geol. Nat. History Survey. Pre-Triassic. Derivation of name given.

Frederick Stugard, Jr., 1958, U.S. Geol. Survey Bull. 1042–Q, p. 619, 627–630, pl. 56. Pegmatites of Middletown area cut metasediments of Bolton schist of pre-Mississippian (?) age and, in ascending order of sequence, mafic gneisses, Glastonbury granite gneiss. Maromas granite gneiss, and Monson gneiss. Position of these formations in stratigraphic column cannot be determined with accuracy; their maximum age is indicated by their relation to the pegmatities, which have been dated by uranium- and thorium-lead ratios as about 260 million years old, presumably Mississippian.

John Rodgers, R. M. Gates, and J. L. Rosenfeld, 1959, Connecticut Geol. Nat. History Survey Bull. 84, p. 19, 21, fig. 3. Unconformably underlies Collins Hill formation (new). Ordovician (?).

Named for town of Glastonbury, Hartford County, Conn. An elongate body of biotite gneiss, 4½ miles in maximum width; extends from Great Hill, Middletown area, Connecticut, northward into Massachusetts.

Gleeson Quartz Monzonite

Triassic or Jurassic: Southeastern Arizona.

James Gilluly, 1956, U.S. Geol. Survey Prof. Paper 281, p. 8, 55–59, pl. 5. Consists of three principal facies. The first two facies—collectively called main facies—differ chiefly in the obvious alteration that has affected one and not the other and are mapped together. Main facies is coarse-grained light-gray rock that ranges to greenish gray where highly chloritized and to pink where it contains sufficient pink microcline; weathered surfaces commonly rusty brown. Practically all stages of alteration of main facies of the quartz monzonite recognized, from nearly unaltered normal igneous rocks to recrystallized gneissic rocks, though most of the formation is crystalloblastic-cataclastic in texture and some parts practically entirely cataclastic and grade into true mylonites. Third facies—alaskite facies—differs from other two in being practially devoid of dark minerals. Rock ranges from practically white through pale to pinkish gray. Rock ranges from fine aplitic-appearing material to fairly coarse in texture. Nearly all contacts of Gleeson quartz monzonite are with alluvium or are faults; overlapped by some of the S O volcanics (new) locally; cuts Pinal schist near South Pass.

Crops out over an area of nearly 30 square miles, in Tps. 18 and 20 S., Rs. 24 and 25 E., in southern part of Dragoon Mountains, and in pediment to south and east of it, central Cochise County. Town of Gleeson is at eastern side of the mass, and the Gleeson-Tombstone Road crosses it near its center.

Glenarm Series[1]

Lower Paleozoic (?) : Maryland, New Jersey, Pennsylvania, and Virginia.

Original reference: E. B. Knopf and A. I. Jonas, 1922, Geol. Soc. America Bull., v. 33, p. 110.

A. I. Jonas and G. W. Stose, 1938, Washington Acad. Sci. Jour., v. 28, no. 8, p. 346–347. In Frederick County, Md., includes Wakefield marble, Silver Run limestone, Ijamsville phyllite, Urbana phyllite, and Marburg schist (all new).

G. W. Stose and A. I. Jonas, 1939, Pennsylvania Geol. Survey, 4th ser., Bull. C–67, p. 95–96, 103, 106. Peach Bottom slate and Cardiff conglomerate considered Ordovician (?) ; hence, they are removed from Glenarm series.

Ernst Cloos and Anna Hietanen, 1941, Geol. Soc. America Spec. Paper 35, p. 207. Detailed discussion in connection with geology of Martic overthrust in Pennsylvania and Maryland. It is not possible to determine age of the Glenarm definitely; it certainly is not Precambrian. Further detailed work will be necessary to furnish data on basis of which more definite conclusions can be based.

F. M. Swartz, 1948, Am. Assoc, Petroleum Geologists Bull., v. 32, no. 8, p. 1506–1512. In present review, there is much evidence favoring opinion that Glenarm series, as developed south of Chester Valley, is Cambro-Ordovician in age and less reason for supposition of Precambrian age.

Norman Herz, 1951, Geol. Soc. America Bull., v. 62, no. 9, p. 980. Includes (ascending) Setters quartzite, Cockeysville marble, Wissahickon schist, Peters Creek schist, Cardiff conglomerate, and Peach Bottom slate. Age probably early Paleozoic.

G. J. Wasserburg, F. J. Pettijohn, and J. Lipson, 1957, Science, v. 126, no. 3269, p. 355–357. Report discusses A^{40}/K^{40} ages of micas and feldspars from Glenarm series near Baltimore. Concluded that both the age and the metamorphism of Glenarm series and the time of pegmatite injection was about 350 million years ago corresponding to the end of the Ordovician period on the Holmes time scale. The absolute age is thus seen to coincide with ages of pegmatites in New England and North Carolina. This evidence supports view that whole eastern Appalachian region was "simultaneously" subject to igneous and metamorphic activity about 350 ± 20 million years ago. Thesis that Glenarm series is Precambrian because of its degree of metamorphism is untenable on basis of date presented here. These A^{40}/K^{40} dates do not, however, preclude the possibility that series was originally deposited during Precambrian time.

P. W. Choquette, 1960, Geol. Soc. America Bull., v. 71, no. 7, p. 1029 (table 1). Series comprises (ascending) Setters, Cockeysville, Wissahickon, and Peters Creek formations. Pre-Silurian.

Named for typical development near Glenarm, 13 miles northeast of Baltimore, Md.

Glencairn Shale Member (of Purgatoire Formation)[1]

Lower Cretaceous: Eastern Colorado.

Original reference: G. I. Finlay, 1916, U.S. Geol. Survey Geol. Atlas, Folio 203.

K. M. Waagé, 1953, U.S. Geol. Survey Bull. 993, p. 6 (fig. 2), 7, 9–11, pls. 1, 2, 4, 5. Name extended to include subdivisions of Purgatoire in Fremont, Pueblo, and Huerfano Counties. Finlay's description is not sufficiently detailed to indicate certainly that his unit corresponds exactly to Glencairn as used in this report, but the discrepancy, if any, is not great. Consists of alternating units of olive-brown thin-bedded sandstone and gray and black shale totaling between 70 and 100 feet in thickness. Common sequence is three units of shale alternating with three units of sandstone. Pattern of six alternating units of shale and sandstone within the Glencairn is typical of member in Canon City embayment area, although pattern is obliterated locally by thickening of sandstone units at expense of shale units. At base of lower sandstone, and commonly separated from it by thin bed of silty shale, is a bed of conglomeratic sandstone from 2 to 18 inches thick; this conglomeratic bed rests on planed surface that truncates cross lamination in underlying Lytle sandstone member. Disconformably underlies Dakota sandstone.

Named for a tract of land a few miles north of Lytle, Colorado Springs region.

Glen Canyon Group[1]

Triassic and Jurassic: Southern and eastern Utah, northern Arizona, southwestern Colorado, and northwestern New Mexico.

Original reference: A. A. Baker and others, 1927, Am. Assoc. Petroleum Geologists Bull., v. 11, no. 8, p. 787 (table 1).

James Gilluly and J. B. Reeside, Jr., 1928, U.S. Geol. Survey Prof. Paper 150–D, p. 68–73. Includes (ascending) Wingate sandstone, Todilto(?) formation, and Navajo sandstone. Underlies San Rafael group; overlies Chinle formation. Jurassic(?).

A. A. Baker, C. H. Dane, and J. B. Reeside, Jr., 1936, U.S. Geol. Survey Prof. Paper 183, p. 4–6, pls. Includes (ascending) Wingate sandstone, Kayenta formation (previously designated "Todilto" and "Todilto?" formation), and Navajo sandstone.

A. A. Baker, C. H. Dane, and J. B. Reeside, Jr., 1947, Am. Assoc. Petroleum Geologists Bull., v. 31, no. 9, p. 1667–1668. Includes (ascending) Wingate sandstone, Kayenta formation, and Navajo sandstone. New conclusions as to correlation of units pose problem in stratigraphic nomenclature. Strict application of principles of priority would require that name Wingate be applied to unit heretofore called Entrada and would require that new name be applied to Wingate sandstone of Utah and adjacent regions. In current usage for Colorado Plateau and surrounding areas, these names apply to distinctive and widespread formations, and names are firmly entrenched in literature. Abandonment of this nomenclature through principles of priority would be confusing. Name Entrada is extended to include sandstone at type locality of Wingate sandstone, and name Wingate is retained for sandstone forming lower part of group, with understanding that original type locality of Wingate has been abandoned. Name Glen Canyon group extended to include undivided equivalents of Navajo, Kayenta, and Wingate that crop out below Entrada sandstone and Chinle formation in parts of New Mexico and Arizona.

F. W. Cater, Jr., 1954, Geology of the Bull Canyon quadrangle, Colorado: U.S. Geol. Survey Geol. Quad. Map [GQ–33]. In southwestern Colorado, includes Wingate sandstone, Kayenta formation, and Navajo sandstone. Overlies Chinle formation; underlies San Rafael group.

Paul Averitt and others, 1955, Am. Assoc. Petroleum Geologists Bull., v. 39, no. 12, p. 2515–2535. Includes Moenave formation (new).

L. C. Craig and D. D. Dickey, 1956, Intermountain Assoc. Petroleum Geologists [Guidebook] 7th Ann. Field Conf., p. 93–97; J. C. Wright and D. D. Dickey, 1958, Intermountain Assoc. Petroleum Geologists Guidebook 9th Ann. Field Conf., p. 172–173. In southeastern Utah, includes (ascending) Wingate sandstone, Kayenta formation, and Navajo sandstone.

J. E. Harshbarger, C. A. Repenning, and J. H. Irwin, 1957, U.S. Geol. Survey Prof. Paper 291, p. 3 (fig. 2), 5–53, pl. 2. Described in Navajo country. Overlies Chinle formation; contact lies between Gregory's (1917, U.S. Geol. Survey Prof. Paper 93) "A" and "B" divisions of the Chinle. This reassignment of the Chinle "A" is based upon intertonguing between Wingate sandstone and Chinle "A" in several areas. Underlies various units of San Rafael group—Entrada sandstone, Carmel formation, or Entrada and Carmel undifferentiated. In Kachina Point and Navajo Creek areas, Arizona, includes (ascending) Wingate sandstone, Moenave formation, Kayenta formation, and Navajo sandstone; in Fort Wingate area, New Mexico, includes only Wingate sandstone (Lukachukai member).

R. G. Petersen, 1959, U.S. Geol. Survey Mineral Inv. Field Studies Map MF–215. In Emmett Wash NE quadrangle, Coconino County, Ariz., group comprises (ascending) Moenave formation, Kayenta formation, and Navajo sandstone. Overlies Chinle formation. Upper Triassic(?) Lower Jurassic(?).

Named for exposures in Glen Canyon of Colorado River, Kane County, Utah.

Glendale Beds[1]

Eocene (Jackson): Eastern Texas.

Original reference: A. C. Ellisor, 1933, Am. Assoc. Petroleum Geologists Bull., v. 17, no. 11, p. 1302, 1316.

Crops out at Glendale, Trinity, and south of Groveton, Trinity County.

Glendale Granite[1]

Precambrian(?): Central northern Colorado.

Original reference: R. D. Crawford, 1909, Colorado Univ. Studies, v. 6, p. 97–131.

Occurs on both sides of Lefthand Canyon in vicinity of Glendale and Rowena, Boulder County.

Glendale Member (of Denmark Formation)

Middle Ordovician (Trentonian) : Northwestern New York.

P. A. Chenoweth, 1952, Geol. Soc. America Bull., v. 63, no. 6, p. 530–535. Even-bedded hard blue-gray calcilutites, calcareous shales, and coquinal calcarenites. Distinctive calcilutites rapidly disappear northward. Thickness 35 feet. Underlies upper unnamed member; overlies Camp member (new). Upper limit of unit arbitrarily placed above last zone of abundant calcilutites.

Named for Glendale, Lewis County.

†Glendale Shale[1]

Lower Mississippian : Southeastern Tennessee.

Original reference : J. H. Swartz, 1924, Am. Jour. Sci., 5th, v. 7, p. 24–26.

W. H. Hass, 1956, U.S. Geol. Survey Prof. Paper 286, p. 13. Swartz (1924) named the upper gray-shale unit of Hayes' "Chattanooga black shale" the Glendale shale. Swartz was of the opinion that beds he identified as Glendale were, prior to his work, a part of Fort Payne chert. Name "Glendale shale" is not used herein; beds so named by Swartz are called Maury formation.

Named for exposures at Glendale Station, just outside Chattanooga, on electric road to Signal Mountain.

Glen Dean Limestone[1] or Formation

Glen Dean Limestone (in Homberg Group)

Glen Dean Limestone (in Stephensport Group)

Upper Mississippian (Chester Series) : Kentucky, southern Illinois, southern Indiana, Tennessee, and southwestern Virginia.

Original reference: C. Butts, 1917, Mississippian formations of western Kentucky : Kentucky Geol. Survey, p. 97.

J. M. Weller, 1939, Kansas Geol. Soc. Guidebook 13th Ann. Field Conf., p. 131, 135; J. M. Weller and A. H. Sutton, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 5, p. 766 (fig. 1), 832–833. Uppermost formation in Homberg group (new). Underlies Tar Springs sandstone; overlies Hardinsburg sandstone.

T. G. Perry and N. M. Smith, 1958, Indiana Geol. Survey Bull. 12, p. 90–101, pl. 1. Described in Indiana where it attains thickness of 27 to 60 feet. Consists of gray or tan massive crystalline limestone in oolitic fossiliferous limestone in lower part; dark-gray shale and thin beds of impure limestone. Overlies Hardinsburg sandstone; underlies Tar Springs sandstone. Term Homberg group not applied in Indiana.

H. H. Gray, R. D. Jenkins, and R. M. Weidman, 1960, Indiana Geol. Survey Bull. 20, p. 36 (table 5), 38–39, pl. 1. Uppermost formation in Stephensport group (redefined). Formation has been defined as including a lower or main limestone member and an upper interbedded shale and limestone. Proposed here to restrict name Glen Dean to the more persistent main limestone member. In Huron area, only main limestone is present; in other areas, this restriction will reduce the Glen Dean to about one-half its former thickness. The interbedded shale and limestone should be placed in overlying Tar Springs formation. Thickness about 30 feet in Huron area [this report]. Conformably overlies Hardinsburg formation; unconformably underlies Mansfield formation. Chester series.

Named for exposures along railroad on both sides of Glen Dean, Breckenridge County, Ky.

Glendo Shale (in Phosphoria Group)

Glendo Shale Member (of Lykins Formation)

Permian: Eastern Wyoming, northeastern Colorado, and southwestern South Dakota.

G. E. Condra, E. C. Reed, and O. J. Scherer, 1940, Nebraska Geol. Survey Bull. 13, p. 2 (fig. 2), 5, 6, 10, 19 (fig. 6), 36, 45. Consists of red shale, partly sandy. Comprises the interval between the Forelle and Minnekahta limestones. Thickness 43 to 56 feet.

T. L. Broin, 1958, Dissert. Abs., v. 19, no. 1, p. 114. Member of Lykins formation in eastern Colorado. Underlies Forelle limestone; overlies Falcon tongue of Minnekahta limestone.

Type locality: In Spring Creek valley, 1 mile south and 2 miles west of Glendo, Wyo.

Glendon Limestone Member (of Byram Formation)

Glendon Limestone (in Vicksburg Group)[1]

Glendon Member (of Vicksburg Formation)

Oligocene: Alabama, Florida, and Mississippi.

Original reference: O. B. Hopkins, 1917, U.S. Geol. Survey Bull. 661–H, p. 298, 300.

F. F. Mellen, 1939, Mississippi Acad. Sci. Jour., v. 1, p. 18, 19. Member of Vicksburg formation. Includes Mint Spring facies at base. Overlies Forest Hill member; underlies Byram member.

H. V. Howe, 1942, Jour. Paleontology, v. 16, no. 2, p. 264–271. Discusses fauna at type locality of Glendon formation.

F. S. MacNeil, 1944, Am. Assoc. Petroleum Geologists Bull., v. 28, no. 9, p. 1315 (fig. 1), 1316, 1329–1332. Rank reduced to member status in Byram formation. Underlies unnamed marl member; overlies sandy facies of Marianna limestone. At type section, lower 12 feet consists of coarsely porous, crumbly to hard, crystalline, orbitoidal limestone with well developed but unevenly cemented ledges and interbedded less resistant zones; hard ledges characteristically weather to "horsebone," and locally entire interval is more evenly indurated and so weathered; above the coarse limestone, and constituting remainder of type section, are at least three hard smooth yellowish-brown limestone ledges interbedded with soft fossiliferous argillaceous marl. Evidence indicates that the hard crystalline limestone and open-spaced coquinas of type section pass westward into thicker, more uniform section of buff to cream hard to soft argillaceous marlstone and tough limestone. Sharper faunal break exists between Marianna and Glendon in Alabama than around Vicksburg. Eastward from type locality, member becomes more uniformly indurated and difficult to differentiate from Marianna. In vicinity of Marianna, Fla., largely altered to dolomite; thickness at Marianna about 18 feet.

E. C. Tonti, 1955, Dissert. Abs., v. 15, no. 8, p. 1372. In stratigraphic investigation of Vicksburgian deposits in Mississippi, Alabama, and western Florida, two sedimentary cycles were identified. Lowermost cycle extends from disconformity at base of Mint Springs-Marianna formation to simlar break at top of Byram (in this report excludes Bucatunna marl).

Name Glendon redefined and applied to alternating crystalline limes and marls located, in part, stratigraphically above type section. Typical "horsebone" lithology is extremely variable weathering phenomenon which may develop on any limestone bed immediately beneath lower Bucatunna disconformity. Reference section designated.

Type locality: Glendon, a flag station on Southern Railway between Jackson and Walker Springs, in southern part of sec. 31, T. 7 N., R. 3 E., Clarke County, Ala. Reference section: St. Stephens Quarry, St. Stephens, Ala.

Glendora Volcanics

Miocene: Southern California.

J. S. Shelton, 1946, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 63. Series of flows, chiefly andesitic, breccias, tuffs, and related intrusives.

J. S. Shelton, 1955, Geol. Soc. America Bull., v. 66, no. 1, p. 45–89, pl. 1. Includes undisturbed tuffs, tuff breccias, massive flows, autobrecciated flows, dikes, probable vent fillings of various kinds, volcanic conglomerates, and possibly local fumarolic alteration products; in the field, 22 mappable varieties or members recognized. Thickness varies from a few hundred to over 3,000 feet. Includes Spadra felsophyre, Elephant Hill breccia, and Johnstone Peak tuff breccia (all new). Overlies pre-Upper Cretaceous crystalline rocks of the basement complex which here includes Mountain Meadows dacite. In some areas, upper part of volcanics is interbedded with upper Miocene Topanga formation; more commonly unconformably underlie some part of upper Miocene Puente formation.

Exposed in foothills of San Gabriel Mountains in vicinity of Glendora, in South Hills, and at northeast end of San Jose Hills, Los Angeles County.

Glen Ellen Formation

Pliocene(?) and Pleistocene: Northwestern California.

C. E. Weaver, 1949, Geol. Soc. America Mem. 35, p. 16 (table 3), 98–99, pl. 6. Fluviatile gravel, sand, clay, and boulder deposits composed of materials derived from andesite and tuffs. Largest area of exposure, north and northwest of Glen Ellen, consists of stratified gravels and sands alternating with thick layers and lenses of conglomerates composed of andesite cobbles averaging 3 to 6 inches in diameter; at least 300 feet thick. Deposits may have been formed in part contemporaneously with gravels and sands of Huichica formation (new). Because formation rests upon folded Sonoma volcanics, it is believed to be Pleistocene but cannot be dated more definitely.

G. T. Cardwell, 1958, U.S. Geol. Survey Water-Supply Paper 1427, p. 26 (table 6), 47–54. As used in this report [Santa Rosa and Petaluma Valleys], formation consists of thick sequence (0 to about 3,000 feet) of deformed continental deposits that discontinuously overlie and locally interfinger with Sonoma volcanics and interfinger with Merced formation. The Glen Ellen includes the Glen Ellen of Weaver, the upper part of the Sonoma group of Gealey (1950 [1951]), and the older Quaternary alluvium of Travis (1952, California Div. Mines Bull. 162). Pliocene(?) and Pleistocene.

Named from Glen Ellen in eastern part of Santa Rosa quadrangle, Sonoma County. Exposed intermittently in a northwest-southeast direction for a distance of more than 13 miles; lies within old structural valley of which Kenwood and Sonoma Valleys are now a part.

Glenerie Limestone (in Oriskany Group)[1]

Lower Devonian: Southeastern New York.

Original reference: G. H. Chadwick, 1908, Science, new ser., v. 28, p. 346–348.

G. H. Chadwick, 1944, New York State Mus. Bull. 336, p. [83], 85–88 [1946]. Mapped as Glenerie limestone and chert. Composition ranges from limestone to solid chert beds, soft shale, and conglomerate. Beds are very blue to nearly black in fresh exposures; characteristically weather buff brown. Thickens greatly into limestone southward; northward in the Helderberg, grades into thin sandstone. Thickness about 30 feet in type exposure, which is described. Overlies Port Ewen beds in map area, the Catskill and Kaaterskill quadrangles; farther south overlies Connelly conglomerate. Derivation of name stated.

Type exposure at old quarry on east side of Route 9–W, ¼ mile north of Glenerie Mills, 4 miles below Saugerties, Ulster County. Named from old Glenerie white-lead mills on Esopus Creek at Glenerie Falls.

Glen Eyrie Shale Member (of Fountain Formation)[1]

Glen Eyrie Formation

Pennsylvanian: Eastern Colorado.

Original reference: G. I. Finlay, 1907, Jour. Geology, v. 15, p. 586–589.

K. P. McLaughlin, 1947, Am. Assoc. Petroleum Geologists Bull., v. 31, no. 11, p. 1939 (fig. 2), 1942–1947. As used in this report [Colorado Springs quadrangle], Glen Eyrie is considered formation (this follows Finlay's original usage). Most completely developed and best exposed section, approximately 360 feet thick, is in and near Black Canyon at north edge of Manitou embayment and approximately three-fourths mile southwest of Finlay's probable type locality. Most of exposures are in cuts along Rampart Range Road and Black Canyon loop, both constructed in recent years. Overlies Madison limestone; gradationally underlies Fountain formation.

Well exposed on Glen Eyrie Creek, El Paso County. Glen Eyrie Creek now known as Queens Canyon.

Glenham Gneiss[1]

Precambrian; Southeastern New York.

Original reference: C. E. Gordon, 1911, New York State Mus. Bull. 148, p. 11, 18, 25–27, 33, 34, 78, 79, 85, 104.

Exposed between Fishkill Landing and New Beacon Mountain, Poughkeepsie quadrangle.

Glenhaven Member (of Guttenberg Formation)

Middle Ordovician: Northern Illinois.

J. S. Templeton and H. B. Willman, 1952, Tri-State Geol. Soc. Guidebook 16th Ann. Field Conf., figs. 3, 9. Dolomite, about 3 feet thick. Shown on columnar section as underlying Buckhorn member (new) of Dunleith formation (new) and overlying Garnavillo member (new) of Guttenberg formation.

In copy of guidebook used by compiler, in figure 3, name Glenhaven had been crossed out and name Garnet inserted. However, in figure 9, the name Garnet had been used to replace the name Garnavillo. Since the compiler had no way to determine what changes, if any, had been made in other copies of guidebook, it was impossible to be certain which names should be retained.

Occurs in Dixon-Oregon area.

Glenkirk Limestone[1]

Silurian (Niagaran) : West-central Tennessee.

Original reference: A. F. Foerste, 1903, Jour. Geology, v. 11, p. 566, 578–582, 692.

C. W. Wilson, Jr., 1949, Tennessee Div. Geology Bull. 56, p. 251. Foerste used name Glenkirk to include lithologically indistinguishable Laurel and Lego limestones where the Waldron shale cannot be recognized. This report does not consider name Glenkirk necessary.

Named for Glenkirk Landing, Wayne County.

Glenmary Shale (in Crooked Fork Group)

Pennsylvanian (Pottsville Series) : Eastern Tennessee.

C. W. Wilson Jr., J. W. Jewell, and E. T. Luther, 1956, Pennsylvanian geology of the Cumberland Plateau: Tennessee Div. Geology [folio], p. 6, 19, pls. 2, 3, 4. Includes beds between top of Coalfield sandstone (new) and base of Wartburg sandstone. Thickness usually 40 to 80 feet; at type locality 50 feet; 64 feet in Crooked Fork section; in southeast corner of Barthell Southwest quadrangle 20 feet; disappears in northern part of this quadrangle as it is overlapped by Wartburg sandstone.

Named from Glenmary, Robbins quadrangle, Scott County.

†Glenn Formation[1]

Pennsylvanian: Central southern Oklahoma.

Original reference: J. A. Taff, 1903, U.S. Geol. Survey Geol. Atlas, Folio 98.

C. C. Branson, 1957, Oklahoma Geology Notes, v. 17, no. 11, p. 101. Abandoned by Oklahoma Geological Survey. Unit is a lumping of four series; name applies to all rocks below the Pontotoc and above the Caney shale.

Named for Glenn, Carter County.

Glenn Creek Shale Member (of Jefferson Limestone)[1]

Upper Devonian: Northwestern Montana.

Original reference: C. F. Deiss, 1933, Montana Bur. Mines and Geology Mem. 6, p. 42.

G. A. Cooper and others, 1942, Geol. Soc. America Bull., v. 53, no. 12, pt. 1, p. 1768, chart 4 (facing p. 1788). Correlation chart shows age as Upper Devonian.

Type locality: On south side of southwestern peak of White Ridge. Named for Glenn Creek, whose middle branch heads at eastern base of White Ridge. On Saypo topographic sheet the names Glenn Creek and Moose Creek have been interchanged.

Glennon Limestone Member (of Lykins Formation)

Permian: North-central Colorado.

L. W. LeRoy, 1946, Colorado School Mines Quart., v. 41, no. 2, p. 31, 36–40, fig. 8. Divided into number of distinct lithic units, several of which are persistent throughout the area. They are (ascending) hard brittle pinkish laminated limestone that ranges in thickness from 2 inches to 2½ feet; gray to white fine-crystalline limestone with frequent vugs and laminated chert concretions; pink to gray irregularly laminated limestone; silty, impure laminated limestone; gray and pink limestone with distorted laminae; pink to gray regularly laminated limestone; and gray to pink coarsely crystalline vuggy imperfectly laminated limestone. Thickness at type locality 14 feet. Underlies Strain shale member (new); overlies Bergen shale member (new). Has been referred to commonly by various workers as "crinkled limestone."

Type locality: In quarry on south side of Turkey Creek, about 800 feet west of Glennon-Turkey Creek confluence, Golden-Morrison area, Jefferson County. Named from Mount Glennon, between Bear Creek and Turkey Creek and southeast of town of Morrison.

Glen Park Formation[1]

Glen Park Limestone Member (of Sulphur Springs Formation)

Glen Park Formation (in Hannibal Group)

Mississippian: Central eastern Missouri and southwestern Illinois.

Original reference: E. O. Ulrich, 1904, Missouri Bur. Geology and Mines, 2d ser., v. 2, p. 110.

L. E. Workman and Tracey [Tracy] Gillette, 1956, Illinois Geol. Survey Rept. Inv. 189, p. 8 (fig. 1), 20–23. In this report, name Hannibal is used for formations that lie above the Louisiana limestone and beneath the Chouteau. Glen Park, at base of group, unconformably overlies Louisiana limestone and conformably underlies Maple Mill formation.

M. G. Mehl, 1960, Denison Univ. Jour. Sci. Lab., v. 45, no. 5, p. 76–78. Ulrich proposed name Glen Park for oolitic limestone, the middle member of three constituting Sulphur Springs formation. Term Sulphur Springs abandoned in this report. Ulrich did not designate type locality, but it is evident that he had in mind the vicinity of Glen Park, a small community on Mississippi River in Jefferson County, Mo. Outcrops near there are designated as type locality. Thickness varies from a few inches to more than 20 feet. At type locality, probably no more than 30 inches should be assigned to formation. Separated from underlying strata by unconformity involving Kimmswick, Maquoketa, Chattanooga, and Plattin. Underlies Bushberg formation and in some areas Massie Creek sandstone (new). Upper Devonian. Outcrops form northwest-southeast trending band roughly paralleling Mississippi River through Ste. Genevieve, Jefferson, Franklin, St. Louis, St. Charles, and Warren Counties.

Type locality (Mehl, 1960): In SE cor. SE¼ NE¼ sec. 5, T. 41 N., R. 6 E., in old quarry face along river bluff above Missouri Pacific Railroad, south of Glen Park, Jefferson County, Mo.

Glenray Limestone (in Bluefield Formation[1] or Group)

Mississippian: Southeastern West Virginia and southwestern Virginia.

Original reference: D. B. Reger, 1926, West Virginia Geol. Survey Rept. Mercer, Monroe, and Summers Counties, p. 301, 432.

P. H. Price and E. T. Heck, 1938, West Virginia Geol. Survey [Rept.] Greenbrier County, p. 255, 264. Glenray limestone of Reger (1926) is represented in Greenbrier County by 10 to 60 feet of more or less impure limestone. Commonly a bluish-gray siliceous thick-bedded very fossiliferous limestone, belonging 100 to 150 feet above base of Mauch Chunk series. Above Lillydale shale and below Webster Springs sandstone. Bluefield group.

Type locality: On northwestern side of Greenbrier River, opposite Glenray, Summers County, W. Va.

Glenrock Limestone[1] Member (of Red Eagle Limestone)

Permian: Southeastern Nebraska and northeastern Kansas.

Original reference: G. E. Condra, 1927, Nebraska Geol. Survey Bull. 1, 2d ser., p. 84, 86, 88.

R. C. Moore and others, 1951, Kansas Geol. Survey Bull. 89, p. 48. Consists of gray and brown limestone, impure in northern part of outcrop area, purer in central and northern part; fusulines common. Thickness in northern part of Kansas 1 to 2 feet; in central Kansas as much as 19 feet. Underlies Bennett shale member; overlies Johnson shale. Wolfcamp series.

Named for exposures high in valley side just northwest of Glenrock, Nemaha County, Nebr.

Glen Rose Limestone[1] or **Formation** (in Trinity Group)

Glen Rose Limestone Member (of Shingle Hills Formation)

Lower Cretaceous: Texas.

Original reference: R. T. Hill, 1891, Geol. Soc. America Bull., v. 2, p. 504, 507.

R. T. Hazzard, 1939, Shreveport Geol. Soc. Guidebook 14th Ann. Field Trip, p. 155–165. Glen Rose subgroup of Trinity group consists of Lower Glen Rose formation, Glen Rose anhydrite, and Upper Glen Rose formation. Lower Glen Rose includes Pine Island member below and Rodessa member above. Overlies "Travis Peak" formation; underlies Paluxy formation. Subsurface data.

V. E. Barnes, 1948, Texas Univ. Bur. Econ. Geology Rept. Inv. 2, p. 5, 8. Rank reduced to member status in Shingle Hills formation (new). Overlies Hensell sand member.

F. E. Lozo and F. L. Stricklin, 1956, Gulf Coast Assoc. Geol. Soc. Trans., v. 6, p. 67–78. At generalized reference section of Trinity division, Glen Rose limestone consists of lower unit and an upper unit. Lower subdivision, that is interval below *Corbula* bed, is predominantly massive medium- to thick-bedded limestone with local moundlike concentrations of corals and caprinids in basal and upper parts. The lower Glen Rose above the massive limestone is largely shale alternating with thin-bedded limestones and is highly fossiliferous with several levels of *Orbitulina*, the large Foraminifera used as a subsurface Glen Rose marker. Trinity section above *Corbula* bed consists predominantly of buff-colored shales and fine-grained dolomites in lower and upper parts with darker shales and more resistant fossiliferous limestone in middle. The alternating relation of these lithic types resulted in early designation of "Alternating Beds" for the Glen Rose strata. Formal name was proposed by Hill (1891) from exposures near Glen Rose, Somervell County. Upper limit of Glen Rose in this area is placed at concordant contact of uppermost dolomitic section with overlying limestones similar to those higher in Fredericksburg division. Glen Rose is completely exposed from Hamilton Pool eastward to the Shingle Hills and has local thickness of 525 feet. Overlies Hensell sand. Lower Glen Rose contains basal coral reef at narrows of Blanco River.

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J. M. Forgotson, Jr., 1957, Am. Assoc. Petroleum Geologists Bull., v. 41, no. 10, p. 2328–2363. Terms Glen Rose, Glen Rose undifferentiated, and Glen Rose subgroup, as used in this report [stratigraphy of Comanchean Cretaceous Trinity group], all refer to those rocks below top of Glen Rose as defined in Austin area and above top of either Pearsall formation or its equivalent. These terms are used in areas where the Ferry Lake is not recognizable. Undifferentiated Glen Rose time-stratigraphic unit is defined to include those rocks below isochronous surface contemporaneous with top of Glen Rose as defined in Austin area and above isochronous surface contemporaneous with base of Rodessa formation as defined in type area. Rusk formation (new) occupies stratigraphic interval formerly termed upper Glen Rose formation and Paluxy formation. Top of Trinity group, as term is used in present report, is defined as top of Glen Rose formation of the Austin area and its equivalents. Subsurface data.

Named for Glen Rose, Somervell County.

Glens Falls Limestone (in Trenton Group)[1]

Middle Ordovician: Eastern New York and northwestern Vermont.

Original reference: R. Ruedemann, 1912, New York State Mus. Bull. 162.

G. M. Kay, 1937, Geol. Soc. America Bull., v. 48, no. 2, p. 260 (table 3), 262–263, 265 (fig. 10), 266 (table 4). Discussed under formations of Hull age of Trenton group. Includes Larrabee and Shoreham members (both new). In some areas, overlies Isle la Motte formation and in others Amsterdam formation; underlies Canajoharie formation. In some areas, Shoreham is member of Sherman Fall formation.

W. M. Cady, 1945, Geol. Soc. America Bull., v. 56, no. 5, p. 524 (table), 557–558. In west-central Vermont, overlies Orwell limestone (new) and underlies Hortonville shale. Consists of thin-bedded dark blue-gray rather coarsely granular limestone. Thickness about 115 feet. Kay's (1937) Larrabee and Shoreham members not readily distinguished in strongly folded beds east of Champlain thrust.

Phillip Fowler, 1950, Vermont Geol. Survey Bull. 2, p. 31, 34. Trenton units recognized by Cady in west-central Vermont continue southward into Castleton quadrangle, although the Glens Falls is not certainly identified. A blue marble that may be Shoreham member is called Whipple marble in this report. Larrabee member may be present along Taconic overthrust in Ira, but name Whipple is used until correlation with Glens Falls is certain.

R. B. Erwin, 1957, Vermont Geol. Survey Bull. 9, p. 30–32, 61–62. Formation described on Isle la Motte and South Hero Island, Vt., where both Larrabee and Shoreham limestone members are present. Overlies Lowville and Isle la Motte limestones; underlies Cumberland Head formation.

Named for exposures at Glens Falls, Warren County, N.Y.

Glenwood Shale or **Formation**

Glenwood Shale Member (of Platteville Formation)[1]

Glenwood Subgroup (of Ancell Group)

Middle Ordovician: Northeastern Iowa, western Illinois, southern Minnesota, and southern Wisconsin.

Original reference: S. Calvin, 1906, Iowa Geol. Survey, v. 16, p. 60, 61, 75.

J. S. Templeton and H. B. Willman, 1952, Tri-State Geol. Soc. Guidebook 16th Ann. Field Conf., p. 11 (fig. 3). Shown on columnar section as Glenwood subgroup of Ancell group (new). Includes (ascending) Kingdom, Daysville, Loughridge, and Harmony Hill formations (all new).

M. P. Weiss and W. C. Bell, 1956, Geol. Soc. America Guidebook for Field Trips Minneapolis Mtg., Field Trip 2, p. 57, 58 (table 1) ; M. P. Weiss, 1957, Geol. Soc. America Bull., v. 68, no. 8, p. 1030. Referred to as a formation overlying the St. Peter sandstone and underlying Platteville formation.

A. F. Agnew and others, 1956, U.S. Geol. Survey Prof. Paper 274–K, p. 275–277. Further described as shale member of Platteville. Type locality stated.

Type locality : Sec. 6, T. 98 N., R. 7 W., Winneshiek County, Iowa.

Glenwood Tongue (of Weber Sandstone)

Pennsylvanian-Permian : Western Colorado.

D. W. Vanderwilt, 1953, Rocky Mountain Assoc. Geologists Guidebook Field Conf., May 14–16, p. 15, fig. facing p. 12. Shown on columnar section below South Canyon Creek dolomite member of Maroon formation. Gray sandstone 200 feet thick.

Glenwood Springs area.

Glenwood Tuff

Pleistocene : Hawaii Island, Hawaii.

J. B. Stone, 1926, Bernice P. Bishop Mus. Bull. 33, p. 26, 27. Red clayey material about 10 feet thick; unstratified except for thin carbonaceous streaks. Correlated with Pahala ash.

C. K. Wentworth, 1938, Hawaiian Volcano Observatory 3d Spec. Rept., p. 55–56. Maximum thickness about 12 feet. Underlies Olaa agglomerate (new).

D. A. Davis and G. A. Macdonald *in* Jacques Avias and others, 1956, Lexique Strat. Internat., v. 6, Océanie, fasc. 2, p. 83. Considered to be part of Pahala ash. Pleistocene.

Occurs on east slope of Mauna Loa near Glenwood, Ferndale, and Olaa.

Glenwood Canyon Member (of Dotsero Formation)

Upper Cambrian : Central northwestern Colorado.

N. W. Bass and S. A. Northrop, 1953, Am. Assoc. Petroleum Geologists Bull., v. 37, no. 5, p. 892 (fig. 2), 893–894, 897–899. Proposed to apply to all beds in Dotsero lying below a ledge-forming algal limestone herein named Clinetop algal limestone member. Lower half of member consists of thin beds of light-gray to tannish-gray dolomite, and a few thin beds of flat-pebble dolomite conglomerate, interbedded with thin beds of light greenish-gray very dolomitic shale; upper half consists of thin beds of flat-pebble limestone conglomerate and interbedded light greenish-gray very limy shale. Thickness about 91 feet. Overlies Sawatch quartzite.

Type locality: In Glenwood Canyon in SE¼ sec. 16, T. 5 S., R. 87 W., Garfield County.

†Globe Limestone[1]

Devonian and Carboniferous : Southeastern Arizona.

Original reference : F. L. Ransome, 1903, U.S. Geol. Survey Prof. Paper 12.

Named for development at and around Globe, Gila County.

Glorieta Sandstone[1]

Glorieta Sandstone Member (of San Andres Formation)

Permian: Central northern New Mexico.

Original references: C. R. Keyes, 1915, Iowa Acad. Sci. Proc., v. 22, p. 257, 262; Conspectus of geologic formations of New Mexico, p. 2, 7.

C. E. Needham and R. L. Bates, 1943, Geol. Soc. America Bull., v. 54, no. 11, p. 1662–1664. Because of its wide distribution, persistence of lithology, bold topographic expression, and stratigraphic importance, Glorieta is considered to be formation. Overlies Yeso formation; underlies San Andres formation. Maximum thickness 278 feet in Zuni Mountains. Type locality designated.

C. B. Read and D. A. Andrews, 1944, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 8. Shown on columnar section as basal member of San Andres formation. Thickness 100 to 250 feet. Underlies unnamed limestone member; overlies Yeso formation.

G. O. Bachman, 1953, U.S. Geol. Survey Oil and Gas Inv. Map OM–137. Member described in northwestern Mora County where it is about 266 feet thick near Ocate. Underlies Bernal formation; overlies Yeso formation in extreme southwestern part of mapped area and elsewhere Sangre de Cristo formation.

W. H. Tonking, 1957, New Mexico Bur. Mines Mineral Resources Bull. 41, p. 7 (fig. 2), 10, 11, pl. 1. Member described in Puertecito quadrangle where it is about 230 feet thick. Underlies unnamed middle evaporite member. Gradationally overlies Los Vallos member of Yeso formation; contact placed above uppermost siltstone bed, so that basal part of Glorieta consists entirely of sandstone, which is pinkish at base.

C. H. Dane and G. O. Bachman, 1957, U.S. Geol. Survey Misc. Geol. Inv. Map I–224. Considered of formational rank.

Type section: Glorieta Mesa 1 mile west of village of Rowe, San Miguel County. Section lies in south-central part T. 15 N., R. 12 E.

Gloucesterian (Gloucester) Stage or Substage

Middle Ordovician (Trentonian): Eastern North America.

G. M. Kay, 1937, Geol. Soc. America Proc. 1936, p. 82. Collingwood and Gloucester are stages in latest Trenton.

Marshall Kay, 1960, Internat. Geol. Cong., 21st, Copenhagen, pt. 7, p. 30–31. Trenton group was divided by Raymond (1916, Harvard Coll. Mus. Comp. Zoology Bull., v. 56) into succession of faunal zones that he thought time-stratigraphic but which he called formations. In time these became stages: Rocklandian, Kirkfieldian, Shorehamian, Denmarkian, Cobourgian, Collingwoodian, and Gloucesterian of Kay (1937; 1943; 1948). The Cobourg-Collingwood-Gloucester seems to be time-equivalent to Utica group, but name Utica is strongly associated with black shale facies. Hence, term Pictorian stage is applied to uppermost Trentonian.

Name derived from Gloucester Township, Carleton County, Ontario, Canada, for which Gloucester shale is named.

Goathaunt Member (of Siyeh Formation or Limestone)[1]

Precambrian (Belt Series): Northwestern Montana.

Original reference: C. L. Fenton and M. A. Fenton, 1931, Jour. Geology, v. 39, no. 7, p. 670–679.

C. L. Fenton and M. A. Fenton, 1937, Geol. Soc. America Bull., v. 48, no. 12, p. 1895. Limestones, dolomites, and subordinate oolites, dolomitic sandstones, and argillites, thickly bedded; prevailingly dark gray. Mud breccias, abundant in northern exposures. Mud cracks common in carbonaceous layers. Thickness 2,000 to 3,200 feet. Overlies a *Collenia symmetrica* zone; separated from overlying Granite Park member by *C. frequens* zone. Type locality designated.

Richard Rezak, 1957, U.S. Geol. Survey Prof. Paper 294–D, p. 137, 138. Discussion of stromatolites of Belt series. Goathaunt member of Fenton and Fenton is represented in *Collenia symmetrica* zone 1.

Type locality: South wall of cirque between Mount Goathaunt and Mount Cleveland, Glacier National Park. Well exposed in high peaks of Waterton-Glacier Parks.

Goat Island Member (of Lockport Formation)

Middle Silurian (upper Niagaran): Western New York, and southern Ontario, Canada.

B. F. Howell and J. T. Sanford, 1947, Wagner Free Inst. Sci. Bull., v. 22, no. 4, p. 34. Name proposed to replace preoccupied name, Suspension Bridge, first used for a lower Ordovician formation in New Brunswick. Underlies Eramosa member; overlies Gasport limestone member.

T. E. Bolton and B. A. Liberty *in* A. J. Mozola, chm., 1955, Michigan Geol. Soc. [Guidebook] Ann. Field Trip [no. 19], p. 29. Described in Niagara Escarpment of Ontario as a thick sequence of dolomites. Essentially thick-bedded gray to buff dolomite. Abundant chert nodules and lenses occur at base. Upper limit arbitrarily drawn at first occurrence of bituminous material characteristic of Eramosa member. Maximum thickness 80 feet in Hamilton region.

Named for Goat Island at brink of Niagara Falls, N.Y.

Goat Rock pyroclastic deposits.

Quaternary: Southwestern Washington.

Jean Verhoogen, 1937, California Univ. Dept. Geol. Sci. Bull., v. 24, no. 9, p. 274–277. Name applied to pyroclastic deposit consisting of angular blocks, some of them weighing several tons, scattered in a loose fine muddy matrix. Deposit is characterized by occurrence of "bread-crusted" bombs. Deposit is narrow; greatest width nowhere exceeds five-eights of a mile.

Occurs in an area between the northeast corner and the outlet of the small glacier which hangs between Goat Rock and "The Lizzard", on north side of Mount St. Helens.

Goat Seep Limestone or Dolomite

Permian (Guadalupe Series): Western Texas and eastern New Mexico.

P. B. King, 1942, Am. Assoc. Petroleum Geologists Bull., v. 26, no. 4, p. 588–589, pl. 2; 1948, U.S. Geol. Survey Prof. Paper 215, p. 38–41, pls. 2, 3. Along west side of Guadalupe Mountains north of Bone Spring, Getaway, and South Wells, limestone members of Cherry Canyon formation thicken northward, and intervening sandstones disappear. On projecting point of escarpment, 1½ miles north of the spring, upslope from top of Bone Spring flexure, the limestones coalesce into solid mass, here termed Goat Seep limestone. Thickens rapidly from 700 feet at southernmost exposure to Bartlett Peak, 1 mile north, where it is 1,200 feet thick. On

Bartlett Peak, consists of gray dolomitic limestone, which forms thick beds in lower half of formation; upper half is single mass with few traces of bedding. The thick-bedded and massive limestones are probably reef deposits. Interfingers with Manzanita limestone member of Cherry Canyon formation; overlies sandstone tongue of Cherry Canyon; underlies Carlsbad limestone; interfingers with Queen sandstone member of Chalk Bluff formation. Unit was described by Crandall (1929, Am. Assoc. Petroleum Geologists Bull., v. 13, p. 933) who called it Chupadera limestone, and by Lang (1937, Am. Assoc. Petroleum Geologists Bull., v. 21, no. 7) who called it Dog Canyon limestone; this latter name now abandoned.

N. D. Newell and others, 1953, The Permian reef complex of the Guadalupe Mountains region, Texas and New Mexico: San Francisco, W. H. Freeman and Co., p. 42–43. It has been determined that Queen formation is equivalent to much, if not all, of shelf phase of King's Goat Seep dolomite. Because of confusion introduced by applying name Goat Seep to shelf, reef, and forereef facies, it is proposed to restrict name Goat Seep to reef and forereef talus facies, a nomenclatural device that has served well with Capitan formation.

Name is taken from Goat Seep, on western slope of Guadalupe Mountains, 1½ miles northwest of Guadalupe Peak, Culbertson County, Tex.

Gobbler Formation (in Magdalena Group)

Pennsylvanian (Morrowan?-Missourian) : Southeastern New Mexico.

L. C. Pray, 1954, New Mexico Geol. Soc. Guidebook 5th Field Conf., p. 93. Appears only on columnar section. Consists of limestone, sandstone, and shale. Coarse quartz sandstone in lower part. Includes massive gray cherty Bug Scuffle limestone member which grades laterally into sandstone and shale. Thickness as much as 1,600 feet. Underlies newly named Beeman formation and overlies Helms formation.

In Sacramento Mountains, Otero County.

Gober Tongue (of Austin Chalk)[1]

Upper Cretaceous : Northeastern Texas.

Original reference: L. W. Stephenson, 1927, Am. Assoc. Petroleum Geologists Bull., v. 11, p. 8–12, pl. 1.

L. W. Stephenson, 1937, U.S. Geol. Survey Prof. Paper 186–G, p. 133–146. Mentioned in discussion of stratigraphic relations of Austin, Taylor, and equivalent formations.

Named for occurrence at village of Gober, Fannin County.

Goble Volcanic Series

Goble Volcanics Member (of Cowlitz Formation)

Eocene, upper : Northwestern Oregon and southwestern Washington.

W. C. Warren, Hans Norbisrath, and R. M. Grivetti, 1945, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map. 42. Name applied to a section of widespread basic flows and pyroclastic rocks with some associated sediments. Basal part of series interfingered with tuffaceous sediments which contain a Cowlitz (upper Eocene) fauna. Thickness 5,000 feet or more, measured along U.S. Highway 99 between Woodland and Kelso, Wash.

D. A. Henriksen, 1956, Washington Div. Mines and Geology Bull. 43, p. 16 (fig. 5), 59–62, 65. Described in lower Cowlitz River-eastern Willapa Hills area, southwestern Washington. Here Goble volcanics are represented by basaltic flows and flow breccia interbedded with both marine and coal-bearing Cowlitz sediments. Aggregate thickness of intercalated rocks less than 1,000 feet. In this area, name Goble volcanics member of Cowlitz formation is used for rocks which constitute a much thicker unit of formational rank elsewhere. Volcanics interfinger with sediments of underlying Olequa Creek member (new) and thin and wedge out toward northwest of mapped area.

Named for exposures in vicinity of Goble, Columbia County, Oreg. Series crops out along both the Oregon and Washington sides of Columbia River.

Goddard Shale Member (of Springer Formation)

Goddard Formation or Shale (in Springer Group)

Pennsylvanian: Oklahoma.

M. G. Cheney and others, 1945, Am. Assoc. Petroleum Geologists Bull., v. 29, no. 2, p. 140 (chart 2), 143. Proposed to replace term "Pennsylvanian Caney." Consists of uniform dark shales with some thin concretionary layers between top of Mississippian rocks (commonly the Caney shale of Meramec age according to Ulrich, 1927, Oklahoma Geol. Survey Bull. 45) and base of Rod Club sandstone. Thickness at least 2,000 feet in type area. Springer series. Name credited to J. M. Westheimer.

H. D. Miser and others, 1954, Geologic map of Oklahoma (1:500,000): U.S. Geol. Survey. Mapped as member at base of Springer. Pennsylvanian.

M. K. Elias, 1956, *in* Ardmore Geol. Soc., Petroleum geology of southern Oklahoma—a symposium, v. 1: Tulsa, Okla., Am. Assoc. Petroleum Geologists, p. 70 (table 2), 74–89. In southern Arbuckle Mountains, includes Redoak Hollow sandstone member (new) in middle part. Mississippian (Chester).

J. M. Westheimer, 1956, *in* Ardmore Geol. Soc., Petroleum geology of southern Oklahoma—a symposium, v. 1: Tulsa, Okla., Am. Assoc. Petroleum Geologists, p. 392–396. Name was proposed for pre-Springer "Pennsylvanian" sediments. Because Goddard shales are indistinguishable from shales above the Rod Club sandstone, it had been proposed that base of Springer group be extended downward to top of the Caney. In view of new faunal evidence, the Goddard should not be included in the Springer and Mississippian-Pennsylvanian boundary should be drawn at base of Rod Club.

C. W. Tomlinson and William McBee, Jr., 1959, *in* Ardmore Geol. Soc., Petroleum geology of southern Oklahoma—a symposium, v. 2: Tulsa, Okla., Am. Assoc. Petroleum Geologists, p. 6 (fig. 2), 8–10. Formation comprises lower half (Chesterian part) of Springer group as defined here.

C. W. Tomlinson, 1959, *in* Ardmore Geol. Soc., Petroleum geology of southern Oklahoma—a symposium, v. 2: Tulsa, Okla., Am. Assoc. Petroleum Geologists, p. 323. Includes Grindstone Creek member (new) in upper part. Mississippian (precise systemic boundary open to question).

C. W. Tomlinson and Allan Bennison, 1960, Oklahoma Geology Notes, v. 20, no. 5, p. 123–124. Tiff member proposed to replace preoccupied name Grindstone Creek member of Tomlinson, 1959.

Type locality: Along Oil Creek, secs. 19 and 20, T. 3 S., R. 4 E., on Goddard Ranch about 7 miles east of Gene Autry (Berwin on older maps), Johnston County. Section starts on west side of Oil Creek in SE¼ sec. 18 where contact between Caney and Goddard shales is well exposed, and extends in southwesterly direction to base of Rod Club sandstone.

Godfrey Shales (in Asuncion Group)

Upper Cretaceous: West-central California.

N. L. Taliaferro, 1943, California Div. Mines Bull. 118, pt. 2, p. 132 [preprint]. Underlies Cantinas sandstones (new); overlies Piedras Altas formation (new).

Santa Lucia Range is mountainous area, between Salinas Valley and the coast, which extends from Monterey Bay to central part of San Luis Obispo County.

Godfrey Flat Shale

See Godfrey Shales (in Asuncion Group).

†Godiva Limestone[1]

Ordovician to Mississippian: Central northern Utah.

Original reference: G. W. Tower, Jr., and G. O. Smith, 1899, U.S. Geol. Survey 19th Ann. Rept., pt. 3, p. 624.

Tintic district.

Godiva[1] or Goldiva limestone[1]

Eocene: Utah.

Original reference: C. R. Keyes, 1924, Pan-Am. Geologist, v. 41, p. 279, 308.

Tintic district.

Gods Pocket Dacite

Pliocene(?): Northeastern Nevada.

R. R. Coats, 1957, U.S. Geol. Survey Trace Elements Inv. Rept. TEI-690, Book 2, p. 306. Sequence of dacite flow material about 700 feet thick. Disconformably overlies Jarbidge rhyolite (new) and locally separated from it by 30 to 50 feet of pale-gray vitric tuff.

U.S. Geological Survey currently considers the Gods Pocket Dacite to be Pliocene(?) in age.

In northeastern quarter of Jarbidge quadrangle.

Goen Limestone (in Millsap Lake Formation)[1]

Goen Limestone Member (of Grindstone Formation)

Pennsylvanian: Central northern Texas.

Original reference: F. B. Plummer, 1929, Geologic map of Pinto County: Texas Bur. Econ. Geology.

M. G. Cheney, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 1, p. 66 (fig. 1). Reallocated to member status in Grindstone Creek formation.

Leo Hendricks, 1957, Texas Univ. Bur. Econ. Geology Pub. 5724, p. 19–20, fig. 3. In Parker County, limestone is 1 to 2 feet thick and is gray to yellowish gray. Limestone either lenses out to east, or its eroded edge is covered by debris from dissected dip slope of underlying sandstone. Occurs at top of formation. Overlies unnamed sandstones above the Santo limestone member; underlies Mingus member of Garner formation. Report follows classification of Cheney (1940) [but also refers to this unit as a limestone bed].

Well exposed on north side of Millsap-Brazos Road one-half mile northeast of Goen Cemetery entrance, Palo Pinto County.

†Goff coal group (in Williams Fork Formation)[1]

Upper Cretaceous: Northwestern Colorado.

Original reference: E. T. Hancock and J. B. Eby, 1930, U.S. Geol. Survey Bull. 812, p. 206.

Meeker quadrangle.

†Gogebic Series[1]

Precambrian: Michigan.

Original reference: C. R. Van Hise and C. K. Leith, 1909, U.S. Geol. Survey Bull. 360, p. 137, 308–309.

Gogebic district, Lake Superior region.

Golconda Formation[1]

Golconda Formation (in Homberg Group)

Golconda Limestone (in Stephensport Group)

Upper Mississippian (Chester Series): Southern Illinois, northwestern Alabama, northwestern Georgia, southern Indiana, western Kentucky, southeastern Missouri, and western Tennessee.

Original references: A. D. Brokaw, 1916, Illinois Geol. Survey Extr. from Bull. 35; 1917, Illinois Geol. Survey Bull. 35, p. 19–29.

J. M. Weller, 1939, Kansas Geol. Soc. Guidebook 13th Ann. Field Conf., p. 131, 136; J. M. Weller and A. H. Sutton, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 5, p. 766 (fig. 1), 830–831. Assigned to Homberg group (new). In standard Mississippian section, underlies Hardinsburg sandstone and overlies Cypress sandstone. Attains maximum thickness of more than 100 feet. Youngest formation present in Perry and Ste. Genevieve Counties, Mo., where it is gray crystalline limestone; in Perry County, overlaps the Ruma and rests unconformably on Paint Creek formation. In Indiana, overlies Indian Springs shale.

Charles Butts and Benjamin Gildersleeve, 1948, Georgia Geol. Survey Bull. 54, p. 42, 47–48. Geographically extended into Georgia where it occurs on Lookout Mountain. Underlies Hartselle sandstone; overlies Gasper limestone.

A. C. McFarlan and others, 1955, Kentucky Geol. Survey, ser. 9, Bull. 16, p. 5–25. Golconda section is (ascending) Beech Creek (lower Golconda) limestone, Fraileys (middle Golconda) shale (new) or Big Clifty, and Haney (upper Golconda) limestone (new). Section overlies Cypress sandstone and underlies Hardinsburg sandstone.

D. J. McGregor, T. G. Perry, and W. J. Wayne, 1957, Indiana Geol. Survey Field Conf. Guidebook 9, p. 6, pl. 3. Shown on chart of evolution of stratigraphic nomenclature in Chester series of Indiana as Golconda formation; underlies Hardinsburg formation and overlies Big Clifty formation, here used to replace Cypress sandstone. As shown on chart, Golconda includes unit formerly termed Indian Springs shale. Thickness 40 to 50 feet. Term Homberg group not used in Indiana.

S. W. Welch, 1958, U.S. Geol. Survey Oil and Gas Inv. Chart OC–58. In northwestern Alabama, strata referred to by Butts (1926, Alabama Geol. Survey Spec. Rept. 14) as Golconda formation are included in Green Hill member of Pride Mountain formation (both new).

H. H. Gray, R. D. Jenkins, and R. M. Weidman, 1960, Indiana Geol. Survey Bull. 20, p. 36 (table 5), 39–40, pl. 1. Included in Stephensport group (redefined). In Indiana, as recently as 1957 rocks considered to belong to Golconda formation have included an upper limestone member and a lower shale member. The shale appears to be more closely related to underlying Big Clifty formation, and it is here proposed to restrict name Golconda to the limestone and refer to unit as Golconda limestone. Thickness in Huron area [this report] 19 to 32 feet. Conformably overlies Big Clifty formation: underlies Hardinsburg formation with contact transitional.

Named for Golconda, Pope County, Ill.

Gold Basin Formation

Recent: Southeastern Utah.

G. M. Richmond, 1956, Dissert. Abs., v. 16, no. 6, p. 1128. Consists of two members comprising 10 lithofacies. Tills form two sets of small cirque moraines or rock glaciers. Weakly developed Spanish Valley soil is developed on lower member. No soil, or only a faint humus, is formed on upper member. Younger than Beaver Basin formation (new).

Located in La Sal Mountains area.

Gold Butte Granite

Precambrian: Southeastern Nevada and northwestern Arizona.

C. R. Longwell, 1936, Geol. Soc. America Bull., v. 47, p. 1405–1406. Pinkish gray, coarse-grained, and distinctly porphyritic granite. Unconformably underlies Cambrian rocks.

Prominent in Gold Butte, Nev., from which it takes its name. Distributed widely in southern Virgin Mountain block. Exposed at head of Virgin Canyon.

Gold Creek Quartzite[1]

Middle(?) Cambrian: Northern Idaho.

Original reference: E. Sampson, 1928, Idaho Bur. Mines and Geology Pamph. 31, p. 9.

C. E. Resser, 1938, Smithsonian Misc. Colln., v. 97, no. 3, p. 2. Estimated average thickness 400 feet. Distinguished from underlying Beltian strata by coarser grain. Underlies Rennie shale. Middle Cambrian.

Named for exposures on North and South Gold Creeks near Lakeview. Conspicuous outcrops on summit of ridge above cement rocks plant at Port Rock.

†Golden Formation or Group[1]

[Upper Cretaceous]: Central Colorado.

Original reference: A. C. Veatch, 1907, Jour. Geology, v. 15, p. 548.

Probably named for Golden, Jefferson County.

Golden Member (of Arapahoe-Denver Formation)

Tertiary: North-central Colorado.

L. W. LeRoy, 1946, Colorado School Mines Quart., v. 41, no. 2, p. 100 (fig. 23), 103, 104. Light-tan to light-brown silts, clays, silty shales, clayey sands, and some medium-grained sandstones. Thickness ranges from 60 feet on South Table Mountain to 76 feet on north side of North Table

Mountain. Overlies Pleasant View member (new); immediately underlies capping basalt flow of North and South Table Mountains.

Type section: On eastern extremity of South Table Mountain; NW¼ sec. 31, T. 3 S., R. 69 W., Morrison quadrangle, Jefferson County. Recognized only on slopes of Table Mountains.

Golden Eagle Limestone[1]

Pennsylvanian: Southwestern Illinois.

Original reference: H. E. Culver, 1925, Illinois Geol. Survey Coop. Min. ser., Bull. 29, p. 20.

Probably named for exposures at or near Golden Eagle, Calhoun County.

†Golden Gate Formation

Upper Cretaceous (Chico Series): Northern California.

J. M. Kirby, 1942, (abs.) Am. Assoc. Petroleum Geologists Bull., v. 26, no. 5, p. 899. Listed as basal formation in Chico series; underlies Mills formation (new).

J. M. Kirby, 1943, California Div. Mines Bull. 118, pt. 3, p. 606. Described as a sandstone varying in thickness from 3,000 to 3,500 feet. Derivation of name given.

J. M. Kirby, 1943, Am. Assoc. Petroleum Geologists Bull., v. 27, no. 3, p. 282 (footnote). Name preoccupied; replaced by Venado formation.

Name derived from prominent gap in the sandstone rimrock in W½ sec. 9, T. 17 N., R. 4 W., through which Funks Creek flows, Colusa County.

†Golden Gate Series[1]

Jurassic(?): Western California.

Original reference: H. W. Fairbanks, 1895, Jour. Geology, v. 3, p. 416–426.

Named for development on north and south shore of Golden Gate, San Francisco County.

Golden Gate Hill Andesite

Neocene: Central California.

F. L. Ransome, 1899, U.S. Geol. Survey Geol. Atlas, Folio 63, p. 6. Consists in main of andesitic-breccia and conglomerate capped by thick mass of hornblende-andesite similar to Jackson Butte andesite (new).

Forms Golden Gate Hill, Calaveras County, Mother Lode district.

Golden Horn Granodiorite

Post-Lower Cretaceous: Northwestern Washington.

Peter Misch, 1952, The Mountaineer, v. 45, no. 13, p. 4 (geol. map), 17–18. Later than Lower Cretaceous sediments and their folding. Intrudes Black Peak granodiorite and quartz diorite (new).

Golden Horn Peak is in Okanogan County. Composes a number of peaks including Methow Pinnacles and Mount Hardy, Golden Horn, the Needles, and Tower Mountain, Cutthroat Peak, Liberty Bell, and Silver Star.

Golden Ray Limestone[1]

Middle Cambrian: Central northern Utah.

Original reference: G. W. Crane, 1915, Am. Inst. Mining Engrs. Bull. 106, p. 2149–2151.

Probably named for Golden Ray mine, Tintic district.

Goldens Ranch Formation

Eocene: Central Utah.

Siegfried Muessig, 1951, Science, v. 114, no. 2957, p. 234. Series of tuffs, bentonites, and volcanic boulder conglomerates; includes Sage Valley member (new) 820 feet above base. Conformably overlies Green River limestone. Volcanic conglomerates grade laterally into volcanic breccias that are part of latite series in northern part of area and in Tintic district.

Well exposed in roadcuts along U.S. Highway 91, in Long Ridge area, southwest of Levan, Juab County. Derivation of name not stated.

Golden Valley Formation

Eocene: Southwestern North Dakota.

W. E. Benson and W. M. Laird, 1947, (abs.) Geol. Soc. America Bull., v. 58, no. 12, pt. 2, p. 1166–1167. Consists of fine-grained micaceous sands with minor amounts of light-colored clays and shales; these sands and shales overlie a basal sequence of hard white to dark-gray clays, and locally, lignites; middle part of basal sequence is characteristically mottled reddish yellow on weathered surfaces and forms good marker bed. Formation includes beds bearing fossil fern *Salvinia preauriculata*. Unit has been referred to as unnamed formation of Wasatch group. Overlies Sentinel Butte shale member of Fort Union; unconformably underlies Oligocene White River group.

W. E. Benson, 1949, (abs.) Geol. Soc. America Bull., v. 60, no. 12, pt. 2, p. 1873–1874. Conformably overlies Tongue River member of Fort Union.

E. G. Meldahl, 1956, North Dakota Geol. Survey Rept. Inv. 26. Overlies Sentinel Butte shale herein considered member of Tongue River formation.

Great Northern Railway Co. Mineral Research and Devel. Dept., 1958, Great Northern Railway Co. Mineral Research and Devel. Dept. Rept. 5, p. 5–23. In area of Mountrail County, includes White Earth, South Ross, Lakeside, and East Tioga clay beds.

Type exposure: Near town of Golden Valley, Mercer County.

†Golden Wall Sandstone (in Blair Formation)[1]

Upper Cretaceous (Montana): Southwestern Wyoming.

Original reference: J. W. Powell, 1876, Geology of eastern portion of Uinta Mountains, p. 40, 48, 155.

Forms main scarp surrounding Baxter Basin, Sweetwater County. This scarp is commonly referred to as the "golden wall."

Gold Hill Conglomerate[1]

Triassic(?): Southwestern Colorado.

Original reference: J. D. Irving, 1905, U.S. Geol. Survey Bull. 260, p. 56.

Gold Hill, Ouray district.

Gold Hill Formation[1]

Cambrian: Central Nevada.

Original reference: H. G. Ferguson, 1924, U.S. Geol. Survey Bull. 723.

H. G. Ferguson and S. H. Cathcart, 1954, U.S. Geol. Survey Geol. Quad. Map GQ–40. No fossils were found in formation of Manhattan district, Toquima Range, but trilobite of Early Cambrian age (*Olenellus gilberti* Meek) was found in rocks of same lithology and stratigraphic position in

Toyabe Range near Jett Canyon. Therefore, established formation name is extended to Cambrian of both ranges. Consists chiefly of quartzite, quartz mica schist with some slate, and beds of crystalline dolomitic limestone, with locally some oolitic limestone in its upper part. Base not exposed; estimated exposed thickness at least 3,000 feet in Toyabe Range north of Summit Creek. Conformably underlies Ordovician Palmetto formation. Probably equivalent to Silver Peak group (Turner, 1902).

Type locality: Gold Hill in Manhattan district, Toquima Range.

Gold Hill Phyllite

Age(?): Northwestern Washington.

J. A. Vance, 1957, Dissert. Abs., v. 17, no. 9, p. 1984. A low grade metamorphic rock.

Occurs in Sauk River area in northern Cascades.

†Gold Hill Porphyry[1]

Eocene: Western central Colorado.

Original reference: S. F. Emmons, 1898, U.S. Geol. Survey Geol. Atlas, Spec. Folio 48.

On Gold Hill, Tenmile district.

Gold Mountain Phyllite

Age not stated: Northern Washington.

R. W. Jones, 1959, Dissert. Abs., v. 20, no. 3, p. 994. Much of eastern part of map area is underlain by broad belt of Gold Mountain phyllite which is flanked on west by belt of Finney greenschist (new). In fault contact with Sutter Mountain unit (new). Occurs in anticlinorium.

Report discusses geology of Finney Peak area, northern Cascades.

Gold Park Gabbro-Diorite

Precambrian: Southern California.

W. J. Miller, 1938, Geol. Soc. America Bull., v. 49, no. 3, p. 419–420. Consists of a variety of rather basic igneous rocks, but average mineral composition is about that of gabbro-diorite. Includes a massive facies and a "salt and pepper" facies. Considered older than Palms granite (new). Cut by White Tank monzonite (new).

Named from an occurrence in Gold Park Canyon, near Twenty-nine Palms, Riverside County.

Gold Road Latite[1]

Tertiary, middle or upper: Northwestern Arizona.

Original references: F. L. Ransome, 1923, U.S. Geol. Survey Bull. 743; Carl Lausen, 1931, Arizona Bur. Mines Bull. 131, Geol. Ser. 6, p. 34, map.

Named for settlement and mine, both of which are called Gold Road, Oatman district.

Goler Formation

Eocene to Miocene, lower: Southern California.

T. W. Dibblee, Jr., 1952, California Div. Mines Bull. 160, p. 12 (fig. 1), 19–25, pls. 1, 2, 3. Consists of some 6,500 feet of terrestrial conglomerate, sandstone, and clay. Comprises two unnamed members. Unconformably underlies Ricardo formation; unconformably overlies basement rocks; southwest from type section the Goler is overlapped by the Ricardo. Age shown on columnar section as Eocene-Oligocene-Miocene.

M. C. McKenna, 1955, Am. Assoc. Petroleum Geologists Bull., v. 39, no. 4, p. 512–515. Paleontological evidence indicates that most and probably all of formation is at least as old as early Tertiary.

Type section: Exposed in drainage area of Goler Gulch and northwestward to east slope of Black Hills, Saltdale quadrangle, Kern County.

Golf Course Formation (in Dornick Hills Group)

Pennsylvanian (Morrow Series): Southern Oklahoma.

B. H. Harlton, 1956, *in* Ardmore Geol. Soc., Petroleum geology of southern Oklahoma—a symposium, v. 1: Tulsa, Okla., Am. Assoc. Petroleum Geologists, p. 137 (fig. 2), 138–139. Includes Primrose sandstone member at base and Otterville member at top. Primrose sandstone, and shale between it and the Otterville, are transferred from the Springer group to the Dornick Hills. Thickness at type locality 1,400 to 1,500 feet. Entire sequence, which carries large and varied Morrow fauna, includes all rocks generally recognized as of Morrow age in Ardmore basin. South of Ardmore, Jolliff conglomerate is lowest unit so recognized. In Harrisburg trough, formation is divided into (ascending) Rowland (new), Limestone Gap, and Otterville members. Unconformably underlies Lake Murray formation (new); unconformably overlies rocks of Springer group.

C. W. Tomlinson and William McBee, Jr., 1959, *in* Ardmore Geol. Soc., Petroleum geology of southern Oklahoma—a symposium, v. 2: Tulsa, Okla., Am. Assoc. Petroleum Geologists, p. 6 (fig. 2), 18. Morrowan series, in Ardmore basin, includes maximum of about 2,000 feet of strata from base of Primrose sandstone to a horizon above Otterville limestone and below Bostwick conglomerates. This is sequence of strata which Harlton (1956) has designated Golf Course formation.

Type locality: Along a creek in SW¼SW¼ sec. 7, T. 4 S., R. 2 E., Carter County. Name derived from golf course of Dornick Hills Country Club, type locality of Dornick Hills group.

Goliad Sand[1]

Goliad Formation

Pliocene: Southern Texas.

Original reference: J. T. Lonsdale and J. R. Day, 1933, Ground-water resources of Webb County, Texas: U.S. Geol. Survey Press Bull. 68861.

A. W. Weeks, 1945, Am. Assoc. Petroleum Geologists Bull., v. 29, no. 12, p. 1726–1732. Termed formation. Includes Lagarto and Lapara formations of Dumble as members. Unconformably underlies Willis or younger Pleistocene. Composed of limestone, gray and black chert, and fossil wood, all commonly interbedded with sand or intermixed with clay balls. Dips coastward about 25 feet per mile; near downdip edge of outcrop, probably reaches average thickness of about 500 feet.

J. H. Quinn, 1952, (abs.) Geol. Soc. America Bull., v. 63, no. 12, pt. 2, p. 1292. On basis of fauna, considered late-upper Miocene.

Named for exposures along San Antonio River at Goliad, Goliad County.

Gonic Formation[1]

Pennsylvanian (?): Southeastern New Hampshire and southwestern Maine.

Original reference: F. J. Katz, 1917, Washington Acad. Sci. Jour., v. 7, p. 199.

Jacob Freedman, 1950, Geol. Soc. America Bull., v. 61, no. 5, p. 460. Katz (1917) assigned to Gonic formation schists, in Dover quadrangle to the east, that are continuous with Littleton formation in Mount Pawtuckaway quadrangle [this report].

Named for exposures near Gonic, Strafford County, N.H.

Gonzales Limestone Member (of Graham Formation)[1]

Gonzales Formation (in Graham Group)

Gonzales Shale (in Caddo Creek Group)

Upper Pennsylvanian: Central northern Texas.

Original reference: C. S. Ross, 1921, U.S. Geol. Survey Bull. 726–G, p. 307.

Wallace Lee and others, 1938, Texas Univ. Bur. Econ. Geology Pub. 3801, p. 18–19. Member of Graham formation. Well exposed on high westward-facing bluff in southside of Brazos River and southeast of Salem Bend, where it is 18 feet thick. This is only place where complete unweathered section was noted in area of this report [Brazos River valley]. Separated from underlying Salem School member (new) by unnamed interval of shale and sandstone; underlies sandstone interval below Bunger limestone member.

M. G. Cheney, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 1, p. 66 (fig. 1). Shown on correlation chart as formation in Graham group. Includes Salem School limestone member. Occurs below North Leon formation and above Home Creek limestone in Caddo Creek group. Cisco raised to series rank in this report.

C. E. Davis, 1956, *in* North Texas Geol. Soc. Field Guidebook, May 25–26, p. [6], fig. 2. Shown on correlation chart as Gonzales shale in Caddo Creek group.

Named for Gonzales Creek, Stephens County.

†Gonzales Shale[1]

Pennsylvanian: Central northern Texas.

Original references: F. B. Plummer, 1929, Geologic map of Palo Pinto County: Texas Bur. Econ. Geology; O. F. Hedrick, E. Owens, and P. A. Myers, 1929, Geologic map of Shackelford County: Texas Bur. Econ. Geology.

Palo Pinto, Shackelford, and Stephens Counties.

Gonzales Creek Shale Member (of Graham Formation)[1]

Pennsylvanian: Central northern Texas.

Original references: F. B. Plummer and R. C. Moore, 1922, Jour. Geology, v. 30, p. 24, 31; 1922, Texas Univ. Bull. 2132, p. 127–134.

Named for Gonzales Creek in Eastland County.

Goodbread Sandstone Member (of Manning Formation)

Eocene (Jackson): East-central Texas.

W. L. Russell, 1955, Gulf Coast Assoc. Geol. Soc. Trans., v. 5, p. 166–171. Name applied to a sandstone in the Manning formation about 100 to 150 feet above the top of the Carlos sandstone. Thickness near type locality 5 to 30 feet; in Brazos County 40 to 50 feet. Separated from overlying Tuttle sandstone [member] (new) by a 75-foot interval that contains shales, shaly sandstone, lignitic beds, and ash beds. Unit had been mapped as part of Carlos sandstone by Renick (1936).

Type locality: On Lake Creek 1 mile west of Carlos, Grimes County.

Goodenough Member (of Franconia Sandstone)[1]

Upper Cambrian: Southwestern Wisconsin.

Original reference: A. C. Trowbridge and others, 1935, Kansas Geol. Soc. Guidebook 9th Ann. Field Conf., p. 81, 92, 134, 140, 159, 446, 449, 455.

C. R. Stauffer, G. M. Schwartz, and G. A. Thiel, 1939, Geol. Soc. America Bull., v. 50, no. 8, p. 1239. Name Taylor Falls member (new) used in Minnesota in preference to extending term Goodenough member.

R. R. Berg, 1953, Jour. Paleontology, v. 27, no. 4, p. 553, 554, 555; 1954, Geol. Soc. America Bull., v. 65, no. 9, p. 858 (fig. 1), 864. Name abandoned. Franconia member names used by Twenhofel, Raasch, and Thwaites (1935) are geographic names applied to faunal zones. New member names are proposed to designate rock types, because distribution of faunal zones in formation is largely independent of natural rock units. Goodenough member is *Conaspis* zone. This fauna occurs most abundantly in Tomah member and less abundantly in underlying Birkmose and overlying Reno members.

Type locality: Goodenough Hill, between Elroy and Mauston, Juneau County.

†Good Hope Formation[1]

Pliocene(?): District of Columbia and southern Maryland.

Original reference: W. B. Clark, 1890, Johns Hopkins Univ. Circ., v. 9, no. 81, p. 69–70.

Named for Good Hope Hill, D.C.

Goodland Limestone (in Fredericksburg Group)[1]

Goodland Formation (in Fredericksburg Group)

Lower Cretaceous (Comanche Series): Southwestern Arkansas, central southern and southeastern Oklahoma, and northeastern Texas.

Original reference: R. T. Hill, 1891, Geol. Soc. America Bull., v. 2, p. 504, 514.

B. F. Perkins, 1957, Dissert. Abs., v. 17, no. 6, p. 1310; 1960, Geol. Soc. America Mem. 83, p. 9 (fig. 3), 12 (fig. 4), 15–21, pl. 2. Formation described in Fort Worth-Weatherford area, Texas, where it is subdivided into Marys Creek marl member below and Benbrook limestone member above (both new). Thickness about 120 feet. Conformably and gradationally overlies Walnut marl; conformably underlies Kiamichi formation.

L. V. Davis, 1960, Oklahoma Geol. Survey Bull. 86, p. 16–17, 31–34, pl. 1. Described in McCurtain County, Okla., where it is 25 to 50 feet thick, conformably overlies Paluxy sand and conformably underlies Kiamichi formation. Walnut clay, which underlies Goodland in other parts of Oklahoma and Texas, not identified in McCurtain County.

F. E. Lozo and others, 1960, Texas Bur. Econ. Geology Pub. 5905, p. 4. East of type locality, formation thickens to as much as 75 feet of more massive and purer limestone with rudists common in upper part and is in part same facies developed in Edwards limestone of Brazos River valley, Texas. Along outcrop south of Red River, formation thickens to about 125 feet west of Fort Worth. Near Tarrant-Johnson County line upper part is marked by massive beds containing rudists, lower part becomes argillaceous, and formation passes by transition into the Edwards, Comanche Peak, and upper Walnut of Brazos Valley section.

In northeastern Texas only, formation includes Walnut Shaly Member. Elsewhere the Walnut is considered formation in Fredericksburg Group.

Named for Goodland, Choctaw County, Okla. Old settlement of Goodland is present site of Good Switch on St. Louis and San Francisco Railroad, 3 miles south of Hugo, not present-day Goodland, 3 miles southwest of Hugo.

Goodnight Formation[1]

Pliocene: Northwestern Texas.

Original reference: W. F. Cummins, 1893, Texas Geol. Survey 4th Ann. Rept., pt. 1, p. 201–203.

Named for Goodnight, Armstrong County.

Goodrich Quartzite[1] (in Baraga Group)

Precambrian (Animikie Series): Northern Michigan.

Original reference: C. R. Van Hise and W. S. Bayley, 1895, U.S. Geol. Survey 15th Ann. Rept., p. 591.

H. L. James, 1958, U.S. Geol. Survey Prof. Paper 314–C, p. 30 (table 1), 36. Lowermost formation of newly defined Baraga group. Underlies Hemlock formation; overlies Vulcan iron-formation.

Named for exposures at Goodrich mine in Marquette Range, Iron County.

†Goodridge Formation[1]

Goodridge Limestone

Pennsylvanian: Southern Utah.

Original reference: E. G. Woodruff, 1912, U.S. Geol. Survey Bull. 471, p. 80.

W. H. Easton and others, 1953, Am. Assoc. Petroleum Geologists Bull., v. 37, no. 1, p. 146 (fig. 2). Appears on correlation chart as Goodridge limestone. Pennsylvanian.

Named for town of Goodridge, now known as Mexican Hat.

Goodsprings Dolomite[1]

Upper Cambrian to Devonian(?): Southeastern Nevada and southeastern California.

Original reference: D. F. Hewett, 1931, U.S. Geol. Survey Prof. Paper 162, p. 10, 11.

D. F. Hewett, 1956, U.S. Geol. Survey Prof. Paper 375, p. 38–40, pl. 1. Described in Ivanpah quadrangle (California-Nevada), where it is mapped in San Bernardino County, Calif. Underlies Sultan limestone; overlies Bright Angel shale or Pioche shale. Upper Cambrian to Devonian. Hazzard and Mason, working in Providence and Marble Mountains, and Hazzard, working in Nopah Range, have made fossil collections, and, with other workers, have attempted to correlate faunal zones found in beds equivalent to the Goodsprings dolomite; as a result they have given formation names to following units: Cadiz formation, about 700 feet thick, probably Middle Cambrian; Bonanza King formation, about 1,500 feet thick, Middle Cambrian; Cornfield Springs, about 3,000 feet thick, Middle Cambrian; and Nopah formation, Upper Cambrian. Hazzard also recognizes units equivalent to Pogonip limestone (Lower Ordovician), Eureka quartzite (Middle Ordovician), Ely Springs dolomite (Upper Ordovician), and an unnamed unit of Silurian age. Validity and significance of faunal zones and correlations not discussed in this report.

Named for exposures near town of Goodsprings, Goodsprings quadrangle, Clark County, Nev.

Goodwin Limestone (in Pogonip Group)

Goodwin Formation[1]

Goodwin Formation (in Mount Hamilton Group)

Lower Ordovician: Central Nevada.

Original reference: C. D. Walcott, 1923, Smithsonian Misc. Colln., v. 67, no. 8, p. 466–467, 475.

T. B. Nolan, C. W. Merriam, and J. S. Williams, 1956, U.S. Geol. Survey Prof. Paper 276, p. 25–27. Goodwin limestone lowest formation in Pogonip group (redefined), stratigraphically restricted to exclude beds now assigned to Windfall formation (new) which originally were included in Goodwin formation (of Walcott). Composed dominantly of well-bedded fairly massive light-gray limestone. Platy limestones occur locally. Light-gray to white chert common in lower 350 feet of unit; decreases in amount in higher beds. Much of limestone very fine grained or aphanitic. Thickness ranges from 900 to 1,100 feet in Eureka area, and about 1,650 feet in Antelope region. Underlies Ninemile formation (new); overlies Windfall formation.

F. L. Humphrey, 1960, Nevada Bur. Mines Bull. 57, p. 17–19, pl. 1. Reallocated to Mount Hamilton group (new). Comprises two members: lower, platy yellow and blue limestone about 800 feet thick; and upper, dolomite, about 700 feet thick. Basal formation of group; underlies Pogonip formation; overlies Dunderberg shale. Upper Cambrian. In White Pine district, forms peak of Mount Hamilton and extends along ridge from Seligman thrust south to Ophir fault; makes up greater part of upper plate of Monte Cristo thrust. [Editor's note states that since completion of Humphrey's ms., unit here called Goodwin has been named Windfall formation at Eureka by Nolan, Merriam, and Williams (1956) and Goodwin has been used by them for basal formation of their Pogonip group.]

Type locality: On either side of Goodwin Canyon just east of Hill 7708 of Eureka mining district quadrangle, where limestone is well exposed. Also recognized in Antelope Valley area. Named for Goodwin Canyon.

Goodwinian series[1]

Lower Ordovician: Nevada.

Original reference: C. R. Keyes, 1923, Pan-Am. Geologist, v. 40, p. 53, 78.

Goodwyn Sandstone (in Hinton Formation)[1]

Mississippian: Southeastern West Virginia.

Original reference: D. B. Reger, 1926, West Virginia Geol. Survey Rept. Mercer, Monroe, and Summers Counties, p. 297, 358.

Type locality: Along Princeton-Narrows Road on Fivemile Creek, at Goodwyn Chapel, Mercer County.

Goodwyn Shale (in Hinton Formation)[1]

Mississippian: Southeastern West Virginia.

Original reference: D. B. Reger, 1926, West Virginia Geol. Survey Rept. Mercer, Monroe, and Summers Counties, p. 297, 359–360.

Type locality: Along Princeton-Narrows Road on Fivemile Creek, at Goodwyn Chapel, Mercer County.

Goose Creek Granite[1]

Precambrian: Central southern Montana.

Original reference: T. S. Lovering, 1929, U.S. Geol. Survey Bull. 811A, p. 16.

Occurs in Cooke district, southeastern corner of Park County. Goose Creek flows over it for practically its entire length.

†Goose Creek Marl[1] or phase[1]

Pliocene: Southern South Carolina.

Original references: E. Sloan, 1905, South Carolina Geol. Survey geognostic map of South Carolina, advance copies; published in 1908, in South Carolina Geol. Survey, ser. 4, Bull. 2; 1907, Summary of mineral resources of South Carolina, p. 12, 18, 19.

Named for exposures at Yeaman's Hall, on Goose Creek, north of Charleston, Berkeley County.

Goose Egg Formation

Permian and Lower Triassic: Eastern Wyoming and central northern Colorado.

C. A. Burk and H. D. Thomas, 1956, Wyoming Geol. Survey Rept. Inv. 6, p. 3–10. Sequence of interbedded red to ocher shales and siltstone, thin limestones, gypsums, and limestone breccias. Unconformably overlies Tensleep, Casper, Hartville, or Minnelusa formations; conformably underlies Chugwater or Spearfish formations. At typical exposure, unit is 380 feet thick; overlies Casper formation and underlies Chugwater formation. Measured section at Goose Egg post office shows that formation comprises (ascending) shale and siltstone, 70 feet, represents Opeche shale of central and eastern Wyoming; gray fossiliferous limestone, 10 feet, represents Minnekahta tongue of Phosphoria; shale and siltstone, 58 feet, represents Glendo shale of central and eastern Wyoming: gray to purple limestone, 22 feet, represents Forelle tongue of Phosphoria; unnamed shale and siltstone, 40 feet; gypsum with interbedded limestone, 98 feet; purple to gray limestone, 6 feet, Ervay member; shale and siltstone, 48 feet; limestone and sandstone, 18 feet, Little Medicine member; and shale and siltstone, 10 feet, known to be facies of Dinwoody and Phosphoria formations of western Wyoming. Middle Permian and Lower Triassic.

N. C. Privrasky and others, 1958, Wyoming Geol. Assoc. Guidebook 13th Ann. Field Conf., p. 48–55. Formation divided into several mappable units all of which had been assigned names prior to definition of formation. Comprises (ascending) Opeche shale, Minnekahta limestone, Glendo shale, Forelle limestone, lower unnamed shale member, Ervay limestone, upper unnamed shale, and Little Medicine members. Top of formation can be mapped on surface when Little Medicine member can be identified, but, where Little Medicine grades into gypsum anhydrite sequence in Powder River Basin, it is generally difficult to determine top of formation; the top, however, can be picked accurately in subsurface. Permian-Triassic.

J. C. Stewart, 1958, Geology of the Dryhead-Garvin Basin, Bighorn and Carbon Counties, Montana (1:63,360): Montana Bur. Mines and Geology. Maximum thickness 60 feet. Composed of two members: basal red shale and upper carbonate member. Where upper carbonates are not present, it is impossible to distinguish redbeds of Goose Egg from those of Chugwater formation. Overlies Tensleep formation. In this area, rocks of Goose Egg are of Permian age only.

S. S. Oriel and L. C. Craig, 1960, *in* Guide to the geology of Colorado: Rocky Mountain Assoc. Geologists, p. 43, 45. Red beds and interbedded evaporites, including anhydrite, dolomite, and limestone, formerly included in basal part of Chugwater, are now assigned to Goose Egg formation in central and eastern Wyoming and in northern part of central northern Colorado.

Typically exposed near Goose Egg post office, NW¼ sec. 12, T. 32 N., R. 81 W., Natrona County, Wyo.

Goose Lake Clay

Pennsylvanian: Northeastern Illinois.

H. R. Wanless, 1939, Geol. Soc. America Spec. Paper 17, p. 25–26, 84, pl. 5. Composite of two or more underclays of lower Carbondale and upper Pottsville age. Occurs below Colchester coal. Approximately equivalent to Cheltenham fire clay of Missouri.

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 33. Goose Lake clay is trade name and not recognized as part of Illinois stratigraphic nomenclature.

Named for occurrence near Goose Lake, east Grundy County. Used as a refractory clay.

Goosenest Flows

Recent: Northern California.

Howel Williams, 1949, California Div. Mines Bull. 151, p. 49, pls. 1, 2. Name applied to flows from Goosenest Volcano. Lithologically flows are extremely uniform. All are true block lavas; that is, they have crusts composed of smooth-faced blocks, as much as several yards across, that pass downward through a shattered layer into massive, unbroken lava.

Goosenest is conspicuous landmark in Macdoel quadrangle, Siskiyou County.

†Goose Pond Limestone[1]

Precambrian: Massachusetts.

Original reference: B. K. Emerson, 1899, U.S. Geol. Survey Bull. 159, p. 51–52.

Exposed north and east of Goose Pond, eastern Berkshire County.

Gorbut Member (of Gravel Point Formation)

Middle Devonian: Northern Michigan.

W. A. Kelly and G. Smith, 1947, Am. Assoc. Petroleum Geologists Bull., v. 31, no. 3, p. 448 (fig. 1), 449, 457. Sequence of dark-colored to black limestone and black shale that occurs near middle part of formation. Thickness 10 feet.

Well exposed in LeGrand quarry northeast of Gorbut School, Cheboygan County.

Gordo Formation (in Tuscaloosa Group)

Upper Cretaceous: West-central Alabama and east-central Mississippi.

L. C. Conant and W. H. Monroe, 1945, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 37. Overlies Coker formation. Provisionally defined as the interbedded series of nonmarine gravel, sand, and clay beds between the horizon [top of Coker formation] at which gravel first appears consistently and abundantly and the base of the McShan formation (new). Base of unit is marked by abrupt appearance of abundant chert gravel and gravelly sand, the gravel gradually decreasing in abundance upward. Consists of two unnamed members: the lower consists of 130 feet of gravel and sand, and the upper chiefly of clay and nongravelly sand and ranges in thickness from a little less than 200 feet west of Warrior River to about 60 feet east of river.

W. H. Monroe, L. C. Conant, and D. H. Eargle, 1946, Am. Assoc. Petroleum Geologists Bull., v. 30, no. 2, p. 200–204. Designated type section is an exposure of middle third of formation showing typical gravelly sand and mottled clay; thickness 92 feet. Geographically extended into Tishomingo County, Miss., where it is overlapped by Eutaw formation.

C. W. Drennen, 1953, Am. Assoc. Petroleum Geologists Bull., v. 37, no. 3, p. 537. Recent study reveals evidences of a marine origin of at least part of formation.

W. S. Parks, 1960, Mississippi Geol. Survey Bull. 87, p. 22 (table 2), 23–26. In present report [Prentiss County], name Gordo refers to those sediments overlying Paleozoic basement and underlying McShan formation. Thickness 87 feet. Basal contact not exposed in area of report. Gulf series.

Type locality: South-facing slope of Little Bear Valley, sec. 20, T. 20 S., R. 13 W., 2 miles southeast of Gordo, Pickens County, Ala.

Gordon Sandstone (in Strawn Formation)[1]

Pennsylvanian: Central northern Texas.

Original references: E. T. Dumble, 1890, Texas Geol. Survey 1st Ann. Rept., p. lxv, pl. 3; F. B. Plummer, 1919, Am. Assoc. Petroleum Geologists Bull., v. 3, p. 138.

Probably named for Gordon, Palo Pinto County.

Gordon Shale[1]

Middle Cambrian: Northwestern Montana.

Original references: C. D. Walcott, 1917, Smithsonian Misc. Colln., v. 67, no. 1, pub. 2444, p. 7–8; no. 2, pub. 2445, p. 16–19.

Charles Deiss, 1938, Geol. Soc. America Bull., v. 49, no. 7, p. 1076, 1082, 1087–1088, 1089–1090. Deiss (1933, Montana Bur. Mines and Geology Mem. 6) divided Cambrian of northwestern Montana into 11 formations (ascending): Flathead quartzite, Wolsey shale, Damnation limestone, Nannie Basin limestone, Dearborn limestone, Steamboat limestone, Pagoda oolite, Pentagon shale, Gordon Mountain limestone, Switchback limestone and Devils Glen dolomite. This sequence is revised as follows: Flathead sandstone, Gordon shale (instead of Wolsey), Damnation limestone (redefined to include Nannie Basin), Dearborn limestone. Pagoda limestone, Pentagon shale, Steamboat limestone (replaces Gordon Mountain limestone), Switchback shale, and Devils Glen dolomite. All appear to be Middle Cambrian. Thickness Gordon shale 140 to 274 feet.

Charles Deiss, 1943, Geol. Soc. America Bull., v. 54, no. 2, p. 219–220. Described in Saypo quadrangle where it is approximately 220 feet thick; overlies Flathead sandstone and underlies Damnation limestone.

Type locality: On Gordon Creek, 6 miles from South Fork of Flathead River, Ovando quadrangle, Powell County.

Gordon Creek Shale Member (of Cook Mountain Formation)

Gordon Creek Shale Member (of Wautubbee Formation)

Eocene: Eastern Mississippi.

E. P. Thomas, 1942, Mississippi Geol. Survey Bull. 48, p. 54, 57–59, profile B. Defined as uppermost member of Wautubbee formation in eastern Mississippi. Carbonaceous shale to blocky clay, chocolate-brown to light-yellowish-gray to red; basal 2 feet sandy and glauconitic and heterogeneous; typical feature of member is a thin ledge of white, sparingly glauconitic, siliceous siltstone that occurs 2 feet above base. Thickness 15 to 25 feet. Overlies Potterchitto member (new) with contact conformable and sharply defined; overlies Cockfield formation.

F. S. MacNeil, 1947, U.S. Geol. Survey Oil and Gas Inv. Prelim. Chart 29. Considered uppermost member of Cook Mountain formation.

Type section: Along U.S. Highway 11 from Basic City to Pachuta, Clark, and Lauderdale Counties. Name taken from Gordon Creek which flows through Wautubbee Station and which is crossed by U.S. Highway 11 a short distance south of the station.

†Gordon Mountain Limestone[1]

Middle or Upper Cambrian: Northwestern Montana.

Original reference: C. F. Deiss, 1933, Montana Bur. Mines and Geol. Mem. 6, p. 39.

Charles Deiss, 1938, Geol. Soc. America Bull., v. 49, no. 7, p. 1089; 1939, Geol. Soc. America Spec. Paper 18, p. 35, 100. Name dropped from sequence of Cambrian formations recognized in northwestern Montana. Steamboat limestone, as used in 1933 sequence, has proved to be part of massive upper Dearborn limestone which was repeated in the Dearborn section by low-angle overthrust. Therefore, rocks to which name Steamboat was applied do not exist, and this name is freed for use and here applied to limestone and shale formerly designated Gordon Mountain limestone, which lies between the Pagoda or Pentagon and overlying Switchback formation.

Type locality: Middle part of cliffs which form lower part of east side of a peak, 8,300 feet elevation, the top of which is just 1 mile S. 48° E. of top of Pentagon Mountain. Forms top of central and principal peak of Gordon Mountain.

Gore Limestone (in Pottsville Formation)[1]

Pennsylvanian: Southeastern Ohio.

Original reference: E. Orton, 1878, Ohio Geol. Survey, v. 3, p. 889, 898, 903, pls. facing p. 889, 900, 912, 921.

Can be traced from Hocking Valley to Ohio River. Probably named for occurrence at Gore, Hocking County.

Gore Mountain Gabbro

Precambrian (Algoman): Northeastern New York.

M. H. Krieger, 1937, New York State Mus. Bull. 308, p. 28–32, 36. Chiefly medium-grained massive hypersthene-olivine gabbro or norite; speckled appearance on weathered surface. Bounded on the north and east by body of gabbroic and Whiteface-type anorthosite, on the south by a hornblende-garnet deposit, and on the west by Marcy-type and gabbroic anorthosite. Nowhere in contact with syenite, although syenite occurs within 100 to 300 feet of the gabbro on south side of garnet deposit. North of gabbro and between it and the anorthosite is a narrow zone of garnet gneiss. Considered younger than Grenville series.

Occurs in vicinity of Gore Mountain, Thirteenth Lake quadrangle.

Gorge Formation[1]

Upper Cambrian: Northwestern Vermont.

Original reference: Charles Schuchert, 1933, Am. Jour. Sci., 5th ser., v. 25, p. 359, 367, 368, 375–377.

Charles Schuchert, 1937, Geol. Soc. America Bull., v. 48, no. 7, p. 1052–1057. Lithogically separable into two parts: upper Gorge consists of 145 feet of thin-bedded dolomite and limestone, black dolomitic slate, at least eight intraformational flat-pebble breccia beds, and thick beds of sandstone; lower Gorge, about 75 feet thick, is massive dolomite, more or less replete with thick-bedded black dolomite inclusions, making whole series conglomeratic. Separated from overlying Highgate by thrust plane; overlies Hungerford slates (new). Keith (1924) called upper series of beds Missisquoi, but term was preoccupied.

A. B. Shaw, 1958, Geol. Soc. America Bull., v. 69, no. 5, p. 523 (table 1), 532 (fig. 5), 548–549, pl. 1. In this report [St. Albans area, Vermont], all rocks below Highgate thrust are assigned to Gorge formation. North of type section only, the lower dolomite is generally exposed. This dolomite is 550 feet near Highgate Center; 60 to 75 feet at international boundary overlying shale-limestone-shale sequence present only at type locality where it is more than 400 feet thick. Overlies Hungerford slate; underlies Highgate formation. Most contacts with Highgate are faults.

W. M. Cady, 1960, Geol. Soc. America Bull., v. 71, no. 5, p. 572, pl. 3 (correlation chart). Crops out in west limb of St. Albans synclinorium in Quebec, notably at Rosenberg, where it plunges north, at axis of minor anticline beneath Highgate formation. Cut out to west at Champlain overthrust. Gorge is uppermost formation in terrane that Clark (1934, Geol. Soc. America Bull., v. 45, no. 1) referred to "Milton dolomite."

Type locality: Highgate Gorge at Highgate, St. Albans quadrangle.

Gorgora Shale Member (of Fayette Formation)

Eocene (Jackson): Western Texas.

J. M. Patterson, 1942, Am. Assoc. Petroleum Geologists Bull., v. 26, no. 2, p. 259 (fig. 2), 268–269. Name applied to a thick, predominantly shaly group of beds lying between Sanchez sandstone tongue above and Roma sandstone tongue below. Basal 30 feet are marine or lagoonal gray shales with some lignite beds; middle part made up of blue and green and red bentonitic shales, thin sandstones, and oyster beds usually less than 1 foot thick; upper 30 feet is persistently marine or brackish-water shale. Electric logs show member about 500 feet thick; in Zapata County, it increases to 900 feet, for the most part at expense of Roma sandstone.

Named from Gorgora Hill, located 1 mile northeast of Roma, Roma quadrangle. Beds make a north-south valley across Starr County and south half of Zapata County.

Gorman Formation (in Ellenberger Group)

Lower Ordovician: Central Texas.

V. E. Barnes and P. E. Cloud, Jr., 1945, Texas Univ. Bur. Econ. Geology Mineral Resources Circ. 34, p. 1, 8–19. Limestone and dolomite. Thickness 426 feet. Overlies Tanyard formation (new); underlies Honeycut formation (new). Cherokee Creek section, San Saba County described.

P. E. Cloud, Jr., V. E. Barnes, and Josiah Bridge, 1946, Texas Univ. Bur. Econ. Geology Pub. 4301, p. 144–146, pls. 4, 6 [1945]. Proposed that name Gorman formation be used to designate rocks similar to and correlative with those in the composite type section (herein designated). Basal zone characterized by varicolored and very fine grained dolomites—yellows, pinks, browns; upper calcitic facies consists principally of sublithographic, thickly to thinly bedded limestone with locally interbedded microgranular to fine-grained dolomite; a sequence of pure, unusually thick-bedded limestone present in top 40 to 60 feet of formation. Dolomitic facies 81 to 230 feet thick; calcitic facies 237 to 393 feet. Chert common. Where not thinned by post-Ellenburger truncation, between 426 and 498 feet thick.

P. E. Cloud, Jr., and V. E. Barnes, 1948, Texas Univ. Bur. Econ. Geology Pub. 4621, p. 9–10, 39–40, 137–138, 158–159, 195–197, 227–229, 235–239, pls. 9, 35 [1946]. Type section described in detail. Stratigraphy described by areas.

Type section: Along and near gorge of Colorado River in vicinity of Gorman Falls, in southeastern San Saba County. Also present in McCulloch, Mason, Gillespie, Lampasas, and Burnet Counties.

Goshen Schist[1]

Precambrian: North Carolina and central southern Virginia.

Original reference: F. B. Laney, 1917, Virginia Geol. Survey Bull. 14, p. 19, 23, map.

Named for typical occurrence in vicinity of Goshen, in southeastern part of Virgilina district, North Carolina.

Goshen Schist[1]

Silurian(?): Western Massachusetts, southwestern New Hampshire, and southeastern Vermont.

Original reference: B. K. Emerson, 1898, U.S. Geol. Survey Geol. Atlas, Folio 50; 1898, Mon. 29, p. 177–183, pl. 34.

C. G. Doll, 1943, Am. Jour. Sci., v. 241, no. 11, p. 678. Age of mica schist designated Lower Devonian.

Typical region: Around Goshen, Mass.

Goshute Canyon Formation

Precambrian or Cambrian: Western Utah.

K. F. Bick, 1959, Am. Assoc. Petroleum Geologists Bull., v. 43, no. 5, p. 1065–1066, 1068. Prospect Mountain quartzite, in Deep Creek Mountains, Utah, restricted at base to exclude 3,000 feet of alternating quartzite and shale units herein named Goshute Canyon formation. In absence of fossils, formation does not warrant a date more exact than Precambrian or Cambrian or both.

Type section: In and south of Goshute Canyon, Deep Creek Mountains. Section begins in NE¼ sec. 1, T. 11 S., R. 18 W., and ends in SW¼ sec. 36, T. 10 S., R. 18 W.

Gospel Hill Gneiss

Carboniferous: Eastern Massachusetts.

W. R. Hansen, 1956, U.S. Geol. Survey Bull. 1038, p. 39–41, pl. 1. Name suggested for a large mass of granitic rocks of Carboniferous age that Emerson (1917) mapped as a variant of Andover granite but in this area is regarded as a granitized product of Nashoba (new) and Marlboro formations. Medium to coarse textured and composed chiefly of microcline albite, quartz, muscovite, and biotite.

Well exposed on southeast slope of Gospel Hill in Hudson, the locality from which it was named. Extends from Concord quadrangle southwestward across Maynard quadrangle through corner of Hudson quadrangle and into Marlboro quadrangle.

Gosport Sand (in Claiborne Group)[1]

Eocene, middle: Southern Alabama and Georgia.

Original reference: E. A.Smith, 1907, Alabama Geol. Survey Bull. 9, p. 5, 18.

C. W. Cooke, 1939, Jour. Paleontology, v. 13, no. 3, p. 337–340. Gosport sand of Alabama, heretofore classified as topmost formation of Claiborne group, and the only known formation of upper Claiborne age, is nearly equivalent to Moodys marl of Mississippi, basal formation of Jackson group. Recommended that name Gosport be replaced by Moodys and that Claiborne group be restricted to formations heretofore classified as lower Claiborne.

L. D. Toulmin, Jr., 1944, Southeastern Geol. Soc. [Guidebook] 1st Field Trip, p. 11. Formation is here considered to include overlying lithologically and faunally similar *Poriachus* bed or "*Scutella*" bed which was formerly considered to be basal bed of Jackson group. Entire formation exposed at Claiborne Bluff where it is 24 to 26 feet thick; thickness 35 feet at Willow Branch in Choctaw County. Disconformably overlies Lisbon formation; conformably underlies Moodys Branch marl.

F. S. MacNeil, 1947, U.S. Geol. Survey Oil and Gas Inv. Prelim. Chart 29. Correlation chart of outcropping Tertiary formations of Eastern Gulf region shows Gosport sand, in Claiborne group, above Lisbon formation and present in Alabama and Georgia. Base of Gosport sand, which lies disconformably on different parts of Lisbon formation in central eastern Alabama, passes into upper part of Cockfield formation in Mississippi and becomes indistinct. Gosport pinches out just east of Ocmulgee River in central Georgia, but recurs filling channels in Cretaceous beds for some distance to the east. C. W. Cooke believes that Gosport at type locality is entirely of Jackson age, but that in general it represents a facies different faunally from Moodys Branch formation; he does not believe that name Gosport should be used in Georgia.

Named for Gosport, a landing on Alabama River, a few miles below Claiborne Bluff, in Clarke County, Ala.

Goss Mill limestone facies[1] (of Floyds Knob Formation)

Lower Mississippian: Southern Indiana.

Original reference: P. B. Stockdale, 1931, Indiana Dept. Conserv., Div. Geology Pub. 98, p. 76, 197–208.

J. M. Weller and others, 1948, Geol. Soc. America Bull., v. 59, no. 2, p. 127–128, pl. 1. Mississippian facies nomenclature discussed. Correlation chart lists Goss Mill limestone facies of Floyds Knob formation.

Name derived from abandoned post office, Goss Mill, 6½ miles north of Medora, Jackson County.

Gothic Formation

Pennslvanian (Desmoinesian): Western Colorado.

R. L. Langenheim, Jr., 1951, (abs.) *in* Am. Assoc. Petroleum Geologists 36th Ann. Mtg. [Program], p. 29. Introduced for coarse and fine buff clastic rock assemblage overlying Belden shale and underlying Maroon formation (restricted). Thins toward northeast with concurrent thickening of the Maroon.

R. L. Langenheim, Jr., 1952, Am. Assoc. Petroleum Geologists Bull., v. 36, no. 4, p. 550 (fig. 2), 552 (fig. 3), 553–555, 556, 557, 558, 561–563. Thickness varies: 1,763 feet at Jack's Cabin, 1,350 at Granite Basin, 1,266 at Walrod Gulch, 572 at Cement-Taylor Divide, and 1,486 at Copper Creek (type section). Base and top arbitrarily designated; base is bottom of lowest prominent sandstone in section, and top is point where rock becomes predominantly red in color; upper boundary gradational in most places with occasional pink and red beds occurring well below formation boundary. At type section, conformably underlies Maroon formation, and base of section is intrusive contact; overlies Belden shale at Walrod Gulch and Cement-Taylor Divide; base of formation faulted out at Jack's Cabin and Granite Basin, and Gothic directly and unconformably overlain by Entrada sandstone.

Type section: Copper Creek, Crested Butte quadrangle, Gunnison County. Section is measured along top of ridge separating Copper Creek valley and Virginia basin and down wall of unnamed cirque northeast of Virginia basin.

Gould Glacial Substage

Gould Till

Pleistocene (Wisconsin): North-central Colorado.

D. F. Eschman, 1952, (abs.) Geol. Soc. America Bull., v. 63, no. 12, pt. 2, p. 1380. Time of next to oldest of four glacial advances in the area. Marked by a nearly complete moraine at elevation of about 9,000 feet. Followed Owl Mountain advance (new), preceded Silver Creek advance (new).

D. F. Eschman, 1955, Jour. Geology, v. 63, no. 3, p. 203–205, fig. 2, table 1. Deposits of substage mapped as Gould till. Till is more sandy than that of Owl Mountain substage but more clayey than that of Silver Creek substage; light gray brown; reddish-brown clayey streaks common in upper 3 feet.

Substage represented by three rather extensive deposits of till: on north side of Middle Fork Michigan River about one-half mile above village of Gould; between Middle Fork and South Fork Michigan River one-third mile south of Gould; and on southwest side of South Fork Michigan River 1½ miles south of Gould. In North Park.

Gould Shale Member (of Monterey Formation)[1]

Miocene, middle: Southern California.

Original reference: G. M. Cunningham and W. F. Barbat, 1932, Am. Assoc. Petroleum Geologists Bull., v. 16, no. 4, p. 418.

R. R. Simonson and M. L. Krueger, 1942, Am. Assoc. Petroleum Geologists Bull., v. 26, no. 10, p. 1616. In Recruit Pass area, an interval of 1,850 feet of well-bedded siliceous light-brown shale, with a minor amount of interbedded tan silt and lentils of massive buff limestone, comprise a single lithologic unit from which have been collected faunules common to both the Gould shale and the Devilwater silt as they are defined on Chico-Martinez Creek. This unit has been termed the Devilwater-Gould member of the Monterey.

L. B. McMichael, chm., 1959, San Joaquin Geol. Soc. Guidebook Field Trip May 9, p. 13 (table) map, topog. profile. Underlies Devilwater silt member; overlies Media shale member of Temblor formation in Chico-Martinez Creek area. Thickness about 550 feet.

Type locality: Near center of W½ sec. 14, T. 29 S., R. 20 E., and continuing to southeast side of Chico-Martinez Creek, Kern County. Name is from Gould Hill near type locality.

Gouldbusk Limestone Member (of Moran Formation)

Permian (Wolfcamp Series): North-central Texas.

R. C. Moore *in* M. G. Cheney, 1948, Abilene Geol. Soc. [Guidebook] Spring Field Trip, June 11–12, p. 5, 13, sheets 3, 4. New name replacing Drake's Horse Creek limestone. Underlies Santa Anna shale member; overlies Watts Creek shale member.

R. C. Moore, 1949, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 80, sheet 2. Name applied to limestone beds and included thin shale that were called Horse Creek limestone by Drake (1893). Sellards (1933, Texas Univ. Bull. 3232) pointed out duplication by Drake in use of this name, as applied to beds in his Strawn division farther east in Colorado River valley and to limestone, now considered Permian(?) in age, exposed in Coleman County; Sellards restricted application of Horse Creek to beds in the Strawn sequence but did not rename the upper beds, which have continued to be called Horse Creek. Member consists of (1) lower massive blue-gray limestone, 1 to 2 feet thick, that is medium grained and weathers brownish; (2) gray to yellowish clay shale, 2 to 6 feet thick, that is unfossiliferous; and (3) upper gray irregularly thin-bedded limestone of fine-grained texture that weathers in slabs and shelly fragments of light-gray color splotched with tan; average thickness of this bed 3 feet. Thickness about 8 feet.

Type locality: Village of Gouldbusk, southwest Coleman County.

Gourd Head Run Clay (in Conemaugh Formation)[1]

Pennsylvanian: Southwestern Pennsylvania.

Original reference: I. C. White, 1878, Pennsylvania Geol. Survey Rept. Q, p. 159–161, 308.

In Allegheny County.

Gourdhead Run Limestone in Conemaugh Formation)[1]

Pennsylvanian: Southwestern Pennsylvania.

Original reference: I. C. White, 1878, Pennsylvania 2d Geol. Survey Rept. Q, p. 159–161, 308.

Crops out locally in valley of Gourdhead Run in Hampton Township, Allegheny County.

Gouverneur Granite[1]

Precambrian: Northern New York.

Original reference: H. P. Cushing and D. H. Newland, 1925, New York State Mus. Bull. 259, p. 40–41.

Occurs just northwest of Gouverneur, St. Lawrence County.

Gouverneur Limestone[1]

Precambrian (Grenville Series) : Northwestern New York.

Original reference: A. F. Buddington, 1934, New York State Mus. Bull. 296, p. 136–138, map.

In Antwerp, Hammond, and Gouverneur quadrangles, St. Lawrence and Jefferson Counties.

Gove chalk

Cretaceous (Mid-Cretacic) : Northwestern Kansas.

[C. R.] Keyes, 1941, Pan-Am. Geologist, v. 76, no. 4, p. 304 (chart). Name applied to lower formation in Buckskinian series. Consists of chalks about 400 feet thick. Underlies Wallace shale. Overlies Apishapa shale of Pueblan series.

[C. R.] Keyes, 1941, Pan-Am. Geologist, v. 76, no. 5, p. 371–372. Proposed for heavy chalk formation in northwestern Kansas, heretofore regarded as representing Niobrara chalk of upper Missouri River country.

Occurs in Gove, Logan, and Wallace Counties.

Gove Member (of Berwick Formation)

Gove Member (of Littleton Formation)

Probably Ordovician and Silurian: Southeastern New Hampshire.

Jacob Freedman, 1950, Geol. Soc. America Bull., v. 61, no. 5, p. 453 (fig. 2), 460, 464, pl. 1. Chiefly silvery mica-schist, some mica-staurolite schist, mica-sillimanite schist and quartzite. Maximum thickness 200 feet. Member of Littleton formation of Lower Devonian age.

M. P. Billings, 1955, Geologic map of New Hampshire (1:250,000). U.S. Geol. Survey. Reallocated to Berwick formation. Age designated as probably Ordovician and Silurian.

M. P. Billings, 1956, Geology of New Hampshire, pt. 2, Bedrock geology: Concord, New Hampshire State Plan. Devel. Comm., p. 42, 43. Age of Berwick formation tentatively considered Silurian.

Exposed in narrow belt in Mount Pawtuckaway quadrangle between Nottingham Square and Raymond, Rockingham County. Named from Gove School, 2 miles northeast of Raymond.

Governor Diorite

Miocene, upper: Southwestern Colorado.

McClelland Dings, 1941, Geol. Soc. America Bull., v. 52, no. 5, p. 701–707, fig. 1. Essentially a dark fine-grained diorite. Fresh rock is fine grained and greenish gray to greenish black; weathered surfaces range from dull gray to reddish brown. Most prominent lithologic variation occurs along west-central side of Stony Mountain stock where diorite grades into light-colored hornblende-bearing monzonite facies. Most of outer border of diorite is in contact with San Juan tuff. In contrast to usually wide metamorphic cones developed in San Juan tuff, Silverton and Potosi volcanic rocks generally show only slight metamorphism where intruded by diorite. Older than Stony Mountain diorite (new).

Typically exposed a short distance north of Governor mine in Stony Mountain region, which in turn, is located about 5 miles southwest of Ouray in San Juan Mountains. Vertical range of exposures is 1,875 feet; highest outcrop occurs about 275 feet northwest of summit of Stony Mountain, and lowest in extreme southeast, near junction of Governor and Yankee Boy Creeks.

Gowanda Shale Member (of Perrysburg Formation)

Gowanda Shale[1]

Gowanda Shale Member (of Canadaway Formation)

Upper Devonian: Western New York.

Original reference: G. H. Chadwick, 1919, Geol. Soc. America Bull., v. 30, p. 157.

W. H. Bradley and J. F. Pepper, 1938, U.S. Geol. Survey Bull. 899, p. 19, pl. 3. In this report [southwestern New York], the whole series of beds from top of Dunkirk sandstone to highest beds mapped in area—more than 1,000 feet higher—are grouped as Gowanda shale and overlying beds undifferentiated.

Bradford Willard, 1939, Pennsylvania Geol. Survey, 4th ser., Bull. G–19, p. 251. Gowanda beds included in Canadaway group.

J. F. Pepper and Wallace de Witt, Jr., 1951, U.S. Geol. Survey Oil and Gas Inv. Chart OC–45. Rank reduced to member status in Perrysburg formation (new). Includes all rocks between top of South Wales member (new) and base of Laona sandstone. In section exposed along Cattaraugus Creek southeast of town of Gowanda, neither base nor top of Gowanda member can be identified although most of member is exposed in high cliffs bordering the creek. Because top of member has not been found east of Little Indian Creek, Perrysburg quadrangle, Cattaraugus County, name Gowanda is not applied to rock sequence to the east, and local names are used for units found there. Thickness 210 to 276 feet. Figure 4 shows that Canisteo (new), Caneadea, and Gowanda members, although closely related in time of deposition, are not strictly correlative throughout.

I. H. Tesmer, 1954, Dissert. Abs., v. 14, no. 12, p. 2318. Canadaway group reduced to formational status and Gowanda member renamed Forestville member and assigned to new type locality.

I. H. Tesmer, 1955, New York State Mus. Sci. Service Circ. 42, p. 10 (fig. 1), 15. Member of Canadaway formation. Overlies South Wales member; underlies Laona siltstone member. Thickness about 240 feet. As the Laona cannot be traced as far east as Gowanda, N.Y., Gowanda shale has no upper limit at its type locality. New type locality is herein assigned; this section described by Pepper and de Witt (1951).

Type locality (Tesmer, 1955): Along Walnut Creek, in vicinity of Forestville. Named for exposures in vicinity of Gowanda, Cattaraugus County.

Gower Dolomite[1]

Silurian (Niagaran): Central eastern Iowa.

Original reference: W. H. Norton, 1899, Iowa Geol. Survey, v. 9, p. 422, 423.

C. K. Swartz and others, 1942, Geol. Soc. America Bull., v. 53, no. 4, chart 3. Shown on correlation chart as underlying Bertram dolomite and overlying Hopkinton dolomite (restricted).

Named for Gower Township, Cedar County.

Graciosa Coarse-Grained Member (of Careaga Sandstone)

Pliocene, upper: Southern California.

W. P. Woodring, M. N. Bramlette, and K. E. Lohman, 1943, Am. Assoc. Petroleum Geologists Bull., v. 27, no. 10, p. 1356–1358; W. P. Woodring and M. N. Bramlette, 1950, U.S. Geol. Survey Prof. Paper 222, p. 42–49, pl. 1. Made up of two parts: lower consisting of coarse-grained soft sandstone and conglomerate, and upper consisting of coarse-grained soft sandstone. Thickness 25 to 425 feet. Underlies Paso Robles formation; on Graciosa Ridge, in Orcutt field, Graciosa overlaps Cebada member (new) and rests on Sisquoc formation.

Type region: On north flank of Purisima Hills south of Careaga Station on now-abandoned Pacific Coast Railroad, Santa Maria district.

Graford Formation (in Canyon Group)[1]

Graford Group

Upper Pennsylvanian: Central and central northern Texas.

Original references: F. B. Plummer, 1919, Am. Assoc. Petroleum Geologists Bull., v. 3, p. 133–145; F. B. Plummer and R. C. Moore, 1921, Texas Univ. Bull. 2132.

C. O. Nickell, 1938, Texas Univ. Bur. Econ. Geology Pub. 3801, p. 96–100. Formation redefined for Colorado River area. Winchell member (new) and Cedarton shale member (136 feet thick) are referred to as upper part of Graford and Adams Branch limestone and underlying shale (221 feet) referred to as lower Graford. Interval from top of Palo Pinto limestone of Cheney to top of Winchell member, an interval which may ultimately be found to include parts of Palo Pinto in other areas, is 357 feet. Underlies Brad formation (redefined).

M. G. Cheney, 1940, Am. Assoc. Petroleum Geologists Bull., v 24, no. 1, p. 66 (fig. 1), 88. Rank raised to group. Restricted below to exclude beds nearly equivalent to the Brownwood and here included in Whitt group (new). Underlies Brad group. Includes (ascending) Adams Branch limestone. Cedarton shale, and Winchell limestone.

Robert Roth, 1956, North Texas Geol. Soc. Field Guidebook, May 25–26, fig. 2. Generalized columnar section shows group comprises (ascending) Wolf Mountain shales and sandstone. Staff limestone (Adams Branch limestone), unnamed shale, and Winchell limestone; overlies Whitt group.

D. H. Eargle, 1958, San Angelo Geol. Soc. Guidebook, Apr. 17–19, p. 51. Composite section of Brown and Coleman Counties shows formation comprises (ascending) Brownwood shale, Adams Branch limestone, and Cedarton shale members. Underlies Winchell limestone. Thickness about 300 feet.

D. H. Eargle, 1960, U.S. Geol. Survey Prof. Paper 315–D, p. 63, pl. 27. Formation as defined by Plummer and Moore (1921) for locality in Palo Pinto County was intended to include a thick limestone forming a prominent cuesta in that country, which they considered to be the Adams Branch, and the underlying shale, down to Palo Pinto limestone. They showed the Palo Pinto to be absent in Colorado River valley and defined basal member of Graford as Brownwood shale (Drake's Brownwood bed), in which they included their Capps limestone lentil and Rochelle conglomerate. They considered Rochelle to underlie Capps lentil, although later workers have found it to be in position of Capps, or to be a channel-fill conglomerate and sandstone of later age which has replaced their Capps. Cheney (1929, Texas Univ. Bull. 2913) showed that limestone at top of Graford in Palo Pinto County was not correlative with Adams Branch, but with part of limestone now called Winchell limestone. Sellards (1933, Texas Univ. Bull. 3232) defined Graford to include his Merriman (equivalent to part of Winchell as later defined) and underlying Cedarton shale of Plummer and Moore (1921) as well as their Adams Branch limestone and Brownwood shale. He included, therefore, in one formation all units he considered equivalent in both Brazos and Colorado River valleys. Graford, as herein redefined for Colorado River valley, includes (ascending) Brownwood shale (redefined), Adams Branch limestone, and Cedarton shale members. Underlies Winchell herein raised to rank of formation; overlies Strawn group. Thickness 285 feet in southern part of Brown County; 340 feet in central part of county.

Named for town of Graford, in Palo Pinto County, Brazos River region.

†Graford Limestone Member (of Graford Formation)[1]

Pennsylvanian: Central and central northern Texas.

Original reference: F. B. Plummer, 1919, Am. Assoc. Petroleum Geologists Bull., v. 3, p. 133–145.

Probably named for town of Graford, Palo Pinto County.

Grafton Formation[1]

Pennsylvanian: Southwestern Pennsylvania.

Original reference: G. H. Ashley, 1926, Pennsylvania Topog. and Geol. Atlas 65, pl. 4.

Punxsutawney quadrangle.

Grafton Member (of Conemaugh Formation)[1]

Pennsylvanian: Pennsylvania.

Original reference: M. E. Johnson, 1929, Pennsylvania Geol. Survey Topog. and Geol. Atlas 27, p. 31.

Pittsburgh quadrangle.

†Grafton Quartzite[1]

Precambrian: Eastern Massachusetts and northern Rhode Island.

Original reference: B. K. Emerson, 1898, U.S. Geol. Survey Mon. 29, p. 18.

Named for occurrence at Grafton, Worcester County, Mass.

Grafton Sandstone (in Conemaugh Formation)[1]

Grafton (upper) shale and sandstone member

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

Original reference: I. C. White, 1903, West Virginia Geol. Survey, v. 2, p. 244, 255, 298.

M. T. Sturgeon and others, 1958, Ohio Geol. Survey Bull. 57, p. 94 (table 11), 148. Member of Elk Lick cyclothem in report on Athens County. Upper Grafton is used for shale and sandstone, locally massive sandstone, which heretofore has been called Morgantown in Ohio. Thickness 24½ feet. Occurs above Birmingham redbed member and below Elk Lick limestone member. Conemaugh series.

Has been quarried in vicinity of Grafton Hills, Taylor County, W. Va.

Graham Formation (in Cisco Group)[1]

Graham Group

Upper Pennsylvanian: Central and central northern Texas.

Original reference: R. C. Moore, 1921, Am. Assoc. Petroleum Geologists Bull., v. 5, p. 324.

Wallace Lee and C. O. Nickell, 1938, Texas Univ. Bur. Econ. Geology Pub. 3801, p. 12–53, 118–122. Formation, in Brazos River valley, comprises (ascending) channel deposits, Salem School limestone member, shale and sandstone, Gonzales limestone member, shale and sandstone, Bunger limestone member, shale with numerous channels and unconformities, and Wayland shale member. Thickness at least 590 feet, not counting channel deposits (Kisinger channel) at base. Interval from top of Bunger limestone to top of formation are referred to as post-Bunger deposits or post-Bunger cycles. Nine cycles discussed. Group of limestones in No. 8 post-Bunger cycle is herein named Rocky Mound limestone member. Gunsight member, which at its type locality is overlain by Wayland shale, has not been identified in Stephens County. Underlies Avis sandstone member of Thrifty formation. In Colorado River basin, formation is divided into (descending) Wayland shale, Gunsight limestone, and Bluff Creek members. Thickness 243 feet from top of Home Creek limestone of northern Brown County up to base of *Bellerophon* bed of Drake (1893, Texas Geol. Survey 4th Ann. Rept., pt. 1).

M. G. Cheney, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 1, p. 66 (fig. 1), 90. Rank raised to group. Includes following formations (ascending): Gonzales, North Leon, Bunger, post-Bunger cycles 1–7, Gunsight limestone, and Wayland shale. Underlies Thrifty group; overlies Caddo Creek group.

John Kay, 1956, North Texas Geol. Soc. Field Guidebook, May 25–26, fig. 4. Generalized columnar section shows that group comprises (ascending) Salem School limestone, Bunger limestone, Number 3 limestone, Upper Gunsight limestone, Rocky Mound limestone, Wayland shale, Number 9 limestone, Avis sandstone, Ivan limestone, Blach Ranch limestone, Breckenridge limestone.

D. H. Eargle, 1958, San Angelo Geol. Soc. Guidebook, Apr. 17–19, p. 50. Composite section of Brown and Coleman Counties shows that formation comprises (ascending) Bluff Creek shale, Gunsight limestone, Wayland shale, and Ivan limestone. Underlies Thrifty formation; overlies Caddo Creek formation. Thickness about 260 feet.

D. H. Eargle, 1960, U.S. Geol. Survey Prof. Paper 315–D, p. 58 (table 1), 68–69, pl. 27. Boundary between Graham and Thrifty formations has been defined as base of Avis sandstone member (Sellards, 1933, Texas Univ. Bull. 3232; Lee and Nickell, 1938), a prominent sandstone in Brazos River valley. In Colorado River valley [this report], this boundary is not mappable because only discontinuous lenses of sandstone are present at stratigraphic position of Avis. Also, the Ivan limestone member which overlies the Avis is discontinuous. Recommended that base of Speck Mountain limestone, a persistent member throughout Colorado River valley and probably equivalent to Blach Ranch limestone in Brazos River valley, be designated boundary between Thrifty and Graham formations. In areas where Speck Mountain limestone member has been replaced by channel-fill conglomeratic sandstone, as by Parks Mountain sandstone member in southeastern Coleman County, boundary between the Graham and the Thrifty is considered base of sandstone. Thickness of Graham, as herein defined, is about 265 feet in southeastern Coleman County and about 290 feet in northern Brown County. Comprises (ascending) Bluff Creek shale, Gunsight limestone, Wayland shale, and Ivan limestone members. Overlies Caddo Creek formation of Canyon group.

Type locality: Bluff on Salt Creek, west of Graham, Young County, Brazos River region.

†Graham Jasper (in Niobrara Formation)[1]

Upper Cretaceous: Northwestern Kansas.

Original reference: F. W. Cragin, 1896, Colorado Coll. Studies, v. 6, p. 51.

Named for Graham County.

Graham Limestone (in Bluefield Formation)[1]

Mississippian: Southwestern Virginia and southeastern West Virginia.

Original reference: D. B. Reger, 1926, West Virginia Geol. Survey Rept. Mercer, Monroe, and Summers Counties, p. 299, 387.

Type locality: In a cut of Norfolk & Western Railway, about one-half mile northwest of new station at Graham (now Bluefield), Tazewell County, Va.

Graham Sandstone (in Bluefield Formation)[1]

Mississippian: Southwestern Virginia and southeastern West Virginia.

Original reference: D. B. Reger, 1926, West Virginia Geol. Survey Rept. Mercer, Marion, and Summers Counties, p. 299, 385.

Type locality: In cut of Norfolk & Western Railway, about one-half mile northwest of new station at Graham (now Bluefield), Tazewell County, Va.

Graham Shale (in Bluefield Formation)[1]

Mississippian: Southwestern Virginia and southeastern West Virginia.

Original reference: D. B. Reger, 1926, West Virginia Geol. Survey Rept. Mercer, Monroe, and Summers Counties, p. 299, 387.

Type locality: In cut of Norfolk & Western Railway, about one-half mile northwest of new station at Graham (now Bluefield), Tazewell County, Va.

Graham Ferry Formation

Pliocene: Southeastern Mississippi.

G. F. Brown and others, 1944, Mississippi Geol. Survey Bull. 60, p. 45–54. Series of deltaic sediments overlying Pascagoula formation and disconformably underlying Citronelle formation. Continental and brackish-water deposits predominate although type locality contains marine fossils. Thickness ranges from 113 feet in Jackson County to 975 feet at Gulfport.

Type sections: Rice Bluff, NW¼NW¼ sec. 38, T. 5 S., R. 7 W., and bluff beneath power line near center of irregular sec. 38, T. 5 S., R. 7 W., west bank Pascagoula River, Jackson County. Midway between the two bluffs is an old river crossing locally known as Graham Ferry.

Grahamville Formation

Cambro-Ordovician: East-central Vermont.

W. F. Brace, 1953, Vermont Geol. Survey Bull. 6, p. 47–48, tables 2, 3. Dark-gray-green massive albite grit occurs at base. Above is a variety of dark fine-banded sandstones, sandy graphitic phyllites, and, in southern part of outcrop area, buff ankeritic sandstone. At top is Plymouth member consisting of massive gray dolomite and white vitreous thinly bedded quartzite. Total thickness ranges from about 700 feet at Chittenden to 1,500 feet at Plymouth, depending on thickness of middle unit. Underlies Pinney Hollow formation; overlies Tyson formation. Upper boundary difficult to trace in this area because of color similarities of phyllites;

arbitrarily placed beneath lowest green phyllite bed 50 feet or more in thickness. Name credited to Thompson (unpub. thesis).

Well exposed in lower slopes of Ottauquechee and Black River valleys south of West Bridgewater in Rutland area.

Grainger Shale[1] or **Formation**

Mississippian: Northeastern Tennessee, western North Carolina, and southwestern Virginia.

Original references: A. Keith, 1895, Phil. Soc. Washington Bull. 12, p. 74, 78, pl. 1; 1896, U.S. Geol. Survey Geol. Atlas, Folio 27, p. 3.

J. E. Sanders, 1952, (abs.) Geol. Soc. America Bull., v. 63, no. 12, pt. 2, p. 1295. Grainger formation traced and mapped in detail in Greendale syncline northeastward from type locality in Grainger County, Tenn., to Tennessee-Virginia line. Basal member, 200 to 300 feet thick, changes laterally from fissile gray shale in Grainger County to fossiliferous green siltstone in Hawkins County, and to yellowish silty shale near State line. Lower sandstone member composed of 75 to 200 feet of very fine grained medium-bedded sandstone that locally includes pebbly layers and fossiliferous beds. Middle sandstone member predominantly structureless green fossiliferous siltstone with a few beds of fine-grained sandstone, shale, and fossiliferous glauconitic material. Upper sandstone member, 100 to 150 feet thick, is gray, coarse grained, crossbedded feldspathic sandstone and conglomerate. Fossils indicate formation spans part of Kinderhook and probably most of Osage intervals of Mississippian standard section. Grainger formation, as used here, agrees with "Grainger shale" of Campbell (1894, U.S. Geol. Survey Geol. Atlas, Folio 12) and requires that "Grainger shale" of Keith (1896) be redefined in its type section to exclude Devonian beds included by Keith.

John Rodgers, 1953, Tennessee Div. Geology Bull. 58, pt. 2, p. 106–107, pt. 1, pls. Formation mapped in eastern Tennessee. Overlies Chattanooga shale; underlies Newman limestone; grades into Fort Payne chert. Thicknesses: 1,100 feet on southeast side of valley in Blount and Monroe Counties; about 900 feet in belt southeast of Clinch Mountain; about 500 feet in belts in Hancock and eastern Claiborne Counties; less than 350 feet at Cumberland Gap.

R. B. Neuman and R. L. Wilson, 1960, U.S. Geol. Survey Geol. Quad. Map GQ–131. In Blockhouse quadrangle, Tennessee, formation consists of siltstone, sandstone, and conglomerate. Gray and blue-gray noncalcareous siltstone dominant in lower two-thirds; gray medium- to coarse-grained, crossbedded calcareous sandstone with layers of pebble conglomerate in upper third. Thickness 1,000 feet. Overlies Chattanooga shale; underlies Greasy Cove formation (new) which replaces term Newman as used in this area. Brachiopods, pelecypods, and bryozoans abundant in some areas suggest correlation with Keokuk limestone of Mississippi Valley.

Named for Grainger County, Tenn.

Grampian Limestone[1]

Cambrian(?) and Ordovician: Southwestern Utah.

Original reference: B. S. Butler, 1913, U.S. Geol. Survey Prof. Paper 80.

E. H. East, 1957, (abs.) Geol. Soc. America Bull., v. 68, no. 12, pt. 2, p. 1825. Upper contact marked by extensive overthrust, and contact with Morehouse quartzite is not conformable as proposed by Butler (1913), necessitating stratigraphic revision to replace Grampian by Ely limestone, Kanosh shale, and unnamed interval of Cambrian beds.

Type locality: Grampian Hills, Frisco district.

Grampian Hills Member (of Nanafalia Formation)

Eocene, lower: Alabama.

B. W. Blanpied and R. T. Hazzard, 1939, Shreveport Geol. Soc. Guidebook 14th Ann. Field Trip, p. 128. Shown on correlation chart as upper member of formation. Overlies Salt Mountain limestone member.

P. E. LaMoreaux and L. D. Toulmin, 1959, Alabama Geol. Survey County Rept. 4, p. 96 (fig. 32), 100, 101, 102, 108 (fig. 38), 109–110, 112, 116, 117, pls. 2, 3. Allocated to member status in Nanafalia formation. Blanpied and Hazzard did not specify type locality or section. At type locality and section, herein designated, entire thickness, including upper and lower contacts, is exposed. Consists of yellowish- to greenish-gray indurated clay or claystone; includes several beds of greenish-gray coarse-grained glauconitic sand and sandstone and, in upper part, gray to greenish-gray massive blocky clay. Thickness 80 to 110 feet in Grampian Hills area. Overlies unnamed middle member of formation; underlies Tuscahoma sand.

Type locality and section: In continuous roadcut along Alabama Highway 41 on south side of Gravel Creek valley, 7.1 miles south of Camden on road to Monroeville, Wilcox County. Named for exposures in Grampian Hills, southern part of Wilcox County.

Grampus Gneiss[1]

Precambrian: Eastern New York.

Original references: H. P. Cushing, 1907, New York State Mus. 60th Ann. Rept., pt. 2; 1907 New York State Mus. Bull. 115, p. 463, 467–469.

Named for exposures around Grampus Lake, Hamilton County.

Granby Conglomerate[1]

Pennsylvanian (?): Southwestern Missouri.

Original reference: E. R. Buckley and H. A. Buehler, 1906, Missouri Bur. Geol. and Mines, v. 4, 2d ser., p. 33, 87, 88, 100, 102, pl. 14.

Probably named for Granby or Granby Junction, Newton County, or for Granby Branch Junction, Jasper County.

Granby Tuff (in Newark Group)[1]

Upper Triassic: Connecticut and south-central Massachusetts.

Original reference: B. K. Emerson, 1891, Geol. Soc. America Bull., v. 2, p. 451–456.

Robert Balk, 1957, Geol. Soc. America Bull., v. 68, no. 4, p. 494–497, pl. 1. Consists of four mappable units: Granby tuff, a brown, purple, or maroon compact or stratified diabase tuff or tuffaceous sandstone; a diabase flow, the Hampden diabase of Emerson (1898), a fine-grained locally altered compact or vesicular diabase; intrusive diabase pipes, dikes and sills of fine-grained diabase; and Black Rock diabase breccia. Maximum thickness 500 feet. Younger than earliest beds of Longmeadow sandstone; older than middle and upper parts of the Longmeadow. Triassic.

E. D. McKee and others, 1959, U.S. Geol. Survey Misc. Geol. Inv. Map I–300, table 1. Correlation chart shows Granby tuff in Connecticut.

Exposed in vicinity of Granby, southeastern Hampshire County, Mass.

Grandad Limestone[1]

Silurian: Southeastern Indiana.

Original reference: W. W. Borden, 1874, Indiana Geol. Survey 5th Ann. Rept., p. 138, 143, 146.

Derivation of name not stated.

Grand Bayou Member (of Hall Summit Formation)

Paleocene (Midway): Northwestern Louisiana and northeastern Texas.

D. P. Meagher and L. C. Aycock, 1942, Louisiana Dept. Conserv. Geol. Pamph. 3, p. 13. Named in stratigraphic summary of Louisiana lignite district. Name credited to G. Murray, Jr.

G. E. Murray, Jr., and E. P. Thomas, 1945, Am. Assoc. Petroleum Geologists Bull., v. 29, no. 1, p. 48 (fig. 2), 59; G. E. Murray, 1948, Louisiana Dept. Conserv. Geol. Bull. 25, p. 130–131, pl. 10. Typical carbonaceous shale. Maximum thickness 80 feet on south flank of Sabine uplift. In northeastern part of uplift, believed to thin and merge with overlying Bistineau member; overlies Loggy Bayou member. Paleocene. Type locality designated. Mapped in Texas.

Type locality: Exposures in secs. 19, 20, 29, and 30, T. 14 N., R. 9 W., Red River Parish, La. Outcrop belt extends into Shelby County, Tex.

†Grand Canyon Group[1]

Precambrian: Northern Arizona.

Original reference: C. D. Walcott, 1883, Am. Jour. Sci. 3d, v. 26, p. 440–441.

†Grand Canyon Schist[1]

Precambrian: Northern Arizona.

Original reference: J. W. Powell, 1876, Geology of eastern portion of Uinta Mountains.

Occurs at bottom of Grand Canyon.

Grand Canyon Series[1]

Precambrian: Northern Arizona.

Original reference: J. W. Powell, 1876, Geology of the eastern portion of Uinta Mountains, p. 43, 61–62, 70.

C. E. Van Gundy, 1934, Grand Canyon Nature Notes, v. 9, no. 8, p. 345–346; 1951, Geol. Soc. America Bull., v. 62, no. 8, p. 953–959, pl. 1. Series includes more than 12,000 feet of sediments, diabase, and basalts. Comprises (ascending) Unkar, Nankoweap (new), and Chuar groups. Algonkian.

C. R. Keyes, 1938, Pan-Am. Geologist, v. 38, no. 2, p. 107 (table). Table shows series (Proterozoic) comprises (ascending) Hotauta, Newberry (new), Bass, Hakatai, Shinumo, and Dox formations. Thickness 5,350, feet. Underlies Cardenasan series (new); overlies Proterozoic.

C. A. Anderson, 1951, Geol. Soc. America Bull., v. 62, no. 11, p. 1333. Overlies older Precambrian rocks which include Vishnu schist.

Grand Creek Sand Member (of Nanafalia Formation)

Probably lapsus for **Gravel Creek Sand Member** (of Nanafalia Formation).

Grand Detour Formation (in Platteville Group)

Middle Ordovician: Northern Illinois.

J. S. Templeton and H. B. Willman, 1952, Tri-State Geol. Soc. Guidebook 16th Ann. Field Conf., p. 6, fig. 3. Consists of dolomite or limestone, alternately pure and argillaceous, partly cherty, thin- to thick-bedded. Thickness about 500 feet. Subdivided into seven members (ascending): Dement, Walgreen, Stillman, Clement, Hely, Victory, and Forreston (all new). Underlies Nachusa formation (new); overlies Mifflin formation.

Occurs in Dixon-Oregon area.

Grande limestone[1]

Mississippian: Southwestern New Mexico.

Original reference: C. R. Keyes, 1908, Am. Inst. Mining Engrs. Bi-Monthly Bull. 19, p. 7–21.

At Lake Valley, Sierra County.

Grandeur Member or **Tongue** (of Park City Formation)

Permian: Utah, Idaho, Montana, and Wyoming.

T. M. Cheney and others *in* V. E. McKelvey and others, 1959, U.S. Geol. Survey Prof. Paper 313–A, p. 3 (fig. 1), 12–17, 36–37, pls. 2, 3. Defined as the interbedded carbonate rock, cherty carbonate rock, carbonitic sandstone, and carbonitic siltstone that overlie Weber quartzite in Utah, Wells formation (restricted) in Idaho, Tensleep sandstone in Wyoming, and Quadrant formation in Montana. Underlies Meade Peak phosphatic shale member (new) of Phosphoria. Thickness at type locality about 280 feet. Present at all outcrops of Park City formation in Uinta Mountains except east of Lake Fork on south flank and ranges in thickness from featheredge to about 350 feet.

Type section: About 1 mile southwest of Grandeur Peak, in sec. 36, T. 1 S., R. 1 E., on north side and near mouth of Mill Creek Canyon, Salt Lake County, Utah.

Grand Falls Chert Member (of Boone Formation)[1]

Grand Falls Chert Member (of Keokuk Limestone)

Grand Falls Formation

Lower Mississippian: Southwestern Missouri, southeastern Kansas, and northeastern Oklahoma.

Original reference: A. Winslow, 1894, Missouri Geol. Survey, v. 7, 417–419.

R. C. Moore, G. M. Fowler, and J. P. Lyden, 1939, Geol. Soc. America Spec. Paper 24, p. 3, 10. Named subdivisions of Keokuk are Grand Falls chert, at base, and Short Creek oolite near top. Grand Falls is an irregularly bedded mass of dense "butcher knife" chert, mostly light gray but appears light yellowish brown or dark brown in weathered exposures. Thickness at type locality (including beds below water level) 35 feet. Locally discontinuous but identified over hundreds of square miles in Tri-State district. Osage series.

E. B. Branson, 1944, Missouri Univ. Studies, v. 19, no. 3, p. 197, 204. Report refers to Grand Falls chert at top of Reeds Spring member of Chouteau formation. Also refers to Reeds Spring limestone and quotes at length from unpublished manuscript by Clark (1941) who classed the Grand Falls as member of Reeds Spring.

E. L. Clark and T. R. Beveridge, 1952, Kansas Geol. Soc. Guidebook 16th Field Conf. p. 13 (fig. 1), 14–15 (fig. 2), 38 (fig. 12), 40 (fig. 15), 41 (fig. 16), 53 (fig. 26), 72 (fig. 1). Report refers to Grand Falls formation. Overlies Reeds Spring formation or Pierson formation; underlies Burlington formation or Keokuk formation.

C. H. Behre, Jr., and A. V. Heyl, Jr., 1959, Deutschen Geol. Gesell. Zeitschr. v. 110, pt. 3, p. 517 (fig. 2). Chart shows Grand Falls member of Boone formation below Short Creek member and above Reeds Spring member. Thickness 6 to 38 feet.

Named for development around Grand Falls, Newton County, Mo.

Grand Falls Formation

Lower Cambrian: Central Maine.

Rudolf Ruedemann and E. S. C. Smith, 1935, Am. Jour. Sci., 5th ser., v. 30, no. 178, p. 354. Name proposed for thick sequence of metamorphic shales and sandstones.

R. B. Neuman, 1960, U.S. Geol. Survey Prof. Paper 400–B, p. B166–B167. Discussion of pre-Silurian stratigraphy in Shin Pond and Stacyville quadrangles. Grand Falls formation (Ruedemann and Smith, 1935) occurs in this area. Name Grand Falls is preoccupied.

Exposed for several miles along the Grand Falls of the Penobscot River, Penobscot County.

Grandfield Conglomerate[1]

Pliocene or Pleistocene: Southwestern Oklahoma.

Original reference: M. J. Munn, 1914, U.S. Geol. Survey Bull. 547, p. 17, 28–30.

Named for Grandfield, Tillman County.

Grand Forks Schist[1]

Age (?): Southern British Columbia, Canada, and northeastern Washington.

Original reference: R. A. Daly, 1912, Canada Geol. Survey Dept. Mines Mem. 38, maps 9, 10.

Mapped at and around Township of Grand Forks, British Columbia.

Grandge Slate

Lower Ordovician: Northwestern Vermont.

Charles Schuchert, 1937, Geol. Soc. America Bull., v. 48, no. 7, p. 1014. 1072–1074, 1075. Slate containing limestone blocks and calcareous sandstone. Probably several hundred feet thick. Unconformably overlies Highgate formation. May be same unit as Georgia slate.

P. E. Raymond, 1937, Geol. Soc. America Bull., v. 48, no. 8, p. 1080, 1134. Replaces Georgia slate. Type section described as shale.

A. B. Shaw, 1958, Geol. Soc. America Bull., v. no. 5, p. 550. Name Grandge slate abandoned. Included in Highgate formation as herein defined.

Type locality: On Oliver Grandge Farm, 4½ miles north of Highgate Center, Franklin County.

†Grand Gulf Group[1]

Miocene: Gulf Coastal Plain.

Original reference: E. W. Hilgard, 1860, Report on agriculture and geology of the State of Mississippi: [Mississippi Geol. Survey], p. 3, 108, 147–154.

U. B. Hughes and others, 1940, Mississippi Geol. Soc. [Guidebook] Field Trip, Feb. 10, 11, chart. Group includes (ascending) Bucatunna clay, Chickasawhay (lower and upper), Catahoula sand, Hattiesburg clay, and Pascagoula clay. Occurs above Vicksburg group [boundary between Oligocene and Miocene is queried, and Bucatunna and Chickasawhay may be considered part of Vicksburg group].

H. N. Fisk, 1940, Louisiana Geol. Survey Bull. 18, p. 138–174. Term Grand Gulf group revived. Considered to include all sediments exposed in central Louisiana from Vicksburg Oligocene to southernmost exposures of Tertiary sediments in Rapides Parish. As thus defined, includes Catahoula and Fleming formations.

Named for exposures in bluff at Grand Gulf, Claiborne County, Miss.

†Grand Gulf Sandstone[1]

Miocene: Southern Mississippi and southern Alabama.

Original reference: B. L. C. Wailes, 1854, Report on agriculture and geology of Mississippi: [Mississippi Geol. Survey], p. 216–219.

Named for exposures in bluff at Grand Gulf, Claiborne County, Miss.

Grandhaven Limestone Member (of Stotler Limestone)

Grandhaven Limestone (in Wabaunsee Group)[1]

Pennsylvanian (Virgil Series): Northeastern Kansas, southwestern Iowa, and southeastern Nebraska.

Original reference: R. C. Moore, May 1935, Kansas Geol. Survey Bull. 20, table opposite p. 14.

R. C. Moore and M. R. Mudge, 1956, Am. Assoc, Petroleum Geologists Bull., v. 40, no. 9, p. 2274 (fig. 1), 2275. Rank reduced to member status in Stotler limestone (new). Overlies Dry shale member; underlies Friedrich shale member of Root shale (new).

H. G. Hershey and others, 1960, Iowa Highway Research Board Bull. 15, p. 11, fig. 5. Bluish gray, weathers to buff brown, commonly micaceous and argillaceous; upper part tends to be slabby. Thickness about 2 feet. Underlies Friedrich shale; overlies Dry shale. Wabaunsee group. Condra and Reed suggest that their Morton limestone may occupy horizon of Grandhaven limestone.

Type locality: In sec. 31, T. 13 S., R. 14 E., near Grandhaven, Shawnee County, Kans.

Grandian Epoch or Series[1]

Pleistocene (Nebraskan and Aftonian): Illinois and Iowa.

Original reference: G. F. Kay, 1931, Geol. Soc. America Bull., v. 42, pt. 1, p. 449–452.

J. C. Frye and A. B. Leonard, 1952, Kansas Geol. Survey Bull. 99, p. 38. In Iowa and Illinois, the Pleistocene is classed as a Period (System), and four Epochs (Series) are used to include a glacial-interglacial pair each. These are Grandian (Nebraskan and Aftonian), Ottumwan (Kansan and Yarmouthian), Centralian (Illinoian and Sangamonian), and Eldoran (Wisconsinan and Recent). Of these units, each of first three essentially coincides with a glacial cycle; present data indicate that the youngest (Eldoran) includes two distinct cycles, each of which is complex within itself. These terms have not been adopted for official use in Kansas partly because of this inconsistency and partly because retention of Quaternary as the System-Period with Pleistocene as its contained Series-Epoch would force erection of new category of names to include these terms and thus produce further complication of classification system.

Named for Grand River valley, southwestern Iowa.

Grand Island Formation[1]

Grand Island Member (of Meade Formation)

Pleistocene (Kansan) : Southern and eastern Nebraska, eastern Colorado, western Iowa, and Kansas.

Original reference: A. L. Lugn and G. E. Condra, 1932, Geol. Soc. America Bull., v. 43, no. 1, p. 190.

J. C. Frye, Ada Swineford, and A. B. Leonard, 1948, Jour. Geology, v. 56, no. 6, p. 520 (fig. 3), 521, 522; R. C. Moore and others, 1951, Kansas Geol. Survey Bull. 89, p. 15. Lower member of Meade formation in Kansas. Underlies Sappa member. Thickness commonly 25 feet.

G. E. Condra and E. C. Reed, 1950, Nebraska Geol. Survey Bull. 15–A, p. 12 (fig. 6). Correlation table shows relation of Nebraska Pleistocene formations to continental glaciations on cyclic basis involving erosion, alluviation, eolation, and soil formation. Grand Island sand and gravel (Kansan) divided into "Upper Grand Island" and "Lower Grand Island". Thickness of Upper Grand Island about 28 feet in Little Sioux Valley, near Harrison-Monona County line, Iowa.

C. B. Schultz, E. C. Reed, and A. L. Lugn, 1951, Science, v. 114, no. 2969, p. 547–548. Proposed that name Grand Island be restricted to Upper Grand Island, and name Red Cloud sand and gravel be applied to Lower Grand Island of Condra and Reed (1950), which includes pro-Kansan sand and gravel. The restricted Grand Island was deposited during retreat and waning of Kansas ice sheet (late Kansan and early Yarmouth Sappa time).

D. R. Hill and J. M. Tompkin, 1953, U.S. Geol. Survey Bull. 1001, p. 9 (table 1), 23–24. Geographically extended into Wray area, Colorado. Does not crop out in natural exposures. Thickness about 10 feet, measured in gravel pits. Overlies Ogallala formation.

C. W. Hibbard, 1958, Am. Jour. Sci., v. 258, no. 1, p. 55 (fig. 1). Chart of revised classification of Kansas Pleistocene shows Grand Island as member of unnamed formation in Meade group.

J. M. Jewett, 1959, Graphic column and classification of rocks in Kansas: Kansas Geol. Survey. Shown as formation in Kansas.

Named for exposures at and around Grand Island, Hall County, Nebr.

Grand Lake Member[1] (of Presque Isle Stage)

Middle Devonian : Northeastern Michigan.

Original reference: A. W. Grabau, 1915, unpublished ms., as reported by E. R. Pohl, 1930, U.S. Natl. Mus. Proc., v. 76, art. 14, p. 4, 25.

A. S. Warthin, Jr., and G. A. Cooper, 1943, Am. Assoc. Petroleum Geologists Bull., v. 27, no. 5, p. 573, 580. Pohl (1930) showed Presque Isle stage composed of Bell shale, Grand Lake, and Long Lake members. In classification of Traverse rocks of Thunder Bay region, Presque Isle series or stage with its synonym, Long Lake series, are abandoned. It might have been possible to have used name Grand Lake limestone instead of Rockport Quarry, but term Grand Lake had never been adequately described.

Probably named for Grand Lake, eastern part of Presque Isle County.

Grand Ledge cyclothem (in Saginaw Formation)

Pennsylvanian: Southern Michigan.

Michigan Geol. Soc., 1954, *in* Geologic cross section of Paleozoic rocks central Mississippi to northern Michigan: Tulsa, Okla., Am. Assoc. Petroleum Geologists, p. 28. One of seven cyclothems in the Saginaw. Consists of irregularly laminated sandy shale and shaly sandstone overlain by a hard, fine-textured underclay; underclay is overlain by coal above which are basal beds of a younger cyclothem.

Exposed in vicinity of Grand Ledge, Eaton County.

†Grand Portage Amygdaloid[1]

Precambrian (Keweenawan): Northern Michigan.

Original reference: A. R. Marvine, 1873, Michigan Geol. Survey, v. 1, pt. 2, p. 35, 69.

Named for occurrence in old Grand Portage mine, Houghton County.

†Grand Portage flow[1]

Precambrian (Keweenawan): Northern Michigan.

Original reference: B. S. Butler and W. S. Burbank, 1929, U.S. Geol. Survey Prof. Paper 144 (chart compiled by M. G. Wilmarth).

Copper district of Keweenaw Point.

Grand Portage Graywacke[1]

Precambrian (upper Huronian): Northeastern Minnesota.

Original reference: N. H. Winchell, 1899, Minnesota Geol. Nat. History Survey Final Rept., v. 4, p. 510.

Occurs in Grand Portage Indian Reservation, Cook County.

†Grand Prairie Formation[1]

Lower Cretaceous: Eastern Texas.

Original reference: R. T. Hill and R. A. F. Penrose, 1889, Am. Jour. Sci., 3d, v. 38, p. 470.

Named for prairie, known to old travelers as the "Grand Prairie," which extends from 4 miles east of Fort Worth to 7 miles west of Weatherford, Parker County.

Grand Rapids Group[1]

Mississippian: Michigan.

Original reference: A. C. Lane, 1893, Michigan Geol. Survey Rept. 1891 and 1892, p. 66; reported by M. E. Wadsworth.

G. M. Ehlers and W. E. Humphrey, 1944, Michigan Univ. Contr. Mus. Paleontology, v. 6, no. 6, p. 114–117. Discussion of fauna from Point au Gres limestone at Grand Rapids. History of nomenclature reviewed, and references made to work of Lane (1893, 1895, 1899, 1900, 1909). Concluded that Point au Gres instead of "Grand Rapids" or "Bayport" should be used for limestone under discussion. Usage is based on definition of Point au Gres by Douglass (1841 [1839]). Continued reference to limestone as "Bayport" would be unfortunate because this name and "Grand Rapids" were used only in casual manner by Lane.

Named for exposures at Grand Rapids, where Bayport limestone is quarried.

†Grand Rapids Limestone[1]

Mississippian: Michigan.

Original reference: A. C. Lane, 1899, U.S. Geol. Survey Water-Supply Paper 30, p. 81.

Grand Rapids Sandstone[1]

Devonian(?): Northwestern Ohio.

Original references: E. Orton, 1888, Ohio Geol. Survey, v. 6, p. 20; 1890, Ohio Geol. Survey 3d Organization, 1st Ann. Rept., p. 24.

Wood County.

Grand River Formation

Grand River Group

Pennsylvanian: Southern Michigan.

W. A. Kelly, 1936, Michigan Dept. Conserv., Geol. Div. Pub. 40, Geol. Ser. 34, p. 159, 206–214. Pennsylvanian formations in Michigan, which are stratigraphically higher than beds of the Saginaw group, have been variously called Woodville, Ionia, and Red beds. However, either term, Woodville or Ionia, implies correlation of all younger beds than the Saginaw although there are few facts to substantiate such correlation. Grand River group proposed to include various formations, which stratigraphic evidence indicates are younger than Saginaw, though not strictly to be correlated with each other as occupying the same position in the geologic time scale. Group would include Woodville sandstone, Ionia sandstone, Eaton sandstone (new), and any other formations correlated with them.

G. V. Cohee, 1944, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 11. Grand River formation, youngest Pennsylvanian formation in area, is present only in northern Eaton and Ingham Counties.

G. V. Cohee, Carol Mach, and Margery Holk, 1951, U.S. Geol. Survey Oil and Gas Inv. Chart OC–41, sheet 5. Recommended that Eaton and Ionia sandstones be considered members of Saginaw formation and that Woodville be restricted to a sandstone in member of lower part of Saginaw.

Michigan Geol. Soc., 1954, *in* Geologic cross section of Paleozoic rocks central Mississippi to northern Michigan: Tulsa, Okla., Am. Assoc. Petroleum Geologists, p. 28–29. Herein considered a formation with Eaton and Ionia as members.

Formations of group are exposed in mines and quarries, and natural outcrops in valley and drainage basin of the Grand River, from vicinity of Jackson to that of Ionia.

Grand River Limestone

Mississippian (Chester Series): Northeastern Oklahoma.

R. A. Brant, 1941, *in* Tulsa Geol. Soc. [Guidebook] Field Trip, Oct. 18, strat. sections. Fossiliferous, coarsely oolitic limestone as much as 65 feet thick. Overlies Batesville formation; underlies Fayetteville formation. Formerly a part of the "Mayes" formation.

R. C. Slocum, 1955, Oklahoma Geol. Survey Circ. 35, p. 12. Brant (1941) applied term "Grand River" to limestones between Fayetteville shale and "Batesville" siltstone along Grand River in Mayes County. Although term is ideal for this locality, it is preoccupied. Term Hindsville is substituted for purpose of this report.

C. C. Branson, 1957, Oklahoma Geology Notes, v. 17, no. 11, p. 107. Abandoned by Oklahoma Geological Survey.

Type section: Along Grand River in sec. 26, T. 20 N., R. 19 E., Mayes County.

Grandstand Formation (in Nanushuk Group)

Lower Cretaceous: Northern Alaska.

R. L. Detterman *in* George Gryc and others, 1956, Am. Assoc. Petroleum Geologists Bull., v. 40, no. 2, p. 235–237, figs. 2, 4, 5. Predominantly marine but contains several interfingering units of Killik tongue (new) of nonmarine Chandler formation in upper part. Thick sandstone beds in lower part, which, consequently, is better exposed. Basal part of formation predominantly fine-grained light-olive-gray to dark-yellow-red sandstone, with thin greenish "salt-and-pepper" sandstone bed at base, and subordinate amounts of siltstone and shale. In upper part, siltstone and silt shale constitute about 50 percent of unit; minor amounts of coal in sequence. Thickness of type section about 1,700 feet. Unconformably overlies Tuktu formation (redefined) ; underlies and intertongues with Killik tongue. Age shown on chart as Lower(?) and Upper (?) Cretaceous.

F. M. Robinson, 1959, U.S. Geol. Survey Prof. Paper 305–J, p. 527, fig. 46. Age given as Lower Cretaceous.

Type locality: On left bank of Anaktuvuk River, where river breaches Grandstand anticline, lat 68°56′ N., long 151°10′ W.

Grand Tower Limestone[1]

Grand Tower Limestone (in Ulsterian Group)

Middle Devonian: Southwestern Illinois and eastern Missouri.

Original reference: C. R. Keyes, 1894, Missouri Geol. Survey, v. 4, p. 30, 42.

J. M. Weller, 1940, Illinois Geol. Survey Rept. Inv. 71, p. 16, 25, 26; 1944, Illinois Geol. Survey Bull. 68, p. 89, 95. Described in Illinois, where it is included in Ulsterian group. Best exposed at Devil's Bakeoven north of Grand Tower; here nearly entire thickness of formation, 124 feet, is present. In northern Union County, outcrops are restricted; formation thins out southward and is not known to extend much south of Highway 146. Succeeds Dutch Creek sandstone conformably but appears to be separated by an unconformity from overlying "Lingle" limestone; this contact has been observed only in hills north of Grand Tower where an abrupt change in lithology and fossils occurs. Strata intervening between the Grand Tower limestone (or Dutch Creek sandstone where Grand Tower is absent) and the Mountain Glen shale (or Springville shale where the Mountain Glen is absent) have been referred by Savage (1920) to the Misenheimer shale and the Lingle and Alto limestones. Restudy of this area suggests that recognition of these formations may be neither stratigraphically logical nor practically feasible.

G. A. Cooper and others, 1942, Geol. Soc. America Bull., v. 53, no. 12, pt. 1, chart 4. Age shown as Lower and (or) Middle Devonian.

Carey Croneis, 1944, Illinois Geol. Survey Bull. 68, p. 103 (chart), 115–119, 121. Described in southeastern Missouri where it crops out in synclinal block of Little Saline fault zone southeast of Ozora and in Quarry Hill structure to northeast. Also occurs in small patches in hills south of Little Saline Creek on St. Mary's road south of Ozora. In Perry County, distribution is limited to two exposures: a narrow strip less than 2 miles long in fault zone between Bailey and Burlington escarpments near Union School, and the other, one-half mile south of Ridge School, is bounded on south by faults. Thickness in Ste. Genevieve County 225 to 250 feet; in Perry County 100 feet or less. In Ste. Genevieve County, no basal arenaceous beds are present, contact with Little Saline strata is gradational, and first appearance of cherty limestone is arbitrarily assumed to mark base of formation. Underlies Beauvais formation in Little Saline fault area; in Perry County, underlies St. Laurent formation.

Named for exposures in vicinity of Grand Tower, Jackson County, Ill.

Grand View Dolomite[1]

Upper Devonian: Southern central Idaho.

Original reference: C. P. Ross, 1932, Idaho correlation chart compiled by M. G. Wilmarth.

C. P. Ross, 1947, Geol. Soc. America., v. 58, no. 12, pt. 1, p. 1109–1110, pl. 1. Thickness 2,115 feet in Borah Peak quadrangle, Idaho. Overlies Jefferson dolomite; underlies Three Forks limestone.

Type locality: Grand View Canyon, near center T. 12 N., R. 20 E., south of Challis, Custer County.

Grandview Limestone (in Brazil Group)

Pennsylvanian (Pottsville Series): Southwestern Indiana.

D. W. Franklin, 1944, Illinois Acad. Sci. Trans., v. 37, p. 87 (fig. 1), 89, 90. Light-gray finely crystalline crinoidal limestone with bedded gray chert. Thickness 5 feet. Lies near top of group about 15 feet below Buffaloville coal in Staunton group.

Type exposure: Along State Highway 66 east of Grandview in Ohio River bluffs in SE¼NE¼ sec. 15, T. 6 S., R. 4 W., Spencer County.

Graneros Shale (in Colorado Group)[1]

Graneros Shale Member (of Mancos Shale)

Graneros Shale (in Benton Group)

Lower and Upper Cretaceous: Eastern Colorado, northwestern Iowa, western Kansas, southeastern Montana, Nebraska, northeastern New Mexico, South Dakota, and eastern Wyoming.

Original reference: G. K. Gilbert, 1896, U.S. Geol. Survey 17th Ann. Rept., pt. 2, p. 564.

A. J. Collier, 1922, U.S. Geol. Survey Bull. 736, p. 79–84, table. In Osage oil field, Weston County, Wyo., Graneros shale comprises about 1,000 feet of shale in which following members can be distinguished (ascending): Skull Creek shale, Newcastle sandstone, Nefsy shale (new), Mowry shale, and Belle Fourche shale. Overlies Dakota sandstone; underlies Greenhorn limestone. Colorado group.

R. C. Moore, 1935, Rock formations of Kansas *in* Kansas Geol. Soc: Wichita, [Am. Assoc. Petroleum Geologists 20th Ann. Mtg., Mar 21–23]. Overlies Solomon formation (new) of Dakota group.

M. E. Wing, 1940, South Dakota Geol. Survey Rept. Inv. 35, p. 3–6, chart facing p. 10. Formation, in Butte County, comprises lower unit, 250 to 300 feet thick, of dark shale, with sandstone at top that is believed to be Newcastle; middle unit, or Mowry, 250 feet thick; upper unit, about 600 feet thick, of dark shales, with limestone ledge herein named Middle Creek limestone. Overlies Fall River (Dakota) sandstone; underlies Greenhorn limestone.

B. F. Latta, 1941, Kansas Geol. Survey Bull. 37, p. 74. In Hamilton County, conformably overlies Cockrum sandstone (new) of Dakota group.

Norman Plummer and J. F. Romary, 1942, Kansas Geol. Survey Bull. 41, pt. 9, p. 330–331 (fig. 4), 337. Overlies Janssen clay member of Dakota formation.

G. E. Condra and E. C. Reed, 1943, Nebraska Geol. Survey Bull. 14, p. 15 (fig. 7), 18. Thickness 60 to 70 feet in northeastern Nebraska (near Ponca and Homer) ; 40 to 90 feet in subsurface in Republican Valley; 550 to 700 feet in northern Dawes County; about 900 feet in exposures around Black Hills. Formation changes facially westward becoming the argillaceous Belle Fourche shale above and gray calcareous Mowry shale below in western Nebraska, eastern Wyoming, and southwestern South Dakota. Underlies Greenhorn limestone; overlies Omadi sandstone (new) of Dakota group.

J. B. Reeside, Jr., 1944, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 10. As shown on correlation chart, Graneros shale in southern Great Plains occupies interval between Dakota sandstone below and Greenhorn limestone above. In northern Great Plains, the equivalent interval is occupied by (ascending) Mowry shale and Belle Fourche shale. Newcastle sandstone is shown equivalent to Dakota sandstone, and Skull Creek shale is shown as a Lower Cretaceous formation below the Newcastle and above Fall River sandstone of Inyan Kara group.

R. C. Moore, J. C. Frye, and J. M. Jewett, 1944, Kansas Geol. Survey Bull. 52, pt. 4, p. 153, 155 (fig. 3). Consists of shale and clay shale, fissile, noncalcareous, and blue black, that weathers to dark gray and coffee brown. Thickens southward across western Kansas. Thickness 30 to 35 feet in Russell County; 65 feet near Colorado line. Overlies Janssen clay of Dakota formation; underlies Lincoln limestone member of Greenhorn limestone. Colorado group; Gulfian series.

B. C. Petsch, 1946, South Dakota Geol. Survey Rept. Inv. 53, p. 43, 44 (fig. 13), 47. Basal formation in Benton group. Underlies Greenhorn limestone; overlies Dakota formation. Outcrops of Graneros present in bluffs along east side of Big Sioux River in Iowa between Westfield and Sioux City.

N. W. Bass, C. E. Straub, and H. O. Woodbury, 1947, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 68. As used in this report [Model anticline, Las Animas County, Colo.] Graneros shale is 105 feet thick and includes interval between Dakota sandstone below and Lincoln limestone member of Greenhorn limestone. Includes Thatcher limestone member (new). As originally defined by Gilbert (1896), Graneros shale in vicinity of Pueblo was 200 to 210 feet thick and included in its upper part beds that are herein designated Lincoln limestone and Hartland shale members of Greenhorn limestone. If these younger beds were included in the Graneros, its total thickness over Model anticline would be 153 feet. Upper Cretaceous.

C. H. Dane, 1948, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 78. Lowermost member of Mancos shale in area of this report [eastern side of San Juan basin, Rio Arriba County, N. Mex.]. Consists chiefly of gray and black evenly thin-bedded shale; locally shale is sandy in basal 6 to 10 feet. Thin beds of bentonite present, particularly in lower and upper part. Underlies Greenhorn limestone member; overlies Dakota sandstone. Upper Cretaceous.

B. C. Petsch, 1949, South Dakota Geol. Survey Rept. Inv. 65, p. 8–15. In Black Hills region Graneros formation divided into (ascending) Skull Creek shale, Newcastle sandstone, Nefsy shale, Mowry shale, and Belle Fourche shale members. Estimated thickness 1,200 feet in area of this report [Whitewood anticline]. Nefsy not distinguished from Mowry in area of present report. Overlies Dakota (Fall River) formation; underlies Greenhorn formation. Unit termed Middle Creek limestone by Wing (1940) is herein renamed Orman Lake limestone and classified as bed in Belle Fourche member.

A. J. Crowley, 1951, Am. Assoc. Petroleum Geologists Bull., v. 35, no. 1, p. 83–107. Newcastle sandstone, formerly regarded as member of Graneros shale, is herein assigned to Lower Cretaceous. Table 1 shows restricted Graneros shale comprises (ascending) Mowry shale and Belle Fourche shale in Black Hills area.

G. O. Bachman, 1953, U.S. Geol. Survey Oil and Gas Inv. Map OM–137. Cretaceous system in area of this report [northwestern Mora County, N. Mex.] is represented by Dakota sandstone and Benton formation; the Benton consists of Graneros shale, Greenhorn limestone, and Carlile shale equivalents. Upper Cretaceous.

U.S. Geological Survey currently designates the age of the Graneros as Lower and Upper Cretaceous. This age designation is made on the basis that the base of Colorado Group is drawn at top of Mowry and its equivalents. Base of Colorado group thus drawn is accepted as boundary between Upper Cretaceous and Lower Cretaceous. Where the Mowry is not present the age of the Graneros is designated as Upper Cretaceous.

Named for Graneros Creek, Walsenburg quadrangle, Pueblo County, Colo.

Granger Sandstone Member (of Spoon Formation)

Pennsylvanian: Northern Kentucky and southeastern Illinois.

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 32, 45 (table 1), 65, pl. 1. Proposed to replace Curlew sandstone in order to retain name Curlew for the limestone. In southeastern Illinois, stratigraphically above O'Nan coal member (new) and below Creal Springs limestone (new). Thickness 20 to as much as 60 or 70 feet. Presentation of new rock-stratigraphic classification of Pennsylvanian of Illinois. Cyclical classification retained but is entirely independent of rock-stratigraphic classification.

Type locality: Indian Hill, near Curlew, Union County, Ky. Name derived from village of Grangertown, about 5 miles southeast of Indian Hill.

Granite Creek Granodiorite[1]

Probably Jurassic or Cretaceous: Northern Idaho.

Original reference: J. L. Gillson, 1927, Jour. Geology, v. 35, no. 1.

Named for exposures around mouth of Granite Creek, Bonner County.

Granite Falls Garnetiferous Quartz Diorite Gneiss

Precambrian: Southwestern Minnesota.

E. H. Lund, 1956, Geol. Soc. America Bull., v. 67, no. 11, p. 1481–1482, pl. 2. Forms part of basic complex of area. Characterized by abundant pink garnet. Contains numerous quartz veins and quartz and granite stringers, which in general follow foliation of the gneiss but frequently cut across it. Locally, the large amount of introduced siliceous material results in an abnormally light-gray color. Just south of Minnesota River, the gneiss is characterized by fairly uniform nearly east-west strike of foliation with average dip of 40° to south. Structure is reflected in topography by a number of east-west ridges with scarp-like slopes on north side and more gentle slopes on south side.

Underlies an area of about 2 square miles south of Granite Falls, Yellow Medicine County.

Granite Falls Limestone

Upper Pennsylvanian and (or) Permian: Northwestern Washington.

R. A. Anderson, 1941, Washington State Coll. Research Studies, v. 9, no. 3, p. 189, 201. Fusulinid-bearing limestone composed largely of cryptocrystalline calcite. Lies in contact with a dark basic rock.

Exposed in quarry near E¼ cor. sec. 5, T. 30 N., R. 7 E., about 3 miles northeast of Granite Falls and on south side of Canyon Creek, Snohomish County.

Granite Gap Granite

Precambrian: Southwestern New Mexico.

Elliot Gillerman, 1958, New Mexico Bur. Mines Mineral Resources Bull. 57, p. 9–10, 12, table 1, pl. 1. Where fresh and unaltered, granite is a holocrystalline equigranular medium-grained light-pink to gray rock with a hypidiomorphic texture. Unconformably underlies Bolsa quartzite.

Named from exposures at Granite Gap, where Highway 80 crosses the Peloncillo Range, Hidalgo County. In vicinity of Granite Gap, exposures occupy an area of 1½ miles square. Also crops out in narrow band, a few hundred feet wide to one-half mile, between main ridge of Peloncillo Mountains and smaller ridge north of Preacher Mountain.

Granite Mountain Porphyry[1]

Tertiary, lower(?): Central Arizona.

Original reference: F. L. Ransome, 1919, U.S. Geol. Survey Prof. Paper 115, p. 126, pl. 45.

E. D. Wilson, 1952, Arizona Geol. Soc. Guidebook for Field Trip Excursions in Southern Arizona, p. 8. Age shown as Laramide (Late Cretaceous to early Tertiary).

Principal body is the irregular intrusive mass that makes up much of Granite Mountain.

Granite Park Member (of Siyeh Formation or Limestone)[1]

Precambrian (Belt Series): Northwestern Montana.

Original reference: C. L. Fenton and M. A. Fenton, 1931, Jour. Geology, v. 39, no. 7, p. 670–679.

C. L. Fenton and M. A. Fenton, 1937, Geol. Soc. America Bull., v. 48, no. 12, p. 1896–1897. Thickness ranges from 280 to 900 feet. At type locality, which is here designated, member consists of 285 feet of dolomites, argillites, and thin quartzites, with thin strata of oolite, sandstone, and mud breccia. Clastic materials diminish northwestward on crest of Lewis Range. Represents final stage of Siyeh sedimentation. Separated from underlying Goathaunt member by *Collenia frequens* zone. Underlies Spokane formation.

Richard Rezak, 1957, U.S. Geol. Survey Prof. Paper 294–D, p. 138–139. Discussion of stromatolites of Belt series, *Collenia multiflabella* zone of Siyeh limestone represents Granite Park member of Fenton and Fenton (1937).

Type locality: Cliffs of Continental Divide southeastward from Granite Park, Glacier National Park, where strata are crossed by trail to the dike above Grinnell Glacier. Well exposed in Hole-in-the-Wall Basin, near Boulder Peak, and on trail from Alderson to Carthew Lakes, Waterton Lakes Park.

Graniteville Granite

Precambrian: Southeastern Missouri.

H. B. Graves, 1938, Acad. Sci. St. Louis Trans., v. 29, no. 5, p. 119. Proposed for granites of area [St. Francois Mountains] that appear to be related to the granites at Graniteville. Granite at Graniteville is red and coarse grained, and much of it is porphyritic; pegmatitic phases appear in southern part of area. Similar granite occurs near Cornwall and Coldwater.

Graniteville is in northeastern Iron County.

Grant Conglomerate[1]

Precambrian (probably middle Huronian): Northern Minnesota.

Original reference: J. W. Gruner, 1929, Lake Superior Min. Inst. Proc., v. 27, p. 184–187.

J. W. Gruner, 1941, Geol. Soc. America Bull., v. 52, no. 10, p. 1600. In Knife Lake area, a granite pebble conglomerate lies on greenstone in secs. 10 and 11, T. 65 N., R. 6 W., east of Hanson Lake. It lies in a wedge formed by two faults; hence, its relationship to other members is not clear. Thickness does not exceed 600 feet. It was called Grant conglomerate by Gruner (1929); however, it does not deserve an individual name because it probably does not represent as long an erosion interval as was thought at first.

Well exposed in vicinity of Grant Lake, Lake County.

Grant Shale Member (of Winfield Limestone)

Grant Shale (in Chase Group)[1]

Permian: Eastern Kansas and southeastern Nebraska.

Original reference: G. E. Condra and J. E. Upp, 1931, Nebraska Geol. Survey Bull. 6, 2d ser., p. 50.

R. C. Moore and others, 1951, Kansas Geol. Survey Bull. 89, p. 44. Member of Winfield limestone. Consists of gray calcareous fossiliferous shale; a distinct unit except in southern Kansas where it probably has been included in lower part of Cresswell limestone member. Thickness in northern part about 10 to 12 feet; in central about 6 feet. Overlies Stovall limestone member. Wolfcamp series.

Type locality: Between 5 and 6 miles north of Florence, Marion County, Kans. Named for Grant Township in Marion County.

Grant Mills Granodiorite

Grants Mills Granite[1]

Devonian or older: Northern Rhode Island.

Original reference (Grants Mills granite): C. H. Warren and S. Powers, 1914, Geol. Soc. America Bull., v. 25, p. 437 (map), 458.

Alonzo Quinn, R. G. Ray, and W. L. Seymour, 1948, *in* Alonzo Quinn and others, Rhode Island Port and Indus. Devel. Comm. Geol. Bull. 3, p. 15, geol. map. Redescribed as gray to greenish-gray medium-grained granodiorite, generally porphyritic and massive to foliated in structure. Contains inclusions of greenstone, schist, and quartzite. Grades into Esmond granite; relative ages unknown. Intrusive into an unnamed quartz diorite in Olney Pond area. Magmatic origin suggested. Devonian or earlier.

Occurs near Grants Mills, Providence County.

Granton trap[1]

Upper Triassic: Northern New Jersey.

Original reference: N. H. Darton, 1890, U. S. Geol. Survey Bull. 67.

Occurs midway between Jersey City, Hudson County, and Hackensack, Bergen County.

Grantsville Formation

Middle Triassic: Southwestern Nevada.

S. W. Muller and H. G. Ferguson, 1939, Geol. Soc. America Bull., v. 50, no. 10, p. 1592–1594, pl. 2. Divided into two members: a lower conglomerate member with minor argillites and an upper limestone member with minor shales. Thickness of lower member, several hundred feet; upper member 100 to 300 feet. Rests unconformably upon a thick section of altered volcanic rocks and overlain unconformably by Luning formation.

N. J. Silberling, 1959, U.S. Geol. Survey Prof. Paper 322, p. 10–14, pls. 10, 11. Described in Union district, Shoshone Mountains, Nev., where it is about 700 feet thick. Overlies Pablo formation; underlies Luning formation.

Type locality: On crest of spur separating mouth of Union Canyon from next large canyon to the north. Named after mining camp on west flank of Shoshone Mountains in north-central part of Tonopah quadrangle. Outcrops also on ridge due north of Grantsville, at mouth of Grantsville Canyon, and on low isolated hill just south of Union Canyon.

Granville Beds[1]

Mississippian: Central Ohio.

Original reference: L. E. Hicks, 1878, Am. Jour. Sci., 3d, v. 16, p. 217–219.

Named for Granville, Licking County.

Granville Enstatite Serpentine[1]

Silurian: Massachusetts.

Original reference: B. K. Emerson, 1898, U.S. Geol. Survey Mon. 29, p. 90.

Occurs in Old Hampshire County now divided into Franklin, Hampshire, and Hampden Counties.

Granville Formation

Lower Cambrian: West-central Vermont.

P. H. Osberg, 1952, Vermont Geol. Survey Bull. 5, p. 49–55, 116. Typically a gray to black rusty-weathering graphitic albite-quartz-chlorite-miscovite schist. Thin beds of blue-gray quartzite are interbedded with the schist in places. Beds of dark-green albite-epidote-calcite-chlorite schist and lenses of buff-colored dolomitic marble also occur. Thickness about 350 to 400 feet throughout the area with a slight thickening probably toward the northern border. Underlies Pinney Hollow formation; overlies Monastery formation (new).

Named from exposures in township of Granville. Lithology well displayed in outcrops in White River three-tenths of a mile northwest of village of Granville, Rochester quadrangle.

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Granville shale facies[1] (of Cuyahoga Formation)

Mississippian (Kinderhook) : Central Ohio.

Original reference: J. E. Hyde, 1915, Jour. Geology, v. 23, p. 657, 679–682.

F. T. Holden, 1941, Illinois Acad. Sci. Trans., v. 34, no. 2, p. 172; 1942, Jour. Geology, v. 50, no. 1, p. 43 (fig. 2), 46–47. Includes Black Hand siltstone member and Raccoon shale member. Lies between Toboso conglomerate facies to the northeast and the Hocking Valley conglomerate facies to the southwest.

Occurs in Morrow, Knox, Fairfield, Licking, and Perry Counties.

Grape Creek Limestone Member (of Clyde Formation)

Grape Creek Formation (in Clyde Group)

Grape Creek Shale and Limestone (in Clyde Formation)[1]

Permian: North-central Texas.

Original reference: N. F. Drake, 1893, Texas Geol. Survey 4th Ann. Rept., pt. 1, p. 412, 427.

M. G. Cheney, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 1, p. 66 (fig. 1). Given formational status in the Clyde herein given group status.

R. C. Moore, 1949, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 80, sheet 2. In Colorado River valley, member constitutes lower three-fifths of formation. Consists of thin beds of uniform blue-gray limestone. Thickness uniformly about 325 feet. Underlies Talpa limestone member; overlies Bead Mountain limestone member of Belle Plains formation. Division of the Clyde into members in this area is not as natural as in the area north of Abilene; in this mapped area they might appropriately be treated as formations.

P. T. Stafford, 1960, U.S. Geol. Survey Bull. 1081–G, p. 275. Grape Creek limestone member, in Brazos River valley, is 20 to 45 feet thick, and consists of upper and lower limestone beds separated by shale. Limestone beds range from 2 to 8 feet in thickness and shale from 15 to 40 feet. Overlies unnamed shale member at base of formation; separated from overlying Talpa limestone member by unnamed shale member.

Named for Grape Creek, Coleman County.

Grapevine conglomerates[1]

Tertiary, lower: Southern California.

Original reference: C. R. Keyes, 1923, Pan-Am. Geologist, v. 40, p. 52, 79.

Named for exposures around base of Grapevine Range, on east side of Death Valley, Inyo County.

Grapevine Sandstone (in Kanawha Formation[1] or Group)

Pennsylvanian: Southern West Virginia.

Original reference: R. V. Hennen and D. B. Reger, 1914, West Virginia Geol. Survey Rept. Logan and Mingo Counties, p. 211.

H. R. Wanless, 1939, Geol. Soc. America Spec. Paper 17, p. 62, 84. In this report, the Kanawha is considered a group.

Type locality: At mouth of Grapevine Creek, Mingo County.

Grapevine Gulch Formation (in Ash Creek Group)

Precambrian (Yavapai Series) : Central Arizona.

C. A. Anderson and S. C. Creasey, 1958, U.S. Geol. Survey Prof. Paper 308, p. 17–20, pl. 1. Six map units recognized in the formation: coarse-grained lithic tuffaceous sedimentary rock; fine-grained tuffaceous sedimentary rock interbedded with chert and siltstone; volcanic breccia; jasper-magnetite beds; intercalated dacitic flows that in part grade into dacitic intrusive masses; and intercalated andesitic flows. Estimated thickness 8,000 to 10,000 feet. Overlies dacite of Burnt Canyon southwest of Mingus Mountain but elsewhere rests upon and intertongues with Deception rhyolite. Top of formation not exposed.

Well exposed southwest of Mingus Mountain where it forms broad northwestward-trending belt, cut off by Shylock fault to the west and by younger quartz diorite to the south and east. Named from excellent exposures along Grapevine Gulch, Jerome area, Yavapai County.

Graphic lavas[1]

Precambrian: Central northern New Mexico.

Original references: C. R. Keyes, 1915, Iowa Acad. Sci. Proc., v. 22, p. 257–259; 1915, Conspectus of geologic formations of New Mexico, Des Moines, Robert Henderson, State Printer, p. 4, 7.

Derivation of name not given.

†Graphic-Kelly Limestone[1]

Mississippian: Central or southwestern New Mexico.

Original reference: C. L. Herrick, 1904, Am. Geologist, v. 13, p. 310–312.

Occurs in Kelly mining district, Socorro County.

Grass Creek Member (of Frontier Formation)

Upper Cretaceous: Northeastern Utah.

L. A. Hale, 1960, Wyoming Geol. Assoc. Guidebook 15th Ann. Field Conf., p. 136 (chart 1), 139 (fig. 1), 140, 141, 143 (fig. 2), 145 (fig. 3). Consists of basal unit, 600 to 700 feet, of lenticular coarse-grained sandstone and reddish clay shales of fluviatile origin; upper unit contains thin-bedded tan sandstone alternating with thin layers of gray shale, 275 to 325 feet thick. Upper unit seems to correlate with Trexler's Meadow Creek sandstone member (new). Contains early Niobrara fauna. Overlies Dry Hollow sandstone member (new); underlies Judd shale member (new).

Named for exposures in lower drainage of Grass Creek valley near Echo Reservoir and in Lewis Canyon southwest of reservoir, Summit County.

Grasselli Dolomite (in Kingsport Formation)

Ordovician (Canadian) : Eastern Tennessee.

C. R. L. Oder and H. W. Miller, 1945, Am. Inst. Mining Metall. Engineers Tech. Pub. 1818, p. 4, 6 (table 2). Composed of dark fine-grained to finely crystalline dolomite through which are scattered a few white spots and at base of which is a green shale and some quartzite grains. Underlain by brown limestone which may be altered to crystalline dolomite; overlain by 3 to 5 feet of fine-grained to finely crystalline mottled and sparsely spotted greenish to pinkish medium-gray dolomite. Thickness about 5 feet.

Named because of its prominent position in ore section in Grasselli mine at New Market, Jefferson County, about 14 miles northeast of Mascot.

Grass Valley Formation

Upper Triassic: North-central Nevada.

S. W. Muller, H. G. Ferguson, and R. J. Roberts, 1951, Geology of the Mount Tobin quadrangle, Nevada: U.S. Geol. Survey Geol. Quad. Map [GQ–7]; 1951, Geology of the Winnemucca quadrangle, Nevada: U.S. Geol. Survey Geol. Quad. Map [GQ–11]. Dominantly shales and quartzitic sandstones. Shales are mostly slaty, in part micaceous, olive drab, or black, with prominent worm trails. Quartzitic sandstones are white, gray, or black, and locally crossbedded. In Tobin Range, nearly all quartzite; in Stillwater Range, up to 30 percent limestone, mostly in upper part, remainder slate and quartzite; at type locality, limestone lenses near top. Thickness may exceed 2,000 feet. Underlies Dun Glen formation (new); overlies Natchez Pass formation (new).

Type locality: Mountain slope facing Grass Valley, northern part of East Range, Winnemucca quadrangle.

Grass Valley Formation

Tertiary: Southwestern Utah.

E. F. Cook, 1957, Utah Geol. and Mineralog. Survey Bull. 58, p. 16 (fig. 2a), 18–20, 59, 61. Includes, in ascending order, a basal limestone, thin andesite flow, and two ignimbrites. Limestone is hard, dense, and pure, dominantly white with some pale-pink bands; bedding thin but irregular; maximum thickness of 100 feet; well exposed near crest of divide at north end of Grass Valley. Dull black augite amygdaloidal andesite flow attains thickness of about 50 feet. Volcanic sandstone and soft white ashy tuff at base of lowest vitric-crystal rhyolite ignimbrite or red-violet color on fresh surface; thickness up to 700 feet. Upper ignimbrite with brick-red groundmass is about 150 feet thick. Maximum thickness of formation about 1,000 feet. Overlies with apparent angular unconformity all older extrusive rocks in area. Upper ignimbrite truncated by an unconformity. Underlies Atchinson formation (new).

Exposed in Grassy Flat Canyon, on east side of Grass Valley, and in area northwest and west of Pine Valley, Washington and Iron Counties.

Grassy Member (of Blackhawk Formation)

Upper Cretaceous (Montana): Central eastern Utah.

R. G. Young, 1955, Geol. Soc. America Bull., v. 66, no. 2, p. 183, 186, figs. 2, 3, pl. 3. Consists of basal littoral marine sandstone with maximum thickness of about 60 feet and series of coal-bearing rocks with maximum thickness of about 50 feet. Basal white-capped sandstone first appears at Sunnyside and fades into underlying Mancos shale at Coal Canyon. It is a medium-grained, buff sandstone, which grades downward and eastward from massive into thin-bedded sandstone and finally into marine shale tongue. This shale rests disconformably on coal-bearing rocks of Sunnyside member (new). Thin beds of coal present. Disconformably underlies tongue of Mancos shale which separates it from overlying Desert member (new).

Named from exposures in vertical cliffs east of railroad siding of Grassy, Emery County. In Book Cliffs.

Grassy Creek Shale[1]

Grassy Creek Formation (in Sulphur Springs Group)

Grassy Creek Shale (in Champ Clark or Fabius Group)

Upper Devonian or Mississippian: Northeastern Missouri, western Illinois, and southeastern Iowa.

Original reference: C. R. Keyes, 1898, Iowa Acad. Sci. Proc., v. 5, p. 59–63.

J. M. Weller and others, 1948, Geol. Soc. America Bull., v. 59, no. 2, p. 101, chart 5; J. M. Weller, 1948, (abs.) Am. Jour. Sci., v. 246, no. 3, p. 150. Basal formation in Fabius group (new). Underlies Saverton shale. Devonian or Mississippian.

A. G. Unklesbay, 1952, Missouri Geol. Survey and Water Resources, 2d ser., v. 33, p. 39–43. Formation described in Boone County where it is basal formation of Sulphur Springs group. Here, consists of basal, fine- to medium-grained, calcareous sandstone overlain by gray to brown shale. Thickness about 7 feet. Underlies Bushberg formation; overlies Callaway limestone.

L. E. Workman and Tracey [Tracy] Gillette, 1956, Illinois Geol. Survey Rept. Inv. 189, p. 8 (fig. 1), 14–16. Reallocated to Champ Clark group (new) proposed to replace Fabius group of Weller and others (1948). Name Grassy Creek is applied in western and central Illinois and east as far as Champ Clark group can be differentiated. Farther east, the Grassy Creek is equivalent to part of New Albany shale. Overlies discontinuous Sylamore sandstone; underlies Saverton shale; north of area in which Saverton has been differentiated, seems to be directly overlain by Maple Mill shale of Hannibal group.

T. J. Laswell, 1957, Missouri Geol. Survey and Water Resources Rept. Inv. 22, p. 9 (fig. 2), 22–27, pl. 1. Formation described in Bowling Green quadrangle where it is 1 to 44 feet thick and consists of brownish-black fissile shale with a 4- to 8-inch basal conglomerate in some areas. Conformably overlain by Saverton formation; in some areas, lies conformably on Edgewood formation of lower Silurian age; where Edgewood is absent, lies unconformably on Upper Devonian Maquoketa formation. No general agreement as to age of formation. Occurring as it does near disputed Devonian-Mississippian contact, it has been assigned to Devonian by some geologists and to Mississippian by others.

M. G. Mehl, 1960, Denison Univ. Jour. Sci. Lab., v. 45, art. 5, p. 81–85, 105. In Pike County, Mo., includes Turpin sandstone member (new) at base. Discussion of controversy in use of terms Grassy Creek and Saverton. Keyes did not mention precise type locality, but it is evident that he intended type locality to be in vicinity of Louisiana in area of the thin Grassy Creek and not "10 miles west of Grassy Creek," where the shales attain thickness of 30 feet. Type locality designated in this report is type locality of Grassy Creek as amended by Keyes (1913, Am. Jour. Sci., v. 36, 4th ser.). This section is figured by Branson and Mehl (1933, Missouri Univ. Studies, v. 8, no. 3). Branson and Mehl (1933) did not distinguish between their supposed distribution of the Grassy Creek conodont fauna and the distribution of the Grassy Creek shale. Hence, they seem to suggest the substitution of the name Grassy Creek for such regional designations of strata as Noel, Chattanooga, and others. This procedure is now believed to be ill-advised. Considered Upper Devonian.

Type locality (Mehl, 1960): Mississippi River bluff in Pike County, Mo., some distance above Champ Clark Bridge (approximately SW¼NW¼ NE¼ sec. 18, T. 54 N., R. 1 W.). This is same type locality at given for Saverton shale.

Grassy Knob Chert[1]

Lower Devonian: Southwestern Illinois.

Original reference: T. E. Savage, 1925, Am. Jour. Sci., 5th, v. 10, p. 139–144.

J. M. Weller, 1939, Kansas Geol. Soc. Guidebook 13th Ann. Field Conf., p. 127, 128; 1940, Illinois Geol. Survey Rept. Inv. 71, p. 22–23. Recognized in Illinois only where Backbone limestone can be identified to separate it from Clear Creek chert. Beds assigned by Bassett (1925, Illinois Acad. Sci. Trans., v. 18) to Grassy Knob chert attain thickness of 225 feet at north end of Devonian exposures in Mississippi River bluffs. There appears to be no stratigraphic break between this formation and underlying Bailey limestone, and it is probable that in the midst of this succession unweathered beds have been referred to the Bailey and weathered strata at same horizon have been assigned to the Grassy Knob.

L. E. Workman, 1954, *in* Geologic cross section of Paleozoic rocks central Mississippi to northern Michigan: Tulsa, Okla., Am. Assoc. Petroleum Geologists, p. 1. There is actually no means of separating the so-called Grassy Knob chert above from the Bailey limestone below. Evidently the chert is a concentration of silica in upper part of a single formation, the Bailey. It is recommended that only the term Bailey be used to designate the strata underlying the Little Saline and overlying Silurian strata.

Type locality: West side of Grassy Knob, 3½ miles southeast of Grand Tower, Jackson County.

Grassy Mountain Basalt[1]

Miocene and Pliocene(?): Southeastern Oregon.

Original references: K. Bryan, 1929, U.S. Geol. Survey Water-Supply Paper 597, p. 55; B. C. Renick, 1930, Jour. Geology, v. 38, p. 506.

E. M. Baldwin, 1959, Geology of Oregon: Ann Arbor, Mich., Edwards Brothers, Inc., p. 109. Overlies Pinnacle Point beds (new).

Named for the fact it caps Grassy Mountain, Malheur County.

Grassy Swale Lavas

Cenozoic. Northern California.

Howel Williams, 1932, California Univ. Pub., Bull. Dept. Geol. Sci., v. 21, no. 8, p. 295. Name applied to lavas that lie near contact between black andesites of Central Plateau and the pale flows of Saddle Mountain (Saddle Mountain lavas), but whether they are older or younger, intrusive or extrusive, is not known.

Grassy Swale shown on map in Lassen Volcanic National Park east of Mount Lassen.

Graters Member (of Brunswick Formation)

Graters Shales (in Brunswick Formation)[1]

Upper Triassic: Southeastern Pennsylvania and western New Jersey.

Original reference: D. B. McLaughlin, 1933, Geol. Soc. America Bull., v. 44, no. 1, p. 179.

M. E. Johnson and D. B. McLaughlin, 1957, Geol. Soc. America Guidebook for field trips Atlantic City Mtg., p. 51. Stratigraphic section shows Graters member consists of (ascending) red shale, 220 feet; black and gray shale and argillite, 50 feet; red shale, 42 feet; black and gray shale and argillite, 42 feet. Occurs about 2,000 feet above base of formation.

Named for exposures in Landis Brook just west of Grater's Ford, on Perkiomen Creek, Montgomery County, Pa.

Gratiot Flow (in Portage Lake Lava Series)

Precambrian (Keweenawan) : Northern Michigan.

J. C. Wright and H. R. Cornwall, 1954, Bedrock geology of the Bruneau Creek quadrangle, Michigan: U.S. Geol. Survey Geol. Quad. Map [GQ–35]. Ophitic basalt flow wih numerous pegmatitic layers in upper half. About 850 feet thick near road to Lake Gratiot. Thins rapidly toward southwest and about 1 mile west of Bruneau Creek quadrangle is only 130 feet thick. Where it is thinnest, many thin melaphyre layers occupy the interval between it and the Scales Creek flow.

Exposed near road to Lake Gratiot in sec. 36, T. 58 N., R. 31 W., Bruneau Creek quadrangle.

Gratton Limestone

Middle Ordovician : Southwestern Virginia and northeastern Tennessee.

B. N. Cooper and C. E. Prouty, 1943, Geol. Soc. America Bull., v. 54, no. 6, p. 836–838, 872–873, 884 (fig. 3), pl. 5. In Tazewell County the strata embraced by the Chazyan and Black River groups of Butts (1940, Virginia Geol. Survey Bull. 52, pt. 1) are subdivided into (ascending) 29 zones. Name Gratton limestone applied to lower laminated limestone (zone 14) and overlying third calcilutite (zone 15). Thickness varies from 0 to 120 feet and averages about 60 feet in northeastern half of county. In Clear Fork Valley and in Clinch-Bluestone belt northeast of Five Oaks, directly underlies upper laminated limestone (zone 22, included in newly defined Witten limestone) and overlies Burkes Garden member of Benbolt limestone (both new) ; in other parts of the county, underlies Wardell formation (new) ; between Pisgah and Five Oaks, overlies either Cliffield formation (new) or Shannondale member (new) of Benbolt limestone. The Gratton corresponds to lower part of Butts' Lowville-Moccasin east of Tazewell, but he includes it in his Ottosee formation southwest of Tazewell.

C. E. Prouty, 1946, Am. Assoc. Petroleum Geologists Bull., v. 30, no. 7, p. 1165–1166. Geographically extended into northeastern Tennessee. Formation thins toward southwest as underlying Benbolt and overlying Wardell thicken. Between Tazewell and Sharps Chapel, the Gratton rests directly on Beekmantown dolomites and locally has thickness of several hundred feet.

Type section: Tazewell County Farm, Tazewell County, Va. Named for exposures near Gratton, about 5 miles east of Tazewell.

Gratz Shale[1] Member (of Cynthiana Formation)

Middle or Upper Ordovician : Northern Kentucky and southern Ohio.

Original reference: E. O. Ulrich, 1911, Geol. Soc. America Bull., v. 22, p. 416–418, 569, pl. 27.

J. J. Wolford, 1937, Geol. Soc. America Proc. 1936, p. 113. At type locality, Gratz division of the Cynthiana series is 40 feet thick. Middle Ordovician.

A. C. McFarlan and W. H. White, 1948, Am. Assoc. Petroleum Geologists Bull., v. 39, no. 8, p. 1643. Consists of rather barren shale and fine-grained earthy limestone forming upper part of Cynthiana in Henry and Owen Counties. Essentially a barren facies including in its upper part the Rogers Gap. Pre-Cincinnatian.

D. K. Hamilton, 1950, Kentucky Geol. Survey, ser. 9, Bull. 5, p. 18. In northeastern Kentucky, uppermost member of Cynthiana. Overlies Bromley member.

Type locality: Village of Gratz, Owen County, Ky.

Gravel Creek Sand Member (of Nanafalia Formation)

Eocene, lower: Southwestern Alabama.

P. E. LaMoreaux and L. D. Toulmin, 1959, Alabama Geol. Survey County Rept. 4, p. 96 (fig. 32), 98, 99 (fig. 33), 100–106, 110–111, 120–121, pls. 2, 3. Name applied to lowest member of formation. Consists of white to yellow medium- to coarse-grained crossbedded sand with thin lenses of fine gravel and clay pebbles. Thickness 2 to 80 feet; 47 feet at type locality. Thickest in updip exposures; pinches out downdip to south in separate narrowing lenses of sand; absent in some areas. Generally unfossiliferous except for borings of *Halymenites*. Underlies unnamed middle member; unconformably overlies Coal Bluff member of Naheola formation. Transgressive and in places oversteps older formations. Sand beds included in member have been called Fearn Springs sand member (MacNeil, 1946), type locality of which is in Winston County, Miss. Boundary positions at Fearn Springs type locality are in dispute, and stratigraphic relationships with section in Alabama uncertain; hence, new name used in this report.

Type locality: South wall of Gravel Creek, 7.1 miles south of Camden, Wilcox County, on highway to Monroeville. Present in outliers far north of normal outcrop area.

Gravel Point Limestone or Formation

Gravel Point Stage[1]

Middle Devonian: Northwestern Michigan.

Original reference: E. R. Pohl. 1930, U.S. Nat. Mus. Proc., v. 76, art. 14, p. 2–25.

L. L. Sloss, 1939, Jour. Paleontology, v. 13, no. 1, p. 52. For purposes of this report, Pohl's divisions of Traverse beds, Petoskey, Charlevoix, and Gravel Point, are referred to as faunal zones.

G. A. Cooper and A. S. Warthin *in* G. A. Cooper and others, 1942, Geol. Soc. America Bull., v. 53, no. 12, pt. 1, p. 1763, chart 4. At base of Gravel Point limestone (or formation), a foot of calcareous shale contains fossils like those in blue shale 40 feet below top of Alpena limestone; at top of Gravel Point, another blue shale, "the upper blue shale," or zone 6 of Pohl, contains crinoids and brachiopods similar to those of Dock Street clay at top of Alpena. Therefore, interval occupied by Gravel Point is essentially that of upper 40 feet of Alpena.

W. A. Kelly and G. W. Smith, 1947, Am. Assoc. Petroleum Geologists Bull., v. 31, no. 3, p. 448 (fig. 1), 455–460. In Afton-Onaway area, formation subdivided to include Gorbut member near middle. Overlies Koehler formation and underlies Beebe School formation (both new).

Named for exposures south of Gravel Point, 1½ miles west of Charlevoix, Charlevoix County.

Graves Creek Formation[1]

Pleistocene: Western Kentucky.

Original reference: L. C. Glenn, 1912, Kentucky Geol. Survey Rept. Prog. 1910 and 1911, p. 26.

On Graves Creek, Webster County.

Graves Gap Group

Pennsylvanian (Pottsville Series) : Eastern Tennessee.

C. W. Wilson, Jr., J. W. Jewell, and E. T. Luther, 1956, Pennsylvanian geology of the Cumberland Plateau: Tennessee Div. Geology [folio], p. 1, 11, 19, pls. 2, 3, 4, 6, 8. Includes all strata from top of Indian Bluff group (new) below to base of Redoak Mountain group (new) above; that is, between the top of the Pioneer sandstone and the top of the Windrock coal. In type section where Armes Gap sandstone (new) is thin and Roach Creek sandstone (new) is apparently absent, thickness of group is 365 feet; in Cross Mountain-Briceville-Graves Gap area, thickness averages 360 feet but elsewhere is 200 to 300 feet. Includes (ascending) shale interval, Armes Gap sandstone (new), and Windrock coal.

Type locality: Cross Mountain, Lake City quadrangle, Anderson County. Section begins with top of Pioneer sandstone at Mountain View Church and ends at top of Windrock coal about 80 feet above Cumberland Mountain Church. Name derived from Graves Gap on State Highway 116 in southwestern part of quadrangle.

†Gravina Series[1]

Upper Triassic and Jurassic or Cretaceous : Southeastern Alaska.

Original reference: A. H. Brooks, 1902, U.S. Geol. Survey Prof. Paper 1, p. 40–52, map.

Occurs at Dall Head and elsewhere on southern end of Gravina Island.

Gravoisan glacial epoch[1]

Pleistocene : Missouri.

Orignal reference : C. R. Keyes, 1925, Pan-Am. Geologist, v. 44, p. 140–141.

Named for occurence on Gravois Creek, near Osage River, Morgan County.

Gray Porphyry Group[1]

Upper Cretaceous(?) or Tertiary, lower: West-central Colorado.

Original references: S. F. Emmons, 1882, U.S. Geol. Survey 2d Ann. Rept., p. 215–230; 1883, U.S. Geol. Survey Leadville Atlas; 1886, U.S. Geol. Survey Mon. 12, p. 80; 1927, U.S. Geol. Survey Prof. Paper 148.

C. H. Behre, Jr., 1953, U.S. Geol, Survey Prof. Paper 235, p. 46–47, pl. 1. As used in this report, includes Iowa Gulch, Lincoln, Sacramento, Evans Gulch, and Johnson Gulch porphyries. Mount Zion porphyry not recognized in immediate area [west slope of Mosquito Range].

Term originally applied in Leadville district.

Grayback Flows, Lavas

Pleistocene to Recent: Southwestern Oregon.

Howel Williams, 1942, Carnegie Inst. Washington Pub. 540, p. 37. Probably first dacites erupted by Mount Mazama were those forming Grayback Ridge and southern end of Vidae Ridge. They predate time of maximum glaciation of Mount Mazama and are older than lavas of Llao Rock, Cleetwood Cove, Grouse Hill, and Redcloud Cliff. Grayback flows thicken southward to as much as 1,000 feet in southeast corner of park.

Grayback Ridge is south of Crater Lake.

Grayback Formation[1]

Devonian : Northwestern California.

Original reference: J. H. Maxson, 1933, California Jour. Mines and Geology, v. 29, nos. 1 and 2, p. 128, map.

Occurs at Little Grayback, a peak in Siskiyou County.

Grayback wash[1]

Quaternary : Central southern Colorado.

Original reference: G. M. Butler, 1910, Colorado Geol. Survey Bull. 2, p. 59–61, pl. 2.

In Grayback mining district, Costilla County.

Grayback Mountain Rhyolite Tuff

Upper Cretaceous (?) or (?) Tertiary, lower : West-central Arizona.

C. A. Anderson, E. A. Scholz, and J. D. Strobell, Jr., 1955, U.S. Geol. Survey Prof. Paper 278, p. 1, 21–22, pl. 3. Rather massive welded rhyolite tuff. Classified as lithic-crystal-vitric. About 500 feet of tuff exposed in thicker sections. Rests on an eroded surface of unnamed alaskite porphyry.

Exposed only on Grayback Mountain, in southwestern corner of Bagdad area, Yavapai County.

†Gray Bull Beds[1]

Gray Bull Member[1]

Eocene, lower : Western Wyoming.

Original reference: W. Granger, 1914, Am. Mus. Nat. History Bull., v. 33, p. 202–205.

G. L. Jepson, 1940, Am. Philos. Soc. Proc., v. 83, no. 2, p. 238. Overlies Clark Fork beds in Polecat Bench formation (new).

H. E. Wood 2d and others, 1941, Geol. Soc. America Bull., v. 52, no. 1, p. 20–21. Although usually considered a faunal zone, Gray Bull should be considered a member of the so-called "Bighorn Wasatch", a formation for which no valid name has yet been proposed.

G. L. Jepson and F. B. Van Houten, 1947, Wyoming Geol. Assoc. Guidebook 2d Ann. Field Conf., p. 148 (chart 1). Chart shows Gray Bull beds in basal part of Willwood formation. Occur below Lost Cabin or Lysite beds.

Named for exposures along Gray Bull River.

Grayburg Formation (in Whitehorse Group or Artesia Group)

Permian (Guadalupe Series) : Subsurface and surface in southeastern New Mexico and subsurface in western Texas.

R. K. DeFord, 1939, *in* Addison Young, Max David, and E. A. Wahlstrom, Am. Assoc. Petroleum Geologists Bull., v. 23, no. 10, p. 1551. Name Grayburg will be proposed by R. I. Dickey.

R. I. Dickey, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 1, p. 44–47. Basal unit of Whitehorse group. In type well, underlies Queen formation and overlies San Andres formation. Lies between depths of 2,380 feet and 2,647 feet. Predominantly dolomite, gray, pink, white; locally sandy, some beds of anhydrite present.

W. R. Moran, 1954, (abs.) Geol. Soc. America Bull., v. 65, no. 12, pt. 2, p. 1288. At surface type section, herein designated, Grayburg is 475 feet thick, consists of alternating sandstone and dolomites and underlies Queen formation.

P. T. Hayes and R. L. Koogle, 1959, U.S. Geol. Survey Geol. Quad. Map GQ–112. Described in Carlsbad Caverns West quadrangle which contains Moran's type section. Top of formation, as proposed by Moran, is unmodified in this report. Basal contact is probably 40 to 50 feet above that used by Moran who apparently included part or all of what is here mapped as tongue of San Andres formation. Basinward gradation of Grayburg into lower part of Goat Seep limestone (Newell, 1953) is not exposed in this quadrangle but can be seen in quadrangles to west and southwest [Whitehorse group not used in area of this report].

Term Artesia Group (D. B. Tait and others, 1962, Am. Assoc. Petroleum Geologists Bull., v. 46, no. 4) used in preference to Whitehorse Group in New Mexico.

Type well: Cecil H. Lockhart's Root Permit No. 2, in center SW¼SW¼ sec. 7, T. 17 S., R. 30 E., Eddy County, N. Mex. Name derived from Grayburg Pool.

Type section (surface): On a spur and in an unnamed canyon above Sitting Bull Spring in NE¼ sec. 9, T. 24 S., R. 22 E., Eddy County.

†Gray Cliff group[1]

Jurassic(?): Central southern Utah.

Original reference: G. K. Gilbert, 1877, Geology of Henry Mountains, p. 6, 7.

Henry Mountains region.

†Gray Cliff Sandstone[1]

Jurassic(?): Central southern Utah.

Original reference: G. K. Gilbert, 1877, Geology of Henry Mountains, p. 6, 7.

Henry Mountains region.

Graydon Channel Sandstone[1]

Graydon Formation (in Cherokee Group)

Pennsylvanian: Western and central Missouri.

Original reference: A. Winslow, 1894, Missouri Geol. Survey, v. 7, p. 422–425.

T. R. Beveridge, 1951, Missouri Geol. Survey and Water Resources, v. 32, 2d ser., p. 53–55, pl. 11. Youngest indurated formation exposed in Weaubleau Creek area. Underlies Dederick subgroup of the Cherokee (Des Moines series); where the Dederick is absent, lies on deeply eroded Mississippian or Ordovician.

T. J. Laswell, 1957, Missouri Geol. Survey and Water Resources Rept. Inv. 22, p. 47. Name "Graydon" is now used informally by the Missouri Geological Survey to refer to deposits which lie below the Cheltenham clays in northeastern Missouri. Term Graydon applied in southwestern Missouri apparently includes much of the deposits now assigned to the Venteran age, and the deposits below the Cheltenham clays cannot now be assigned with certainty to any part of it.

Named for exposures at Graydon Springs, Polk County.

Graydon Shales[1]

Pennsylvanian : Southwestern Missouri.

Original reference: E. M. Shepard, 1905, Bradley Geol. Field Sta. Drury Coll. Bull., v. 1, p. 56.

Green County.

†Graydon Springs Sandstone and Conglomerate[1]

Pennsylvanian : Western and central Missouri.

Original reference: A. Winslow, 1894, Missouri Geol. Survey, v. 7, p. 422–425.

Probably named for exposures at Graydon Springs, Polk County.

Gray Gulch Formation

Tertiary : Central Utah.

E. M. Spieker, 1949, Utah Geol. Soc. Guidebook 4, p. 37–38, [pl. 1]. Consists of sandstones and shales, some of volcanic derivation and others not; fresh-water limestones; bentonites; ash beds; agglomerates; and other volcanic derivatives, generally gray to blue but locally punctuated by beds and blotches of bright orange. Provisionally divided into two units which may prove on detailed study to be distinct formations. Disconformably overlies Crazy Hollow formation (new) ; unconformably underlies unnamed lava beds. It is possible that formation is same as the Bullion Canyon, and, if so, that name will be used. At present, correlation is too uncertain to allow use of either Moroni or Bullion Canyon.

D. P. McGookey, 1960, Am. Assoc. Petroleum Geologists Bull., v. 44, no. 5, p. 605–606. Formation as designated by Spieker (1949) includes strata equivalent to Bald Knoll formation of Gilliland (1951), part of Bullion Canyon volcanics of Callaghan (1939) and a previously unnamed interval that was mapped as Gray Gulch(?) by Lautenschlager (1952, unpub. thesis). Proposed that term Gray Gulch be abandoned. Term Bald Knoll formation used for lower part of interval formerly assigned to Gray Gulch. Name Dipping Vat (new) applied to upper coarse interval of lacustrine beds formerly included in Gray Gulch. Type section stated.

Type section: Exposed in Gray Gulch, W½ sec. 32, T. 21 S., R. 1 E., Salina district.

Grayhorse Limestone Member (of Vanoss Formation)

Grayhorse Limestone Member (of Wood Siding Formation)

Grayhorse Limestone Member (of Caneyville Formation)

Grayhorse Limestone Member (of Sand Creek Formation)[1]

Pennsylvanian (Virgil Series) : Central northern Oklahoma and eastern Kansas.

Original reference: K. C. Heald, 1918, U.S. Geol. Survey Bull. 686–K, p. 130.

R. C. Moore, J. C. Frye, and J. M. Jewett, 1944, Kansas Geol. Survey Bull. 52, pt. 4, p. 172. Classed as member of Caneyville limestone in Kansas. Overlies unnamed shale ; underlies Pony Creek shale.

R. C. Moore and M. R. Mudge, 1956, Am. Assoc. Petroleum Geologists Bull., v. 40, no. 9, p. 2273, 2274 (fig. 1). Reallocated to Wood Siding formation herein redefined. Overlies Plumb shale member (new) ; underlies Pony Creek shale member.

U.S. Geological Survey currently classifies the Grayhorse Limestone as a member of the Vanoss Formation in Oklahoma.

Named for exposure on crest of Little Grayhorse anticline in NW¼ sec. 11, T. 24 N., R. 6 E., Osage County, Okla.

Graylock Formation

Lower Jurassic: Northeastern Oregon.

W. R. Dickinson, 1960, Dissert. Abs., v. 20, no. 11, p. 4367. Overlies Rail Cabin formation (new). Hettangian.

Type locality and derivation of name not stated. Report discusses Izee area, Grant County.

Gray Mesa Member (of Madera Limestone)

Pennsylvanian: West-central New Mexico.

V. C. Kelley and G. H. Wood, 1946, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 47. Thick- to thin-bedded, predominantly cherty and gray to dark-gray ledgy limestone with minor amount of gray shale and gray to brown fine- to coarse-grained sandstone. Thickness 850 to 900 feet. Conformably underlies Atrasado member (new); conformably overlies Sandia formation.

Extends in continuous outcrop from Comanche Arroyo along steep east face of Gray Mesa and southward past Monte de Belen. Another belt extends from Red Tanks Arroyo near Salaido Ranch southeastward into west slopes of Ladron Mountains. Most completely exposed section lies in steep east face of Monte de Belen, Socorro and Valencia Counties.

Grayson Granodiorite Gneiss

Grayson Granite Gneiss[1]

Precambrian: Southwestern Virginia.

Original reference: A. I. Jonas, 1928, Virginia Geol. Survey prelim. ed. of geol. map of Virginia.

A. J. Stose and G. W. Stose, 1957, Virginia Div. Mineral Resources Bull. 72, p. 38–41, pl. 1. Porphyritic gneiss of granodiorite composition; hence, termed Grayson granodiorite gneiss. Injected by aplite and diabase of Mount Rogers volcanic series.

Covers most of Grayson County. Forms crest of Point Lookout Mountain, the southeastern spurs of Brierpatch Mountain, and crest of Buck Mountain. Widely distributed in Elk Creek anticline.

Grayson Marl, or Formation (in Washita Group)

Grayson Marl Member (of Denison Formation)[1]

Upper Cretaceous (Comanche Series): Northeastern Texas, central southern Oklahoma, and northern Mexico.

Original reference: F. W. Cragin, 1894, Colorado Coll. Studies, v. 5, p. 43–48.

R. W. Imlay, 1944, U.S. Geol. Survey Oil and Gas Inv. Prelim. Chart 3. Correlation chart shows Grayson shale in Washita group. Upper Cretaceous (lower Cenomanian). Underlies Buda limestone; overlies Georgetown limestone and in some area, Main Street limestone. [Grayson replaces Del Rio which is abandoned.] Present in Chihuahua, Mex.

L. W. Stephenson, 1944, Am. Assoc. Petroleum Geologists Bull., v. 28, no. 10, p. 1538–1541. Discussion of fossils from limestone of Buda age in Denton

County. If it is admitted that this limestone is a facies of Buda age in upper part of Grayson marl, then the Grayson is not exact equivalent of Del Rio but includes equivalents of both Del Rio and Buda.

S. S. Goldich and M. A. Elms, 1949, Geol. Soc. America Bull., v. 60, no. 7, p. 1138 (table 1), 1139–1140, pl. 1. Grayson clay described in Buck Hill quadrangle, Texas, where it is 60 to 76 feet thick; overlies Georgetown limestone and disconformably underlies Buda limestone. Lower Cretaceous.

Elliot Gillerman, 1953, U.S. Geol. Survey Bull. 987, p. 11 (table 1), 27–31, pl. 1. In Eagle Mountains, Tex., formation is divided into (asending) Carpenter limestone (new), reef-limestone, and Eagle Mountains sandstone (new) members. Thickness 200 feet. Overlies Georgetown limestone; underlies Buda limestone. Upper Cretaceous.

L. W. Stephenson, 1953, U.S. Geol. Survey Prof. Paper 243–E, p. 58. Grayson marl (formerly Del Rio clay) unconformably underlies Pepper shale member of Woodbine formation.

Robert Greenwood, 1956, Gulf Coast Assoc. Geol. Soc. Trans., v. 6, p. 167–177. Shale described in Uvalde County, Tex., where it includes West Prong lentil (new) in basal part. West Prong shows penecontemporaneous relationship with overlying volcanic materials of Grayson. Overlies Georgetown limestone; underlies Buda limestone. Thickness 100 to 150 feet. In west and south Texas, formation has been called Del Rio clay.

R. G. Yates and G. A. Thompson, 1959, U.S. Geol. Survey Prof. Paper 312, p. 9–10, pl. 1. Formation described in Terlingua district, Texas, where it is 80 to 200 feet thick; overlies Devils River limestone and underlies Buda limestone. Undifferentiated in this area.

B. F. Perkins, 1960, Geol. Soc. America Mem. 83, p. 9 (fig. 3), 12 (fig. 4), 35–38. In Fort Worth area, Grayson marl member of Denison is about 80 feet thick and divisible into four subdivisions (ascending): yellowish-gray marl 18 feet thick with abundant *Exogyra arientina* Roemer, containing in lower 3 to 5 feet a small number of lenticular bodies of hard highly fossiliferous clastic limestone about 5 to 8 feet long and 1 foot in maximum thickness; unfossiliferous yellow to greenish-gray marly clay 24 feet thick; highly fossiliferous gray marl 21 feet thick with buff marly limestone and clay; greenish-gray marly clay less fossiliferous than underlying unit. Overlies Main Street limestone member; underlies Buda limestone.

Named for numerous outcrops in Grayson County, Tex.

†Graysonton Formation[1]

Lower and Middle Cambrian: Southwestern Virginia.

Original reference: M. R. Campbell, 1894, Geol. Soc. America Bull., v. 5, p. 171, 175, 183, pl. 4.

Named for Graysonton, Montgomery County.

Graysville Limestone

See Grayville Formation.

Graysville Member (of Stonehenge Limestone)

Lower Ordovician (Canadian): Central Pennsylvania.

A. C. Donaldson, 1960, Dissert. Abs., v. 20, no. 9, p. 3693. Overlies Spring Creek member (new); underlies Baileyville member (new). Contains pebbles but lacks oolites which characterize underlying Spring Creek member.

Type locality and derivation of name not stated.

Grayville Formation[1]

Grayville Limestone (in McLeansboro Formation)

Grayville Limestone (in Wabash Formation)

Pennsylvanian: Southeastern Illinois and southwestern Indiana.

Original reference: M. A. Harrell, 1935, Indiana Dept. Conserv. Pub. 133.

J. A. Culbertson, 1932, The paleontology and stratigraphy of the Pennsylvanian strata between Caseyville, Kentucky, and Vincennes, Indiana: Urbana, Ill., Univ. Illinois, Abs. Thesis, p. 3, 7. Gray fossiliferous limestone in McLeansboro formation. Underlies Lawrenceville shale (new); separated from underlying Mumford Hills sandstone (new) by Aldrich coal.

Marshall Harrell, 1935, Indiana Div. Geology Pub. 133, p. 73 (chart). Chart shows post-Alleghenian Grayville formation as a subdivision of the Wabash. In the sequence occurs between Buffkin above and McClearys Bluff formation.

H. R. Wanless, 1939, Geol. Soc. America Spec. Paper 17, p. 85. There is some doubt that these beds [Grayville formation] overlie McClearys Bluff beds and underlie Buffkin beds; superposition of formations may be erroneous.

R. C. Moore and others, 1944, Geol. Soc. America Bull., v. 55, no. 6, Chart 6 (col. 25). Correlation chart shows Graysville limestone in Wabash formation below Livingston limestone and above Buffkin limestone.

Named from typical exposures at Grayville, White County, Ill.

Grazier Formation (in Hatter Group)

Grazier Member (of Hatter Formation)

Middle Ordovician (Bolarian): Central and south-central Pennsylvania.

G. M. Kay, 1943, Econ. Geology, v. 38, no. 3, p. 193. Middle member of formation. Described as dark, dense, heavy ledged stylolitic limestone with wavy argillaceous partings; tends to weather with rows of holes. Thickness 33 feet at type section. Underlies Hostler member (new); overlies Eyer member (new). Chazyan series.

G. M. Kay, 1944, Jour. Geology, v. 52, no. 1, p. 10. Thickness 7 to 60 feet; thins southeastward. Conformably underlies more siliceous Hostler member in all exposures. Disconformably overlaps Eyer member northeastward from type section so as to lie on Clover member of Loysburg formation. Contact with Clover is a slightly undulating stylolitic bedding plane separating sharply differing lithologies. Derivation of name.

Marshall Kay, 1948, Am. Assoc. Petroleum Geologists Bull., v. 32, no. 8, p. [1402], 1407. Rank raised to formation in Hatter group or Hatterian subseries (Bolarian series).

Marshall Kay, 1956, Geol. Soc. America Bull., v. 67, no. 1, p. 82, 102. Discussed as a member.

Type section: On two sides of Pennsylvania Railroad cut north of Union Furnace, Huntingdon County. Named for Grazier Mills northeast of Union Furnace.

Greasy Cove Formation

Upper Mississippian: Eastern Tennessee.

R. B. Neuman and R. L. Wilson, 1960, U.S. Geol. Survey Geol. Quad. Map GQ–131. Gray argillaceous limestone (about 40 percent), red shale and fine-grained sandstone (10 percent), gray shale and siltstone (25 percent), and gray fine-grained sandstone (25 percent), all interbedded. Thickness at least 400 feet, top faulted. Overlies Grainger formation. Name replaces Newman limestone formerly used in this area because Newman at its type locality consists of relatively pure limestone.

Type section: Along small unnamed creek southeast of Butterfly Gap, Blockhouse quadrangle. Named from Greasy Cove.

Greasy Creek facies (of Fort Payne Formation)

Lower Mississippian: Northern Tennessee and southern Kentucky.

H. J. Klepser, 1937, Ohio State Univ. Abs. Doctors' Dissert. 24, p. 182. Listed as northern facies of Fort Payne formation.

P. B. Stockdale, 1939, Geol. Soc. America Spec. Paper 22, p. 49, 53, 76. Variable in lithology, ranging from silty shale to siltstone to crinoidal limestone; gray siltstone, which prevails, is generally massive. Facies overlies Maury formation in Tennessee. Listed under Brodhead formation in Kentucky. Derivation of name given.

Named from Greasy Creek, central Russell County, Tenn.

Great Conglomerate[1] (in Copper Harbor Group)

Precambrian (Keweenawan): Northern Michigan and Wisconsin.

Original reference: R. D. Irving, 1883, U.S. Geol. Survey Mon. 5, p. 186, pls. 17, 18.

T. M. Broderick, C. D. Hohl, and H. N. Eidemiller, 1946, Econ. Geology, v. 41, no. 7, p. 679. Name appears in stratigraphic column of Michigan copper district. Thickness 1,757 feet.

Named for fact it was supposed to be very much thicker than Outer conglomerate.

Great Bend coal group[1]

Paleocene: North Dakota.

Original reference: A. G. Leonard, 1908, North Dakota Geol. Survey 5th Bienn. Rept.

†Great Bend Conglomerate[1]

Pennsylvanian: Pennsylvania.

Original reference: F. A. Randall, 1875, Pennsylvania 2d Geol. Survey Rept. I, p. 51–54.

At Great Bend, Warren County.

Great Bend Limestone (in Chemung Formation)[1]

Upper Devonian: Northeastern Pennsylvania.

Original reference: I. C. White, 1881, Pennsylvania 2d. Geol. Survey Rept. G_5, p. 91.

Occurs at Great Bend, Susquehanna County.

Great Blue Limestone[1] or Formation

Upper Mississippian: Central northern Utah.

Original reference: J. E. Spurr, 1895, U.S. Geol. Survey 16th Ann. Rept., pt. 2, p. 374–376.

H. R. Cramer, 1954, Dissert. Abs., v. 14, no. 10, p. 1681. Discussion of coral zones in Mississippian of Great Basin area. Great Blue limestone, which is stratigraphically and lithologically similar to the more properly though later named Ochre Mountain limestone, is dropped.

H. T. Morris, 1957, Utah Geol. Soc. Guidebook 12, p. 15 (fig. 4), 20–22. Described in East Tintic Mountains where it is 2,400 to 2,600 feet thick; underlies Manning Canyon shale and overlies Humbug formation. Includes (ascending) basal limestone member about 400 feet thick; limestone and shale member about 650 feet; shale and quartzite member 850 to 1,000 feet; and an upper limestone member about 600 feet.

J. K. Rigby, 1958, Utah Geol. Soc. Guidebook 13, p. 38 (fig. 5), 46–48. Described in Stansbury Mountains where it is 980 to 1,300 feet thick; overlies Humbug formation and underlies Manning Canyon formation.

R. E. Cohenour, 1959, Utah Geol. and Mineralog. Survey Bull. 63, p. 12 (table 1), 90–93, 172–173, 174–177, pl. 1. Formation described in Sheeprock Mountains area where it is about 4,139 feet thick and is divided into lower limestone, 911 feet; Chiulos shale member (new), 1,818 feet; and upper limestone, 1,410 feet. Gradationally overlies Humbug formation; in fault contact with Pennsylvanian Oquirrh formation.

J. R. Rigby, 1959, Utah Geol. Soc. Guidebook 14, p. 55–58. Spurr (1895) did not designate type area for formation. Gilluly (1932, U.S. Geol. Survey Prof. Paper 173) applied name only in slightly different manner than used by Spurr, in his study of Stockton and Fairfield quadrangles. Great Blue limestone crops out in much of southwestern part of mapped area [southern Oquirrh Mountains]. Overlies Humbug formation; lower boundary arbitrarily taken in most places at top of highest orthoquartzite, quartzitic sandstone, or calcarenite of significance in the Humbug. Three major divisions: lower limestones, shales below the middle, and limestone above. Gilluly's (1932) Long Trail shale member recognized and mapped.

H. J. Bissell, 1959, Utah Geol. Soc. Guidebook 14, p. 166–167. In Five Mile Pass and northern Boulter Mountain area, comprises three members. Lower consists of 368 feet of massive dark-gray-blue fine to coarse crystalline and medium-grained limestones which weather light blue gray. Upper consists of blue-gray and gray-blue limestones which superficially resemble basal member. Overlies Humbug formation; underlies Manning Canyon shale.

First described in Oquirrh Mountains region.

†Great Falls coal series[1]

†Great Falls Group[1]

Lower Cretaceous: Central northern Montana.

Original references: J. S. Newberry, 1887, School Mines Quart., v. 8, p. 328; 1891, Am. Jour. Sci., 3d v. 41, p. 193.

Great Falls region.

Great Falls Lake Sands

Pleistocene: Northwestern Montana.

J. B. Lyons. 1944, Geol. Soc. America Bull., v. 55, no. 4, p. 449 (fig. 2), 452, pl. 1. Fine-grained, well-bedded yellow sands. Thickness 0 to 250 feet; 150 feet at Craig. Unconformably overlie Adel Mountain volcanics (new). Present only in river valleys.

Derivation of name not stated. Area of report includes about 990 square miles of northern end of Big Belt Range and adjacent plains.

Great Hill Formation

Lower Silurian: Central Connecticut.

G. P. Eaton and L. J. Rosenfeld, 1960, Internat. Geol. Cong., 21st, Copenhagen, pt. 2, p. 170 (fig. 1), 171 (table 1). Quartzite, quartzite conglomerate, and kyanitic quartz-sericite schist. Unconformably overlies Collins Hill formation; underlies Mine Brook formation (new). Previous workers with the exception of Percival (1842, Report on the Geology of the State of Connecticut: New Haven), grouped the sequence of rocks from Collins Hill schist through Camp Jenkins schist (new) as a single formation, and believed it to be intruded by Glastonbury, Maromas, and Haddom gneisses. Present work shows that these rocks represent four distinct formations, with unconformity separating Collins Hill from the others.

Great Hill is in central part of Middle Haddam quadrangle, Middlesex County.

Great Meadows Formation

Lower Ordovician: East-central New York.

John Rodgers, 1952, *in* M. P. Billings, John Rodgers, and J. B. Thompson, Jr., Geol. Soc. America Guidebook for field trips in New England, p. 35 (table 2). Described as mainly dolomite. Prominent basal crossbedded sandstone. Includes Fort Ann limestone, a persistent layer at top. Thickness 110 feet. Overlies Baldwin Corner formation (new). Refers to R. H. Flower (unpub. ms.).

Occurs in Fort Ann quadrangle.

Great Sitkin Volcanics

Tertiary and Quaternary: Southwestern Alaska.

F. S. Simons and D. E. Mathewson, 1947, U.S. Geol. Survey Alaskan Volcano Inv. Rept. 2, pt. 4, p. 63, pls. 4, 5; 1955, U.S. Geol. Survey Bull. 1028–B, p. 29–31, pl. 5. Comprise the rocks of the main cone of Great Sitkin Volcano. Included are rocks of the cone itself, a newly formed crater dome and five older plugs, basalt flow of Sitkin Valley, and parasitic tuff cone on northwest flank of main cone. Main cone is composite of flows and tuff beds with flows predominating, at least in upper part of cone. Flow rocks predominantly of porphyritic andesite and basalt. Excellent exposures of lavas displayed in walls of crater. Crater occupied by a dome composed of black glassy porphyritic basalt. Basalt flow near head of Sitkin Creek was extruded from flank of cone and is only fairly young flow known; 100 to 125 feet thick, with prominent columnar jointing. Great Sitkin volcanics unconformably overlie Sand Bay volcanics (new). Most of the rocks of main cone buried under thin blanket of pumice and rock fragments.

Great Sitkin Volcano forms northern half of Great Sitkin Island, in central part of Aleutian Islands.

Great Smoky Group

Great Smoky Conglomerate[1]

Great Smoky Formation or Quartzite

Precambrian (Ocoee Series) : Central northern Georgia, eastern Tennessee, and western North Carolina.

Original reference: A. Keith, 1907, U.S. Geol. Survey Geol. Atlas, Folio 143, p. 3.

G. W. Crickmay, 1936, Geol. Soc. America Bull., v. 47, no. 9, p. 1381. In Nantahala, Ellijay, and Tate folios, Great Smoky formation, which is at base of sequence here included in Talladega series, is mapped with unconformable relation to Carolina gneiss. However, there is complete lack of field evidence to support statements that Great Smoky formation, "Hiwassee" schist, or any other formation belonging in Talladega series rests unconformably on Precambrian rocks in Georgia or North Carolina.

G. W. Stose, 1946, (abs.) Geol. Soc. America Bull., v. 57, no. 12, pt. 2, p. 1233; 1949, Geol. Soc. America Bull., v. 60, no. 2, p. 278–282. Great Smoky quartzite included in Ocoee series, Late Precambrian. Overlies Hurricane graywacke (new) and underlies Nantahala slate. Term quartzite considered more appropriate than formation. Consists of lower member of thickbedded white to gray arkosic quartzite, middle member of light- to dark-gray, poorly bedded quartzite containing pebble beds, and upper member of coarse-grained dark quartzite, pebbly in places, and interbedded black slaty graywacke. Extends from northeast end of belt of Ocoee series (Roan Mountain quadrangle) southwestward across northwestern North Carolina and southeastern Tennessee, passes into Georgia, and continues to point 10 miles east of Cartersville. Thickness about 4,100 feet.

P. B. King, 1949, Am. Jour. Sci., v. 247, no. 9, p. 631 (table 4), 639. Conglomerate included in Ocoee series. Thickness in Great Smoky Mountains about 6,000 feet. Underlies Nantahala slate. Type area is in Great Smoky Mountains of Knoxville quadrangle: probably it also includes outcrops of formation in Mount Guyot quadrangle to east. It is here capable of precise delimitation and should be restricted to unit as defined in this area and its equivalents. Further south, as in Nantahala and Ellijay quadrangles, term has come to be used as general expression for rocks of Ocoee type. This usage is improper, and term Ocoee series should be substituted.

G. W. Crickmay, 1952, Georgia Geol. Survey Bull. 58, p. 27, 28. Great Smoky formation included in Talladega series believed to be Precambrian.

John Rodgers, 1953, Tennessee Div. Geology Bull. 58, pt. 2, p. 26 (table 2), 31–32, pt. 1, pls. Conglomerate mapped in eastern Tennessee where, southwest of Pigeon River mountain belt, it underlies Nantahala slate and overlies sandstone and slate forming lowest part of Ocoee series.

V. J. Hurst, 1955, Georgia Geol. Survey Bull. 55, p. 7, 8–45, pl. 1, geol. map. In Mineral Bluff quadrangle, Georgia, oldest rocks belong to Great Smoky group, a sequence of graywacke-type metasediments at least 15,000 feet thick, of probable Precambrian age. Group includes (ascending) Copperhill, Hughes Gap, Hothouse, and Dean formations (all new). Underlies Nantahala slate. Cambrian-Precambrian boundary provisionally drawn between Great Smoky group and Nantahala slate.

P. B. King and others, 1958, Geol. Soc. America Bull., v. 69, no. 8, p. 955 (table 1), 957–960. Group, in Great Smoky Mountains, is divided into (ascending) Elkmont sandstone (new), Thunderhead sandstone, Anakeesta formation (new), and unnamed higher strata. Group lies in upper plate of Greenbrier fault, terminates northwestward along trace of fault, and extends thence 20 or 25 miles southeastward. Southwestward, outcrop belt continues more than 100 miles with about same width into northern Georgia. East of Great Smoky Mountains, group is preserved only in isolated downfolds in older Precambrian rocks. Through most of its extent in Great Smoky Mountains, base of group is cut off by Greenbrier fault, but, in southeast part of mountains, it lies conformably on Snowbird group. Near Middle Prong of Little River, as much as 25,000 feet of group is present, but base and top are not exposed. Ocoee series. Late Precambrian.

J. L. Stuckey and S. G. Conrad, 1958, North Carolina Div. Mineral Resources Bull. 71, p. 35, 36; J. L. Stuckey, 1958, Geologic map of North Carolina (1:500,000): North Carolina Div. Mineral Resources. Ocoee series in North Carolina includes (ascending) Snowbird formation, Great Smoky conglomerate, Nantahala slate, and Sandsuck shale. Great Smoky is most extensive member of Ocoee series. Covers large areas in Cherokee, Graham, Swain, and Hayward Counties and smaller areas in Macon, Jackson, and Madison Counties. Precambrian.

Named for extensive development in Great Smoky Mountains, in southern part of Knoxville quadrangle, which adjoins Nantahala quadrangle on north.

Gredal Formation

Gredal Member (of Lodo Formation)

Eocene, upper; Central California.

Martin Van Couvering and H. B. Allen, 1943, California Div. Mines Bull. 118, pt. 3, p. 496–500. Variegated green-red claystone containing occasional sandstone beds and considerable glauconite. Maximum thickness 1,000 feet. Unconformably underlies Point of Rocks sandstone; overlies Mabury formation (new).

V. S. Mallory, 1959, Lower Tertiary biostratigraphy of the California Coast Ranges: Tulsa, Okla., Am. Assoc. Petroleum Geologists, p. 10, 281–282 Rank reduced to member status in Lodo formation; overlies Mabury member.

Occurs in Devils Den oil field district in northwestern Kern County, adjacent to Kings County line, about 40 miles from Paso Robles and about 60 miles northwest of Bakersfield.

Greece Ranch horizon[1]

Oligocene: Southwestern Washington.

Original reference: B. L. Clark, 1924, Pan-Pacific Sci. Cong., Australia, 1923, Proc., v. 1, p. 877.

Occurs on Greece Ranch locality near Vader, on Cowlitz River, southwestern Lewis County.

Greeley Gypsum (in Sumner Group)[1]

Permian: Central Kansas.

Original reference: F. W. Cragin, 1896, Colorado Coll. Studies, v. 6, p. 10.

Named for Greeley Township, Saline County.

Greenbrier Limestone[1] **or Formation**

Greenbrier Limestone Member (of Mauch Chunk Formation)

Greenbrier Limestone (in Mauch Chunk Group)

Greenbrier Series

Upper Mississippian: Northern West Virginia, eastern Kentucky, western Maryland, southern Pennsylvania, and Virginia.

Original reference: W. B. Rogers, 1879, Macfarlane's Geol. Railway Guide, p. 179.

D. B. Reger, 1926, West Virginia Geol. Survey [County Repts.] Mercer, Monroe, and Summers Counties, p. 445–491. Greenbrier series is assemblage of preeminently calcareous rocks lying just below Mauch Chunk series and just above Maccrady series. Includes (ascending) Hillsdale limestone, Sinks Grove limestone, Patton shale and limestone, Taggard shale and limestone, Pickaway limestone, Union limestone, Greenville shale, and Alderson limestone members. Thickness about 1,800 feet.

P. H. Price and E. T. Heck, 1939, West Virginia Geol. Survey [Rept.] Greenbrier County, p. 266–279. Series described in Greenbrier County where thickness varies from about 475 to 750 feet. Subdivisions as named by Reger (1926) recognized.

J. M. Weller and others, 1948, Geol. Soc. America Bull., v. 59, no. 3, p. 170, 171, chart 5 (column 102) ; M. N. Shaffer, 1952, Pennsylvania Geol. Survey, 4th ser., Prog. Rept. 141. Correlation chart shows Greenbrier limestone in Mauch Chunk group in Pennsylvania.

R. H. Wilpolt and D. W. Marden, 1949, U.S. Geol. Survey Oil and Gas Inv. Prelim. Chart 38. Chart shows Meramec-Chester age.

T. W. Amsden, 1954, Maryland Dept. Geology, Mines and Water Resources Bull. 13, p. 34–44. Described in Garrett County, Md., as formation. Overlies Pocono formation and underlies Mauch Chunk formation. Includes Loyalhanna member in lower part. Thickness about 250 feet.

R. H. Wilpolt and D. W. Marden, 1959, U.S. Geol. Survey Bull. 1072–K, p. 593–596, 598 (fig. 26), pls. 28, 29. Rocks called Greenbrier limestone in this report have been referred to as Greenbrier series by other writers. Consists of thick sequence of dense and crystalline, highly fossiliferous, locally cherty limestone which commonly ranges in color from gray to brownish gray to black. Hillsdale and Taggard members differentiated in some areas; main body of Greenbrier is undifferentiated. Thickness 250 to 848 feet. Overlies Maccrady; underlies Bluefield formation. Geographically extended into Kentucky.

Carlyle Gray and others, 1960, Geologic map of Pennsylvania (1:250,000) : Pennsylvania Geol. Survey, 4th ser. Mauch Chunk formation includes Greenbrier limestone in Fayette, Westmoreland, and Somerset Counties; Loyalhanna limestone at base in southwestern Pennsylvania.

Named for exposures on Greenbrier River, Pocahontas County, W. Va.

†Greenbrier Shales[1]

Mississippian: West Virginia.

Original reference: W. B. Rogers, 1879, Macfarlane's Geol. Railway Guide, p. 179.

Greenbush Coal Member (of Spoon Formation)

Pennsylvanian: Western Illinois.

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 33, 46 (table 1), pl. 1. Assigned member status in Spoon formation (new). Occurs above Wiley coal member and below Isabel sandstone member. Coal named by Wanless (1931, Illinois Geol. Survey Bull. 60). Presentation of new rock-stratigraphic classification of Pennsylvanian strata in Illinois.

Type locality: E¼ sec. 24, T. 8 N., R. 1 W., Warren County.

Greenbush cyclothem (in Spoon Formation)

Greenbush cyclothem[1] (in Tradewater Group)

Pennsylvanian: Western, central, and southern Illinois and western Indiana.

Original reference: H. R. Wanless, 1931, Illinois Geol. Survey Bull. 60, p. 188, 192.

J. M. Weller and others, 1942, Am. Assoc. Petroleum Geologists Bull., v. 26, no. 10, p. 1586 (fig. 1), 1589. Underlies Abingdon cyclothem (new). Includes Greenbush limestone.

H. R. Wanless, 1957, Illinois Geol. Survey Bull. 82, p. 50 (fig. 22), 63, 81–82, 191, 197, 198, 200, 201, 202. Thickness of cyclothem as much as 14 feet; average 6 to 10 feet. Rests with apparent conformity on Wiley cyclothem; underlies Abingdon cyclothem; Isabel sandstone rests on Greenbush shale with an abrupt contact and truncates shale at some places. Greenbush limestone is discontinuous and is commonly 3 to 6 inches thick and is fine grained, light gray, and nearly lithographic. Cyclothem is present in western Kentucky where it includes the highest beds referred to the Tradewater group. Gives type exposure.

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 52 (table 2), pl. 2. In Spoon formation (new). Above Wiley cyclothem and below Abingdon cyclothem. Presentation of new rock-stratigraphic classification of Pennsylvanian strata in Illinois; cyclical classification is independent of rock-stratigraphic classification.

Type exposure: In ravine tributary to Swan Creek in E½ sec. 24, T. 8 N., R. 1 W., Greenbush Township, Avon quadrangle, Warren County, Ill.

Green Canyon Group

Pennsylvanian (Derry Series): Central and southern New Mexico.

M. L. Thompson, 1942, New Mexico Bur. Mines Mineral Resources Bull. 17, p. 27 (table 2), 31 (fig. 2), 32, 35. Term proposed to include the two basal formations of the Derry series (ascending): Arrey and Apadoca (both new).

Type locality: West facing slope of hill approximately three-fourths of a mile east of Derry, near center of sec. 32, T. 17 S., R. 4 W., Sierra County. Name derived from Green Canyon about one-half mile north of village of Derry.

Greencastle Bed[1] (in Chambersburg Limestone)

Greencastle Formation

Middle Ordovician: South-central Pennsylvania.

Original reference: R. S. Bassler, 1919, Maryland Geol. Survey, Cambrian and Ordovician Volume, p. 49, 120, 133, 140–147, 152, 153, 154.

L. C. Craig, 1941, (abs.) Geol. Soc. America Bull., v. 52, no. 12, pt. 2, p. 1964. Rank raised to formation; includes uppermost part of Chambersburg limestone. Consists of black massive limestone with a thin locally occurring basal calcarenite. Thickness 63 feet at type locality. Underlies Martinsburg shale; overlies Mercersburg formation (new) and converges with it in western belts of outcrop in Cumberland Valley. Type locality designated.

L. C. Craig, 1949, Geol. Soc. America Bull., v. 60, no. 4, p. 738–739. Name abandoned. Original use appears to have been inconsistent. Excessive restriction of the bed was necessary in defining the formation. As described at Marion, base was at an indefinite horizon in middle of Kauffman member (new) of Mercersburg formation. In section at Greencastle, base appears to have been drawn at base of Kauffman member; upper part of this section poorly exposed. Replaced by Oranda formation except for *Sinuites* zone at top, which is referred to base of Martinsburg formation.

Type section: Two miles southwest of Marion, Franklin County. [Named for Greencastle, Franklin County.]

Green Cove Beds[1]

Eocene: Western Wyoming.

Original reference: H. E. Wood 2d, 1934, Am. Mus. Nat History Bull. 67, art. 5, p. 245–249.

H. E. Wood 2d and others, 1941, Geol. Soc. America Bull. v. 52, no. 1, p. 21, pl. 1. Bridgerian.

Named for section at Green Cove, east of Hailey, Fremont County.

Greendale Limestone Member (of Cynthiana Formation)[1]

Middle Ordovician: Central northern Kentucky.

Original reference: A. F. Foerste, 1906, Kentucky Geol. Survey Bull. 7, p. 10, 19, 211.

A. C. McFarlan, 1943, Geology of Kentucky: Lexington, Ky., Kentucky Univ., p. 11 (footnote), 20–22. Overlies Sulphur Well beds (new) in Jessamine County. Although Bromley is given in literature as post-Greendale in age, it underlies the Greendale at Butler, Pendleton County, and at Clay's Ferry in northern Madison County.

A. C. McFarlan and W. H. White, 1948, Am. Assoc. Petroleum Geologists Bull., v. 32, no. 8, p. 1641, 1643. Division of the Cynthiana. There has been little precision in use of name. In general, it has been used for rather fossiliferous limestones and shales around Frankfort and Lexington. Foerste (1909) defined the Greendale as including that part of the Cynthiana below Nicholas limestone. However, because of wedging-out of the Nicholas, Greendale lithologic characteristics and fauna continue to near top of formation. At type locality of Cynthiana, much of exposed section is the Nicholas. More or less equivalent to Millersburg limestone. Term Sulfur [Sulphur] Well member has been used for limestone and shale rich in bryozoans underlying the Greendale and Millersburg in much of thickened Cynthiana section of southern and southwestern Bluegrass. In present report, this pre-Greendale division of the Cynthiana is recognized as facies of upper Lexington, but containing a Cynthiana fauna.

D. K. Hamilton, 1950, Kentucky Geol. Survey, ser. 9, Bull. 5, p. 18. All subdivisions of the interval between the top of the Benson limestone and base of the Eden formation should be referred to as members of the Cynthiana. This includes as members the lithologic and paleontologic units heretofore defined as Brannon, Woodburn, Greendale, Millersburg, Nicholas, Rogers Gap, Bromley, and Gratz.

L. H. Lattman, 1954, Am. Jour. Sci., v. 252, no. 5, p. 265, 268. Rogers Gap limestone and Fulton shale, which cannot be distinguished faunally, rest northwardly on the Nicholas and southwardly on the Greendale. It is suggested that lowest occurrence of *Cryptolithus tesselatus* marks base of Nicholas member; beds below this zone carry a typical Greendale fauna, and name Greendale should be applied to these beds. Cincinnatian series should be extended downward to embrace Cynthiana formation.

Probably named for Greendale, Fayette County.

Greene Formation (in Dunkard Group)[1]

Greene Group

Greene Series

Lower Permian: Southwestern Pennsylvania, western Maryland, eastern Ohio, and northern West Virginia.

Original reference: J. J. Stevenson, 1876, Pennsylvania 2d Geol. Survey Rept. K, p. 35–44.

R. E. Lamborn, C. R. Austin, and Downs Schaaf, 1938, Ohio Geol. Survey, 4th ser., Bull. 39, p. 217. Permian rocks of Ohio divided into Washington series below and Greene series above. Each series separated into members. Base of Green series is base of Jollytown "A" coal; top is top of Gilmore sandstone and shale.

W. O. Hickok 4th and F. T. Moyer, 1940, Pennsylvania Geol. Survey, 4th ser., Bull. C–26, p. 152–153. Green group forms upper part of Dunkard series. Lies above Washington group. Composed of highest and youngest consolidated rocks in Fayette County [this report]. Only lowest part of group preserved in area of this report. Base of group is at top of Upper Washington limestone, and only shales and sandstone have been preserved above this stratum. Group has been divided into nine parts, only lowest of which, Donley sandstone, is preserved in county. Stevenson noted presence of sandstone about 10 feet above top of Upper Washington limestone in his Greene group for Washington County. He did not name the sandstone. In this report, it will be called Dunlap.

Thomas Arkle, Jr., 1959, Geol. Soc. America Guidebook Pittsburgh Mtg., p. 117–121, 135, 138. Washington and Greene groups of Dunkard series are herein ranked as series and considered of equal rank with Pennsylvanian Monongahela series. The Greene is about 700 feet thick. Base is at base of Jollytown coal below Jollytown sandstone; top is at top of Upper Proctor sandstone. Monongahela, Washington, and Greene series crop out in elliptical synclinorium (Huntington-Pittsburgh basin) which extends southwest from Pittsburgh area into eastern Ohio and western West Virginia to Kentucky.

Carlyle Gray and others, 1960, Geologic map of Pennsylvania (1:250,000): Pennsylvania Geol. Survey, 4th ser. Greene formation consists of cyclic sequences of sandstone, shale, and red beds, limestone and coal; base at top of upper Washington limestone. Permian [Dunkard group not used on map].

H. L. Berryhill, 1960, *in* C. O. Dunbar and others, 1960, Geol. Soc. America Bull., v. 71, no. 12, pt. 1, p. 1789–1790. There are no reasons, lithologic nor faunal-flora, for differentiating Washington and Greene formations anywhere in Dunkard basin. Subdivision of Stevenson (1876) has been handed down through tradition. Stevenson's Washington group is actually a facies. Away from northern edge of basin, Washington "group" has few lithologic characteristics of the "type" area. During recent mapping of Belmont County, Ohio, by U.S. Geological Survey, no bases for subdivision of these rocks were found. In that area, these rocks were classified as Washington-Greene formations undifferentiated.

Named for exposures in central and southwestern parts of Greene County, Pa.

†Greene County Group[1]

Pennsylvanian and Permian: Western Pennsylvania.

Original reference: H. D. Rogers, 1858, Geology Pennsylvania, v. 2, pt. 1, p. 503–507.

Greenefield Bed[1]

Upper Triassic: Central Massachusetts.

Original reference: B. K. Emerson, 1897, Geol. Soc. America Bull., v. 8, p. 65–72.

Occurs in vicinity of Greenfield, Franklin County.

Greeneville Limestone

See Greenville Dolomite.

†Greenfield Dolomite (in Whitehorse Sandstone)[1]

Permian: Southwestern Oklahoma.

Original reference: C. D. Stephenson, 1925, Am. Assoc. Petroleum Geologists Bull., v. 9, no. 3, p. 626–631.

Named for exposures just west of Greenfield, Blaine County.

Greenfield Dolomite[1] Member (of Bass Islands Dolomite)

Greenfield Dolomite or Formation (in Bass Islands Group)

Upper Silurian: Western Ohio and northern Kentucky, and Ontario, Canada.

Original reference: E. Orton, 1871, Ohio Geol. Survey Rept. Prog. 1870, p. 307, fig. 1. facing p. 310.

Wilber Stout, 1941, Ohio Geol. Survey Bull. 42, p. 38–39, chart facing p. 46. Basal formation of Bass Island[s] group in Ohio. Consists of dolomite, thin- to massive-bedded, gray to brown. Thickness commonly 175 to 225 feet. Underlies Tymochtee formation; upper limit very indefinite and fixed more on faunal than stratigraphic evidence. Type locality stated; distribution noted.

C. K. Swartz and others, 1942, Geol. Soc. America Bull., v. 53, no. 4, chart 3. Correlation chart shows occurrence in Ontario, Canada.

Type locality: Near Greenfield, Highland County, Ohio. From Greenfield the formation extends northwestward and crops out in belt across parts of Fayette, Logan, Shelby, Auglaize, Allen, Van Wert, and Paulding Counties.

†Greenfield Limestone[1]

Upper Cambrian: Eastern New York.

Original reference: J. M. Clarke, 1903, New York State Mus. Handb. 19, p. 9, 12, table 2.

Probably named for Greenfield, Saratoga County.

Green Gulch Volcanics (in Alder Group)

Precambrian (Yavapai Series): Central Arizona.

C. A. Anderson and S. C. Creasey, 1958, U.S. Geol. Survey Prof. Paper 308, p. 31–32, pl. 1. Comprises basaltic and andesitic flows and sedimentary tuffaceous rocks of variable composition. Flow unit lies east of tuff. Most flows are medium to dark gray with greenish cast. Locally in flows, relict pillow and breccia structures, amygdules, vesicles, and bedding are preserved. Tuffaceous rocks range in composition from rhyolitic to basaltic. Most characteristic rock ranges in color from greenish black to greenish gray or dark to light olive gray. Fine-grained dark-gray siliceous rocks that weather to light pinkish gray and lesser amounts of light-gray porcellaneous slate are also present. Tuffaceous rocks range from finely laminated phyllite to more massive and locally coarser grained rocks. Thickness not known. Outcrop width about 10,500 feet. Formation bounded on east by Chaparral fault; on west, extends beyond map area; to north covered by Cenozoic rocks of Lonesome Valley.

Named for exposures along Green Gulch in southeastern part of Prescott quadrangle, Yavapai County. Forms triangular-shaped mass in extreme southwest corner of Jerome area.

Green Hill Member (of Pride Mountain Formation)

Upper Mississippian: Northern Alabama and northeastern Mississippi.

S. W. Welch, 1958, U.S. Geol. Survey Oil and Gas Inv. Chart OC–58. Light-brownish-gray oolitic thick-bedded limestone in lower part and olive-gray thin-bedded calcareous shale in upper part. Basal limestone is equivalent to upper limestone of Southward Bridge formation of Morse (1928); upper shale is equivalent to the lower part of the Forest Grove formation of Morse (1928), these strata were referred to by Butts (1926) as the Golconda formation. Maximum thickness about 80 feet near Mingo, Miss.; thins to 30 feet or less in Colbert County, Ala., at type locality 20 feet. Conformably overlies Mynot member (new); underlies Hartselle sandstone, contact poorly exposed, but evidence suggests an unconformity of at least local extent.

Named for exposure at roadside near head of Green Hill Branch about 3 miles south of Barton, Colbert County, Ala., in SW¼NW¼ sec. 22, T. 4 S., R. 13 W.

Greenhorn Bentonite Bed (in Colorado Formation)

Cretaceous: Southwestern Montana.

Great Northern Railway Co. Mineral Research and Development Department, 1960, Great Northern Railway Co. Mineral Research and Devel. Dept., Rept. 12, pt. 2, p. 38, 42. About 250 feet above Geyser bentonite bed (new). Thickness about 4 feet. Greenhorn bentonite is 20 to 30 feet below base of Greenhorn equivalent (Vine, 1956, U.S. Geol. Survey Bull. 1027–J).

Most westerly outcrop is north of Arrow Creek in S½ sec. 13, T. 18 N., R. 11 E; easternmost exposures are along Surprise Creek in sec. 36, T. 18 N. R. 11 E., and sec. 30, T. 18 N., R. 12 E.

Greenhorn Calcareous Member (of Cody Shale)

Greenhorn Limestone Member (of Colorado Shale or Mancos Shale)

Greenhorn Limestone[1] **or Formation** (in Colorado Group)

Greenhorn Member or Formation (of Benton Formation or Group)

Upper Cretaceous: Eastern Colorado, northwestern Iowa, western Kansas, southeastern Montana, Nebraska, northeastern New Mexico, and South Dakota.

Original reference: G. K. Gilbert, 1896, U.S. Geol. Survey 17th Ann. Rept., pt. 2, p. 564.

W. W. Rubey and N. W. Bass, 1925, Kansas Geol. Survey Bull. 10, p. 45–50. In western Kansas, subdivided into four members (ascending): Lincoln limestone, unnamed member, Jetmore chalk (new), and unnamed member. Thickness about 100 feet. Overlies Graneros shale; underlies Fairport chalky shale member (new) of Carlile shale.

N. W. Bass, 1926, Kansas Geol. Survey Bull. 11, p. 31–35, 66–71. In Ellis County comprises (ascending) Lincoln limestone, Hartland shale (new), Jetmore chalk, and Pfeifer shale (new) members. In Hamilton County, comprises (ascending) Lincoln limestone, Hartland shale, and Bridge Creek limestone (new) members.

J. B. Reeside, Jr., 1944, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 10. As shown on correlation chart, Greenhorn limestone overlies Belle Fourche shale and underlies Carlile shale in northern Great Plains region.

R. C. Moore, J. C. Frye and J. M. Jewett, 1944, Kansas Geol. Survey Bull. 52, pt. 4, p. 153. Consists of chalky limestone and calcareous shale interbedded, thin-bedded, light-gray to dark-gray; weathers yellow gray to light gray. Thickness 85 feet in Barton County; 95 feet in Ellis County; 132 feet in Hamilton County. Comprises (ascending) Lincoln limestone, Hartland shale, Jetmore chalk, and Pfeifer shale members. Where Pfeifer shale and Jetmore chalk cannot be distinguished, they are termed Bridge Creek member. Overlies Graneros shale; underlies Carlile shale. Colorado group. Gulfian.

B. C. Petsch, 1946, South Dakota Geol. Survey Rept. Inv. 53, p. 17 (fig. 5), 46. Middle formation of Benton group. Crops out on east side of Big Sioux River north of Sioux City, Iowa. Underlies Carlile formation; overlies Graneros formation.

N. W. Bass, C. E. Straub, and H. O. Woodbury, 1947, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 68. Greenhorn limestone, as used in this report [Model anticline, Las Animas County, Colo.], is 93 feet thick and consists of (ascending) Lincoln limestone, Hartland shale, and Bridge Creek limestone members. Underlies Codell member of Carlile shale; upper boundary drawn on basis of faunal change and placed within a zone that lies about 35 feet above base of Bridge Creek member; overlies Graneros shale.

C. H. Dane, 1948, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 78. Member of Mancos shale in area of this report [eastern side San Juan basin, Rio Arriba County, N. Mex.]. Consists of alternating beds of marl and limestone. Thickness about 70 feet. Overlies Graneros shale member; underlies Carlile shale member. Upper Cretaceous.

W. A. Cobban and J. B. Reeside, Jr., 1951, Wyoming Geol. Assoc. Guidebook 6th Ann. Field Trip, p. 61 (fig. 2). In Black Hills area, includes Orman Lake limestone member at base. Overlies Belle Fourche shale; underlies Carlile shale.

P. W. Richards and C. P. Rogers, Jr., 1951, U.S. Geol. Survey Oil and Gas Inv. Map OM-111. In Hardin area, Big Horn and Yellowstone Counties, Mont., the Greenhorn is classed as calcareous member of Cody shale.

W. A. Cobban, 1951, Am. Assoc. Petroleum Geologists Bull., v. 35, no. 10, p. 2183–2187, 2197 (fig. 2). Formations in Black Hills that are equivalent to Colorado shale of central and northwestern Montana are (ascending) Fall River sandstone, Skull Creek shale, Newcastle sandstone, Mowry shale, Belle Fourche shale, Greenhorn formation, Carlile shale, and Niobrara formation. Greenhorn formation attains maximum known thickness of 360 feet on east flank of Colony-Albion anticline in E½ sec. 9, T. 57 N., R. 61 W., Crook County, Wyo. In Carter County, Mont., formation thins sharply to 180 feet or less and, in addition, becomes less calcareous.

G. O. Bachman, 1953, U.S. Geol. Survey Oil and Gas Inv. Map OM-137. In northwestern Mora County, N. Mex., the Benton shale is represented by equivalents of Graneros shale, Greenhorn limestone, and Carlile shale.

W. J. Mapel, 1959, U.S. Geol. Survey Bull. 1078, p. 47–48, 56, pls. Described as calcareous member of Cody shale in Buffalo-Lake De Smet area, Johnson and Sheridan Counties, Wyo. Thickness about 136 feet. Overlies lower unnamed shale member and underlies Carlile shale member.

U.S. Geological Survey currently classifies the Greenhorn Limestone as a member of the Colorado Shale in the Cleveland quadrangle, Blaine County, Mont., on the basis of a study now in progress.

Named for Greenhorn Station, 14 miles south of Pueblo, Colo., and for Greenhorn Creek [Pueblo and Walsenburg quadrangles].

Greenhorn Mountain Quartzite

Precambrian (Belt Series): West-central Montana.

Adolph Knopf, 1950, Am. Mineralogist, v. 35, nos. 9–10, p. 839. Notably feldspathic; feldspar consisting of clear limpid microcline. Lower part of formation is massive quartzite, in places showing festoon cross-lamination; upper third is well stratified in beds of uniform thickness ranging from 1 to 2 inches. Thickness 1,800 feet. Overlies Marsh formation; top is bounded by erosion surface on which rests Flathead quartzite (Middle Cambrian). In extant geologic maps, Greenhorn Mountain quartzite has been included with "undifferentiated Devonian and Cambrian" strata, with the result that the Flathead, which averages 100 feet in thickness over a distance of scores of miles, is implied to have thickness of several thousand feet on Greenhorn Mountain.

Constitutes country rock of Continental Divide, making up bulk of Greenhorn Mountain, which forms highest summit between Mullan Pass and Marysville.

Greenian series[1]

Eocene: Wyoming.

Original reference: C. R. Keyes, 1924, Pan-Am. Geologist, v. 41, p. 36, 66, 279, 308.

Greenland Sandstone Member (of Atoka Formation)

Pennsylvanian (Atoka Series) : Northwestern Arkansas.

L. G. Henbest, 1953, Am. Assoc. Petroleum Geologists Bull., v. 37, no. 8, p. 1946–1947, 1948 (fig. 2). Consists of silty ripple-marked flaggy sandstone with shaly partings. Locally, marine quartz-gravel conglomerate, which alters on exposure to contorted limonite-cemented sand, lies at base of unit or interfingers with it at higher levels. In some areas, lenses of marine quartz-gravel sandstone that are more or less massive or cross-bedded either interfinger or partly cut out parts of the member. Overlies Kessler limestone lentil of Bloyd shale.

Named from characteristic exposures and development in vicinity of Greenland, Washington County.

†Greenleaf Sandstone[1]

Lower Cretaceous: Southwestern Kansas.

Original reference: G. N. Gould, 1898, Am. Jour. Sci., 4th ser., v. 5, p. 170–174.

B. F. Latta, 1947, Kansas Geol. Survey Bull. 65, p. 86, 87. Not differentiated as stratigraphic unit. Included in Kiowa shale.

Named for Greenleaf Ranch, on upper Medicine River, 10 or 12 miles west of Belvidere, Kiowa County.

Green Lodge Formation[1]

Upper Cambrian: Eastern Massachusetts.

Original reference: E. J. Rhodes and W. H. Graves, Jr., 1931, Am. Jour. Sci., 5th, v. 22, p. 364–372.

Occurs at Green Lodge, Dedham quadrangle.

†Green Mountain Beds[1]

Green Mountain Conglomerate

Eocene: Central Colorado.

Original reference: G. L. Cannon, Jr., 1893, Colorado Sci. Soc. Proc., v. 4, p. 253.

L. W. LeRoy, 1946, Colorado School Mines Quart., v. 41, no. 2, p. 111–113. Sediments herein designated as Green Mountain conglomerate were assigned to division "D" of Denver formation (Cross, 1896, U.S. Geol. Survey Mon. 27). Hares (1926) suggested that these conglomerates be removed from Denver formation. Marr (1930, unpub. rept.) gave name Green Mountain conglomerate series to unit. In this report, name Green Mountain conglomerate is retained and unit is removed from Arapahoe-Denver formation. Thickness at least 600 feet.

S. O. Reichert, 1956, Geol. Soc. America Bull., v. 67, p. 111. Green Mountain conglomerate should be abandoned because it is a partial representative of Dawson formation as herein restricted.

Exposed on slopes of Green Mountain, Denver basin region.

Green Mountain Gneiss[1]

Green Mountain Series

Precambrian: Southwestern to northwestern Vermont.

Original reference: C. B. Adams, 1845, Vermont State Geologist 1st Ann. Rept., p. 60–61.

E. C. Jacobs, 1938, Vermont State Geologist 21st Rept. 1937–1938, p. 36–37. Age of Green Mountain series is Precambrian.

Green Mountains cross the State of Vermont.

Green Pond Conglomerate[1]

Silurian: Northern New Jersey and southeastern New York.

Original reference: H. D. Rogers, 1836, New Jersey Geol. Survey, p. 127.

P. K. Sims, 1958, U.S. Geol. Survey Prof. Paper 287, p. 42, pl. 1. Crops out on both Copperas and Green Pond Mountains in Dover district where it overlies Precambrian rocks. Silurian.

Named for Green Pond Mountains, N.J.

†Green Pond Quartzite[1]

Silurian: New Jersey.

Original references: N. H. Darton, 1894, New Jersey Geol. Survey Ann. Rept. State Geologist; H. B. Kummel and S. Weller, 1902, New Jersey Geol. Survey Ann. Rept. State Geologist.

†Green Pond Mountain Formation[1]

Silurian: New York.

Original reference: D. S. Martin, 1888, Geologic map of New York City and vicinity.

†Green Pond Mountain Group[1]

Devonian: New Jersey and New York.

Original reference: F. J. H. Merrill, 1887, New York Acad. Sci. Trans., v. 6, p. 59.

Extends from northern New Jersey through Orange County, N.Y., to Hudson River and for some distance beyond.

Green River Formation[1]

Eocene, lower and middle: Southwestern Wyoming, northwestern and central Colorado, and eastern Utah.

Original references: Henry Engelmann, 1859, Preliminary report on the geology of the country between Fort Bridger and Camp Floyd, Utah Territory, and southwest of the latter place, along Captain J. H. Simpson's routes, 1858; Appendix A *in* Report of the Secretary of War communicating, in compliance with a resolution of the Senate, Captain Simpson's report and map of wagon road routes in Utah Territory: U.S. 35th Cong. 2d sess., S. Ex. Doc. 40, p. 45–75; F. V. Hayden, 1869, U.S. Geol. Survey Terr. 3d Ann. Rept.

W. H. Bradley, 1931, U.S. Geol. Survey Prof. Paper 168, 58 p. Formation of Colorado and Utah is series of lake beds of middle Eocene age that occupy two broad, shallow, structural basins: the Piceance Creek in northwestern Colorado, and the Uinta in northeastern Utah. Average thickness about 2,000 feet; about 1,200 feet at north end of Piceance Creek basin, and about 2,800 feet in central part of basin; about 4,900 feet in western part of Uinta basin. In both basins, underlain by beds of sandy mudstone of Wasatch formation. In Piceance Creek basin, rocks of the Green River are youngest rocks exposed except in one area where they are overlain by 400 feet of sandy beds of fluviatile origin that appear to be lithologically and stratigraphically equivalent to basal beds of Bridger formation of Uinta basin. In Uinta basin, the Green River is conformably overlain by Bridger formation, and that, in turn, is subdivided into (ascending) Douglas Creek, Garden Gulch, Parachute Creek, and Evacuation Creek members (all new). West of Bitter Creek, Utah, formation is not divided into members. In at least two localities, it contains thick deltaic facies. In western part of Uinta basin, lower beds interfinger with Wasatch formation. Locally contact between Green River and overlying Bridger has been greatly distorted by differential compaction.

P. T. Walton, 1944, Geol. Soc. America Bull., v. 55, no. 1, p. 120–121. Most of southern part of Uinta basin consists of outcrops of Green River formation. Varies in thickness; along Indian Canyon, exceeds 5,000 feet; farther east at Duchesne County line, about 1,800 feet present; at Colorado border 2,000 feet. Along north of Uinta basin, lower boundary of Green River is surface of overlap. From Asphalt Ridge, eastward along Rim Rock, beds unconformably overlie Mesaverde group. Throughout this distance, base of Green River rises stratigraphically until, at Raven Ridge, the Wasatch is exposed. On south side of Uinta basin, Green River shale overlies and interfingers with Colton formation (new). It also concordantly overlies Flagstaff limestone at north end of Wasatch Plateau. Throughout south and middle parts of Uinta basin, Green River strata are conformably overlain by Uinta formation. Part of unit herein termed Uinta(?) may be facies change of Green River formation similar to Cathedral Bluff tongue of northwestern Colorado.

E. M. Spieker, 1946, U.S. Geol. Survey Prof. Paper 205-D, p. 122, 140, 141 (fig. 18). Formation, on northern and western borders of Wasatch Plateau, is about 5,000 feet thick. In eastern area, overlies Colton formation (formerly considered an upper member of Wasatch), and, in western area, overlies Flagstaff limestone (formerly considered member of Wasatch).

E. M. Spieker, 1949, Utah Geol. Soc. Guidebook 4, p. 13 (table), 35. Overlies Colton formation and locally Flagstaff formation and underlies Crazy Hollow formation (new) in Sanpete-Sevier district.

J. H. Donavan, 1950, Wyoming Geol. Assoc. Guidebook 5th Ann. Field Conf., p. 63. In Sublette and Lincoln Counties, Wyo., includes Fontenelle member (new). Fontenelle overlies Knight member of Wasatch. Middle Eocene.

J. R. Donnell, 1953, Rocky Mountain Assoc. Geologists Guidebook Field Conf. May 14–16, chart facing p. 17. Comprises (ascending) Anvil Points (new), Parachute Creek, and Evacuation Creek members in area between Rifle and De Beque Canyon, Colo. Overlies Wasatch formation. Thickness about 3,000 feet.

C. H. Dane, 1954, Am. Assoc. Petroleum Geologists Bull., v. 38, no. 3, p. 405–425. Discussion of stratigraphic and facies relationships of upper part of Green River formation and lower part of Uinta formation in Duchesne, Uintah, and Wasatch Counties, Utah. Parachute Creek member of Green River is an approximate time-equivalent zone across Uinta basin, as shown by correlation of extensive thin tuff beds within the member. Top of overlying Evacuation Creek member is regarded as base of Uinta formation. This formation boundary rises stratigraphically toward center of basin, as also shown by correlation of tuff beds. Much of lower part of fluviatile beds of Uinta formation as exposed along Colorado-Utah line grades westward into beds that are in considerable part of lacustrine, playa, and mudflat origin in area of which Indian Canyon is center. These beds, formerly considered saline facies of Green River are here included as part of Uinta formation.

G. N. Pipiringos, 1955, Wyoming Geol. Assoc. Guidebook 10th Ann. Field Conf., p. 100–103. Discussion of central part of Great Divide basin, Sweetwater County, Wyo. The Green River comprises Luman tongue (new), Tipton tongue, Laney shale member, and Morrow Creek member, Intertongues with Wasatch formation. Battle Spring formation (new) intertongues with all parts of Wasatch and Green River formations except Laney shale member. In northern part of area, the Battle Spring replaces all parts of Wasatch and Green River formations except Morrow Creek member. Underlies Bridger formation.

W. H. Bradley, 1959, Am. Assoc. Petroleum Geologists Bull., v. 43, no. 5, p. 1072–1075. Discussion of revision of stratigraphic nomenclature of Green River formation of Wyoming. In southwestern Wyoming, lacustrine Green River formation of early and middle Eocene age intertongues laterally with fluviatile deposits of Wasatch formation. For many years, the Green River has been subdivided into Tipton tongue (or Tipton shale member) as base, Laney shale member, and, at top, Morrow Creek member. East of eastern margin of Bridger basin, the Cathedral Bluffs tongue of the Wasatch separates Tipton tongue from Laney shale member. A comparable tongue of the Wasatch enters Green River formation along western margin of Bridger basin. Donavan (1950) named this tongue the New Fork tongue of Wasatch and named the basal unit of Green River in that area the Fontenelle member. Concluded from present study that what has until now been called Laney shale member of Green River in Bridger basin is older than type Laney and is time equivalent of Cathedral Bluffs and New Fork tongues of Wasatch formation. Beds in Bridger basin formerly thought to be Laney shale member of Schultz (1920) are herein named Wilkins Peak member of Green River. Morrow Creek member is equivalent to Schultz' type Laney shale member; term Morrow Creek is herein abandoned. Luman tongue of Green River continues upward into base of Tipton tongue. Laney shale is overlain by Bridger formation.

Type locality: At town of Green River, Sweetwater County, Wyo.

Greensburg or Flat Rock stone[1]

Silurian: Southeastern Indiana.

Original reference: E. T. Cox, 1879, Indiana Geol. Survey 8th, 9th, and 10th Ann. Repts., p. 57, 88–89.

Extensively quarried on Flat Rock Creek, near St. Paul, and near Greensburg, Decatur County.

Greenstone Flow[1] (in Portage Lake Lava Series)

Precambrian (Keweenawan): Northern Michigan.

Original reference: R. D. Irving, 1883, U.S. Geol. Survey Mon. 5, p. (see index), pls. 17 and 18.

H. R. Cornwall, 1951, Geol. Soc. America Bull., v. 62, no. 2, p. 164, 165. Southwest of Ahmeek, consists of ophitic basalt and columnar basalt topped by cellular amygdaloid. Contains amygdaloidal inclusions and streaks. Thickness at Quincy mine 55 feet; at Delaware 1,299 feet.

W. S. White, H. R. Cornwall, and R. W. Swanson, 1953, U.S. Geol. Survey Geol. Quad. Map GQ–27. Included in Portage Lake lava series.

So named because its great basal bed forms the well-known Greenstone Ridge, Keweenaw County.

Greenup cyclothem (in McLeansboro Group)

Greenup cyclothem (in Mattoon Formation)

Pennsylvanian: Southeastern Illinois.

W. A. Newton and J. M. Weller, 1937, Illinois Geol. Survey Rept. Inv. 45, p. 9, 26–27. Lies above Newton cyclothem (new) and below Gila cyclothem (new). Includes Greenup limestone.

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 52 (table 2), pl. 1. In Mattoon formation (new). Above Bogota cyclothem and below Woodbury cyclothem. Presentation of new rock-stratigraphic classification of Pennsylvanian strata in Illinois; cyclical classification is independent of rock-stratigraphic classification.

Type locality: Just north of town of Greenup, Cumberland County.

Greenup Limestone Member (of Mattoon Formation)

Greenup Limestone (in McLeansboro Group)

Pennsylvanian: South-central Illinois.

W. A. Newton and J. M. Weller, 1937, Illinois Geol. Survey Rept. Inv. 45, p. 26–27. Included in Greenup cyclothem, McLeansboro group. Commonly light-gray limestone; fossiliferous. Thickness 2½ to 3 feet. Overlies massive to thin-bedded sandstone that varies in thickness from few feet to more than 25 feet. Stratum above limestone may be thin-bedded to massive sandstone, or it may be poorly bedded slightly greenish shale which grades into basal member of Gila cyclothem above.

J. M. Weller, L. G. Henbest, and C. O. Dunbar, 1942, Illinois Geol. Survey Bull. 67, p. 19 (fig. 4), 28–29 [1943]. In Cumberland County, consists of about 4 feet of light-gray earthy limestone that is nodular in places; thins southward and in Jasper County is represented by 1 foot of hard brownish-gray limestone or more or less inconspicuous zone of limestone nodules. No coal or underclay is present beneath the Greenup, and locally it is in direct contact with underlying sandstone.

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 40, 41, 51 (table 1), 79, pl. 1. Assigned to member status in Mattoon formation (new). Occurs below Gila limestone member and above Bogota limestone member. Thickness 3 feet at type outcrop. Presentation of new rock-stratigraphic classification of Pennsylvanian strata in Illinois.

Type locality; Near center W½NE¼ sec. 3, T. 9 N., R. 9 E., Cumberland County.

Green Valley Formation

Pliocene, lower: Western California.

Carlton Condit, 1938, Carnegie Inst. Washington Pub. 476, p. 248. Name applied to formation consisting of interbedded brown sands and gray shales occurring in quarry on south side of Mount Diablo.

B. L. Clark, 1940, (abs.) Geol. Soc. America Bull., v. 51, no. 12, pt. 2, p. 195. Series of continental beds (previously referred to as Orinda formation). Overlies marine beds of lower Pliocene age, locally known as Alamo formation; underlies lacustrine deposits locally known as Tassajara formation. Type section noted.

B. L. Clark, 1943, California Div. Mines Bull. 118, pt. 2, p. 189 (fig. 72), 191 [1941]. Above the Alamo are between 2,000 and 3,000 feet of continental beds, the Green Valley formation. Name Green Valley is used here for first time. It is equivalent to "Orinda formation," the name used by Clark (1935, Geol. Soc. America Bull., v. 46, no. 7) for continental deposits which immediately overlie the Alamo in section to west and southwest of Mount Diablo. Underlies Tassajara formation and separated from it by series of tuffaceous deposits, the "Moraga" tuff (Clark, 1935).

C. E. Weaver and others, 1944, Geol. Soc. America Bull., v. 55, no. 5, p. 585, chart 11. Heterogeneous series of continental deposits may be in part lacustral; thickness 300 feet. Shown on chart as overlying Diablo formation (new name for Alamo formation) and underlying Tassajara formation.

N. L. Taliaferro, 1951, California Div. Mines Bull. 154, p. 143–144. Diablo formation grades upward into at least 6,000 feet of nonmarine floodplain and lacustrine sediments to which name Green Valley has been given.

Type section: Immediately to west and southwest of Mount Diablo.

Green Valley Tonalite

Upper Cretaceous: Southern California.

F. S. Miller, 1937, Geol. Soc. America Bull., v. 48, no. 10, p. 1408–1409. Incidental mention in discussion of San Marcos gabbro.

E. S. Larsen, Jr., 1948, Geol. Soc. America Mem. 29, p. 53–57, pl. 1. Gray medium-grained tonalite; uniform in character; resembles Bonsall tonalite but lacks abundant streaked inclusions of that tonalite. Intrudes Triassic sedimentary, Jurassic volcanic rocks, and San Marcos gabbro; intruded by Woodson Mountain granodiorite.

D. L. Everhart, 1951, California Div. Mines Bull. 159, p. 74–78, pls. 2–5. Described in Cuyamaca Peak quadrangle. Older than Bonsall tonalite; younger than Cuyamaca gabbro. Age considered to be Upper Cretaceous.

Richard Merriam, 1958, California Div. Mines Bull. 177, p. 12–13, pl. 1. Limited to two small masses at west edge of Santa Ysabel quadrangle. In contact with younger Lake View Mountain tonalite. No other contacts exposed, but relations elsewhere show the Green Valley to be younger than San Marcos gabbro and older than Bonsall tonalite.

Named for its development in southeastern part of San Luis Rey quadrangle.

Green Valley Volcanic Series

Tertiary: Southwestern Texas.

S. S. Goldich and M. A. Elms, 1946, (abs.) Geol. Soc. America Bull., v. 57, no. 12, pt. 2, p. 1197. Lake deposits, pyroclatics, and intercalated lava flows which rest on basement of Cretaceous strata. Lower 900 feet of series is named Pruett formation, and the upper 1,000 feet, the Duff tuff; these two formations are separated by basaltic lava flows up to 325 feet thick which are designated the Cottonwood Springs basalts. Duff tuff is overlain by Mitchell Mesa rhyolite (new) which is youngest rock of series.

Occurs in Green Valley on southern Davis Mountain from in Trans-Pecos Texas, in Buck Hill quadrangle, Brewster County.

Greenville Dolomite[1]

Upper Cambrian : Northeastern Tennessee.

Original references: E. O. Ulrich, 1924, Tennessee Dept. Education, Div. Geol. Bull. 28, p. 34 ; Bull. 31, p. 16.

C. E. Resser, 1938, Geol. Soc. America Spec. Paper 15, p. 4, 15. Abandoned. It is not clear whether name Greeneville limestone used by Ulrich was intended to represent a part of or a bed beneath the Copper Ridge.

Type locality not stated but understood to be Greenville, Greene County.

Greenville Shale (in Greenbrier Limestone[1] or Series)

Mississippian (Meramecian) : Southeastern West Virginia.

Original reference: D. B. Reger, 1926, West Virginia Geol. Survey Rept. Mercer, Monroe, and Summers Counties, p. 449, 466.

P. H. Price and E. T. Heck, 1939, West Virginia Geol. Survey Greenbrier County, p. 267, 271–272; J. M. Weller and others, 1948, Geol. Soc. America Bull., v. 59, no. 2, chart 5 (columns 98, 99). Shale in Greenbrier series (Meramec). Underlies Alderson limestone ; overlies Union limestone.

Type locality: In road on north side of Indian Creek, 0.1 mile northwest of Hunter Spring School and 1.6 miles southeast of Greenville, Monroe County.

Greenwater volcanics[1]

Tertiary : California and Nevada.

Original reference : C. R. Keyes, 1923, Pan-Am. Geologist, v. 40, p. 52, 79.

Probably named for exposures at or near Greenwater, east of Death Valley, in Inyo County, Calif.

Greenwater Volcanics

Pliocene(?) : Southern California.

L. F. Noble, 1941, Geol. Soc. America Bull., v. 52, no. 7, 955, 966. Glassy andesitic and latitic lavas, tuffs, and breccias, which in Greenwater Canyon interfinger with pumiceous water-laid tuffs. Thickness 2,500 feet. Unconformably underlies Funeral fanglomerate (new) ; unconformably overlies Furnace Creek formation. Name credited to T. P. Thayer.

Typically exposed between Greenwater Canyon and Brown's Peak, in Greenwater Range, southern Death Valley region.

†Greenwich Formation[1]

Precambrian(?) : Southwestern Connecticut.

Original reference: J. G. Percival, 1842, Connecticut Geol. Survey Rept., p. 46, 49, 58, 63, 72, map.

Occurs in Stamford and Greenwich, Fairfield County, and extends along the Sound from east side of Stamford Harbour into New York State.

†Greenwich Formation[1]

Lower Cambriam : Eastern New York.

Original reference: T. N. Dale, 1904, U.S. Geol. Survey Bull. 242, p. 43, 50, pl. 1.

U.S. Geological Survey has abandoned the term Greenwich Formation on the basis that C. D. Walcott's manuscript [not Walcott, 1910, Smithsonian Misc. Colln., v. 53, no. 6] for which the name was approved was never published.

Occurs in Washington and Rensselaer Counties. Named for exposures at Greenwich, Washington County.

Greenwich Shale[1]

Cretaceous (?) : Southeastern Colorado.

Original reference: W. T. Lee, 1901, Jour. Geology, v. 9, p. 343–352.

In Purgatoire Canyon near mouth of Plum Canyon.

Greenwood Iron-Formation Member (of Michigamme Slate)

Greenwood Iron-Formation[1]

Precambrian (Animikie Series) : Northern Michigan.

Original reference: J. Zinn, 1933, Michigan Acad. Sci., Arts and Letters, v. 18, p. 442, 443, 451–454.

H. L. James, 1958, U.S. Geol. Survey Prof. Paper 314–C, p. 36. Lower part of Michigamme slate in Marquette area includes Bijiki iron-formation, Clarksburg volcanics, and Greenwood iron-formation members.

Type locality and derivation of name not stated. Greenwood is in Marquette County.

Greenwood Sandstone[1]

Pennsylvanian: Western Arkansas and central eastern Oklahoma.

Original reference: A. Winslow, 1896, New York Acad. Sci. Trans., v. 15, p. 51.

Probably named for Greenwood, Sebastian County, Ark.

†Greer Formation[1]

Permian: Southwestern Oklahoma and central and northern Texas.

Original reference: C. N. Gould, 1902, Oklahoma Geol. Survey 2d Bienn. Rept., p. 42, 52.

C. C. Branson, 1957, Oklahoma Geology Notes, v. 17, no. 11, p. 101. Abandoned by Oklahoma Geological Survey. Was named to designate rocks of the Blaine and rocks mistakenly thought to correlate with it.

Type locality: Butte known as Cedar Top in northwestern corner of Kiowa County, Okla. Named for Greer County, Okla.

Greggs Breccia[1]

Tertiary, upper; Northwestern Arizona.

Original reference: W. T. Lee, 1908, U.S. Geol. Survey Bull. 352, p. 17.

C. R. Longwell, 1936, Geol. Soc. America Bull., v. 47, no. 9, p. 1414. Pliocene (?).

Exposed south of Colorado River and east of Greggs Ferry and fills Grand Wash Trough [northwest corner of Mohave County].

Greggs Landing Marl Member (of Tuscahoma Sand)[1]

Eocene, lower: Southwestern Alabama.

Original reference: E. A. Smith, 1886, Alabama Geol. Survey Bull. 1, p. 12.

L. D. Toulmin, P. E. LaMoreaux, and C. R. Lanphere, 1951, Alabama Geol. Survey Spec. Rept. 21, p. 65, pl. 3. Described in Choctaw County where it lies about 25 feet below the Bells Landing marl member.

Named for exposures at Greggs Landing, on Alabama River, in northwestern part of Monroe County.

†Greggs Landing Series[1]

Eocene, lower: Alabama.

Original reference: W. H. Dall, 1898, U.S. Geol. Survey 18th Ann. Rept., pt. 2, p. 346.

Gregorian series[1]

Pleistocene: Iowa.

Original reference: C. R. Keyes, 1935, Pan-Am. Geologist, v. 63, no. 4, p. 281.

Derivation of name not stated.

Gregory Member (of Pierre Shale)

Gregory zone (in Sully Member of Pierre Formation)

Upper Cretaceous: Central South Dakota.

W. V. Searight, 1937, South Dakota Geol. Survey Rept. Inv. 27, p. 10–20, pls. 2, 3. Includes all beds from top of Niobrara to base of Oacoma zone of Sully member (new) south of the Great Bend and, northward from this locality, all beds lying below Agency shale zone of Sully. At and near type locality, divisible into two lithologically and faunally distinct subdivisions. Lower consists of dark bentonite-bearing bituminous shales which contain fish scales. Upper is thin zone of chalk, chalky shale, argillaceous chalk, or marl. From vicinity of mouth of White River, Lyman County, to northernmost exposures near DeGrey, Hughes County, lower and upper Gregory are separated by thin but persistent sandstone bed. Thickness 12 to 145 feet.

W. V. Searight, 1938, Iowa Acad. Sci. Proc., v. 45, p. 137. Microfaunal studies indicate that chalky beds of Gregory underlying Agency faunal zone of Sully member are closely related to the Sully and that beds previously described as upper Gregory should be included in Sully as lowermost zone of that member. Name Gregory [marl] is retained for this zone. Beds described as lower Gregory are contemporaneous with the Sharon Springs of Kansas and Colorado and the name [Sharon Springs] is adopted for beds between the Niobrara and Gregory zone of Sully as revised.

A. L. Moxon, O. E. Olson, and W. V. Searight, 1939, South Dakota State Coll. Agriculture and Mech. Arts Tech. Bull. 2, p. 20, 22. Gregory marl [zone] in Sully member consists of marl, shale, and chalky shale. Underlies Agency shale [zone].

J. P. Gries and E. P. Rothrock, 1941, South Dakota Geol. Survey Rept. Inv. 38, p. 8 (table 1), 11–14. Name Gregory resurrected and used to include all beds between base of Gregory marl and base of upper calcareous zone herein named Crow Creek zone of Sully member. These beds form distinct lithologic unit in type locality and as far north as Hughes County, where they pass beneath river level. Overlies Sharon Springs member; underlies Sully member.

D. R. Crandell, 1950, Am. Assoc. Petroleum Geologists Bull., v. 34, no. 12, p. 2340 (table 1), 2346. Underlies Crow Creek herein given member status in Pierre; overlies Sharon Springs member. Thickness at type section 34 feet. Consists of beds of light-gray to buff-colored shale with concretions and calcareous layers, and locally, as in Gregory County, basal marl beds. Gregory member as here adopted is Gregory member of Gries and Rothrock (1941).

Type locality: Outcrops along Missouri River in eastern Gregory County. Well exposed in cut bank at south end of Rosebud Bridge, south of Wheeler. Also well exposed to east of Missouri River, especially south of U.S. Highway 18 in Charles Mix County.

Grenada Formation (in Wilcox Group)[1]

Eocene, lower: Mississippi, Kentucky, and western Tennessee.

Original reference: E. N. Lowe, 1913, Mississippi Geol. Survey Bull. 10, p. 23–25.

[Tom McGlothlin] 1940, Mississippi Geol. Soc. [Guidebook 2], p. 3, 4–5. At least upper part, and perhaps all of Grenada formation belongs in Tallahatta section.

Tom McGlothlin, 1944, Am. Assoc. Petroleum Geologists Bull., v. 28, no. 1, p. 53. Suggested that term Grenada be abandoned.

G. F. Brown, 1947, Mississippi Geol. Survey Bull. 65, p. 34. Discussion of geology of alluvial plain of northwestern Mississippi. Outcrop beds earlier assigned to the Wilcox were divided into three formations: basal Ackerman, Holly Springs sand, and Grenada. Grenada is now known to be of Claiborne age, and outcrops of sand around Holly Springs are exposures of Meridian sand member of Tallahatta formation (basal Claiborne).

Benjamin Gildersleeve, 1953, Kentucky Geol. Survey Spec. Pub. 1, p. 18 (fig. 1). Generalized section—embayment region of Tennessee and Kentucky—shows Grenada formation above Holly Springs formation and below Jackson formation. Wilcox group. Lower Eocene.

Named for exposures at Grenada, Grenada County, Miss., especially on Yalobusha River, near Grenada.

Grenola cyclothem

Lower Permian (Wolfcamp): Eastern Kansas.

N. G. Lane, 1958, Kansas Geol. Survey Bull. 130, pt. 3, p. 150–156. Defined as beginning at base of unfossiliferous red and green shale in the Roca formation next below the Grenola.

Study was made at type area of Grenola formation in Elk and Cowley Counties.

Grenola Limestone (in Council Grove Group)

Grenola Formation[1]

Permian: Eastern Kansas, southeastern Nebraska, and northern Oklahoma.

Original reference: G. E. Condra and C. E. Busby, 1933, Nebraska Geol. Survey Paper 1.

R. C. Moore and others, 1951, Kansas Geol. Survey Bull. 89, p. 47–48. Grenola limestone in Council Grove group. Redefined in accordance with usage of Nebraska Geological Survey to include strata between base of Sallyards limestone and top of Neva limestone. As thus redefined, includes (ascending) Sallyards limestone, Legion shale, Burr limestone, Salem Point shale, and Neva limestone members. Underlies Eskridge shale; overlies Roca shale. Thickness 38 to 48 feet. Lower Permian, Wolfcamp series.

Type section: Ravines and creeks north and south of Highway 160, 4 to 5 miles west of Grenola, Elk County, Kans. All five members present in type section.

†Grenville Limestone[1]

Precambrian: Quebec, Canada, and northern New York.

Original references: W. E. Logan, 1859, Canada Geol. Survey Rept. Prog. 1858, p. 35–40; 1863, Canada Geol. Survey 15th Rept. Prog., p. 43–45; 1865, Canada Geol. Survey 16th Rept. Prog., p. 20, map.

Grenville Quartzite[1] or Amphibolite[1]

Precambrian: Northern New York.

Original reference: R. Balk, 1932, New York State Mus. Bull. 290, p. 14.

Grenville Series[1]

Precambrian: Ontario, Canada, and New York.

Original references: W. E. Logan, 1863, Canada Geol. Survey 15th Rept. Prog., p. 43–45; F. D. Adams, 1893, Jour. Geology, v. 1, p. 328–330.

K. E. Lowe, 1950, Geol. Soc. America Bull., v. 64, no. 5, p. 515. Term "Hudson Highlands complex" or "Highlands complex" includes entire sequence of crystalline rocks older than Storm King granite. Grenville sediments (quartzitic micaceous, and calacareous beds) comprise oldest formation in Hudson Highlands. The rocks are characteristically layered and have been intensely metamorphosed. At Bear Mountain, where Grenville series constitutes major part of Highlands complex, biotite, hornblende, epidote, and graphite schists and garnetiferous biotite gneiss are common. Pochuck diorite phase and Canada Hill granite phase associated with Grenville metamorphics.

R. J. Bean, 1953, Geol. Soc. America Bull., v. 64, no. 5, p. 515. Grenville formation mentioned in relation of gravity anomalies to geology of central Vermont and New Hampshire.

For detailed discussion of Grenville Series, see A. F. Buddington, 1939, Geol. Soc. America Mem. 7, 354 p. (Adirondack region), and J. E. Thomson, ed., 1956, The Grenville Problem: Toronto, Canada, Univ. Toronto Press and Royal Soc. of Canada, 119 p.

Name derived from Grenville Township, Argenteuil County, Ontario, Canada.

Greybull Sandstone Member (of Cloverly Formation)[1]

Lower Cretaceous: Central northern Wyoming and central southern Montana.

Original reference: F. F. Hintze, Jr., 1915, Wyoming Geologists Office Bull. 10.

P. W. Richards, 1955, U.S. Geol. Survey Bull. 1026, p. 44, 45. In upper part of Cloverly formation which is considered to be Lower Cretaceous in age. Underlies "rusty beds" here included in Cloverly.

D. L. Eicher, 1960, Yale Univ. Peabody Mus. Nat. History Bull. 15, p. 7–8, 15–16. Term Greybull sandstone member (Hewett and Lupton, 1917, U.S. Geol. Survey Bull. 656) has been applied to some sandstone beds in this general section. Inasmuch as type locality was not designated accurately, it is not now possible to ascertain whether term referred only to channel sandstones in upper part of Cloverly or to sandstone beds at base of rusty beds, or to some of each. Term Greybull should not be used beyond confines of Greybull oil field where originally it was informally applied to an oil sand.

Named for Greybull, Wyo.

Greyhorse Limestone (in Wabaunsee Group)[1]

Pennsylvanian: Oklahoma, northwestern Missouri, and southeastern Nebraska.

Original reference: G. E. Condra, 1935, Nebraska Geol. Survey Paper 8, p. 9.

Type locality: In NW¼ sec. 11, T. 24 N., R. 6 E., Osage Reservation, Okla. Correct spelling is Grayhorse.

†Greylock Limestone[1]

Silurian: Massachusetts.

Original reference: R. Pumpelly, 1894, U.S. Geol. Survey Mon. 23.

Greylock Mountain region.

Greylock Schist[1]

Middle Ordovician: Northwestern Massachusetts and southern Vermont.

Original reference: T. N. Dale, 1891, Am. Geologist, v. 8, p. 1–7.

Norman Herz, 1958, U.S. Geol. Survey Geol. Quad. Map GQ–108. Described in Cheshire quadrangle where it crops out in vicinity of Saddle Ball Mountain. In this report, color was used as primary distinction between Berkshire schist below and Greylock: black for Berkshire, green or greenish blue for Greylock. Some rocks formerly mapped as Greylock are included in Berkshire schist of this report.

J. B. Thompson, Jr., 1959, New England Intercollegiate Geol. Assoc. Guidebook 51st Ann. Mtg., p. 72, 77, 86. Geographically extended into Vermont. Thickness about 1,000 feet. If Berkshire schist is equivalent to Ira formation, Greylock schist may represent rocks that overlie Ira unconformably. However, Greylock closely resembles Biddie Knob formation of Castleton area which is believed to underlie conformably fossiliferous Cambrian of Taconic slate belt. Age uncertain.

Named for exposures on Mount Greylock, Mass.

†Greylock Series[1]

Precambrian: Massachusetts.

Original references: W. H. Hobbs, 1892, Geol. Soc. America Bull., v. 3, p. 460; 1893, Jour. Geology, v. 1, p. 717–736.

Occurs in Mount Greylock region.

Greyson Shale (in Missoula Group)

Greyson Member (of Spokane Formation)

Greyson Shale[1] (in Piegan Group)

Precambrian (Belt Series): Western central Montana.

Original reference: C. D. Walcott, 1899, Geol. Soc. America Bull., v. 10, p. 199–215.

C. L. Fenton and M. A. Fenton, 1937, Geol. Soc. America Bull., v. 48, no. 12, p. 1898. Member of Spokane formation. Consists of thinly bedded gray and greenish-gray shales that weather olive brown; conglomerate, pinkish sandstone, and brown sandy lenses in lower portion. Thickness 2,300 to 3,000 feet. In little Belt Mountains, consists of about 1,000 feet of gray argillite. Underlies Prickly Pear member (new).

C. P. Ross, D. A. Andrews, and I. J. Witkind, 1955, Geologic map of Montana (1:500,000): U.S. Geol. Survey. Shale distinguished only in vicinity of Helena. In Piegan group.

U.S. Geological Survey currently classifies the Greyson Shale as a formation in the Missoula Group on the basis of a study now in progress.

Type locality: On side of ridge between Deep and Greyson Creeks in Belt Mountains, southeast of Townsend.

Gries Ranch Formation

Gries Formation

Gries Ranch horizon[1]

Oligocene, lower: Western Washington.

Original reference: W. L. Effinger, 1936, Geol. Soc. America Proc. 1935, p. 411.

C. E. Weaver, 1937, Washington [State] Univ. Pubs. in Geology, v. 4, p. 108–109. Term Gries Ranch zone was applied by Dickerson (1917, California Acad. Sci. Proc., 4th ser., v. 7, no. 6) to relatively thin section of brownish-gray sandstone and sandy shale exposed in south bank of Cowlitz River, in south part of sec. 24, and north part of sec. 25, T. 11 N., R. 2 W., Cowlitz County. Collection of fossils made by Anderson and Martin was described by Dickerson as representing a lower facies of the *Molopophorus lincolnensis* zone. Original description of type locality was designated by Martin as "Locality 181 on east bank of Cowlitz River, just back of Greece ranchhouse about 4 miles east of Vader. There appear to be two formations represented at this point. The fossils occur in a sandstone which is associated with a conglomerate composed of basalt pebbles and boulders. These two beds dip northwest at very small angle varying from 1° to 5°. A few yards to south a well-stratified coarse gray compact sandstone is exposed dipping south at angle of 10° and striking N. 70° E. This sandstone is probably Eocene. About 20 feet south of fossil beds a mass of coarse conglomerate is butting perpendicularly against sand to the south. This conglomerate appears to be same as that where the fossils occur." Term Grecco ranch is used in description given by Dickerson. As ascertained by present writer [Weaver], the name of people who originally owned this ranch was spelled Gries and this name should be used rather than Grecco. Several years ago the property was sold by Gries family who moved some distance up river. Because name Gries Ranch fauna has become familiar to investigators of marine Oligocene, it is herein suggested that small headland on river on property formerly owned by Gries family be named Gries Point and that beds exposed in river bank and west of the point be termed Gries formation. Strata of Gries formation are exposed in south bank of Cowlitz River for distance of about 1,200 feet where they occupy nose of shallow faulted syncline, which plunges toward north, and whose dips in either limb are under 4°. Formation is commonly regarded as lowermost Oligocene and is probably in part at least equivalent to Keasey formation in Oregon.

W. L. Effinger, 1938, Jour. Paleontology, v. 12, no. 4, p. 355–390. Description of Gries Ranch fauna. Measured section at Gries Ranch locality gives thickness of Gries Ranch beds as 106 feet. Seems likely that the Gries Ranch may be correlated with Willapa River shales of southwestern Washington and Keasey shales of Oregon, but their faunas are apparently of deeper water facies.

Type locality: Outcrop on southeast bank of Cowlitz River, in Lewis County, about 4 miles east of Vader, sec. 25, T. 11 N., R. 2 W. Named for Gries Ranch.

Griffin Bed[1]

Miocene, lower: Western Florida and southwestern Georgia.

Original reference: A. F. Foerste, 1894, Am. Jour. Sci., 3d, v. 48, p. 52–54.

Named for exposures on Griffins Creek, 4½ miles south of Bainbridge, Decatur County, Ga., and about one-half mile west of Griffin's House.

Griffin Sandstone Member (of Lake Murray Formation)

Pennsylvanian: Southern Oklahoma.

B. H. Harlton, 1956, *in* Ardmore Geol. Soc., Petroleum geology of southern Oklahoma—a symposium, v. 1: Tulsa, Okla., Am. Assoc. Petroleum Geologists. p. 137 (fig. 2), 140, 141 (fig. 3). Middle member of Lake Murray formation (new). Overlies Bostwick member: underlies Frensley member.

Derivation of name not stated. Area of report is Harrisburg trough, Stephens and Carter Counties.

Griffith Beds

Cretaceous(?): Southern California.

G. J. Neuerburg, 1953, California Div. Mines Spec. Rept. 33, p. 7 (table 1), 18–19, pl. 1. Sandstone and fanglomerate about 2,500 feet thick. Separable into four units or members (unnamed): lowest, about 500 feet consists predominantly of thick-bedded medium-grained arkose with beds of silty clay shale, siltstone, and pebble conglomerate; second, about 150 feet, is thick beds of cobble conglomerate and arkose; third and fourth members are boulder conglomerate; third has about 20 percent arkose matrix as compared to 30 to 40 percent in the fourth member. Probably oldest sedimentary unit in area. Unconformably overlies pre-Cretaceous(?) basement rocks; underlies Cahuenga beds (new). Griffith beds occupy an isolated fault block; unit is in fault contact with sediments of Topanga formation and Hollycrest formation (new) on all sides.

Occurs in Griffith Park area, city of Los Angeles.

Grimes Siltstone Member (of West Falls Formation)

Grimes Sandstone[1]

Upper Devonian: Western and west-central New York.

Original reference: D. D. Luther, 1902, New York State Mus. Bull. 52, p. 616–629.

J. F. Pepper, Wallace de Witt, Jr., and G. W. Colton, 1956, U.S. Geol. Survey Oil and Gas Inv. Map OC–55. Unit termed Grimes sandstone by Luther is here designated as Grimes siltstone member of West Falls formation (new). Consists largely of light-greenish-gray and light-bluish-gray siltstone in lenticular beds 1 inch to 6 feet thick. Maximum thickness not more than 60 feet; 1 foot in west-central Livingston County; 15 feet near Dansville, Livingston County; about 50 feet in southern Ontario and western Yates Counties; 5 feet in Steuben County. Overlies Hatch shale member; underlies Gardeau shale member; both contacts gradational.

Named for exposures in Grimes Glen at Naples, Ontario County.

Grimes Canyon Sand and Gravel Member (of Santa Barbara Formation)

Pleistocene, lower: Southern California.

California State Water Resources Board, 1953 (revised 1956), California State Water Resources Board Bull. 12, v. 2, p. B–24, B–103–B–104, pls.

B-1C, B-2. Sand and gravel 100 to 1,000 feet thick near top of formation; rusty-brown color; slightly cemented. Underlies Fox Canyon member (new) of San Pedro formation.

T. L. Bailey, 1954, *in* Pacific Petroleum Geologist, v. 8, no. 9, p. 1; R. G. Thomas and others, 1954, California Div. Mines Bull. 170, chap. 6, p. 20, pls. 2, 6, 7. Marginal facies of formation. Grades from fine sand ranging from 20 feet thick in Las Posas Hills to 1,000 feet thick in southernmost part of Oxnard Plain.

Exposed in Grimes Canyon and southeastward, mostly on flank of Oak Ridge, Ventura County.

Grimsby Sandstone (in Albion Group)

Grimsby Sandstone[1] (in Medina Group)

Lower Silurian: Ontario, Canada, and New York.

Original reference: M. Y. Williams, 1914, Science, new ser., v. 39, p. 915–918.

Tracy Gillette, 1940, New York State Mus. Bull. 320, p. 21, 22 (fig. 6), 24–26. Top formation in Albion group, Medinan series. Oldest rock exposed in Clyde and Sodus Bay quadrangles. Underlies Thorold sandstone of Clinton group.

Tracy Gillette, 1947, New York State Mus. Bull. 347, p. 13 (fig. 2), 30, 31 (fig. 4). In area of Fulton, the Grimsby underlies Oneida conglomerate.

D. W. Fisher, 1954, Am. Assoc. Petroleum Geologists Bull., v. 38, no. 9, p. 1982 (fig. 3), 1991–1993. Top formation in Medinan group. Correlation chart shows that Grimsby underlies Thorold sandstone and overlies Cabot Head shale in all areas except Lockport where it is unconformable below the Neagha and overlies Fish Creek shale (new). Thickness 3 to 70 feet.

D. W. Fisher, 1959, New York State Mus. Sci. Service Geol. Survey Map and Chart Ser. 1. Term Medina group used in this report in preference to Medinan group. Term Rumsy Ridge replaces preoccupied name Fish Creek. Chart shows Grimsby overlies Rumsy Ridge in some areas.

Named for exposures along east side of Niagara Gorge at Grimsby, Ont.

Grindstaff cyclothem (in Abbott Formation)

Grindstaff cyclothem (in Tradewater Group)

Pennsylvanian: Southwestern and southeastern Illinois.

H. R. Wanless, 1955, Am. Assoc. Petroleum Geologists Bull., v. 39, no. 9, p. 1764 (table 2). In list of cyclothems of southern Illinois, the Grindstaff occurs at base of Tradewater group and underlies Delwood cyclothem.

H. R. Wanless and Raymond Siever, 1956, Illinois Geol. Survey Circ. 217, p. 5, 9, pl. 1. Includes (ascending) Grindstaff sandstone, Willis coal, and Boskydell marine horizon. Underlies Delwood cyclothem; overlies Pounds cyclothem of Caseyville group. Type locality given.

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 52 (table 2), pl. 1. In Abbott formation (new). Above Pounds cyclothem and below Delwood cyclothem. Presentation of new rock-stratigraphic classification of Pennsylvanian strata in Illinois; cyclical classification is independent of rock-stratigraphic classification.

Type locality: NE¼ sec. 28, T. 10 S., R. 8 E., Gallatin County.

Grindstaff Sandstone Member (of Abbott Formation)

Grindstaff Sandstone Member (of Tradewater Formation)[1]

Grinsdtaff Sandstone (in Tradewater Group)

Middle Pennsylvanian: Southeastern Illinois and western Kentucky.

Original reference: C. Butts, 1925, Illinois Geol. Survey Bull. 47, p. 44.

J. M. Weller, 1940, Illinois Geol. Survey Rept. Inv. 71, p. 40. Rank raised to formation in Tradewater group. Underlies Delwood formation (new).

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 31, 44 (table 1), 62. Rank reduced to member in Abbott formation (new). Thickness about 50 feet in type section of Abbott. Occurs above Reynoldsburg coal member and below Willis coal member (both new). Presentation of new rock-stratigraphic classification of Pennsylvanian strata in Illinois.

U.S. Geological Survey has discontinued use of the name Tradewater in Illinois.

Type locality: NE¼ cor. sec. 28, T. 10 S., R. 8 E., Gallatin County, Ill. Area is known as Grindstaff Hollow.

Grindstone Group

Upper Jurassic (Knoxville): Northern California.

F. M. Anderson, 1943, California Div. Mines Bull. 118, pt. 2, p. 184 (fig. 68) [preprint 1941]. Shown as middle group of Knoxville series. Underlies Newville group (new): overlies Elder Creek group (new).

F. M. Anderson, 1945, Geol. Soc. America Bull., v. 56, no. 10, p. 926–929. Begins with well-marked basal conglomerate; upper parts dark sandstone and black sandy shale. Thickness on Grindstone Creek between Chrome and Elk Creek village 5,400 feet; on Redbank Creek 2,800 feet—due to faulting; west of Bennett Creek and Toms Creek, 6,600 feet or more. In some areas, rests directly upon Klamath complex; in other areas, overlies Elder Creek group or overlies Paleozoic limestones. South of Cold Fork, conglomerates lie discordantly on Elder Creek group in disconformable overlap, and constitute a belt that stands out in relief along strike of beds. Derivation of name given.

Named from Grindstone Creek which crosses the group 1 to 2 miles west of road between Chrome and Elk Creek village, Glenn County. Well exposed in sec. 26, T. 28 N., R. 9 W., on northeast slope of Tedoc Peak, northwest Tehama County.

Grindstone Creek Formation (in Millsap Lake Group)

Grindstone Creek Member (of Millsap Lake Formation)[1]

Pennsylvanian: North-central Texas.

Original reference: E. H. Sellards, 1933, Texas Univ. Bull. 3232, p. 106, 107.

M. G. Cheney, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 1, p. 66 (fig. 1). Rank raised to formation in Millsap Lake herein given group status. Includes (ascending) "Buck Creek sandstone", Santo limestone, Goen limestone-Ricker limestone. Underlies Garner formation; overlies Lazy Bend formation.

Leo Hendricks, 1957, Texas Univ. Bur. Econ. Geology Pub. 5724, p. 18–20, fig. 3, pl. 4. Chiefly a succession of shales, sandy shales, and sandstones occurring immediately above Brannon Bridge limestone. Thickness about

450 feet. In this report, includes Santo limestone bed about middle of formation and Goen limestone bed at top. Top of formation has been defined in Palo Pinto County (Plummer and Hornberger 1936, Texas Univ. Bull. 3232) as base of Thurber coal where present and top of Goen limestone where coal is missing. Thurber coal is missing in Parker County, and the Goen can be traced from Palo Pinto County only one-half mile eastward into Parker County; hence, in this report, boundary between Grindstone Creek and overlying Garner is mapped by projection of topographic and structural position of Goen limestone, but this method is considered unsatisfactory.

Type locality: West of Grindstone Creek, Parker County. Exposures occur in scarps and artificial cuts near Brazos River; lower shales are exposed in scarp north of U.S. Highway 80, east of river; middle part exposed in roadcut southeast of Bennett. Upper part composes scarp west of Bennett; type section includes these exposures and extends from top of Brannon Bridge limestone to top of easternmost Goen limestone on highland west of Bennett.

Grinnell Formation
Grinnell Argillite[1] } (in Ravalli Group)

Precambrian (Belt Series): Northwestern Montana, and southwestern Alberta and southeastern British Columbia, Canada.

Original reference: Bailey Willis, 1902, Geol. Soc. America Bull., v. 13, p. 316, 322.

C. L. Fenton and M. A. Fenton, 1937, Geol. Soc. America Bull., v. 48, no. 12, p. 1887–1888. Red or purplish argillites and white to light-green quartzites. Formation comprises three members (ascending): Rising Wolf, Red Gap, and Rising Bull. Thickness 1,500 to 3,500 feet. Overlies Appekunny formation; underlies Siyeh formation. Type locality restated.

C. P. Ross, 1950, U.S. Geol. Survey Bull. 974–E, p. 142, 144 (table), pl. 4. Argillite, in Ravalli group, underlies Wallace formation in Hamilton quadrangle, Montana.

C. P. Ross, 1959, U.S. Geol. Survey Prof. Paper 296, p. 19 (table), 27–33, pls. 1, 2. Grinnell argillite, in Flathead and Swan Ranges, crops out extensively with Appekunny argillite below and Siyeh limestone above, evidently in normal stratigraphic relations uncomplicated by deformation. Formation consists largely of pale- and grayish-blue-green, grayish-purple, and grayish-red-purple siliceous argillite, in part calcareous, and some quartzite. In Swan Range, lowest and thickest part of formation is dominantly pale- and grayish-red-purple argillite, nowhere well exposed. Above this is middle member in which proportion of red-purple beds decreases upwards, and much of rock is quarzitic argillite and argillaceous quartzite, with thin argillite partings, commonly rather dark-red-purple. Uppermost member commonly consists of grayish-blue-green calcareous argillite and argillaceous limestone, constituting transition zone below Siyeh limestone of Piegan group. Thickness 1,000 to 4,000 feet. Fenton and Fenton (1937) studied the Grinnell mainly in and north of northern part of Glacier National Park in localities not examined closely during present study. The members they proposed differ from those in Swan Range.

Type locality: Grinnell Point (Stark Point of some maps), at head of Swiftcurrent formerly McDermott Lake, Glacier National Park, Mont.

Griswold Conglomerate
Griswold Gap Conglomerate (in Pocono Formation)[1]
Griswolds Gap Conglomerate

Mississippian: Northeastern Pennsylvania.

Original reference: I. C. White, 1881, Pennsylvania 2d Geol. Survey Rept. G_5, p. 56, 57.

Bradford Willard, 1939, Pennsylvania Geol. Survey, 4th ser., Bull. G–19, p. 255, 279, 282. Griswold Gap conglomerate at base of Pocono. Above Mount Pleasant red shale.

Well exposed opposite Grisword's Gap, just east of Forest City, Susquehanna County.

Grizzly Formation

Precambrian: Southwestern South Dakota.

T. A. Dodge, 1942, Geol. Soc. America Bull., v. 53, no. 4, p. 563. Name appears on list of Precambrian rocks of area. Phyllite, about 3,000 feet thick. Overlies Flag Rock formation (new).

J. A. Noble and J. A. Harder, 1948, Geol. Soc. America Bull., v. 59, no. 9, p. 944 (fig. 1), 962. Consists almost wholly of fine-grained gray to dark-gray sericitic phyllite with no distinctive character and almost no bedding. Thickness about 3000 feet not allowing for possible duplication by undisclosed folding; probably thicker in vicinity of Deadwood. Top of formation not observed overlies Flag Rock formation.

Occurs at Homestake mine, in vicinity of Lead, Lawrence County.

Grizzly Formation[1]

Silurian(?) (may be Ordovician): Northern California.

Original reference: J. S. Diller, 1892, Geol. Soc. America Bull., v. 3, p. 370–394.

P. A. Lyndon, T. E. Gay, Jr., and C. W. Jennings, 1960, Geologic map of California Westwood sheet (1:250,000): California Div. Mines. Gray quartzite and slaty sandstone (pre-Permian). Mapped with Paleozoic marine sedimentary and metasedimentary rocks.

Named for exposures on east and northeast slopes of Grizzly Mountains, Plumas County.

Grizzly Creek Member (of Crack Canyon Formation)

Upper Jurassic[?] or Cretaceous[?]: Northern California.

J. E. Lawton, 1956, Dissert. Abs., v. 16, no. 10, p. 1885. Listed as upper member of formation. Overlies Blue Ridge member (new); underlies Leesville member of Little Valley formation (both new). Upper Jurassic and Cretaceous section, about 40,000 feet thick, consists of sequences of shale and silty shale which alternate with sequences of sandstone.

Occurs in Morgan-Wilbur area in Lake, Yolo, and Colusa Counties.

Grizzly Mountain Rhyolite[1]

Tertiary: Central Colorado.

Original reference: J. T. Stark and F. F. Barnes, 1935, Colorado Sci. Soc. Proc., v. 13, no. 8, p. 477, map.

Named for Grizzly Mountain Sawatch Range.

†Grizzly Peak Andesite[1]

Grizzly Peak Basalt

Pliocene: Western California.

Original reference: A. C. Lawson and C. Palache, 1902, California Univ. Pubs. Dept. Geol. Bull., v. 2, p. 379, map.

[O. P. Jenkins], 1949, *in* Mineral Inf. Service, v. 2, no. 2, p. 7, 14 (map). Described and mapped as Grizzly Peak basalt. Includes agglomerates, tuffs, and mud flows. Underlies Siesta formation; overlies Orinda formation.

D. E. Savage and O. E. Bowen, 1955, *in* Geol. Soc. America Cordilleran Sec. [Guidebook] Apr. 28–30, Trip 2, p. 2. Lower member of Moraga volcanic series is locally called Grizzly Peak basalt.

Forms Grizzly Peak, in Berkeley Hills, San Francisco region.

Grizzly Peak Rhyolite[1]

Tertiary: Central Colorado.

Original reference: J. V. Howell, 1919, Colorado Geol. Survey Bull. 17.

Occurs in Grizzly Peak, Chaffee County.

Groat Sandstone Bed (in Gammon Ferruginous Member of Pierre Shale)[1]

Upper Cretaceous: Southeastern Montana, western South Dakota, and northeastern Wyoming.

Original reference: W. W. Rubey, 1930, U.S. Geol. Survey Prof. Paper 165–A.

M. E. Wing, 1940, South Dakota Geol. Survey Rept. Inv. 35, p. 10, columnar section. Geographically extended into Belle Fourche district, South Dakota. Apparently not extensive in South Dakota.

Named for exposures along Groat Creek in T. 7 S., R. 56 E., Carter County, Mont.

Groesbeck Dolomite[1]

Permian: Central northern Texas and southwestern Oklahoma.

Original reference: F. W. Cragin, 1897, Am. Geologist, v. 19, p. 357.

Named for Groesbeck Creek, Hardeman County, Tex.

Groos Quarry Member (of Trenton Formation)

Middle Ordovician: Northern Michigan.

R. C. Hussey, 1952, Michigan Dept. Conserv., Geol. Survey Div. Pub. 46, Geol. Ser. 39, p. 13, 14, 33, 34. Middle member of formation. Underlies Haymeadow Creek member and overlies Chandler Falls member (both new). Forty feet of rock exposed in Groos quarry section; lower 6 feet consist of even-bedded dolomite that grades upward into irregularly bedded argillaceous limestone; parting lenses and thin layers of black shale present throughout section; disconformity about 12 feet above base.

Type locality: Abandoned Bichler quarry at Groos, sec. 1, 39 N., 3 W., Delta County, 5 miles north of Escanaba.

Gros Ventre Formation[1]

Gros Ventre Group

Gros Ventre Member (of Depass Formation)

Middle Cambrian: Northwestern Wyoming and central southern Montana.

Original reference: E. Blackwelder, 1918, Washington Acad. Sci. Jour., v. 8, p. 417.

B. M. Miller, 1936, Jour. Geology, v. 44, no. 2, p. 119–123, 129, 132, 134. Formation in northwestern Wyoming comprises lower shale division, Death Canyon member (new), and upper shale division. Thickness 675 feet. Overlies Flathead formation; underlies Gallatin formation.

Charles Deiss, 1938, Geol. Soc. America Bull., v. 49, no. 7, p. 1096–1098, 1101 (fig. 3), 1103. Rank reduced to member status in Depass formation (redefined). Overlies Flathead sandstone member. Underlies Maurice member of Boysen formation (new). Thickness 300 feet.

A. J. Bertagnolli, Jr., 1941, Am. Assoc. Petroleum Geologists Bull., v. 25, no. 9, p. 1732 (table 1), 1733. Restricted in La Barge region, Wyoming, to exclude Death Canyon limestone herein raised to formation rank. Thickness 450 to 800 feet. Consists of dark fissile shales with thin gray fossiliferous limestones. Underlies Gallatin formation.

A. B. Shaw and P. O. McGrew, 1954, Wyoming Geol. Assoc. Guidebook 9th Ann. Field Conf., chart 2. Rank raised to group in western Wyoming where it includes three mappable formations (ascending): Wolsey shale, Death Canyon limestone, and Park shale. Where Death Canyon limestone is missing, entire green shale sequence may be called Gros Ventre formation, but where these rocks are in a brown to red sand and siltstone facies, name Buck Spring formation (new) is applied. Overlies Flathead sandstone; underlies Gallatin group.

H. R. Wanless, R. L. Belknap, and Helen Foster, 1955, Geol. Soc. America Mem. 63, p. 11–13. Formation as used in this report includes Wolsey shale, Death Canyon limestone, and Park shale members. Overlies Flathead sandstone; underlies Boysen limestone.

First described in Gros Ventre Range, Wyo.

Groton Granite[1]

Devonian: Northeastern Vermont.

Original reference: E. J. Foyles and C. H. Richardson, 1929, Vermont State Geologist, 16th Rept., table opposite p. 288.

Quarried in southwestern part of Groton Township, Calendonia County.

Grouse Hill Dacite Flow, Lava

Pleistocene to Recent: Southwestern Oregon.

J. S. Diller and H. B. Patton, 1902, U.S. Geol. Survey Prof. Paper 3, p. 36, 111. Name given to dacite flow on Grouse Hill. About same relative age as Cloud Cap dacite flow (new). On inner slope, a layer of pumice beneath flow of Llao Rock overlaps Grouse Hill flow, showing that Grouse Hill flow is older than Llao Rock eruption. At south base of Grouse Hill, the dacite is regularly banded, and on hill next northeast of Llao Rock it is spherulitic. [See Sun Creek Dacite Flow.]

J. E. Allen, 1936, Jour. Geology, v. 44, no. 6, p. 737–739. Grouse Hill flow lies on fairly smooth surface which slopes northward about 250 feet to mile. Flow is almost 2 miles long, 1 mile wide, and averages 250 feet in thickness, rising to over 800 feet in center. This point of highest elevation probably indicates location of vent. Flow has suffered only minor amount of erosion.

Howel Williams, 1942, Carnegie Inst. Washington Pub. 540, p. 49–51, 137–138. Diller supposed that lava of Grouse Hill was older than Llao Rock flow because it seemed to have suffered more erosion and because it was partly overlain by same sheet of pumice that underlies dacite cliffs of Llao. First of these arguments is questionable, and second is invalid because pumice on top of Grouse Hill is part of same sheet that lies above Llao flow. There is no way of telling which of the two flows is the older. Probably they are about the same age. Dominant lava is pale-gray minutely vesicular and glassy dacite, richly charged with phenocrysts of plagioclase, pyroxene, and hornblende.

Grouse Hill is on north rim of Crater Lake.

Grove Limestone[1]

Lower Ordovician: Western Maryland

Original reference: G. W. Stose and A. I. Jonas, 1935, Washington Acad. Sci. Jour., v. 25, no. 12, p. 564–565.

A. J. Stose and G. W. Stose, 1946, Maryland Dept. Geology, Mines and Water Resources [Rept.] Carroll and Frederick Counties, p. 43, 47–52, 84. Thick-bedded high-calcium limestone with beds of massive dolomite in lower part and highly quartzose limestone at base. Thickness in quarry near LeGore, 590 feet. Overlies Frederick limestone; underlies New Oxford formation. Distribution noted.

Named from Grove Quarry and Grove Station, on Baltimore and Ohio Railroad, Frederick County. In middle of Frederick Valley, forms belt about 1 mile wide that extends from point south of Buckeystown northward to LeGore, where it is overlapped diagonally by Triassic sedimentary rocks; belt widens north of Fountain Rock, and at north end, west of Woodsboro, attains width of 2 miles; several narrower bands lie to west of main belt, and extend from south end of Chestnut Hill southwestward to U.S. Highway 40, west of Frederick.

Grove Creek Formation

Grove Creek Limestone (in Gallatin Group)

Grove Creek Member (of Boysen Formation and Snowy Range Formation)

Upper Cambrian: Southern Montana and northwestern Wyoming.

Erling Dorf and Christina Lochman, 1938, (abs.) Geol. Soc. America Proc. 1937, p. 276; 1940, Geol. Soc. America Bull., v. 51, no. 4, p. 543–545. Formation consists of glauconitic limestone rounded pebble conglomerates with patches of white crystalline limestone containing large star-shaped crinoid stem plates overlain by a series of intercalated yellow-green fissile shales, thin gray limestone, and thin-bedded buff to orange-red sandy dolomites. Average thickness 30 feet; at type locality 47 feet. Underlies Bighorn formation; overlies Snowy Range formation (new). Trempealeau equivalent. Term Gallatin formation not applicable in this area [southern Montana].

Charles Deiss, 1938, Geol. Soc. America Bull., v. 49, no. 7, p. 1092–1093, 1101 (fig. 3), 1105. Rank reduced to member status in Boysen formation (new) in Wind River area, Wyoming. Uppermost member of formation; overlies Snowy Range member. Thickness 40 feet in type section of Boysen.

A. B. Shaw, 1954, Billings Geol. Soc. Guidebook 5th Ann. Field Conf., p. 32–34. Name Grove Creek limestone adopted here for capping limy unit in Gallatin group in both Pryor and Bighorn Mountains. Dorf and Lochman defined unit as Trempealeau equivalent, but name is used here in lithic sense, rather than time-rock, for these upper limestones regardless of their age, which is not exclusively Trempealeauan. There is a need for inclusive rock term for entire limy sequence (now called upper Gallatin limestone) above Dry Creek shale. Time-rock terms Grove Creek and Snowy Range of Dorf and Lochman are not legitimately usable where faunal evidence is lacking. Grove Creek of Pryor Mountains comprises 260 feet of predominantly green or gray-green massive flat-pebble conglomerate with thinner beds of fine-grained limestone; interbedded with limestones are green and gray-green arenacous and calcareous, apparently glauconitic shales. Thickness 160 feet in northern Bighorns, flat-pebble conglomerates predominating.

P. W. Richards, 1957, U.S. Geol. Survey Bull. 1021–L, p. 397, 400, 401. Formation described east and southeast of Livingston, Mont., where it is 50 feet thick and consists predominantly of conglomeratic limestone and shale with stringers of sandstone and siltstone. Overlies Snowy Range formation; underlies Bighorn dolomite.

W. G. Pierce, 1957, Am. Assoc. Petroleum Geologists Bull., v. 41, no. 4, p. 611 (fig. 15), 612. In Heart Mountain thrust area, Wyoming, Grove Creek locally underlies Crandall conglomerate (new).

R. E. Grant, 1958, Dissert. Abs., v. 18, no. 6, p. 2107. Reallocated to member status in Snowy Range formation. Upper member of formation overlies Sage member; underlies Maywood formation. Thickness about 25 feet; member nowhere complete; upper part removed by erosion in some areas and by faulting in others. Report covers Horseshoe Hills and Bridger Mountains, Mont., and Yellowstone Park vicinity.

Type locality: South side of North Fork of Grove Creek, a tributary of Clark Fork of Yellowstone River, in Beartooth front, 5 miles southeast of Red Lodge, Carbon County, Mont. Section measured in N½NW¼ sec. 36, T. 8 S., R. 20 E.

†Groveland Formation[1]

Precambrian (upper Huronian): Northwestern Michigan.

Original reference: H. L. Smyth, 1899, U.S. Geol. Survey 19th Ann. Rept., pt. 3, p. 114–121, 137–139.

Well exposed in central part of sec. 31, T. 42 N., R. 29 W., in vicinity of abandoned Groveland mine, in Felch Mountain district.

Grover Gravel

Miocene(?): Eastern Missouri and western Illinois.

Leland Horberg, 1950, Illinois Acad. Sci. Trans., v. 43, p. 173. Incidental mention as Grover gravel of St. Louis region.

W. M. Rubey, 1952, U.S. Geol. Survey Prof. Paper 218, p. 12 (chart), 61–74. Name applied to thin layer of gravel that lies between highest Mississippian or Pennsylvanian formations and overlying Pleistocene deposits. Gravels formerly called "Lafayette." Throughout most of Hardin and Brussels quadrangles (this report), the Grover seems to be merely a thin veneer of pebbles, and in a number of places it is absent. In southern part of Brussels quadrangle, formation is commonly 2 to 5 feet and in a few places 10 feet thick. In parts of St. Louis County, Mo., thickness is slightly more than 30 feet.

Type locality: Uplands near Grover, St. Louis County, Mo. Occurs only on uplands where it caps the high narrow remnants of an old and once much more extensive upland surface.

Grundy Knob Limestone (in Lisman Formation)

Pennsylvanian: Northern Kentucky.

J. A. Culbertson, 1932, The paleontology and stratigraphy of the Pennsylvanian strata between Caseyville, Kentucky, and Vincennes, Indiana: Urbana, Ill., Univ. Illinois, Abs. Thesis, p. 8. Incidental mention; equivalent to New Haven limestone of Illinois.

H. R. Wanless, 1939, Geol. Soc. America Spec. Paper 17, p. 85. Marine limestone in Lisman formation. Locality noted. Formerly called Carthage limestone.

Exposed in Grundy Knob, Union County, Ky., 5 miles northeast of Shawneetown, Ill.

Guadalupan series

Late Carbonic: New Mexico.

C. R. Keyes, 1940, Pan-Am. Geologist, v. 74, nos. 2 and 3, p. 106, 136, 139. Guadalupan series, as shown on chart of geologic formations, spans interval between Mescaleran series below and Malagan (Pecosan) series above. Comprises Otero, Word, Capitan, and Chaves terranes.

Guadalupe Series

Guadalupe Group[1]

Lower and Upper Permian: Western Texas, southern Kansas, eastern New Mexico and Oklahoma.

Original reference: G. H. Girty, 1902, Am. Jour. Sci., 4th, v. 14, p. 363–368.

J. E. Adams and others, 1939, Am. Assoc. Petroleum Geologists Bull., v. 23, no. 11, p. 1675–1676, 1678. Rank raised to series. Thickness 4,100 feet at type locality, south end of Gaudalupe Mountains; consists of 2,300 feet of sandstone overlain by 1,800 feet of (Capitan) limestone. Rests on Bone Spring limestone of Leonard age. Because of erosion, youngest beds of series missing from type section. Getty Oil Co.'s Dooley No. 7 in sec. 24, T. 20 S., R. 29 E., Eddy County, N. Mex., penetrated thickness of 5,250 feet. In Delaware basin, series represented by sandstone facies, Delaware Mountain sandstone, which is 3,000 to 3,500 feet thick at outcrop in Delaware Mountains and is there divided into three approximately equal formations. Series in and around Delaware basin subdivided into two paleontologic units. Lower unit, which includes lower and middle formation of Delaware Mountain sandstone, the equivalent Word formation, and certain limestones of the marginal belt, contains ammonoid *Waagenoceras* and is characterized by species of genus *Parafusulina* more advanced than primitive genus of same species found in underlying Leonard series. Upper unit, which includes upper formation of Delaware Mountain and equivalent Capitan limestone, characterized by fusulind genus *Polydiexodina*. Underlies Ochoa series (new). Includes Whitehorse group and equivalent beds in Texas, Oklahoma, and Kansas. Cimarron series of northern midcontinent region should be abandoned and its strata reclassified as belonging to Leonard series and Guadalupe series.

P. B. King, 1942, Am. Assoc. Petroleum Geologists Bull., v. 26, no. 4, p. 575–608, 699–709. Series in Glass Mountains consists of Word formation below followed by a complex of deposits divided into Altuda formation, Capitan limestone, and Gilliam limestone. If this classification is correct, beds of upper Guadalupe age in eastern Glass Mountains are much more restricted than they were thought to be in 1931, when they were supposed to include Vidrio, Gilliam, and Tessey limestones. The Tessey has been shown to be younger (King, 1938), and it is suggested herein that the Vidrio is older. Rocks of Guadalupe series in Delaware basin constitute Delaware Mountain group, composed dominantly of sandstone and divided into (ascending) Brushy Canyon, Cherry Canyon, and Bell Canyon formations. Away from basin, the sandstones tend to disappear. Their lower part passes out by overlap, and higher part is replaced by thick reef masses, Goat Seep and Capitan limestones. In shelf area, the reef masses grade into a complex of limestone, sandstone, and evaporite that forms Carlsbad and Chalk Bluff formations.

R. C. Moore and others, 1951, Kansas Geol. Survey Bull. 89, p. 37. Rocks of Guadalupian series crop out in southern Kansas. They comprise unfossiliferous deposits that seem to have been laid down partly on land and partly in shallow basins occupied by strongly saline waters. Thickness of outcropping rocks of series about 290 feet. Subsurface thickness averages about 400 feet in southwestern part of state.

J. M. Jewett, 1959, Graphic column and classification of rocks in Kansas: Kansas Geol. Survey. As shown on correlation chart, Guadalupian stage is Middle Permian.

G. V. Cohee, 1960, Am. Assoc. Petroleum Geologists Bull., v. 44, no. 9, p. 1578–1579. U.S. Geological Survey recognizes a two-fold subdivision of the Permian. Reference sequence for United States is designated as outcrops on northwestern Trans-Pecos Texas (Delaware Mountains, Guadalupe Mountains, and Sierra Diablo Mountains) where approximate faunal boundary is taken as that between Cherry Canyon and Bell Canyon formations which are encompassed by Guadalupe provincial series.

C. C. Branson, 1960, Oklahoma Geology Notes, v. 20, no. 9, p. 233 (table 1). In Oklahoma, series includes El Reno and Whitehorse groups.

Type locality: South end of Guadalupe Mountains. Named for Guadalupe Point, south end of Guadalupe Mountains, El Paso, Tex.

Guadalupe Mountain Quartz Diorite

[Jurassic]: Central California.

G. H. Curtis, J. F. Evernden, and J. Lipson, 1958, California Div. Mines Spec. Rept. 54, p. 6. Discussed in report dealing with potassium-argon age determinations. Age given as 142.9 million years.

Occurs in Guadalupe Mountain pluton which intrudes Mariposa formation and older rocks. Dated specimen collected from side of road through southern end of Guadalupe Mountains in Indian Gulch quadrangle, NE¼ sec. 24, T. 6 S., R. 17 E.

Guadalupian Series or Stage

See **Guadalupe Series.**

Guajataca Member (of Cibao Formation)

Oligocene: Puerto Rico.

A. D. Zapp, H. R. Bergquist, and C. R. Thomas, 1948, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 85. Introduced to designate sequence of gravels, sands, and shales with interfingering argillaceous limestone that occurs in upper part of Cibao marl. Gravel beds reach several meters in thickness and contain some cobbles up to 10 centimeters in diameter. Apparently reaches maximum thickness of 120 meters in area about 7 kilometers east of Moca; northwest and west of Moca, beyond point of disappearance of Lares limestone, apparently rests directly on San Sebastian sandstone; thins eastward from the Lago de Guajataca as clastic beds interfinger and intergrade with marls and limestones of the Cibao.

Named from exposures along escarpment east and west of the Lago de Guajataca in Quebradillas quadrangle.

Gualala Group

Gualala Series

Middle or Upper Cretaceous: Northwestern California.

Original references (Wallala beds): G. F. Becker, 1885, U.S. Geol. Survey Bull. 19, p. 7–17; (Wallala group): C. A. White, 1885, U.S. Geol. Survey Bull. 22, p. 8.

C. E. Weaver, 1941, (abs.) Geol. Soc. America Bull., v. 52, no. 12, pt. 2, p. 1959. Described as Gualala series. Consists predominantly of massive and stratified brownish-gray medium- to coarse-grained quartzose sandstones; conglomerate lenses common near base and middle of series; also thick layers of clay shale; interstratified shaly sandstones and sandy shales constitute 30 percent of stratigraphic section. Thickness approximately 20,000 feet. Beds lie in two major synclinal and two anticlinal folds whose axes trend diagonally to course of San Andreas fault.

C. E. Weaver, 1943, California Div. Mines Bull. 118, pt. 3, p. 628, 629, 630 (table), 631 (fig. 280). Stratigraphic table shows Gualala series as underlying Skooner Gulch basalt (new) and overlying Franciscan group (Franciscan absent west of San Andreas fault).

C. E. Weaver, 1944, Washington [State] Pubs. in Geology, v. 6, no. 1, p. 6–17. Referred to as Gualala group. Unconformably underlies Iversen basalt (new). Middle Cretaceous.

Occurs in Point Arena-Fort Ross region in Mendocino and Sonoma Counties. Named from town of Gualala at mouth of Gualala River, Mendocino County.

Guanajibo Formation

Miocene, upper, or Pliocene, lower (?): Puerto Rico (subsurface).

C. L. McGuinness, 1948, Ground-water resources of Puerto Rico: [San Juan?] Puerto Rico Aqueduct and Sewer Service, p. 226–227. Comprises series of light-yellow to gray limestones, sandy or earthy and ranging from soft to fairly hard and sands, silts, and clays. Deepest well to end in these sediments is well Mg36, 256 feet deep.

P. H. Mattson, 1960, Geol. Soc. America Bull., v. 71, no. 3, p. 347–348. Guanajibo formation was described in subsurface, but there are valid surface exposures on north side of Lajas Valley, about one-fourth mile east of western intersection of Routes 4 and 306.

Penetrated by wells at Mayagüez. Name derived from Guanajibo Channel.

Guayabal Group

Eocene, middle: Puerto Rico.

E. A. Pessagno, Jr., 1960, Caribbean Geol. Conf., 2d, Mayagüez, Puerto Rico, 1959, Trans., p. 83. Includes Naranjo and Augustinillo formations (both new). Intruded by Anon andesite-diorite (new). Footnote states group is currently called Jacaguas.

Occurs in Ponce-Coamo area, south-central part of island.

Guayabal Limestone[1]

Upper Cretaceous: Puerto Rico.

Original reference: G. J. Mitchell, 1922, New York Acad. Sci. Scientific survey of Porto Rico and Virgin Islands, v. 1, pt. 3, p. 256.

R. C. Mitchell, 1954, Puerto Rico Univ. Agr. Expt. Sta. Tech. Paper 13, p. 36 (table 2), 47, 48 (table 4). In Ponce district, underlies Ensenada shale; overlies Coamo tuff limestone. Thickness 400 feet. Heading on table 2 (stratigraphic table for Puerto Rico) reads Upper(?) Cretaceous, but text and other table headings do not qualify Upper Cretaceous.

Type locality: Vicinity of Guayabal Reservoir north of Juana Díaz, where rock makes conspicuous white hills to east and west, Ponce district.

Guayama Limestone

Guayama Series[1]

Upper Cretaceous: Puerto Rico.

Original reference: E. T. Hodge, 1920, New York Acad. Sci. Scientific survey of Porto Rico and Virgin Islands, v. 1, pt. 2, p. 142.

R. C. Mitchell, 1954, Puerto Rico Univ. Agr. Expt. Sta. Tech. Paper 13, p. 36 (table 2), 47, 48 (table 4), 51, 60 (table 7). Thickness of Guayama series 2,600 feet. Overlies Sierra de Cayey series. Term series taken from original surveys but is misnomer. Limestone lenses occurring mostly in upper part of Guayama series are here referred to as "Guayama limestone." Heading on table 2 (stratigraphic table for Puerto Rico) reads Upper(?) Cretaceous, but text and other table headings do not qualify Upper Cretaceous.

E. A. Pessagno, Jr., 1960, Geology of the Ponce-Coamo area, Puerto Rico: Puerto Rico Econ. Devel. Adm., and Princeton Univ. Dept. Geology, p. 24, 44. Toa Vaca formation (new) includes Río Jueyes and Guayama series of Hodge (1920). Ildefonso formation (new) also includes part of Hodge's Guayama series.

Named for city of Guayama located upon series in southeastern corner of Coama-Guayama district.

Guaynabo Formation[1]

Upper Cretaceous(?): Puerto Rico.

Original reference: H. A. Meyerhoff and I. F. Smith, 1931, New York Acad. Sci. Scientific survey of Porto Rico and Virgin Islands, v. 2, pt. 3, p. 275.

R. C. Mitchell, 1954, Puerto Rico Univ. Agr. Expt. Sta. Tech. Paper 13, p. 36 (table 2), 46, 60 (table 7). Thickness 850 feet. Underlies La Muda limestone; overlies Hato Puerco tuffs. Upper Cretaceous.

C. A. Kaye, 1959, U.S. Geol. Survey Prof. Paper 317–A, p. 7 (table), 9 (fig. 3), 10 (fig. 4), 12–13, pl. 2. Redefined as study indicates: (1) in several places, sediments sharply terminated by volcanic rocks—Tortugas andesite (new), (2) in several places La Muda limestone, as herein defined, rests either on this volcanic sequence or is separated from it by varied thickness of noncarbonate rocks—Frailes formation (new), and (3) beds cropping out in vicinity of Guaynabo do not include sedimentary rocks having stratigraphic position given by Meyerhoff and Smith. As thus redefined, includes only the section of noncarbonate sediments overlying Hato Puerco tuff and underlying Tortugas andesite, or, where latter horizon is missing, the Frailes formation. Consists of several thousand feet of stratified tuffaceous sandstone or graywacke, conglomerate or shale. May attain thickness of 4,500 feet in Barrio Cupey, although lower contact is an inferred fault. No identifiable fossils found. Since formation in places seems to be conformable with younger Frailes, which contains late Upper Cretaceous fauna, it is designated Late Cretaceous(?). Report discusses San Juan metropolitan area.

Named for occurrence near Guaynabo, Fajardo district. Town lies near southwestern edge of broad formational outcrop, which extends beyond limits of district to Bayamon, where sediments lose their identity in residual soils.

Guayo Conglomeratic Sandstone Member (of Naranjo Formation)

Eocene, middle: Puerto Rico.

E. A. Pessagno, Jr., 1960, Geology of the Ponce-Coamo area, Puerto Rico: Puerto Rico Econ. Devel. Adm. and Princeton Univ. Dept. Geology, p. 85–94; 1960, Caribbean Geol. Conf., 2d, Mayagüez, Puerto Rico, 1959, Trans., p. 84. Thickness 0 to 9,280 feet. Occurs in beds 2 to 20 feet thick. Contains boulders and pebbles of most Eocene rocks as well as many Cretaceous. Interfingers with Coamo Springs limestone and Río Descalabrado members of Naranjo and with Collores member of Augustinillo formation (new).

Type locality: In bed of Río Guayo, opposite kilometer post K2H1 on road to Collares, northeastern Ponce quadrangle.

Gubik Formation

Gubik Sand[1]

Pleistocene: Northern Alaska.

Original reference: F. C. Schrader, 1902, Geol. Soc. America Bull., v. 13, p. 233–252.

George Gryc, W. W. Patton, Jr., and T. G. Payne, 1951, Washington Acad. Sci. Jour., v. 41, no. 5, p. 160 (table 1), 167, fig. 2. Formation as redefined ranges in thickness from few feet to 150 feet, but in most exposures is 10 to 30 feet. Largely marine predominantly of loosely consolidated cross-bedded brown or buff gravel, sand, silt, and clay. Mantles much of Arctic Coastal Plain of northern Alaska. Unconformably overlies Sagavanirktok formation (new) [in some areas] and Colville group in other areas. Type locality designated.

F. S. MacNeil, 1957, U.S. Geol. Survey Prof. Paper 294–C, p. 100. Striking difference in fauna from different localities may suggest that Gubik is not one unit but consists of several thin units of slightly different age.

Type locality: Bluffs along west bank of Colville River from mouth of Anaktuvuk River to Ocean Point. Name is from Eskimo name of Colville River. Eskimo name for the lower river is Kupik or "big river." Gubik, now the accepted spelling, is misspelling of Kupik.

Guernsey Formation[1]

Devonian and Mississippian: Southeastern Wyoming.

Original reference: W. S. T. Smith and N. H. Darton, 1903, U.S. Geol. Survey Geol. Atlas, Folio 91.

J. D. Love, L. G. Henbest, and N. M. Denson, 1953, U.S. Geol. Survey Oil and Gas Inv. Chart OC–44. In Hartville area, formation divisible into two units, upper consists of limestone and dolomite of Mississippian age and lower consists of dolomite and sandstone of Devonian age. Thickness as much as 300 feet. Underlies Hartville; overlies Precambrian.

Mapped around town of Guernsey, Platte County.

Gueydan Ash Member (of Catahoula Formation)

†Gueydan Formation[1]

Oligocene or Miocene, lower: Southern Texas.

Original reference: T. L. Bailey, 1924, Science, new ser., v. 59, p. 299–300.

G. R. Pinkley, 1958, South Texas Geol. Soc. [Guidebook] Fall Field Trip, p. 35. Referred to as Gueydan ash basal member of Catahoula in discussion of Fashing field area, Atascosa County. Overlaps entire Frio to southwest and to north has covered Upper Jackson lying on beds of Manning (Hockley shales) around Falls City.

Named for exposures on Gueydan Ranch and survey, southeastern McMullen County.

Gueydan Group[1]

Oligocene and Miocene (?): Southern Texas.

Original reference: F. B. Plummer, 1933, Texas Univ. Bull. 3232, p. 530, 700–727.

Guffey Volcanics

Oligocene: Central Colorado.

J. E. Bever, 1954, Dissert. Abs., v. 14, no. 7, p. 1088. Oligocene extrusive rocks here named Guffey volcanics with upper section correlated with Thirty-nine Mile andesite series, and lower section here designated Chumway rhyolite. They covered most of area with flows and tuffs thousands of feet thick.

Guffey area [Park County].

Guilarte Limestone[1]

Upper Cretaceous: Puerto Rico.

R. C. Mitchell, 1954, Puerto Rico Univ. Agr. Expt. Sta. Tech. Paper 13, p. 47, 48 (table 4). Distinctive blue-black limestone.

Occurs near Monte Guilarte, Ponce district.

Guilford Granite

Post-Glenarm: Central Maryland.

Ernst Cloos and C. H. Broedel, 1940, Geologic map of Howard County and adjacent parts of Montgomery and Baltimore Counties (1:62,500): Maryland Geol. Survey. Biotite-muscovite granite, structureless, closely associated with pegmatite. Named on map legend with units older than Glenarm series. Age of Glenarm series uncertain.

R. W. Chapman, 1942, Geol. Soc. America Bull., v. 53, no. 9, p. 1301, 1320–1321, pl. 1. Bounds Laurel granite on north.

Type locality and derivation of name not stated.

Guilford Slate[1]

Silurian (?): Southeastern Vermont.

Original reference: C. H. Hitchcock, 1912, Vermont State Geologist 8th Ann. Rept., p. 127.

Guilmette Formation[1]

Middle and Upper Devonian : Western Utah.

Original reference: T. B. Nolan, 1930, Washington Acad. Sci. Jour., v. 20, no. 17, p. 421–432.

C. W. Merriam, 1940, Geol. Soc. America Spec. Paper 25, p. 68–69. In Gold Hill region, varies in thickness from 1,400 feet to 890 feet within distance of 3 miles and is overlain either by Madison limestone of Lower Mississippian age or by Woodman formation of Upper Mississippian age. Overlies Simonson dolomite.

G. A. Cooper and others, 1942, Geol. Soc. America Bull., v. 53, no. 12, pt. 1, p. 1763, chart 4. Shown on correlation chart as Middle and Upper Devonian.

G. S. Campbell, 1951, Utah Geol. Soc. Guidebook 6, p. 21 (fig. 4), 22. In Confusion and House Ranges, underlies Pilot shale and overlies Sevy(?) dolomite. Thickness 1,200 feet.

G. W. Crosby, 1959, Brigham Young Univ. Research Studies, Geology Ser., v. 6, no. 3, p. 19–20, 52, pl. 11. In south Pavant Range, conformably underlies Cove Fort quartzite (new); conformably overlies Simonson dolomite. Thickness 570 feet. Middle Devonian.

Named for exposures in Guilmette Gulch, Gold Hill region.

Guinda Formation

Upper Cretaceous (Chico Series) : Northern California.

J. M. Kirby, 1942, (abs.) Am. Assoc. Petroleum Geologists Bull., v. 26, no. 5, p. 899. Listed as underlying Forbes formation and overlying Funks formation (new).

J. M. Kirby, 1943, Am. Assoc. Petroleum Geologists Bull., v. 27, no. 3, p. 282, 283–284, 291, 293. Described as consisting primarily of massive- to well-bedded, fine- to medium-grained, gray- to buff-weathering concretionary sandstone. Thickness varies from 30 feet to 2,975 feet. Typical exposures noted.

Typically exposed in headwaters of Petroleum and Salt Creeks in central and northern parts of T. 12 N., R. 3 W., Yolo County and along faulted western slope of Rumsey Hills, between town of Rumsey on north and Tancred Siding (abandoned) on south.

†Gulf Group[1]

Tertiary : Gulf Coastal Plain.

Original reference : O. Meyer, 1888, Am. Geologist, v. 2, p. 88–89, 93–94.

Comprises states from Alabama to Texas.

Gulf Series[1]

Upper Cretaceous : Gulf Coast region.

Original reference : R. T. Hill, 1887, Am. Jour. Sci., 3d ser., v. 33, p. 298.

R. W. Imlay, 1944, Geol. Soc. America Bull., v. 55, no. 8, chart 10a. In terms of European equivalents, Gulf series includes upper Cenomanian, Turonian, Santonian, Campanian, and Maestrichtian stages. Overlies Comanche series which includes lower part of Cenomanian stage. Rock units included in standard section (ascending) : Woodbine, Eagle Ford, Austin, Taylor, and Navarro.

Named for extensive development along Coastal Plain of Gulf of Mexico.

Gulf Hammock Limestone

Eocene (Claiborne or Jackson) : Florida.

D. B. Ericson, 1945, Science, v. 102, no. 2644, p. 234. Proposed for surface exposures of limestone that correlates with subsurface Avon Park. Name Avon Park should be dropped.

R. O. Vernon, 1951, Florida Geol. Survey Bull. 33, p. 104. Gulf Hammock formation, as defined by Ericson, includes Inglis member (new) of Moodys Branch formation and upper part of Avon Park limestone as used in this report. Since Avon Park limestone is very thin in parts of outcrop area and since regional unconformity separates it from Moodys Branch formation, Ericson's correlation of Gulf Hammock formation with Avon Park is inexact, and use of term Gulf Hammock should be abandoned.

Named for exposures at Gulf Hammock, Levy County.

Gullette Bluff Beds (in Nanafalia Formation)

†Gullette Bluff Beds (in Wilcox Group)[1]

Eocene, lower : Southwestern Alabama.

Original reference: J. E. Brantly, 1920, Alabama Geol. Survey Bull. 22, p. 148–150.

L. D. Toulmin, Jr., 1940, Alabama Geol. Survey Bull. 46, p. 28. Nanafalia formation, as restricted by Cooke (1933, Am. Assoc. Petroleum Geologists Bull., v. 17, no. 2) is equivalent to Gullette Bluff beds of Brantly.

Lyman Toulmin, Jr., 1944, Alabama Acad. Sci. Jour. v. 16, p. 42. Listed as uppermost unit in Nanafalia formation. Overlies "Nanafalia Landing (*Ostrea thirsae*) marl".

P. E. LaMoreaux and L. D. Toulmin, 1959, Alabama Geol. Survey County Rept. 4, p. 96 (fig. 32), 97. Middle and upper divisions of Nanafalia of Smith and Johnson (1887) are equivalent to the "Gullette Bluff beds" of Brantly (1920), and in present report comprise middle and Grampian Hills members of Nanafalia.

Named for exposures at Gullette Bluff, Wilcox County.

Gum Sulphur Siltstone Member (of New Providence Formation)

Lower Mississippian: Central Kentucky.

P. B. Stockdale, 1939, Geol. Soc. America Spec. Paper 22, p. 77, 117–119. Brittle shelly roughly bedded siltstone up to 40 or more feet thick. Occurs in central part of Dicks River facies (new) of formation. Underlain by an argillaceous basal shale, up to 45 feet thick and overlain by clayey shale as much as 75 feet thick.

Named for village of Gum Sulphur, northwestern Rockcastle County, three-fourths mile east of Lincoln County line. Well exposed along valley sides across Dicks River to the north.

Gunflint Iron-Formation[1] (in Animikie Group)

Precambrian : Northeastern Minnesota.

Original reference: C. R. Van Hise and J. M. Clements, 1901, U.S. Geol. Survey 21st Ann. Rept., pt. 3, p. 401–409, map.

D. A. White, 1954, Minnesota Geol. Survey Bull. 38, p. 3 (table 1), 4. In Gunflint district, the three units of Animikie group corresponding to

Pokegama, Biwabik, and Virginia formations of Mesabi district are called, respectively, Kakabeka, Gunflint, and Rove formations.

Well developed on north shore of Gunflint Lake.

Gunn Member (of Mount Simon Formation)

Upper Cambrian: Northern Illinois (subsurface).

J. S. Templeton, Jr., 1950, Illinois Acad. Sci. Trans., v. 43, p. 153 (fig. 2), 154 (fig. 3), 155. Name applied to the relatively fine-grained unit overlying Lacey member (new). Type section extends from depths of 1,648 to 1,880 feet. Thickness 71 to 260 feet. Underlies Charter member (new).

Type well: McQueen No. 1 (well 6), in SW¼NE¼NE¼ sec. 27, T. 42 N., R. 3 E., Dekalb County. Name derived from Gunn School, 2¾ miles northwest of type well.

Gunners Cove Formation

Oligocene or Miocene: Alaska.

R. Q. Lewis, W. H. Nelson, and H. A. Powers, 1960, U.S. Geol. Survey Bull. 1028–Q, p. 560–561, pl. 70. Includes, in approximate order of decreasing abundance, tuffaceous conglomerate and sandstone, crystalvitric basaltic tuff, and thin flows of basaltic lava. Beds dip from 5° to 35° in diverse directions; structural details not determined; hence, no estimate of total thickness made. Inferred to be younger than Rat formation (new), but contact not exposed; trace of contact trends north-south across high crest of island and is probably high-angle normal fault. On basis of fauna, believed to be Oligocene or Miocene.

Makes up about two-thirds of Rat Island, which is on midpart of segment of Aleutian Ridge that includes Amchitka and southern Kiska Islands. Formation exposed from sea level to an altitude of about 1,050 feet. Named for Gunners Cove, a small embayment on north side of island.

†Gunnison Formation[1]

Upper Jurassic: Central western Colorado.

Original reference: G. H. Eldridge, 1894, U.S. Geol. Survey Geol. Atlas, Folio 9.

Named for exposures in canyon of Gunnison River, Delta and Mesa Counties.

Gunnison or Gunnisonian series

Upper Jurassic: Arizona, Colorado, New Mexico, and Utah.

C. R. Keyes, 1937, (abs.) Geol. Soc. America Proc. 1936, p. 314; 1940, Pan-Am. Geologist, v. 74, no. 2, p. 106 (chart); no. 3, p. 252 (chart). Series in Upper Jurassic. Unconformable above Zunian series and below Morrisonian series. Includes McElmo shales.

Gunnison Tillite

Gunnison Volcanic Conglomerate

Miocene: West-central Colorado.

W. W. Atwood and W. R. Atwood, 1925, (abs.) Geol. Soc. America Bull., v. 36, no. 1, p. 168. Pre-Pleistocene tillite that probably correlates with Ridgway tillite.

W. W. Atwood and W. R. Atwood, 1926, Jour. Geology, v. 34, no. 7, pt. 1, p. 612–622. Light-buff-brown to light-gray tillite overlain by volcanic tuff. Probably mid-Eocene. Type locality stated.

F. B. Van Houten, 1957, Geol. Soc. America Bull., v. 68, no. 3, p. 383–385, 387 (table 1). Referred to as Gunnison volcanic conglomerate. Believed to be volcanic-rich mudflow and stream deposit that seemingly is basal part of Miocene San Juan tuff.

Type locality: Along State highway, 3 miles east of Gunnison, Gunnison County.

Gunnison River Series[1]

Precambrian: Colorado.

Original reference: T. S. Lovering and others, 1935, Geologic map of Colorado.

Series includes the following named units: Irving Greenstone, Dubois Greenstone, River Portal Mica Schist, Black Canyon Schist, and Swandyke Hornblende Gneiss.

Named for exposures in Black Canyon of Gunnison River.

Gunn Peak Formation[1]

Carboniferous(?): Central Washington.

Original reference: C. E. Weaver, 1912, Washington Geol. Survey Bull. 7, p. 34–50.

C. E. Weaver, 1937, Washington [State] Univ. Pub. in Geology, v. 4, p. 19. Intruded by Index granodiorite.

Named for Gunn Peak region, Snohomish County.

Gunpowder Granite[1]

Post-Glenarm: Northeastern Maryland.

Original reference: E. B. Knopf and A. I. Jonas, 1929, Maryland Geol. Survey Baltimore County, Rept., p. 104, 125.

U.S. Geological Survey currently considers the Glenarm Series to be Lower Paleozoic(?).

Named for outcrops along Gunpowder Falls, Baltimore County.

†Gunsight Formation (in Cisco Group)[1]

Pennsylvanian: Central northern Texas.

Original reference: F. B. Plummer, 1919, Am. Assoc. Petroleum Geologists Bull., v. 3, p. 133–145.

Named for Gunsight, Stephens County.

Gunsight Limestone Member (of Graham Formation)[1]

Gunsight Limestone (in Graham Group)

Upper Pennsylvanian: Central and central northern Texas.

Original reference: F. B. Plummer, 1919, Am. Assoc. Petroleum Geologists Bull., v. 3, p. 133–145.

M. G. Cheney, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 1, p. 66 (fig. 1). Rank raised to formation in Graham group. Underlies Wayland shale; overlies units referred to as post-Bunger cycles 1 to 7. Cisco series.

D. H. Eargle, 1960, U.S. Geol. Survey Prof. Paper 315–D, p. 70, pl. 27. Member of Graham formation. Overlies Bluff Creek shale member; underlies Wayland shale member. Generally fine-grained and pale-brownish-yellow to gray fossiliferous limestone. Thickness about 17 feet along Colorado River to as much as 25 feet in north-central Brown County.

Member was called *Campophyllum* bed by Drake (1893, Texas Geol. Survey 4th Ann. Rept., pt. 1) ; Hudnall and Pirtle (1931, Geologic map of Brown County: Texas Univ. Bur. Econ. Geology) divided Gunsight limestone of Plummer into Upper Gunsight and Lower Gunsight limestones.

Named for Gunsight, Stephens County.

Gunstock Gneiss[1]

Age (?) : Eastern New Hampshire.

Original reference: L. V. Pirsson and H. S. Washington, 1906, Am. Jour. Sci., 4th, v. 22, p. 505.

Winnipesaukee quadrangle, Lake Winnipesaukee region. Probably named for Gunstock River.

Gunter Sandstone Member (of Van Buren Formation)[1]

Gunter Formation (in Prairie du Chien Group)

Gunter Member (of Gasconade Formation)

Lower Ordovician: Central and southern Missouri and northern Illinois.

Original reference: S. H. Ball and A. F. Smith, 1903, Missouri Bur. Geology and Mines, v. 1, 2d ser., p. 26.

R. D. Knight, 1954, Kansas Geol. Soc. Guidebook 17th Ann. Field Conf., p. 57–59. [Reprinted as Missouri Geol. Survey and Water Resources Rept. Inv. 17.] Member of Gasconade formation. Unconformably overlies Eminence formation; conformable with overlying nonsandy dolomites of Gasconade. Consists of sandstone and sandy dolomite. Average thickness 25 to 30 feet; maximum 50 feet in localized area. Missouri Geological Survey no longer uses Van Buren as formational name because unit is only locally distinctive. In parts of Kansas and Oklahoma, recognized in subsurface as member of Arbuckle group.

H. B. Willman and J. S. Templeton, 1951, Illinois Acad. Sci., v. 44, p. 111 (fig. 2), 116–117. Geographically extended into Illinois. Formation consists principally of argillaceous, silty, finely glauconitic greenish-gray to cream chalky dolomite which contains fine muscovite flakes and is slightly sandy in lower 2¾ feet. Thickness about 10¼ feet. Overlies Trempealeau; underlies Oneota. Lower Ordovician. Exposures confined to quarry near Rochelle, Lee County, and to prospect pit and ravine in Ogle County.

J. S. Templeton and H. B. Willman, 1952, Tri-State Geol. Soc. Guidebook 16th Ann. Field Conf., fig. 3. Shown on chart as formation in Prairie du Chien group.

Type section: At Hahatonka [Gunter or Hahatonka Springs], Camden County, Mo. Named from now abandoned Gunter post office in Miller County.

Gunther dolomite (in Chuaran series)

Precambrian: Northern Arizona.

Charles Keyes, 1938, Pan-Am. Geologist, v. 70, no. 2, p. 107 (chart), 112. Mainly of massive dolomite; downward the section seems to merge into a calciferous sandstone. Constitutes prominent cliff-forming ledge. Thickness 150 feet. Underlies Jupiter shales (new) ; overlies Chiquito sandstone (new).

Name comes from Gunther Castle, opposite mouth of Little Colorado River. The "Castle" is mainly fashioned from this rock. Grand Canyon region.

Gurnee Formation (in Pottsville Formation)[1]

Pennsylvanian: Central northern Pennsylvania.

Original reference: G. H. Ashley and S. H. Cathcart, 1932, Pennsylvania Topog. and Geol. Survey Bull. 102A, p. 6.

Type locality: Vicinity of Gurnee, Tioga County.

Guthrie Dolomite[1] (in Double Mountain Group)

Guthrie Dolomite Member (of Dog Creek Formation)

Permian (Guadalupe Series): Central northern Texas.

Original reference: M. G. Cheney, 1929, Texas Univ. Bull. 2913, p. 26, pl. 1.

R. L. Clifton, 1942, Jour. Paleontology, v. 16, no. 6, p. 686 (table 1). In this report, classed as member of Dog Creek formation.

T. S. Jones, 1953, Stratigraphy of the Permian basin of West Texas: West Texas Geol. Soc., p. 30 (fig. 9). Shown on correlation chart as member of Dog Creek formation; occurs below Wagon Yard gypsum member and above Mangum dolomite member. Permian (Guadalupe).

Underlies town of Guthrie, King County. Crops out along South Wichita River east of town.

Guthrie Creek Member (of Harrodsburg Limestone)[1]

Guthrie Creek Member (of Warsaw Formation)

Lower Mississippian: Southern Indiana.

Original reference: P. B. Stockdale, 1929, Indiana Acad. Sci. Proc., v. 38, p. 233–242.

J. M. Weller and A. H. Sutton, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 5, p. 805. Reallocated to member status in Warsaw formation. Overlies Leesville member (reallocated); underlies massive regularly bedded limestone of upper part of formation.

Named for exposures along Guthrie Creek, in southeastern part of Lawrence County.

Guttenberg Limestone Member[1] (of Decorah Formation)

Guttenberg Limestone (in Galena Group)

Guttenberg Submember (of Decorah Shale Member of Galena Formation)

Middle Ordovician: Northeastern Iowa, northwestern Illinois, southeastern Minnesota, and southwestern Wisconsin.

Original reference: G. M. Kay, 1928, Science, new ser., v. 67, p. 16.

C. R. Stauffer and G. A. Thiel, 1941, Minnesota Geol. Survey Bull. 29, p. 9 (geol. column), 81, 83, 84, 86. Considered submember of Decorah shale member of Galena formation in Minnesota. Lies at base of restricted Decorah shale member and begins with pebbly corrosion zone at top of *Stictoporella* bed. Largely shale in St. Paul area where it is about 43 feet thick; to south limestone layers increase in importance; chiefly limestone at type locality. Underlies Ion submember.

J. S. Templeton and H. B. Willman, 1952, Tri-State Geol. Soc. Guidebook 16th Ann. Field Conf., p. 6, fig. 3. Considered formation in Galena group in Dixon-Oregon area, Illinois. Thickness about 5 feet. Includes Garnavillo member below and Glenhaven (Garnet) member above (both new). Underlies Dunleith formation (new); unconformable above Quimbys Mill formation of Platteville group; Spechts Ferry formation absent in this area.

M. P. Weiss, 1955, Jour. Paleontology, v. 29, no. 5, p. 763. Members of Decorah formation (Spechts Ferry, Guttenberg, and Ion) not recognizable rock units in Minnesota.

A. F. Agnew and others, 1956, U.S. Geol. Survey Prof. Paper 274–K, p. 289–293; A. V. Heyl, Jr., 1959, U.S. Geol. Survey Prof. Paper 309, p. 16. Member commonly 12 to 14 feet thick; less than 2 feet near Rockford, Ill.; about 6½ feet near Blanchardville, Wis. Limestone, brown, fine-grained, thin-bedded, nodular conchoidal; dark-brown shale; some sections dolomitic; bentonite layer in shale seam near base at Spechts Ferry, Iowa, and northeast of Galena, Ill., also noted in drill holes in Grant County, Wis. Underlies Ion member and, in some areas, is poorly distinguished or indistinguishable from it; overlies Spechts Ferry member. Where Spechts Ferry member is absent, Guttenberg lies with slight regional disconformity on Quimbys Mill member of Platteville.

M. P. Weiss, 1957, Geol. Soc. America Bull., v. 68, no. 8, p. 1034. In this report [Fillmore County, Minn.], the unit of green calcareous shale between limestone and Platteville formation and limestone of Galena formation is called Decorah. Therefore Decorah formation of this report includes shaly upper part of Spechts Ferry, the Guttenberg, and, in places, the Ion of Stauffer and Thiel (1941).

Type section: In bluff of Mississippi River just northwest of Guttenberg, Clayton County, Iowa.

Guyandot Sandstones (in Sewell Formation)[1]

Guyandot Sandstones (in New River Group)

Pennsylvanian (Pottsville Series): Southern West Virginia.

Original reference: M. R. Campbell, 1902, U.S. Geol. Survey Geol. Atlas, Folio 77.

P. H. Price and E. T. Heck, 1939, West Virginia Geol. Survey Greenbrier County, p. 216, 227, 229. In Greenbrier County, Guyandot sandstone (Campbell, 1902) is massive, grayish white, and coarse grained; somewhat lenticular, its interval being occupied locally by sandy shale. Thickness 30 to 50 feet. Underlies Castle coal; overlies Skelt shale; locally apparently coalesces with stratigraphically higher Harvey sandstone. Lower Guyandot sandstone (Hennen and Gawthrop, 1915) is massive coarse grained and grayish white in northern part of county; in Meadow Bluff district, its position in column is, in whole or in part, occupied by sandy shale. Thickness 10 to 30 feet. Underlies Sewell "A" coal; overlies Hartridge shale. Both sandstones are included in New River group.

Named from exposures along Guyandot River from Pineville, Wyoming County to Gilbert, Mingo County.

Guye Formation[1]

Eocene: Central Washington.

Original reference: G. O. Smith and F. C. Calkins, 1906, U.S. Geol. Survey Geol. Atlas, Folio 139.

W. C. Warren, 1941, Jour. Geology, v. 49, no. 8, p. 810–811. Paleobotanical evidence indicates Eocene age.

R. J. Foster, 1960, Geol. Soc. America Bull., v. 71, no. 2, p. 101 (table 1), 111-113, pl. 1. Name was applied by Smith and Calkins to heterogeneous group of sedimentary and volcanic rocks whose structure was not clearly known. As a result, rocks of several ages were included in the formation. This composite unit erroneously dated Miocene from small collection of fossil leaves, although Smith and Calkins and most later workers realized that the rock types and structure resembled lower Tertiary rocks more closely than Miocene. Because the Guye was one of the few dated units in region, its age was used to date more widespread formations. Guye formation of Smith and Calkins here separated into four formations: Denny (new), Guye (restricted), Mount Catherine rhyolite (new), and Naches. Exposure south from Snoqualmie Pass is bounded on three sides by Mount Catherine rhyolite which dips away from the Guye on all sides and apparently unconformably overlies it. Structure interpreted as anticline in the rhyolite with homoclinal Guye exposed in core. On Denny Mountains, underlies Keechelus andesite, apparently unconformably. Locally intruded by Snoqualmie granodiorite. Formation is thick sequence of shale, sandstone, and conglomerate; fluviatile origin shown by lenses of conglomerate that are interbedded with sandstone and leaf-bearing shale. Conglomerate, sandstone, and shale are mixed in all proportions; beds or lenses range from thin to massive. Conglomerate, percentagewise is the least important rock type but is the most distinctive. Thickness about 5,000 feet. Paleobotanic evidence and stratigraphic relationships suggest an Eocene or Paleocene age. Type area designated.

Type area: Coal Creek and its tributaries, on east side of Snoqualmie Pass. Area almost parallels strike; hence, stratigraphic exposure is limited. Named from exposures on Guye Creek.

Guymard Quartzite

Lower to Middle Silurian: Eastern New York.

C. F. Kilfoyle, 1954, New York State Mus. Bull. 348, p. 499, 500, 591, 650. Incidental mention in faunal list.

Occurs at Otisville, Orange County.

Guzmán Formation[1]

Upper Cretaceous: Puerto Rico.

Original reference: H. A. Myerhoff, 1931, New York Acad. Sci. Scientific survey of Porto Rico and Virgin Islands, v. 2, pt. 3, p. 267.

R. C. Mitchell, 1954, Puerto Rico Univ. Agr. Expt. Sta. Tech. Paper 13, p. 36 (table 2), 41, 60 (table 7). Thickness about 750 feet. Underlies Hato Puerco tuffs. Heading on table 2 (stratigraphic table for Puerto Rico) reads Upper (?) Cretaceous, but text and other table headings do not qualify the Upper Cretaceous.

Named from occurrence in western part of Barrio Guzmán Abajo, where they crop out along Río Canovanas about 9 miles south of village of Canovanas.

Gwinn Series[1]

Precambrian (middle Huronian): Northwestern Michigan.

Original reference: R. C. Allen, 1914, Jour. Geology, v. 22, p. 567, 569.

Named for occurrence at and around Gwinn, Marquette County.

†Gwynedd Shale (in Newark Group)[1]

Upper Triassic: Southeastern Pennsylvania.

Original references: B. S. Lyman, 1893, Pennsylvania Geol. Survey geol. and topog. map of Bucks and Montgomery Counties; 1895, Pennsylvania 2d Geol. Survey Summ. Final Rept., v. 3, pt. 2, p. 2589–2638.

Exposed at Gwynedd Tunnel, Bucks and Montgomery Counties.

†Gym Limestone[1]

Permian: Southwestern New Mexico.

Original reference: N. H. Darton, 1916, U.S. Geol. Survey Bull. 618, p. 19, 35.

V. C. Kelley and L. E. Bogart, 1952, Am. Assoc. Petroleum Geologists Bull., v. 36, no. 8, p. 1644–1648. Stratigraphic studies in Florida Mountains Luna County, have revealed that type locality of Gym limestone consists mostly of Fusselman dolomite of Silurian age. Preliminary examination of other principal localities [see this report for discussion] of supposed Gym limestone shows either similar misidentification or considerable dissimilarity. Until all localities of Gym can be restudied, it appears best to restrict term Gym to the small outcrops in southeastern part of Florida Mountains. Gym as originally described is in Luna County.

U.S. Geological Survey has abandoned the term Gym Limestone.

Type locality: Gym Peak and vicinity, Deming region, Luna County.

Gypsum Spring Formation

Gypsum Spring Member (of Twin Creek Limestone)

Gypsum Spring Formation (in Chugwater Group)

Gypsum Spring Member (of Chugwater Formation)

Middle Jurassic: Wyoming, Montana, and South Dakota.

J. D. Love, 1939, Geol. Soc. America Spec. Paper 20, p. 42–43, 45, 46. Uppermost member of Chugwater. Overlies Popo Agie member; underlies Sundance formation. Consists of sequence of limestone, shale, and gypsum. Thickness 181½ feet where exposed on Red Creek.

E. B. Branson and C. C. Branson, 1941, Am. Assoc. Petroleum Geologists Bull., v. 25, no. 1, p. 124 (table 1), 126 (fig. 2), 136. Rank raised to formation in Chugwater group. Uppermost formation of group; overlies Wyopo formation (new) and where Wyopo is absent rests on Popo Agie formation. Thickness 20 to 200 feet. Triassic.

J. D. Love and others, 1945, U.S. Geol. Survey Oil and Gas Inv. Prelim. Chart 14. Classed as formation; all or parts of unit have been included in Chugwater by some geologists and in Sundance by others; it has been defined both as a formation and as a member of Chugwater. Consists of basal red blocky slightly sandy siltstone overlain by 50 to 125 feet of massive white gypsum on surface and white anhydrite in subsurface. Overlying the gypsum bed is alternating sequence of thin beds of gypsum, red shale, gray ribbon dolomites, and fine slabby limestone. Maximum thickness about 250 feet (northwestern part of Wind River Basin). Unconformable above Nugget sandstone; underlies unit referred to as lower Sundance. Contains marine Middle Jurassic fossils.

R. W. Imlay, 1947, Am. Assoc. Petroleum Geologists Bull., v. 31, no. 2, p. 231 (table 1), 236–247, strat. sections. Term Gypsum Spring formation extended to include gypsiferous beds in northern Wyoming and Montana. In Black Hills area, rather thin beds directly below the Sundance are herein called Gypsum Spring formation because they occupy same stratigraphic position of formation in north-central Wyoming and southernmost Montana, directly beneath beds containing *Arcticoceras henryi* (Meek and Hayden), and because they show considerable lithologic resemblance to typical Gypsum Spring formation. If this correlation is correct, formation extends across Powder River Basin in subsurface, a distance slightly more than 100 miles. In Black Hills area, South Dakota and Wyoming, Gypsum Spring represents first widespread invasion and withdrawal of marine waters during Jurassic in Western Interior region; formation is Middle Jurassic in age and correlative with Gypsum Spring and Sawtooth formations farther west. Represents upper Bajocian and Bathonian stages and is separated from adjoining formations by disconformities. Beds herein included in Gypsum Spring comprise two laterally intergrading facies: one consists of gypsum commonly interbedded with soft maroon siltstone and shale, locally attains thickness of 45 feet, and extends roughly on the western side of Black Hills from Elk Mountain to Sundance and on the northeast side from about 10 miles south of Sturgis to vicinity of Spearfish; second facies consists of interbedded gray shale, limestone, and dolomite, occurs in northwestern end of Black Hills, attains at least 21 feet in thickness, and is well exposed on road from Hulett to Alva. Underlies Stockade Beaver shale member (new) of Sundance formation; underlies Canyon Springs sandstone member (new) of Sundance formation at type section of Canyon Springs. Overlies unit referred to as Nugget(?); locally overlies Spearfish formation.

R. W. Imlay and others, 1948, U.S. Geol. Survey Oil and Gas Inv. Prelim. Chart 32. Basal part of Piper formation (new) locally includes equivalents of type Gypsum Spring of central Wyoming as defined by Love.

R. W. Imlay, 1952, Geol. Soc. America Bull., v. 63, no. 9, p. 967–968, chart 8C (columns 44, 45, 46, 50, 51, 53). Formation represents basal deposits of transgressive sea; may not be same age throughout its extent, and may represent much more time at one locality than at another. Imlay considers that rocks assigned to Gypsum Spring formation by U.S. Geological Survey parties in Big Horn Basin of Wyoming are identical with Piper formation of eastern Montana and that they include more than type Gypsum Spring as defined by Love (1939; 1945). This observation has been disputed for sections along west side of Big Horn Mountains. Piper formation was first identified by Imlay (1947) as Gypsum Spring, but later work demonstrated that Gypsum Spring of type area in central Wyoming represents only basal Middle Jurassic and correlates with lower member of Gypsum Spring, as employed by U.S. Geological Survey parties in Montana and in parts of Big Horn basin of Wyoming. This usage in Montana arose because it was practical in mapping and because Gypsum Spring was assumed to include all beds of Middle Jurassic older than type Sundance formation. Because beds equivalent to type Gypsum Spring in Montana are not mappable, name Piper is employed in that state for beds hitherto called Gypsum Spring.

T. P. Storey, 1958, Alberta Soc. Petroleum Geologists Jour., v. 6, no. 4, p. 90–104. Upper and Middle Jurassic of Williston Basin region comprises nine stratigraphic units or regional correlation intervals and two regional unconformities. On basis of faunal, environmental, and tectonic evidence, these units are grouped into four major depositional sequences or stagelike intervals which Imlay refers to as Gypsum Spring (or Piper), Sawtooth, Rierdon, and Swift formations. Miscorrelation of type section of these formations are result of variations in stratigraphic succession caused by sub-Swift and sub-Rierdon unconformities which correspond respectively to Arkell's (1956, Jurassic geology of the World: New York, Hafner Publishing Co.). Lower Callovian and uppermost Callovian to Lower Oxfordian marine transgressions. Recognition of regional extent and significance of these unconformities suggests that these are the following stratigraphic variations from those generally accepted: (1) the lower Swift (Stockade Beaver-Hulett of lower Sundance) is older than type Swift and younger than type Rierdon formations; and (2) Sawtooth is discrete stratigraphic unit which is younger than Piper or Gypsum Spring.

R. E. Skinner, 1960, Wyoming Geol. Assoc. Guidebook 15th Ann. Field Conf., p. 129–130. Stratigraphically extended below to include Kendall sandstone member (new).

U.S. Geological Survey currently classifies the Gypsum Spring as a member of Twin Creek Limestone in Lincoln County, Wyo., on the basis of a study now in progress.

Named for the gypsum spring on Red Creek, Fremont County, Wyo.

Gypsy Quartzite

Cambrian: Northeastern Washington.

C. F. Park, Jr., 1938, Econ. Geology., v. 33, no. 7, p. 713 (chart), 714. Named on stratigraphic chart and map. Thickness 5,300 to 8,500 feet. Underlies Maitlen phyllite (new); overlies Monk formation.

C. F. Park, Jr., and R. S. Cannon, Jr., 1943, U.S. Geol. Survey Prof. Paper 202, p. 6 (table), 13–15, pl. 1. Consists of alternating beds of quartzite and phyllite in nearly equal parts. Grades downward into Monk formation and upward into Maitlen phyllite; limits of quartzite placed where quartzite and grit beds predominate over beds of other types. Derivation of name given.

C. D. Campbell, 1947, Geol. Soc. America Bull., v. 58, no. 7, p. 602 (table 4), 608–609, 611, pl. 1. Remapping of northeastern Stevens County and discovery of Cambrian and Ordovician fossils are thought to justify adoption there of formation names established by Park and Cannon (1943) for Metaline quadrangle. New names replace those given by Weaver (1920). Correlative with Gypsy quartzite is a small part of Boundary argillite.

Named for exposures in high amphitheaters of Gypsy Ridge, Pend Oreille County.

Hackberry Shale[1]

Upper Devonian: Northeastern Iowa.

Original reference: C. L. Webster, 1889, Am. Nat., v. 23, p. 242, 243.

G. A. Cooper and others, 1942, Geol. Soc. America Bull., v. 53, no. 12, pt. 1, p. 1737 (fig. 1), chart 4. Figure 1 A (attributed to Stainbrook) shows undifferentiated Hackberry below the Sheffield and above Shell Rock; figure 1 B (attributed to Cooper and Warthin) shows Hackberry including Juniper Hill, Cerro Gordo, and Owen; probable true position of Independence between Juniper Hill and Cerro Gordo.

M. A. Stainbrook, 1945, Am. Jour. Sci., v. 243, no. 2, p. 67. Hackberry formation of Webster and authors includes Cerro Gordo and Owen members of Lime Creek but not Juniper Hill shale. Column of Iowa Devonian ascribed by Cooper and others to present writer [Stainbrook] has Hackberry intercalated between Shellrock and Sheffield. Hackberry as an Iowa formational term is not recognized by Iowa Geological Survey and has never been used as equivalent to Lime Creek by present writer. Lime Creek, including Juniper Hill, Cerro Gordo, and Owen, is used in Iowa for interval between Sheffield and Shellrock.

Named for exposures at Hackberry Grove, Cerro Gordo County.

Hackberry Shale (in Cimarron Group)[1]

Permian: Central southern Kansas and northwestern Oklahoma.

Original reference: F. W. Cragin, 1896, Colorado Coll. Studies, v. 6, p. 3, 46.

Named for Hackberry Creek, Clark County, Kans.

Hackett Sandstone (in Hinton Formation)[1]

Mississippian: Southeastern West Virginia.

Original reference: D. B. Reger, 1926, West Virginia Geol. Survey Rept. Mercer, Monroe, and Summers Counties, p. 297, 353.

Type locality: On ridge road between Hackett and Island Creeks, 1.6 miles northeast of Pettry, Mercer County.

Hackett Shale (in Hinton Formation)[1]

Mississippian: Southeastern West Virginia.

Original reference: D. B. Reger, 1926, West Virginia Geol. Survey Rept. Mercer, Monroe, and Summers Counties, p. 297, 354.

Type locality: On ridge road between Hackett and Island Creeks, 1.6 miles northeast of Pettry, Mercer County.

Haddam Granite Gneiss[1]

Haddam Tonalite

Paleozoic(?): South-central Connecticut.

Original reference: H. E. Gregory, 1906, Connecticut Geol. Nat. History Survey Bull. 6, p. 115, 143, 145, map.

W. G. Foye, 1949, Connecticut Geol. Nat. History Survey Bull. 74, p. 51, 52, 54, pl. 1. Referred to as orthogneiss and mapped as Monson orthogneiss.

E. N. Cameron and others, 1954, U.S. Geol. Survey Prof. Paper 255, p. 20, 21. Age unknown; possibly the same as Monson gneiss, here designated Devonian.

H. M. Mikami and R. E. Digman, 1957, Connecticut Geol. Nat. History Survey Bull. 86, p. 25–33, 51, pls. 1, 2. Haddam tonalite constitutes Killingworth dome which covers large part of Guilford quadrangle. Present study has shown that entire dome can be mapped as one tonalite mass with peripheral zone of mixed rocks. Entire formation is herein designated Haddam tonalite. Term Haddam preferred to Monson. No petrographic study of rocks between Haddam, Conn., and Monson, Mass., (type locality of Monson) has been made. Foye (1949) correlated Haddam, Eastford, and Glastonbury gneisses of Connecticut with Monson of Massachusetts, but verification awaits detailed study of very difficult region. Mamacoke gneiss shown by Gregory and Robinson (1907, Connecticut Geol. Nat. History Bull. 7) near Guilford village has been eliminated from present map as has Madison hornblende gneiss of Foye (1949). Former is a mixed facies zone of granite and Haddam tonalite, and latter a facies of the Haddam with a hornblende content above average. Haddam is in contact with Middletown gneiss throughout most of the area. Concordant relationship with Clinton granitic gneiss.

Typically exposed about Higganum, Haddam Township, on both sides of Connecticut River.

Hades quartzite[1]

Upper Devonian: Utah.

Original reference: C. R. Keyes, 1924, Pan.-Am. Geologist, v. 41, p. 37, 47–53, 281, 287, 290.

Well exposed in towering cliffs on the hot, gloomy, and inhospitable canyon on east side of Duchesne River.

Hagan Shale Member (of Clinch Sandstone)

Lower Silurian: Southwestern Virginia and northeastern Tennessee.

R. L. Miller and J. O. Fuller, 1947, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 76 (2 sheets); 1954, Virginia Geol. Survey Bull. 71, p. 141–143, 188; R. L. Miller and W. P. Brosgé, 1954, U.S. Geol. Survey Bull. 90, p. 76, 122, pl. 1. Consists of green shale, with interbeds of fine-grained sandstone and siliceous sandstone; massive sandstone 1 to 2 feet thick at base. Thickness 70 to 77 feet. Underlies Poor Valley Ridge member (new); overlies Sequatchie formation.

L. D. Harris and R. L. Miller, 1958, U.S. Geol. Survey Geol. Quad. Map GQ–111. Lower Silurian.

Named for exposures along Louisville and Nashville Railroad cut in gap through Poor Ridge Valley near Hagan, Lee County, Va.

Hager Formation (in Plattin Group)

Middle Ordovician: Southeastern Missouri.

E. R. Larson, 1951, Am. Assoc. Petroleum Geologists Bull., v. 35, no. 9, p. 2053–2058. Named as third of four formations in group. Generally fine-textured calcite rocks; shows three principal facies and their mutual gradations, major part of formation is slabby light-olive-gray calcite with buff-weathering partings; calcarenite and calcilutite constitute lesser part of formation; calcitite facies, principally developed in southern thicker sections, grades downward into calcarenite; calcilutite facies overlies the calcitite in type area but grades laterally into calcarenite in Ste. Genevieve County exposures. Thickness at type locality 66 feet; thickens southward and thins northward. Underlies Macy formation (new); overlies Beckett formation (new).

Type section: Near Hager School, in NW¼NW¼ sec. 29, T. 35 N., R. 12 E., Perry County.

†Hagerman Lake Beds[1]

Pliocene, upper: Southern Idaho.

Original references: H. T. Stearns, 1932, Correlation chart of Idaho compiled by M. G. Wilmarth, dated Sept. 1, 1932; 1936, Jour. Geology, v. 44, no. 4, p. 434–439.

H. T. Stearns, Lynn Crandall, and W. G. Steward, 1938, U.S. Geol. Survey Water-Supply Paper 774, p. 31, 52–56, pl. 4. Thickness about 600 feet. Overlie Banbury volcanics. Upper Pliocene.

C. P. Ross and J. D. Forrester, 1958, Idaho Bur. Mines and Geology Bull. 15, p. 17. Term Hagerman lake beds is essentially synonymous with

Idaho formation for area in which it has been applied but has the advantage that it is tied to upper Pliocene fossils whose stratigraphic relations are known definitely. These show that Hagerman lake beds appear to be continuous with Idaho formation of areas farther west, but detailed relationships remain to be determined.

Type locality: Hagerman Valley, Gooding and Twin Falls Counties, where it forms prominent bluffs along Snake River.

Haggard Limestone (in Cumberland Sandstone)

Upper Ordovician: South-central Kentucky.

W. R. Jillson, 1953, The Haggard limestone: Frankfort, Ky., Roberts Printing Co., p. 9–12. Name applied to fossiliferous group of gray semicompact and crystalline limestones and shaly limestone beds at top of Cumberland sandstone. Thickness 35 feet. Stratigraphically above Burkesville limestone lentil; underlies Chattanooga shale.

Exposed on farm of B. P. Cary near headwaters of Haggard Branch, a south-flowing tributary of Cumberland River, near Burkesville, Cumberland County.

Hagman Formation

Hagman Andesite

Eocene, upper: Mariana Islands (Saipan).

Risaburo Tayama, 1938, Geomorphology, geology, and coral reefs of Saipan Island: Tropical Industry Inst., Palau, South Sea Islands, Bull. 1 [English translation in library of U.S. Geol. Survey, p. 50–51]. Hagman andesite consists of two-pyroxene andesite lava, agglomerate, and tuff. Lower part is mainly lava and agglomerate; upper part mainly agglomerate and tuff, which is locally arenaceous and shows crossbedding. Relationship to Sankakuyama liparite not clear because no contact observed, but Hagman is believed to be younger.

P. E. Cloud, Jr., R. G. Schmidt, and H. W. Burke, 1956, U.S. Geol. Survey Prof. Paper 280–A, p. 46–51, pl. 2, chart 2. Formation includes andesitic pyroclastic rocks, lava flows, and water-laid volcanic sediments, some of which contain late Eocene fossils. Its three principal facies comprise occurrences of andesite flow rock 30 feet or more thick, breccias and tuffs, and conglomerate and tuffaceous sandstone. Differs from Sankakuyama formation below in being dominantly andesitic, and from Densinyama formation mainly above in generally lacking quartz and quartz-bearing rocks. Thickness as much as 1,100 feet.

S. Hanzawa *in* Jacques Avias and others, 1956, Lexique, Strat. Internat., v. 6, Océanie, fasc. 2, p. 37. Age of Hagman andesite given as lower Oligocene-Eocene.

Type section: Exposures at Point Hagman (Puntan Hagman).

Hague Gneiss[1]

Precambrian (Grenville): Northern New York.

Original reference: H. L. Alling, 1918, New York State Mus. Bull. 199.

E. N. Cameron and P. L. Weis, 1960, U.S. Geol. Survey Bull. 1082–E, p. 289 (fig. 28), 290. Mentioned in report on strategic graphite. Occurs above Trumbull gneiss and below Dixon schist.

Type locality: Lakeside mine, at Hague, Warren County.

Haigler Formation

Precambrian: East-central Arizona.

Gordon Gastil, 1958, Geol. Soc. America Bull., v. 69, no. 12, pt. 1, p. 1498 (table 1), 1504–1506, pl. 1. Much of the rock is rhyolite, but formation believed to include thick sections of basic extrusive rock and volcanic sedimentary rock. Lower member mapped as five submembers (sequence not stated): gray to black albite porphyry rhyolite; black or brown rhyolite with vitreous luster; tuff breccia of coarse, irregular volcanic or accidental ejecta in matrix of tuff; and two separate conglomerates composed of rock types that underlie them—rocks subrounded and well sorted. Stratigraphic continuity of members overlying lower member not established, and therefore type section not described for them. Lower member tentatively believed to be overlain in succession by at least 1,450 feet of rhyolite, 1,000 feet of basic and intermediate volcanic and sedimentary rocks, at least 1,100 feet of rhyolite, largely tuff, and 1,600 feet of sedimentary and pyroclastic rocks. Underlies Oxbow Mountain rhyolite (new); overlies Board Cabin formation (new).

Type section of lower member begins at upper contact of Board Cabin formation just east of Board Cabin Draw in hillside southwest of abandoned "Hot Shot" mine and extends northeast to east fork of Board Cabin Draw, Diamond Butte quadrangle. Name derived from Haigler Creek, in northeastern part of quadrangle.

Haiku Volcanics[1] (in Honolulu Volcanic Series)

Pleistocene, upper: Oahu Island, Hawaii.

Original reference: H. T. Stearns, 1935, Hawaii Div. Hydrography Bull. 1.

G. A. Macdonald and D. A. Davis *in* Jacques Avias and others, 1956, Lexique Strat. Internat., v. 6, Océanie, fasc. 2, p. 84–85. Lava flows of nepheline basalt containing pegmatoid veinlets and segregations, and associated cinder and palagonite tuff, containing fragments of Koolau lavas. Pyroclastic rocks more than 30 feet thick in places, and lava flow more than 20 feet. Unconformably overlies Koolau volcanic series and underlies noncalcareous nonmarine and marine sediments. Probably erupted during plus 95-foot (Kaena) stand of sea. Pleistocene.

Named for Haiku Stream along which it is exposed.

Hailey Conglomerate Member (of Wood River Formation)

Pennsylvanian (Morrowan through Derryan): Central and eastern Idaho.

M. R. Thomasson, 1959, Dissert. Abs., v. 20, no. 3, p. 999. Comprises gradation upward from immature graywackes to supermature orthoquartzites. Thickness, 1,900 feet. Late Morrowan where it interfingers with limestones east of Muldoon trough; in the west, upper boundary is Desmoinesian. Older than Slate Creek member (new); overlies Muldoon formation (new).

H. J. Bissell, 1960, Am. Assoc. Petroleum Geologists Bull., v. 44, no. 8, p. 1427 (fig. 3). Correlation chart shows the Hailey at base of Wood River formation in Bellevue area. Underlies unnamed lower sandy limestones of formation; unconformable above Milligen formation.

Deposited in Muldoon trough, aligned N. 30° W., Bellevue area.

Hailey Shale[1]

Upper Cretaceous: Central Wyoming.

Original reference: S. W. Williston, 1905, Science, new ser., v. 22, p. 504.

Probably named for town of Hailey, eastern Fremont County.

Haines Granite[1]

Post-Triassic and pre-Tertiary: Northeastern Oregon.

Original reference: U. S. Grant and G. H. Cady, 1914, Oregon Bur. Min. and Geol. Min. Resources Oregon, v. 1, no. 6, p. 133–144.

Named for town in Baker district.

Hakatai Shale (in Unkar Group)[1]

Precambrian (Grand Canyon Series): Northern Arizona.

Original reference: L. F. Noble, 1914, U.S. Geol. Survey Bull. 549.

J. H. Maxson, 1949, (Abs.) Geol. Soc. America Bull., v. 60, no. 12, pt. 2, p. 1963. Thickness 600 feet in Bright Angel quadrangle. Includes diabase sills. Overlies Bass limestone; underlies Shinumo quartzite.

Named for Hakatai Canyon, where typically exposed, Grand Canyon region.

Halcyon Lake Formation

Lower Ordovician: Southeastern New York.

E. B. Knopf, 1946, (abs.) Geol. Soc. America Bull., v. 57, no. 12, pt. 2, p. 1212; 1956, (abs.) Geol. Soc. America Bull., v. 67, no. 12, pt. 2, p. 1817. Consists of sandstones, dolomites, and calc-dolomites; estimated thickness 350 feet. Conformably underlies Rochdale limestone; younger than Briarcliff dolomite (new).

Described in area of Stissing Mountain, Dutchess County.

Haldeman Siltstone Member (of Brodhead Formation)

Lower Mississippian: Central Kentucky.

P. B. Stockdale, 1939, Geol. Soc. America Spec. Paper 22, p. 76, 180, 184, pl. 16. Included in Morehead facies of Brodhead formation (new). Thickness 32 to 70 feet. Underlies Indian Fort shale (new), Irvine facies, and Perry Branch siltstone (new), Morehead facies; overlies Frenchburg siltstone (new). Persistent for many miles away from type locality.

Type area: Vicinity of Haldeman, 7½ miles northeast of Morehead, Rowan County.

Hale Formation[1]

Hale Sandstone Member (of Morrow Formation)[1]

Lower Pennsylvanian (Morrow Series): Northern Arkansas, southern Missouri, and northeastern Oklahoma.

Original reference: G. I. Adams and E. O. Ulrich, 1905, U.S. Geol. Survey. Geol. Atlas, Folio 119.

E. B. Branson, 1944, Missouri Univ. Studies, v. 19, no. 3, p. 295. Geographically extended into Barry County, Mo., where it is composed of yellowish-brown massive crossbedded sandstone. Unconformably overlies Fayetteville and, in some places, the Keokuk and Reeds Spring.

L. G. Henbest, 1953, Am. Assoc. Petroleum Geologists Bull., v. 37, no. 8, p. 1936–1938. In type area, formation is divided into two members: Cane Hill below and Prairie Grove above.

G. G. Huffman and others, 1958, Oklahoma Geol. Survey Bull. 77, p. 75–80. Described in northeastern Oklahoma on the flanks of the Ozark uplift where it ranges in thickness from zero in portions of Mayes and Craig Counties to 136 feet on Ross Mountain. Rests with pronounced unconformity upon Pitkin and older strata; grades upward into Bloyd formation; contact is typically placed at base of first prominent shale above the massive Hale limestone. It is basal part of Morrow series of the midcontinent section.

Named for Hale Mountain, Washington County, Ark.

Hales Limestone[1]

Cambrian: Central Nevada.

Original reference: H. G. Ferguson, 1933, Nevada Univ. Bull., v. 27, no. 3, p. 15.

Named for Hales shaft of Tybo mine, northern Nye County.

Half Dome Quartz Monzonite[1] (in Tuolumne Intrusive Series)

Cretaceous: East-central California.

Original reference: F. C. Calkins, 1930, U.S. Geol. Survey Prof. Paper 160, p. 126, map.

J. F. Evernden, G. H. Curtis, and J. Lipson, 1957, Am. Assoc. Petroleum Geologists Bull., v. 41, no. 9, p. 2121, 2122, 2123 (fig. 1). Discussed in paper dealing with potassium-argon dating of igneous rocks. Age given as 84.1 millions of years. Younger than Sentinel granodiorite and older than Cathedral Peak granite.

Named for fact that it composes Half Dome in Yosemite National Park.

Halfway horizon (in Duchesne River Formation)[1]

Eocene (Duchesnean): Eastern Utah.

Original reference: J. L. Kay, 1934, Carnegie Mus. Annals, v. 23, p. 357–359.

H. E. Wood 2d and others, 1941, Geol. Soc. America Bull., v. 52, no. 1, p. 21, pl. 1. Overlies Randlett horizon; underlies Lapoint horizon. Eocene (Duchesnean).

Well exposed along Halfway Hollow, basin which drains that district in Tps. 4 and 5 S., Rs. 19 and 20 E. Salt Lake meridian, Uintah County.

Halgaito Tongue or Member (of Cutler Formation)[1]

Halgaito Formation (in Cutler Group)

Permian: Northeastern Arizona and southeastern Utah.

Original reference: A. A. Baker and J. B. Reeside, Jr., 1929, Am. Assoc. Petroleum Geologists Bull., v. 13, no. 11, p. 1420, 1423, 1424, 1441, 1443, 1446.

S. A. Wengerd and M. L. Matheny, 1958, Am. Assoc. Petroleum Geologists Bull., v. 42, no. 9, p. 2054, cross secs. Chart of new terminology shows Halgaito formation in Cutler group; underlies Cedar Mesa formation; overlies Rico transition facies. Pennsylvanian and Permian.

Well exposed near Halgaito Spring, southwest of Mexican Hat (Bluff post office), Utah, but between Lees Ferry and Kayenta, Ariz.

Halifax Chlorite Schist[1]

Upper Cambrian(?) : Southeastern Vermont.

Original reference: George D. Hubbard, 1924, Vermont State Geologist 14th Rept., p. 288–291, map.

Probably named for development in Halifax Township, Windham County.

Hall cyclothem (in McLeansboro Group)

Hall cyclothem (in Modesto-Bond Formation)

Pennsylvanian: Northern Illinois.

C. L. Cooper, 1946, Illinois Geol. Survey Bull. 70, p. 12, 16 (fig. 2). Pennsylvanian succession between the Gimlet and La Salle cyclothems, exposed in upper Illinois valley, contains several prominent but thin limestones which are basis for recognition of incomplete cyclothems to which the names (ascending) Turner, Hicks, and Hall have been applied by H. B. Willman.

H. R. Wanless and Raymond Siever, 1956, Illinois Geol. Survey Circ. 217, p. 12, pl. 1. Includes Hall limestone. Type locality given.

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 52 (table 2), pl. 1. In Modesto-Bond formations (both new). Above Hicks cyclothem. Presentation of new rock-stratigraphic classification of Pennsylvanian strata in Illinois; cyclical classification independent of rock-stratigraphic classification.

Type locality: NW¼SW¼ sec. 33, T. 16 N., R. 11 E., Bureau County.

Hall Limestone Member (of Bond Formation)

Hall Limestone (in McLeansboro Formation)

Hall Limestone (in McLeansboro Group)

Pennsylvanian: Northern Illinois.

R. C. Moore and others, 1944, Geol. Soc. America Bull., v. 55, no. 6, chart 6 (col. 29). Shown on correlation chart as limestone in McLeansboro formation. Occurs below La Salle limestone and above Hicks limestone (new).

H. R. Wanless and Raymond Siever, 1956, Illinois Geol. Survey Circ. 217, p. 12, pl. 1. Shown on correlation chart as limestone in McLeansboro group. Included in Hall cyclothem. Type locality given.

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 39, 50 (table 1). Reallocated to member status in Bond formation (new). Presentation of new rock-stratigraphic classification of Pennsylvanian strata in Illinois.

Type locality: NW¼SW¼ sec. 33, T. 16 N., R. 11 E., Bureau County.

Hall Canyon Formation[1]

Pleistocene, lower: Southwestern California.

Original reference: J. E. Eaton, 1928, Am. Assoc. Petroleum Geologists Bull., v. 12, no. 2, p. 111–151.

J. E. Eaton, 1943, California Div. Mines Bull. 118, pt. 2, p. 204, 205 (fig. 86) [preprint 1941]. Shown as unconformably overlying Barlow Ranch [beds].

T. L. Bailey, 1943, Geol. Soc. America Bull., v. 54, no. 10, p. 1557. Name abandoned in Hall Canyon, the type section of the Pleistocene of Ventura Basin.

Best exposed in Hall Canyon, Ventura Basin.

Hall Canyon Member (of Oquirrh Formation)

Pennsylvanian (Morrowan) : Utah.

H. J. Bissell, 1959, Utah Geol. Soc. Guidebook 14, p. 94–100, pls. 1, 2. Consists essentially of 915 feet of bioclastic and crystalline limestones which are black, dark gray, and medium brown gray; a massive, in part cherty, crystalline, and bioclastic limestone bed that is commonly 40 to 50 feet thick comprises uppermost unit of member. Conformably underlies Meadow Canyon member (new) ; overlies Manning Canyon shale; contact commonly transitional.

Type locality: Eastern ½ sec. 19, T. 5 S., R. 3 W., Tooele County. Named for outcrops in Hall Canyon.

Hall City Limestone[1]

Carboniferous: Northern California.

Original reference: J. S. Diller, 1903, Am. Jour. Sci., 4th, v. 15, p. 342–362.

Hall City mines, Klamath Mountains.

Hallett Formation or Shale (in Wabaunsee Group)

Pennsylvanian (Virgil Series) : Northeastern Oklahoma.

C. C. Branson, 1956, Oklahoma Geology Notes, v. 16, no. 11, p. 122–125. Name given to predominantly shale sequence from top of Bird Creek limestone to base of Wakarusa limestone. Thickness about 105 feet. Name credited to P. B. Greig (unpub. thesis).

P. B. Greig, 1959, Oklahoma Geol. Survey Bull. 83, p. 50–53, pl. 1. Thickness 105 to 110 feet. Overlies Bird Creek limestone; underlies Wakarusa limestone. Equivalent section in Kansas contains nine subdivisions, none of which can be identified in Pawnee County. In Wabaunsee group.

Type section: Exposed south of village of Hallett, Pawnee County.

Hallian Stage

Pleistocene: Southern California.

Manley Natland, 1953, Pacific Petroleum Geologist, v. 7, no. 2, p. 2. Uppermost of four stages, based on foraminiferal assemblages, in Pliocene and Pleistocene of southern California. Occurs above Wheelerian stage; division between the two is within the upper Pico or "Mud Pit shale". Upper Hallian is marine part of series of coarse sediments sometimes referred to as the Saugus in the Ventura area. [Saugus is considered Pliocene and Pleistocene.] Chart shows Hallian as wholly Pleistocene.

Hall Lake Member (of McRae Formation)

Upper Cretaceous and Tertiary (?) : Southwestern New Mexico.

H. P. Bushnell, 1955, Compass, v. 33, no. 1, p. 11 (table), 14–16. Mainly purple, maroon, and chocolate-brown shales among which are interspersed purple, maroon, olive, buff, or gray sandstone and a few purple conglomerate beds. Occasional nodular limestone beds distributed through section. Shale units generally thick and make up as much as 80 percent of section at type locality. A few conglomerate beds scattered throughout member. Total thickness measured at type locality is 1,660 feet where an additional estimated 1,200 feet of section are covered by water of the lake. Conformably overlies Jose Creek member (new).

Type locality: On east shore of Hall Lake, northeast of Elephant Butte and south of McRae Canyon, Sierra County. Named from Hall Lake, which is formal name of lake backed up by Elephant Butte Dam. Crops out widely in McRae Canyon area and in Jornada del Muerto.

Halloran Complex

Precambrian: Southern California.

W. J. Miller, 1946, Geol. Soc. America Bull., v. 57, no. 5, p. 499–500. Includes, in order of age, metasediments, variable altered and granitized diorite, and variably altered granite.

Named for exposures in the area of about 40 square miles of small mountains extending from vicinity of Halloran Spring westward to north of Silver Lake village, San Bernardino County. Best and most typical exposures occur in vicinity of Silver Lake; complex might better be named for that locality, but name is preoccupied.

Halloran Spring Complex

See Halloran Complex.

Hallowell Member (of Cobourg Formation)

Middle Ordovician (Mohawkian): Southern Ontario, Canada, and northern New York.

G. M. Kay, 1937, Geol. Soc. America Bull., v. 48, no. 2, p. 278–280, pl. 4. Lower Cobourg limestone of earlier reports. Lower part lithologically similar to underlying Sherman Falls formation. Upper part composed of gray medium- to coarse-textured massive limestone with very few intercalated shales; contrasts with more argillaceous Hillier member (new) above. Thickness about 100 feet.

Type section: At Picton, Hallowell Township, Prince Edward County, Ontario.

Halls Diorite Porphyry

Miocene, middle or upper: Northwestern Oregon.

T. P. Thayer, 1939, Oregon Dept. Geology and Mineral Industries Bull. 15, p. 10. Varies from fine-grained purple-gray porphyry at the contact to a medium-grained almost white porphyry containing hornblende and plagioclase phenocrysts. Intrudes Sardine lavas.

Exposed in a roughly rectangular area of about 1 square mile in North Santiam River gorge; southeastern contact is approximately 1,000 feet east of Halls siding, Marion County.

Hall Summit Formation

Paleocene (Midway): Northwestern Louisiana and northeastern Texas.

Grover Murray, Jr., 1941, (abs.) Am. Assoc. Petroleum Geologists Bull., v. 25, no. 5, p. 941–942. Youngest of three named divisions of Midway sediments that crop out in northwestern Louisiana and outline the highest structural portion of Sabine uplift. Consists of basal sand member, middle lignitic shale member, and upper calcareous member. Overlies Logansport formation (new).

D. P. Meagher and L. C. Aycock, 1942, Louisiana Dept. Conserv. Geol. Pamph. 3, p. 13. Includes (ascending) Loggy Bayou, Grand Bayou, and Bistineau members (all new).

G. E. Murray, Jr., and E. P. Thomas, 1945, Am. Assoc. Petroleum Geologists Bull., v. 29, no. 1, p. 48 (fig. 2), 58–60; G. E. Murray, 1948, Louisiana Dept. Conserv. Geol. Bull. 25, p. 127–129, pl. 10. Maximum thickness more than 300 feet in northern Sabine Parish; thins to north and west to an estimated 150 feet in Shelby County, Tex. Underlies Marthaville formation; overlies Logansport formation; both contacts gradational. Paleocene. Type locality designated.

Type locality: Exposures in vicinity of village of Hall Summit in T. 14 N., R. 9 W., Red River Parish, La.

Hamakua Volcanic Series

Tertiary, upper(?) and Quaternary: Hawaii Island, Hawaii.

G. A. Macdonald, 1945, Am. Jour. Sci., v. 243, pt. 1, no. 4, p. 211–217. Chiefly olivine basalts with a few intercalated thin ash beds. Greatest exposed thickness 650 feet. Unconformably underlies Laupahoehoe volcanic series (new).

H. T. Stearns and G. A. Macdonald, 1946, Hawaii Div. Hydrography Bull. 9, p. 152–157, 195. Separated into two members: Lower consists largely of olivine with abundant primitive picrite-basalt; upper largely olivine basalt but associated with it are andesites and picrite-basalts of augite-rich type. Underlies Pahala ash. Type section described in detail.

D. A. Davis and G. A. Macdonald *in* Jacques Avias and others, 1956, Lexique Strat. Internat., v. 6, Océanie, fasc. 2, p. 85. Late Tertiary(?) and Quaternary.

Type section: Southern wall of Laupahoehoe Gulch. Named for exposures along Hamakua coast, northwest of Hilo, where it is well exposed in sea cliffs and in walls of large gulches.

†Hambergian series[1] or Hamburgian[1]

Upper Cambrian: Nevada.

Original reference: C. R. Keyes, 1923, Pan-Am. Geologist, v. 40, p. 51, 53, 79.

Hambre Sandstone (in Monterey Group)[1]

Miocene, middle: Western California.

Original reference: A. C. Lawson, 1914, U.S. Geol. Survey Geol. Atlas, Folio 193.

C. A. Hall, Jr., 1958, California Univ. Pub. Geol. Sci., v. 34, no. 1, p. 20, fig. 2, geol. map. Thickness about 500 feet in Pleasanton area. Conformably overlies Tice shale; conformably underlies Briones formation with contact gradational in most places. In Concord quadrangle, separated from Briones by Rodeo shale. In Pleasanton area, lower member of Briones is generally interbedded with brown silty shale layers ranging from 10 to 20 feet in thickness. It is possible that, from Concord quadrangle, the Rodeo grades laterally into interbedded sandstone and shale of Hambre and Briones in Pleasanton area. Upper Miocene. Term Monterey group not considered appropriate in this area.

Named for exposures along Arroyo del Hambre, Concord quadrangle, Contra Costa County.

†Hamburg Beds[1] or Clays[1]

Upper Cretaceous: Western South Carolina.

Original reference: E. Sloan, 1904, South Carolina Geol. Survey, ser. 4, Bull. 1, p. 68, 72–75.

Named for exposures at Hamburg, Aiken County.

Hamburg Limestone[1] or **Dolomite**

Middle and Upper Cambrian: Eastern Nevada.

Original reference: Arnold Hague, 1883, U.S. Geol. Survey 3d Ann. Rept., p. 253, 255–259.

H. E. Wheeler and D. M. Lemmon, 1939, Nevada Univ. Bull., Geol. and Mining Ser., no. 31, p. 25–26, 30, fig. 3. Referred to as Hamburg dolomite. Composed of light-gray coarsely crystalline limestone, dolomitic limestone, and dolomite that has been badly shattered and filled with calcite stringers. Thickness 900 to 1,225 feet. Underlies Dunderberg shale; overlies Secret Canyon shale. Locally in fault contact with Eldorado formation. Upper Cambrian.

T. B. Nolan, C. W. Merriam, and J. S. Williams, 1956, U.S. Geol. Survey Prof. Paper 276, p. 15 (fig. 2), 16–18. Hamburg dolomite described in vicinity of Eureka. Overlies Clarks Spring member (new) of Secret Canyon shale; underlies Dunderberg shale. Middle and Upper Cambrian. Type locality noted.

Type locality: At Hamburg mine in southern branch of New York Canyon, Eureka district.

Hamburg Member (of Hannibal Formation)

†Hamburg Oolite (in Kinderhook Group)[1]

Mississippian: Southwestern Illinois.

Original reference: S. Weller, 1906, St. Louis Acad. Sci. Trans., v. 16, p. 464–467.

J. R. Ball, 1952, Illinois Geol. Survey Bull. 77, p. 15. In Carlinville quadrangle, Hannibal formation consists of Hamburg and Maple Mill members. Hamburg member is 72 to 87 feet thick. Conformably underlies Maple Mill member; separated from underlying Louisiana limestone by sharp unconformity.

Named for occurrence at Hamburg, Calhoun County.

†Hamburg Shale[1]

Upper Cambrian: Eastern Nevada.

Original reference: A. Hague, 1883, U.S. Geol. Survey 3d Ann. Rept., p. 253, 255–256.

Well exposed opposite Hamburg and Dunderberg mines and in ravine north of Adams Hill, Eureka district.

Hamburg Slate[1]

Precambrian (middle Huronian): Central northern Wisconsin.

Original reference: S. Weldman, 1907, Wisconsin Nat. History Survey Bull. 16, p. 61.

In Berlin and Hamburg Townships, Marathon County.

†Hamburg Mountain Gneiss[1]

Hamburgh Mountain Gneiss Series

Precambrian: Northern New Jersey.

Original reference: J. E. Wolff and A. H. Brooks, 1898, U.S. Geol. Survey 18th Ann. Rept., pt. 2, p. 439.

J. M. Hague and others, 1956, Geol. Soc. America Bull., v. 67, no. 4, p. 468. Hamburgh Mountain gneiss series is oldest in sequence of metasedimentary and metavolcanic rocks in Franklin-Sterling area. Thickness unknown because of intrusion by Byram gneiss; probably more than 2,000 feet. Older than Franklin marble.

Type locality not given but town of Hamburg is in Sussex County.

Hamden Limestone or Member (of Allegheny Formation)[1]

Hamden limestone member

Pennsylvanian (Allegheny Series): Southeastern Ohio.

Original reference: Wilber Stout, 1918, Ohio Geol. Survey, 4th ser., Bull. 21, p. 173.

R. C. Moore and others, 944, Geol. Soc. America Bull., v. 55, no. 6, chart 6 (column 10). Shown on correlation chart as limestone in Allegheny series.

N. K. Flint, 1951, Ohio Geol. Survey, 4th ser., Bull. 48, p. 46, 47, table 1. Hamden limestone included in Lower Kittanning cyclothem, Allegheny series, although not well represented in Perry County.

M. T. Sturgeon and others, 1958, Ohio Geol. Survey Bull. 57, p. 48 (table 7), 66. Hamden limestone member of Strasburg cyclothem in report on Athens County. Stout and others (1923, Ohio Geol. Survey, 4th ser., Bull. 26) described in Oak Hill underclay a carbonate zone consisting of limestone, ferruginous limestone, and (or) ironstone. Restudy of type Hamden has revealed that the member is nonmarine and not marine limestone as Stout (1918) intimated and that it belongs to Oak Hill underclay and not to marine shale and limestone overlying Lower Kittanning coal. In this report, name Hamden is restricted to limestone and ironstone member associated with Oak Hill underclay. Thickness about 2 feet. Allegheny series.

Named for its occurrence at stratigraphic horizon of Hamden iron ore of southern Vinton and northern Jackson Counties.

Hamilton Group[1] or Formation

Hamilton Member (of Romney Shale)

Middle Devonian: New York, Indiana, Maryland, New Jersey, Pennsylvania, Virginia, and West Virginia.

Original reference: L. Vanuxem, 1840, New York Geol. Survey 4th Rept., p. 380.

Bradford Willard, 1937, Am. Jour. Sci., 5th, v. 33, no. 196, p. 264–278. Term Hamilton group is here expanded to include all of the Middle Devonian, that is, all beds from subjacent Oriskany formation to superjacent Portage group. This use makes Hamilton synonymous with Middle Devonian. Although number of subdivisions recognized increases from Maryland to New York, three important divisions are almost everywhere present. At base is Onondaga, above is Marcellus, and upper part is Mahantango or its equivalent, the "Hamilton" of Maryland Survey and earlier writers. Group is discussed in New York, New Jersey, Pennsylvania, and Maryland.

Bradford Willard, 1939, Pennsylvania Geol. Survey, 4th ser., Bull. G-19, p. 132-136, 161-200. Term Hamilton group has been used as synonymous with Middle Devonian. Validity of this usage is questioned. Group is restricted at base to exclude Onondaga group. In Pennsylvania, group includes Marcellus formation below and Mahantango formation above. New York terms Skaneateles, Ludlowville, and Moscow are retained as facies of Mahantango formations. Erian stage.

Guy Campbell, 1942, Geol. Soc. America Bull., v. 53, no. 7, p. 1055-1072. Hamilton group in Indiana comprises (ascending) Speeds, Deputy, Silver Creek, Swanville, and Beechwood formations. Overlies Jeffersonville formation of Onondaga; underlies New Albany shale. Terms Sellersberg and Sellersberg beds, as they have been used, are each equivalent to term Hamilton group as used in this paper.

Winifred Goldring, 1943, New York State Mus. Bull. 332, p. 42, 235-279. Hamilton beds (in Coxsackie quadrangle) include (ascending) Bakoven shale (Marcellus "black shale"), Mount Marion beds, Ashokan shales and flags, and Kiskatom beds.

H. P. Woodward, 1943, West Virginia Geol. Survey, v. 15, p. 308-311. In West Virginia, it is not advisable to differentiate members within what has been previously called Hamilton and what, therefore, corresponds to post-Marcellus Hamilton of New York and Pennsylvania. Hamilton can be used in either, but not both, of two ways. It can be retained in its original West Virginia use, which is for interval between Marcellus shale and Tully limestone, in which case it is not available for group name to include the Marcellus. If used as a group name, it would be necessary to have a new name for post-Marcellus, pre-Tully beds. Name Erie (Erian) group is used for Marcellus-Hamilton group of this report.

Theodore Arnow, 1949, New York State Water Power and Control Comm. Bull. GW-20, p. 8 (table 1). Group in Albany County comprises (ascending) Bakoven shale, Mount Marion formation, Ashokan formation, and Kiskatom formation. Underlies Onteora formation; overlies Onondaga limestone.

A. J. Mozola, 1951, New York State Water Power and Control Comm. Bull. GW-26, p. 10 (table 3). Group in Seneca County comprises (ascending) Marcellus, Skaneateles, Ludlowville, and Moscow shale. Underlies Tully limestone; overlies Onondaga limestone.

Ernst Cloos, 1951, Maryland Dept. Geology, Mines and Water Resources [Rept. 14] Washington County, p. 88. Member of Romney shale in Maryland. Overlies Marcellus shale member; underlies Jennings formation.

H. H. Arndt and others, 1959, Geol. Soc. America Guidebook Pittsburgh Mtg., p. 3-4. Group, in east-central Pennsylvania, includes Montebello and Sherman Ridge (new) formations. Mahantango formation embraces that part of Hamilton group above Marcellus formation and below Susquehanna group in west-central Pennsylvania.

Named for Hamilton, Madison County, N.Y.

Hamlin Shale[1] Member (of Janesville Shale)

Hamlin Shale (in Admire Group)

Permian: Southeastern Nebraska and eastern Kansas.

Original references: R. C. Moore, M. K. Elias, and N. D. Newell, 1934, Stratigraphic sections of Pennsylvanian and "Permian" rocks of Kansas River valley: Kansas Geol. Survey, issued Dec.; R. C. Moore, 1935, Rock formations of Kansas *in* Kansas Geol. Soc. [Am. Assoc. Petroleum Geologists 20th Ann. Mtg.] March 21–23: Wichita; G. E. Condra, 1935, Nebraska Geol. Survey Paper 8, p. 8–9.

R. C. Moore and M. R. Mudge, 1956, Am. Assoc. Petroleum Geologists Bull., v. 40, no. 9, p. 2273, 2274 (fig. 1). Rank reduced to member of Janesville shale (new). Locally contains Houchen Creek limestone bed [also Oaks shale bed and Stine shale bed]. Uppermost member of Janesville; overlies Five Point limestone member. Wolfcamp series.

M. R. Mudge and R. H. Burton, 1959, U.S. Geol. Survey Bull. 1068, p. 14 (table 2), 51–52, pl. 2. Hamlin shale member described in Wabaunsee County, Kans. Strata now known as Hamlin shale member was included in West Branch shale by Condra (1927) in his reclassification of Admire shale of Adams (1903). Moore, Elias, and Newell (1934) included Stine shale, Houchen Creek limestone, and Oaks shale as members of Hamlin shale. Moore and Mudge (1956) reduced Hamlin to rank of member. Herein suggested that Houchen Creek limestone bed be used as formal name. Recent field work has shown that this bed of Hamlin shale could not be correlated south of Pottawatomie County. Hamlin consists of silty to clayey shales, beds of sandy shale and sandstone, and beds of siltstone, limestone, and conglomerate. Thickness 35 to 45 feet. Overlies Five Point limestone member; underlies Americus limestone member of Foraker limestone.

Type locality and derivation of name not given; Hamlin was included in section from Forest City, Mo., to Dubois, Nebr.

Hammar Bluff Formation[1]

See **Hammer Bluff Formation,** correct spelling.

Hammer Bluff Formation

Miocene: Western Washington.

Original reference: S. L. Glover, 1936, Pan-Am. Geologist, v. 65, no. 1, p. 77–78

D. R. Mullineaux, L. M. Gard, and D. R. Crandell, 1959, Am. Assoc. Petroleum Geologists Bull., v. 43, no. 3, pt. 1, p. 692–694. Crops out in both valley walls of Green River. On south side of river, consists of about 100 feet of brown to greenish-gray sandy montmorillonitic and kaolinitic clay and clayey sand; near base of section is about 20 feet of cross-bedded pebble gravel underlain by 7 feet of gray kaolinitic quartz sand. Logs as large as 1½ feet in diameter and 15 feet long are scattered throughout the sand and gravel. On north side of river, formation consists of more than 25 feet of quartz sand and kaolinitic plastic clay which contains a layer of woody lignite 2 to 3 feet thick; sand and gravel are overlain by more than 30 feet of brown to greenish-brown sand and pebble gravel. Unconformably overlies sandstone of Puget group; unconformably underlies glacial drift of Orting(?) age. Miocene. Name has been spelled Hammar Bluff.

Named for occurrence near Hammer Bluff, a few miles east of Auburn, King County.

Hammett Shale

Lower Cretaceous: Southeastern Texas (subsurface and surface).

F. E. Lozo and F. L. Stricklin, Jr., 1956, Gulf Coast Assoc. Geol. Soc. Trans., v. 6, p. 69; J. R. Sandige, chm., 1956, Gulf Coast Assoc. Geol. Soc. Guide Book Ann. Mtg. Field Trip, p. 12–13, fig. 5. Name applied to unit between Sycamore sands below and Cow Creek limestone above. Where exposed, lower 20 feet consists of buff-colored shales, dark when fresh, with thin fossiliferous limestone at base. Remaining 40 to 45 feet, as revealed in cored section, is largely shale with fine sand streaks in base and middle, latter associated with a bed of small clams; uppermost part contains fossiliferous dolomitic limestones. Cow Creek boundary is transitional, arbitrarily determined at base of lowermost well-developed limestone; lower contact is surface of disconformity marked sporadically by pebble and boulder layer immediately above top of Sycamore.

Type section: Completely cored section at Hamilton Pool core holes 1 and 2. Name derived from Hammett Crossing, about 1 mile west of Hamilton Pool in western Travis County.

Hammond Fire Clay (in Kanawha Formation)[1]

Hammond Fire Clay (in Kanawha Member of Pottsville Formation)

Pennsylvanian: Northeastern West Virginia.

Original reference: R. V. Hennen and D. B. Reger, 1913, West Virginia Geol. Survey Rept. Marion, Monongalia, and Taylor Counties, p. 369.

J. B. McCue and others, 1948, West Virginia Geol. Survey [Rept.], v. 18, p. 18. Hammond clay occurs about 90 feet below top of Pottsville.

R. L. Nace and P. P. Bieber, 1958, West Virginia Geol. Survey Bull. 14, p. 23 (table 6). Listed as clay in Kanawha member of Pottsville.

W. A. Tallon, 1959, West Virginia Geol. and Econ. Survey Rept. Inv. 17, p. 17. Hammond clay grades downward into horizon here named Bessemer clay.

Named for Hammond, Marion County.

Hammondville Gneiss[1]

Precambrian: Eastern New York.

Original reference: D. H. Newland, 1908, New York State Mus. Bull. 119, p. 43–50.

Occurs at Hammondville mines, Crown Point Township, Essex County.

Hampden Basalt (in Newark Group)

Hampden Diabase (in Newark Group)[1]

Hampden Lava Member (of Meriden Formation)

Upper Triassic: Central Massachusetts and central Connecticut.

Original reference: B. K. Emerson, 1898, U.S. Geol. Survey Geol. Atlas, Folio 50.

John Rodgers and others, 1956, Preliminary geological map of Connecticut (1:253,440): Connecticut Geol. Nat. History Survey. Rank reduced to member status in Meriden formation. Greenish-black rock, weathering bright orange, grading from basalt near contacts to coarse dolerite in interiors. Interior parts are massive and commonly show good columnar jointing; upper parts are commonly vesicular, and upper and lower parts may show flow brecciation. Separated from underlying Holyoke lava member by unnamed upper sedimentary member; underlies Portland arkose.

Robert Balk, 1957, Geol. Soc. America Bull., v. 68, no. 4, p. 495. Diabase is included in Granby tuff and mapped as an unnamed unit.

E. P. Lehmann, 1959, Connecticut Geol. and Nat. History Survey Quad. Rept. 8, p. 6–25 pl. 1. Term Meriden formation not used in this report [Middleton quadrangle]; rock units involved are given formational status. Newark group comprises (ascending) New Haven arkose, Talcott basalt, Shuttle Meadow formation (new), Holyoke basalt, East Berlin formation (new), Hampden basalt, and Portland arkose. Hampden basalt is exposed in series of low ridges trending generally north across center of quadrangle and in northwest corner. Belt of outcrop has been offset and repeated by faulting. Width of outcrop belt is variable, ranging from 600 feet in northwest corner of quadrangle where dip of basalt is at maximum (17° to 20°) to about 3,500 feet in Miramichi area west of Middleton where low dip (7° to 8°) of Hampden and topography combine to widen belt.

R. W. Schnabel, 1960, U.S. Geol. Survey Geol. Quad. Map GQ–134. Described in Avon quadrangle, Connecticut, where it is probably 150 to 200 feet thick, neither upper or lower contact exposed.

Crops out across Hampden County, Mass.

Hampshire Formation[1]

Upper Devonian: Eastern West Virginia, western Maryland, Pennsylvania, and western Virginia.

Original reference: N. H. Darton, 1892, Am. Geologist, v. 10, p. 13, 17, 18.

P. H. Price and H. P. Woodward, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 11, p. 1993–1994; H. P. Woodward, 1943, West Virginia Geol. Survey, v. 15, p. 497–529. Inasmuch as redbeds of Catskill Mountains of New York have been determined to be of Portage and Hamilton age, it seems unwise further to apply name "Catskill" in Appalachian region to redbeds that are post-Chemung. Name Hampshire formation, applied by Darton to exposure of this series in Hampshire County, is here revived for rocks previously called "Catskill" in West Virginia. Term also applies to unit previously called "Catskill formation" by Maryland Geological Survey. Formation is well developed along the Potomac where it attains maximum thickness of about 3,000 feet in Morgan and Hampshire Counties; thins westward and southward. Includes red and green sandstones and shales which overlie Chemung formation and occur below beds of "Pocono" facies, either highest Devonian or lowest Mississippian.

Charles Butts, 1945, U.S. Geol. Survey Geol. Atlas, Folio 227. Described in Hollidaysburg and Huntingdon quadrangles, Pennsylvania. Thickness 2,000 to 2,500 feet. Overlies Chemung formation; underlies Pocono formation.

Named for Hampshire County, W. Va.

†Hampton Clays[1]

Pleistocene: Coastal Plain of South Carolina.

Original references: E. Sloan, 1905, South Carolina Geol. Survey geognostic map of South Carolina, advance copies; published in 1908, in South Carolina Geol. Survey, ser. 4, Bull. 2; 1907, Summary of mineral resources of South Carolina, p. 12, 20.

Probably named for development in Hampton County.

Hampton Formation[1]

Mississippian (Kinderhook): Central northern and southeastern Iowa.

Original reference: L. R. Laudon, 1930, Geol. Soc. America Bull., v. 41, p. 174.

J. M. Weller and others, 1948, Geol. Soc. America Bull., v. 59, no. 2, chart 5 (columns 68, 69). Correlation chart shows Hampton formation including (ascending) Chapin beds, Maynes Creek limestone, Eagle City beds, and Iowa Falls members in north-central Iowa where it underlies Gilmore City limestone and overlies English River sandstone. In southeastern Iowa, includes North Hill beds below and Wassonville limestone. Underlies Burlington limestone and overlies English River sandstone. Kinderhook. [Laudon, 1935, restricted Hampton by excluding North Hill member and part of Chapin beds.]

Named for exposures at Hampton, Franklin County.

Hampton Granodiorite[1]

Devonian(?): Southeastern New Hampshire.

Original reference: A. Wandke, 1922, Am. Jour. Sci., 5th, v. 4, p. 148, 149.

Probably named for exposures at Hampton or in Hampton Township, Rockingham County.

Hampton Shale[1] or **Formation** (in Chilhowee Group)

Lower Cambrian(?): Eastern Tennessee, western North Carolina, and southwestern Virginia.

Original reference: M. R. Campbell, 1899, U.S. Geol. Survey Geol. Atlas, Folio 59, p. 3.

P. B. King and others, 1944, Tennessee Div. Geology Bull. 52, p. 35–37, pls. Consists of beds between Erwin above and Unicoi below. Composed of alternating beds of clay shale, siltstone, vitreous quartzite, and arkosic quartzite. Thickness commonly 1,200 to 1,400 feet. On Embreeville Mountains, formation may be as much as 2,500 feet thick. In sections southeast of Hampton, about 500 feet thick. No consistent sequence of members present. Amount of shale varies from place to place, and few shale bodies are consistent. No part of section can be set off as unit to be designated "Hampton shale." No specific type section was designated, but formation crops out along Doe River both northwest and southeast of Hampton. Sections at the two places are of unlike character. That to northwest is on Shady Valley thrust sheet and is typical of formation in much of region. That to southeast is in Mountain City window and is thinner than elsewhere and less characteristic.

S. S. Oriel, 1950, North Carolina Div. Mineral Resources Bull. 60, p. 16–18, pl. 1. In Hot Springs area, formation is subdivided into three members: upper shale, middle quartzite, and lower shale. Contacts are readily mappable, and Keith (1904, U.S. Geol. Survey Geol. Atlas, Folio 116) used same horizons as formational boundaries between Murray slate and Nebo quartzite and between Nebo and underlying Nichols slate. Thickness 910 to 1,430 feet. Overlies Unicoi formation; underlies Erwin formation. Two sets of names for Lower Cambrian clastic rocks are in use in eastern Tennessee and western North Carolina. Northeast Tennessee names, Unicoi, Hampton, and Erwin, are used for same rocks which Keith (1904) and Stose and Stose (1947, Am. Jour. Sci., v. 245, no. 10) named Cochran, Nichols, Nebo, Murray, and Hesse, all defined by Keith (1895) in Chilhowee Mountain area, Blount and Sevier Counties, Tenn.

W. B. Brent, 1960, Virginia Div. Mineral Resources Bull. 76, p. 19, pl. 1. In this report [Rockingham County], term Hampton formation used in preference to Harpers shale. Estimated thickness 800 to 2,750 feet. Overlies Weverton formation; underlies Erwin (Antietam) quartzite. Cambrian.

P. B. King and H. W. Ferguson, 1960, U.S. Geol. Survey Prof. Paper 311, p. 28, 32, 40–41, pls. 1, 12. Formation described in northeasternmost Tennessee where it crops out along Doe River both northwest and southeast of Hampton, the two sections being unlike and lying in different structural blocks. Section to northwest is herein designated type locality. Consists of interbedded layers of clay, shale, siltstone, arkosic sandstone, and vitreous quartzite. Keith (1907, U.S. Geol. Survey Geol. Atlas, Folio 151) believed that strata between underlying Unicoi and overlying Erwin was single shale unit 100 to 300 feet thick; in many places, he invoked complex faulting to explain wide band of outcrop and apparent repetition of shaly layers within it. As now defined, the Hampton is 1,200 to 1,400 feet thick in area of Holston Mountain and Iron Mountains; appears to thicken to nearly 2,000 feet immediately south of Tennessee-Virginia State line; 500 feet or less in Doe ridges. Nowhere Ridge, and on Doe River southeast of Hampton. In southwestern part of Iron Mountains and Holston Mountain, includes Cardens Bluff shale member (new) at base Chilhowee group. Lower Cambrian.

Type locality: Section to northwest of Hampton, Carter County, Tenn.

Hana Volcanic Series

Pleistocene and Recent: Maui Island, Hawaii.

H. T. Stearns *in* H. T. Stearns and G. A. Macdonald, 1942, Hawaii Div. Hydrography Bull. 7, p. 63, 65 (table), 66 (table), 90–102, pl. 1. Comprises all volcanics laid down since the great valleys reached their maximum size. In Nahiku area, includes (ascending) Big Falls picritic basalts. Makapipi basalt, Waiaaka basaltic andesite, Kapaula basaltic andesite, Makaino basaltic andesite, Mossman picritic basalt, Kuhiwa basaltic andesite, Paakea basalt, and Hanawi basaltic andesite; in Keanae area (ascending). Pauwalu basalt, Wailuanui basalt, Ohia basalt, Piinaau basalt, Waiokamilo basalt, and Keanae basalt; in Kipahulu Valley, Kipahulu member. Commonly separated from Kula lavas (new) by erosional unconformity; in deep valley where Kula lavas were probably removed by erosion, Hana lavas lie either on alluvium or on Honomanu basalts (new).

G. A. Macdonald *in* H. T. Stearns and G. A. Macdonald, 1942, Hawaii Div. Hydrography Bull. 7, p. 238–254, 292–302. Described in Nahiku area. Petrography discussed.

G. A. Macdonald and D. A. Davis *in* Jacques Avias and others, 1956, Lexique Strat, Internat., v. 6, Océanie, fasc. 2, p. 86. Pleistocene and Recent. Includes Kaupo mudflow.

Named for village of Hana where typical lavas and cones of series are exposed. Covers three areas: east end, southwest end, and summit depression of Haleakola (East Maui) volcano.

Hanaupah Formation[1] (in Telescope Group)

Precambrian: Southeastern California.

Original reference: F. M. Murphy, 1933, California Div. Mines Rept. 28 of State Mineralogist, July-Oct. 1932, p. 329–356.

B. K. Johnson, 1957, California Univ. Pubs. Geol. Sci., v. 30, no. 5, p. 355, 378 (fig. 7). This study [Manly Peak quadrangle] has made possible the correlation of formations defined by Murphy (1930, 1932 [1933]) in Telescope Peak quadrangle with formations now commonly used in Death Valley region. Hanaupah formation is correlated with upper part of Johnnie formation here assigned to Precambrian as defined in this report.

Name probably derived from proximity to Hanaupah Canyon, in southern part of Panamint Range.

Hanawi Basaltic Andesite (in Hana Volcanic Series)

Pleistocene (?) : Maui Island, Hawaii.

G. A. Macdonald *in* H. T. Stearns and G. A. Macdonald, 1942, Hawaii Div. Hydrography Bull. 7, p. 230 (table), 253–254, pl. 1. Aa lava; vertical jointing prominent but not regular enough to be columnar. At highway, visible thickness 30 feet with base not exposed; remnant of Hanawi north of Big Spring is about 100 feet thick, which is probably close to original thickness. Relative ages of Hanawi, Kuhiwa, and Paakea lavas not accurately determined; they are nowhere in contact; their topographic position and degree of erosion are similar, and they are regarded as approximately contemporaneous.

G. A. Macdonald and D. A. Davis *in* Jacques Avias and others, 1956, Lexique Strat. Internat., v. 6, Océanie, fasc. 2, p. 86. Forms single band along Hanawi Gulch. Completely filled valley south of Koolau ditch but only partly filled it farther north where valley was deeper; Haleakala (East Maui) volcano. Pleistocene (?).

†Hanbury Slate[1]

Precambrian: Northwestern Michigan.

Original reference: C. R. Van Hise and W. S. Bayley, 1900, U.S. Geol. Survey Geol. Atlas, Folio 62.

C. A. Lamey and C. E. Dutton, 1941, Michigan Dept. Conserv., Geol. Survey Div. Prog. Rept. 6, p. 10–13. Type locality restudied in 1940. Term Hanbury rejected because of lack of definite age relations at type locality and because of possibility that Hanbury of type locality is a complex of several formations.

Type locality: Hanbury Hill, south of Hanbury Lake, Menominee district.

Hance Formation (in Breathitt Group)

Hance Formation (in Pottsville Group)[1]

Pennsylvanian: Southeastern Kentucky and northeastern Pennsylvania.

Original reference: G. H. Ashley and L. C. Glenn, 1906, U.S. Geol. Survey Prof. Paper 49, p. 33, 37, 207 pl. 40A.

H. R. Wanless, 1946, Geol. Soc. America Mem. 13, p. 55, 57, 65–68, 141. Includes strata below Lower Hance coal (Mingo formation) and above Naese sandstone (Lee formation); approximately correlated wih Briceville formation (Tennessee).

U.S. Geological Survey currently classifies the Hance as a formation in the Breathitt Group on the basis of a study now in progress. U.S. Geological Survey does not use the term Pottsville Group in Kentucky.

Named for Hance Ridge, Bell County, Ky.

Hancock Amygdaloid[1] (in Ashbed Group)

Precambrian (Keweenawan): Northern Michigan.

Original reference: B. S. Butler and W. S. Burbank, 1929, U.S. Geol. Survey Prof. Paper 144 (chart compiled by M. G. Wilmarth).

Named for its occurrence in old Hancock mine, Houghton County.

Hancock Conglomerate[1] (in Portage Lake Lava Series)

Precambrian (Keweenawan): Northern Michigan.

Original reference: B. S. Butler and W. S. Burbank, 1929, U.S. Geol. Survey Prof. Paper 144 (chart compiled by M. G. Wilmarth).

W. S. White, H. R. Cornwall, and R. W. Swanson, 1953, U.S. Geol. Survey Geol. Quad. Map GQ–27. Included in Portage Lake lava series.

Named for exposures in a ravine just east of Hancock mine, Houghton County.

Hancock Flow [1]

Precambrian (Keweenawan): Northern Michigan.

Original reference: B. S. Butler and W. S. Burbank, 1929, U.S. Geol. Survey Prof. Paper 144 (chart compiled by M. G. Wilmarth).

Probably named for its occurrence in old Hancock mine, Houghton County.

Hancock Limestone[1] or **Dolomite**

Upper Silurian or Silurian and Devonian: Northeastern Tennessee and western Virginia.

Original reference: A. Keith, 1896, U.S. Geol. Survey Geol. Atlas, Folio 27, p. 3.

R. L. Miller and W. P. Brosgé, 1950, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 104, sheet 2; 1954, U.S. Geol. Survey Bull. 990, p. 83–86. Hancock dolomite described in Jonesville district, Lee County, Va. Consists of basal pebbly sandstone, overlain by bluish-gray ribbon limestone or mottled limestone; upper part is massive-bedded gray fine-grained dolomite. Formation becomes dominantly limestone at east edge of district. Thickness 168 to 188 feet. As used here, formation includes only beds of Cayugan age. Disconformably overlies Clinton shale; unconformably overlain by Upper Devonian shale.

John Rodgers, 1953, Tennessee Div. Geology Bull. 58, pt. 2, p. 103. Hancock limestone in eastern Tennessee consists chiefly of fairly thick-bedded limestone and dolomite, many layers being sandy and a few cherty; some layers, especially at base or where formation is thin, contain so much sand as to grade into calcareous or dolomitic sandstone; some sand carries Lower Devonian fossils. May be more than 300 feet thick locally in belt on south side of Powell Mountain, but elsewhere is thinner. Occurs above Rockwood formation.

Named for Hancock County, Tenn.

Hancock Member (of Pinney Hollow Formation)

Lower Cambrian: West-central Vermont.

P. H. Osberg, 1952, Vermont Geol. Survey Bull. 5, p. 55, 57–58, 59. Dark-green albite-epidote-calcite-chlorite schist occurring in middle of Pinney Hollow formation. West of Hancock, thin beds of white quartz-tremolite-calcite granulite are interstratified with schist; locally, thin discontinuous beds of buff-weathering dolomitic marble are present. Thickness approximately 500 feet in vicinity of Rochester and Hancock; thins to about 200 feet toward northern border of Rochester quadrangle.

Named from exposures in Hancock Tunnel. Crops out in Rochester-East Middlebury area.

Hancock West Conglomerate[1] (in Ashbed Group)

Precambrian (Keweenawan): Northern Michigan.

Original reference: A. R. Marvine, 1873, Michigan Geol. Survey, v. 1, pt. 2, p. 77, 83, chart.

Probably named for old Hancock mine, Houghton County.

Haney Limestone Member (of Golconda Formation)

Haney Limestone

Mississippian (Chester Series): Southeastern Illinois, southwestern Indiana, and northeastern Kentucky.

A. C. McFarlan and others, 1955, Kentucky Geol. Survey, ser. 9, Bull. 16, p. 18, 19. New name is needed for the "Golconda" as recognized east of Todd County, Ky., and north into Indiana. Haney limestone is proposed for upper "Golconda." At type section, consists of 12½ feet of moderate-light-gray, yellowish-gray, and light-brownish-gray limestone with oolite near base; 11 feet of shale and limestone; and 7 feet of light-gray to light-olive-gray coarsely crystalline fossiliferous slightly crossbedded limestone. Unit somewhat thin at this outcrop; upper shale reaches maximum of 30 to 40 feet but occurs only as sporadic remnants beneath pre-Hardinsburg unconformity; main Haney limestone is typically 40 to 50 feet thick, with extremes of 20 to 70 feet along south-central border of Illinois basin; oolite increases westward from type section, and an oolite zone has been named Marigold member [oolite] in western Illinois (Sutton, 1934). Underlies Hardinsburg sandstone; overlies Fraileys shale (new) or Big Clifty sandstone.

U.S. Geological Survey currently classifies the Haney Limestone as a member of the Golconda Formation on the basis of a study now in progress.

Type locality: Easternmost exposure of the Golconda in Illinois, on south slope of hill along west edge of NE¼SE¼ sec. 9, T. 12 S., R. 10 E., Cave in Rock quadrangle, Hardin County, Ill. Outcrop faces Ohio River, 4 miles upstream from Cave in Rock, through a gap in bluff made by branch of Honey Creek (not named on topographic map) but locally known as Haney Creek.

†Hanging Rock Limestone (in Allegheny Formation)[1]

Pennsylvanian: Southeastern Ohio.

Original reference: E. Orton, 1878, Ohio Geol. Survey, v. 3, p. 888, 892–895, pls. opposite p. 889, 900, 912, 921.

Named for Hanging Rock district.

Hanging Rock Sandstone[1]

Pennsylvanian: Southeastern Illinois.

Original reference: F. H. Bradley, 1869, Indiana Geol. Survey 1st Ann. Rept., p. 157.

Named for Hanging Rock, on Big Vermilion River, Vermilion County.

Hanging Rock Sandstone[1]

Pennsylvanian: Central western Indiana.

Original reference: A. H. Worthen, 1875, Illinois Geol. Survey, v. 6, p. 51–60.

Hanging Rock bluff, 3 miles northeast of Mount Carmel, Wabash County.

Hanley Sandstone (in Cattaraugus Formation)

Devonian: Northwestern Pennsylvania.

C. R. Fettke, 1938, Pennsylvania Geol. Survey, 4th ser., Bull. M–21, p. 36, 37–38. Name given to fine- to medium-grained dark-reddish- to purplish-gray very fossiliferous sandstone in lower part of formation. Discoidal quartz pebbles sparingly distributed through upper part. Thickness 14 feet. Occurs approximately half way between Salamanca and Wolf Creek horizons. Apparently a local development.

Exposed in shale quarry at Hanley Co. plant, Lewis Run, McKean County.

Hanna Formation[1]

Eocene: Central southern Wyoming.

Original reference: C. F. Bowen, 1918, U.S. Geol. Survey Prof. Paper 108, p. 228, 231.

H. E. Wood 2d and others, 1941, Geol. Soc. America Bull., v. 52, no. 1, p. 21. Supposedly Paleocene and Wasatchian (Eocene).

Well exposed north and west of town of Hanna, Carbon County.

Hannah Formation

Miocene, lower: Central California.

Martin Van Couvering and H. B. Allen, 1943, California Div. Mines Bull. 118, pt. 3, p. 496–500. Divisible into three shaly members separated by two sandstones. Thickness about 2,180 feet. Unconformably underlies Escudo sandstone (new); unconformably overlies Wagonwheel formation.

Occurs in Devils Den oil field district in northwestern Kern County, adjacent to Kings County line, about 40 miles east of Paso Robles and about 60 miles northwest of Bakersfield.

†Hannan Limestone or Formation

Mississippian: Northwestern Montana.

Charles Deiss, 1941, (abs.) Geol. Soc. America Bull., v. 52, no. 12, pt. 2, p. 1896. One of nine sedimentary formations identified in Sawtooth Range.

Charles Deiss, 1943, Geol. Soc. America Bull., v. 54, no. 2, p. 212 (table 1), 228–231. Name Hannan limestone proposed for all strata which lie between Devonian and Jurassic rocks in Saypo quadrangle. Basal limestone-breccia overlain by gray limestone and alternating units of shaly-bedded argillaceous limestone which grades upward into hard tan- and pale-gray crystalline fossiliferous limestone. Contains much pale-gray chert in nodules and beds as much as 7 inches thick. Upper 200 feet consists of white-gray finely crystalline thin- and thick-bedded dolomite. Thickness 1,370 feet. Disconformably underlies Ellis formation.

W. A. Cobban, 1945, Am. Assoc. Petroleum Geologists Bull., v. 29, no. 9, p. 1294, 1296. In Swift Reservoir and Sun River sections, unconformably underlies Sawtooth formation (new).

J. M. Weller and others, 1948, Geol. Soc. America Bull., v. 59, no. 2, pl. 2 (column 38). Correlation chart shows Hannan limestone to include (ascending) Saypo limestone, Dean Lake chert, Rooney chert, and Monitor Mountain limestone. Kinderhookian, Osagean, and Meramecian.

J. M. Andrichuk, 1955, Billings Geol. Soc. Guidebook 6th Ann. Field Conf., p. 85. Assignment of group status to the Madison of northwestern Montana by U.S. Geological Survey precludes any need for term Hannan.

Name taken from Hannan Gulch where Mississippian rocks form crest of both sides of gulch [Teton County]. Almost the complete section of the Hannan is exposed on north side of Sun River Canyon at south end of Castle Reef, which forms east side of Hannan Gulch.

Hanna Valley Bed (in Strawn Formation)[1]

Pennsylvanian: Central Texas.

Original reference: N. F. Drake, 1893, Texas Geol. Survey 4th Ann. Rept., pt. 1, p. 374, 383.

D. A. Zimmerman and G. D. Glover, 1956, Soc. Econ. Paleontologists and Mineralogists Permian Basin Sec. [Guidebook] Spring Mtg., p. 74. Clay, about 200 feet thick. Overlies Cottonwood Creek bed; underlies Rough Creek bed. Strawn series.

D. H. Eargle, 1960, U.S. Geol. Survey Prof. Paper 315–D, p. 58, pl. 27. Drake (1893) separated rocks of Strawn group [division] into 20 units of alternating sandstone and shale beds. He gave local names to these units or "beds" as he termed them, and numbered them from bottom to top, 4 to 23. Only Drake's name for upper unit, the Ricker, is in common use today, and that name has been restricted to the base of Drake's Ricker bed.

Hannegan Volcanics

Tertiary, middle: Northwestern Washington.

Peter Misch, 1952, The Mountaineer, v. 45, no. 13, p. 4 (geol. map), 18. The flat-lying Hannegan volcanics are later than any of the folding of the Northern Cascades.

Prominently exposed around Hannegan Pass, Whatcom County.

Hannibal Shale[1]

Hannibal Group

Hannibal Shale (in Easley Group)

Lower Mississippian: Northeastern Missouri, western Illinois and southeastern Iowa.

Original reference: C. R. Keyes, 1892, Geol. Soc. America Bull., v. 3, p. 289.

J. M. Weller, 1948, (abs.) Am. Jour. Sci., v. 246, no. 3, p. 150. In type area in Mississippi Valley, Easley group (new) consists of Hannibal shale and Chouteau limestone and related groups or formations.

L. A. Thomas, 1949, Geol. Soc. America Bull., v. 60, no. 3, p. 410. Lateral tracing by means of well cores and similarity of conodont assemblages indicates that Hannibal formation grades laterally into English River and Prospect Hill siltstones of Iowa. Term Hannibal has priority over English River; therefore English River and Prospect Hill are considered members of Hannibal formation.

M. A. Stainbrook, 1950, Am. Jour. Sci., v. 248, no. 3, p. 209, 210. English River siltstone and Maple Mill shale are not considered members of Hannibal shale.

L. E. Workman and Tracey [Tracy] Gillette, 1956, Illinois Geol. Survey Rept. Inv. 189, p. 8 (fig. 1), 20–28. Rank raised to group. Includes formations that lie above Louisiana limestone and beneath the Chouteau. Comprises (ascending) Glen Park siltstone, Maple Mill shale, and English River siltstone. Where the Louisiana is absent, group rests on the Saverton, and where Saverton is absent it lies on Grassy Creek shale. In small area in westernmost Illinois, McCraney formation of North Hill group overlies the Hannibal and where neither the Chouteau nor McCraney is present, the Hannibal is overlain by Osage strata.

T. J. Laswell, 1957, Missouri Geol. Survey and Water Resources Rept. Inv. 22, p. 9 (fig. 2), 34–39, pl. 1. Formation described in Bowling Green quadrangle where it is 90 to 121 feet thick. Composed of two lithologies: upper siltstone to fine-grained sandstone and lower silty shale. Unconformably overlies Louisiana wherever latter is present; where Louisiana is absent, formation lies unconformably on Saverton. Underlies Chouteau formation; where Chouteau is absent, underlies Burlington formation.

M. G. Mehl, 1960, Denison Univ. Jour. Sci. Lab., v. 45, art. 5, p. 98, 99. Unconformably overlies Cuivre shale (new) in Pike County, Mo.

Named for exposures at Hannibal, Marion County, Mo.

Hanover Diorite Porphyry

Hanover Granodiorite Porphyry

Upper Cretaceous or younger: Southwestern New Mexico.

Harrison Schmitt, 1939, Geol. Soc. America Bull., v. 50, no. 5, p. 780, 782, 784. Incidental mention as diorite porphyry sill. Sills. sheets, and laccoliths of quartz diorite porphyry intruded Colorado shale but are truncated by prominent widespread angular unconformity probably representing early Tertiary (Eocene?) erosion.

P. F. Kerr and others, 1950, Geol. Soc. America Bull., v. 61, no. 4, p. 287–288, fig. 3. Granodiorite porphyry is body (stock) of relatively unaltered rock in region of intense mineralization. Generally coarsely crystalline showing prominent phenocrysts of plagioclase, hornblende, and biotite, ranging from porphyritic to granular. Ground mass dense and gray to buff.

Sill in Pewabic mine area, in Central Mining district, near Hanover, Grant County. Stock [approximately 1 mile northwest of Santa Rita in southeast corner of Santa Rita quadrangle].

Hanover Limestone[1]

Hanover Limestone (in Lake Valley Limestone)

Lower Mississippian: Southwestern New Mexico.

Original reference: Harrison Schmitt, 1933, Am. Inst. Mining Metall. Engineers Contr. 39.

Harrison Schmitt, 1939, Geol. Soc. America Bull., v. 50, no. 5, p. 780–781, pl. 2. Underlies Parting shale (new) in Pewabic mine area, Hanover.

L. R. Laudon and A. L. Bowsher, 1949, Geol. Soc. America Bull., v. 60, no. 1, p. 7. Appears that Hanover as originally defined included both Kelly and top part of Lake Valley formation.

P. F. Kerr and others, 1950, Geol. Soc. America Bull., v. 61, no. 4, p. 283 (fig. 5), 284. Lake Valley limestone divided into lower blue limestone and overlying crinoidal or Hanover limestone.

H. L. Jicha, Jr., and Christina Lochman-Balk, 1958, New Mexico Bur. Mines Mineral Resources Bull. 61, p. 59. New Mexico Bureau of Mines and Mineral Resources recommends suppression of the name Hanover limestone.

In vicinity of Hanover, in Central Mining district or Santa Rita-Hanover-Fierro district, Grant County.

Hanover Limestone (in Carbondale Group)

Hanover Limestone Member (of Carbondale Formation)

Pennsylvanian: West-central and southern Illinois.

H. R. Wanless, 1939, Geol. Soc. America Spec. Paper 17, p. 22, 85. In type area, irregularly laminated light-gray fairly pure limestone with knobby upper surface; overlies soft dark-gray shale. In Knox County, thinner than in type area and quite glauconitic and sandy with scattered pebbles of dark-gray phosphatic limestone.

H. R. Wanless, 1957, Illinois Geol. Survey Bull. 82, p. 101, 190, 195, 196, 204. Most persistent near Pleasantview, Beardstown quadrangle, where limestone is conglomerate with dark-blue-gray limestone masses in matrix of light-gray limestone. Commonly massive, but in thickest exposures shows rude bedding. Thickness 1 to 4 feet near Pleasantview but 6 inches or less elsewhere. In most exposures, unconformably underlies St. David underclay and underclay limestone. Included in Summum cyclothem. Name credited to J. R. Pelt (1928, Illinois Geol. Survey field notes).

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 34, 35, 47 (table 1), 66, pl. 1. Rank reduced to member status in Carbondale formation (redefined). Occurs above Summum (No. 4) coal member and below Harrisburg (No. 5) coal member. Thickness 10 feet. Presentation of new rock-stratigraphic classification of Pennsylvanian strata in Illinois.

Type locality: NE¼SW¼ sec. 27, T. 10 N., R. 11 W., Greene County.

†Hanover Pebble Bed (in Cuyahoga Formation)

Mississippian: South-central Ohio.

J. E. Hyde 1953, Ohio Geol. Survey Bull. 51, p. 98. Name applied by Hyde in 1910 manuscript to unit now termed Berne member of Cuyahoga formation. Described as thin pebble bed capping massive conglomerates of Toboso conglomerate province of the Cuyahoga. In Licking County, can be traced westward to beyond Newark where it overlies Cuyahoga shales of Granville province. Bed cannot be traced from outcrop to outcrop in Hocking Valley area.

Named from exposures near Hanover, Licking County.

Hanover Shale Member (of Java Formation)

Hanover Shale[1]

Hanover Shale Member (of Chemung Formation)

Upper Devonian: Western and west-central New York.

Original references: C. A. Hartnagel, 1912, New York State Mus. Handb. 19, p. 76; G. H. Chadwick, 1933, Pan-Am. Geologist, v. 60, p. 96, 98, 193, 198, 199, 357.

J. F. Pepper and Wallace de Witt, Jr., 1950, U.S. Geol. Survey Oil and Gas Inv. Prelim. Chart 37. In western and central New York, includes Pipe Creek shale member at base. Eastward, intertongues with siltstone of Wiscoy sandstone. Underlies Dunkirk shale; overlies Angola shale in west and Nunda sandstone in east.

J. F. Pepper and Wallace de Witt, Jr., 1951, U.S. Geol. Survey Oil and Gas Inv. Chart OC-45. In area between Dunkirk, Chautauqua County, and Franklin Gulf, Erie County, Hanover shale underlies Dunkirk, member of Perrysburg formation (new).

I. H. Tesmer, 1955, New York State Mus. Sci. Service Circ. 42, p. 10 (fig. 1). Considered member of Chemung formation.

J. F. Pepper, Wallace de Witt, Jr., and G. W. Colton, 1956, U.S. Geol. Survey Oil and Gas Inv. Chart OC-55. Overlies Angola shale member of West Falls formation (new).

Wallace de Witt, Jr., 1960, Am. Assoc. Petroleum Geologists Bull., v. 44, no. 12, p. 1934, 1935 (fig. 2). Redefined as member of Java formation (new). Consists largely of medium to medium-greenish-gray slightly calcareous shale and blocky weathering mudrock. East of central Wyoming County, Wiscoy sandstone member of Java separates Hanover member from Dunkirk shale member of Perrysburg.

Type exposure on Silver Creek, Hanover Township, Chautauqua County.

Hanoverian series[1]

Cambrian: Iowa.

Original reference: C. R. Keyes, 1936, Pan-Am. Geologist, v. 65, no. 4, p. 315.

Named for township in Allamakee County.

Hans Lollik Formation (in Virgin Island Group)

Upper Cretaceous: Virgin Islands.

T. W. Donnelly, 1960, Dissert. Abs., v. 20, no. 7, p. 2756; 1960, Caribbean 2d Geol. Conf. Trans., Mayagüez, Puerto Rico, p. 153. Minimum thickness 10,000 feet. Poorly exposed either the youngest unit present or equivalent to Louisenhoj formation (new), which it resembles lithologically, and faulted into place. Virgin Island group considered of Cenomanian age.

Report discusses geology of St. Thomas and St. John Islands.

Hanson Beds

Silurian: Subsurface in northwestern North Dakota and northeastern Montana, and surface and subsurface in southern Manitoba, Canada.

Saskatchewan Geological Survey, 1958. Report of the Lower Paleozoic names and correlations committee: Saskatchewan Geol. Soc., p. 14, 15, charts A and B. Uniformly pale-colored microcrystalline and lithographic dolomites with interbedded porous dolomitized fossiliferous-fragmental and ostracodal limestones. Occasional dark-colored argillaceous dolomites and shale seams. Basal anhydrite in central part of Williston Basin. Depositional thickness ranges from 300 to 365 feet. Underlies Risser beds (new) with possible unconformity; variably truncated by pre-Middle Devonian unconformity beyond edge of Risser beds.

Type locality: Amerada No. 3-C. Hanson (center SW¼NW¼ sec. 18, T. 158 N., R. 94 W., Montrail County, N. D.) between 11,825 and 12,165 feet; Williston Basin, N. Dak.

Hansonburg Group

Pennsylvanian (Missouri Series): Central New Mexico.

M. L. Thompson, 1942, New Mexico Bur. Mines Mineral Resources Bull. 17, p. 27 (table 2), 63–65. Proposed for group of rocks in upper part of Missouri series between top of Veredas group (new) and base of Keller group (new) of Virgil series above. Includes Burrego (base) and Story formations (both new). Thickness ranges from 115 feet at type locality to more than 200 feet in Mocking Bird Gap. With the exception of interval of red shale, sandstone, and gray shale from 38 to 57½ feet below top, type section consists entirely of light-gray to purple massive to nodular limestones.

Type locality: On northeast side of Oscura Mountains, on north bluff of large arroyo that drains northwest past Julian Tank, in and near east part of SE¼ sec. 31, T. 5 S., R. 6 E., Socorro County. Name derived from Hansonburg, headquarters of Bursum Ranch, about 5 miles east of north end of Oscura Mountains.

Hanson Creek Formation

Middle(?) and Upper Ordovician: Central Nevada.

C. W. Merriam, 1940, Geol. Soc. America Spec. Paper 25, p. 8 (table 1), 10–11, pl. 1; C. W. Merriam and C. A. Anderson, 1942, Geol. Soc. America Bull., v. 53, no. 12, pt. 1, p. 1681 (table 1), 1685–1686. Lowest calcareous member of formation is dark-gray to blackish medium-grained poorly stratified dolomitic limestone containing small crinoid stems and irregular calcite veins—about 40 feet thick at type section; grades upward into very fine-textured poorly bedded noncrinoidal medium- to dark-gray limestone with many calcite veinlets and small black chert nodules—about 45 feet; above is 140 feet of thin-bedded slabby and shaly very fossiliferous limestone; succeeding 140 feet is dark-gray poorly stratified limestone; upper 180 feet is massive dark-gray fine-grained limestone. Thickness at type locality 560 feet. Overlies Eureka quartzite with probable unconformity; underlies Roberts Mountains formation (new). Formerly included in lower part of Lone Mountain limestone.

T. B. Nolan, C. W. Merriam, and J. S. Williams, 1956, U.S. Geol. Survey Prof. Paper 276, p. 32–34. In sections east of Eureka, Roberts Mountains formation appears to be absent, and interval between Hanson Creek and strata of Devonian age is occupied by thick-bedded poorly fossiliferous dolomites that have been included within Lone Mountain dolomite. Thickness 318 feet at Lone Mountain; 300 feet in Antelope Valley.

Type section: Northwest side of Roberts Creek Mountain and crosses east fork of Pete Hanson Creek, about 24 miles northwest of Eureka and 20 miles north of Lone Mountain.

Happy Hollow Limestone Member (of Scranton Shale)[1]

Happy Hollow Limestone (in Wabaunsee Group)

Pennsylvanian (Virgil Series): Eastern Kansas, southwestern Iowa, southeastern Nebraska, and northeastern Oklahoma.

Original reference: G. E. Condra, 1927, Nebraska Geol. Survey Bull. 1, p. 40, 58.

R. C. Moore, 1936, Kansas Geol. Survey Bull. 22, p. 49 (fig. 11), 211–212. Rank raised to formation in Wabaunsee group. Term Scranton abandoned. Overlies White Cloud shale; underlies Cedar Vale shale. Thickness 1 to 8 feet.

R. C. Moore and M. R. Mudge, 1956, Am. Assoc. Petroleum Geologists Bull., v. 40, no. 9, p. 2274 (fig. 1), 2277. Rank reduced to member of Scranton shale here reintroduced a formation with stratigraphic span as assigned to it by Haworth and Bennett (1908). Overlies White Cloud shale member; underlies Cedar Vale shale member.

H. G. Hershey and others, 1960, Iowa Highway Research Board Bull. 15, p. 14, fig. 5. Formation in Wabaunsee group. Poorly exposed in Iowa. In limited exposure in Adams County, a fine-grained sandy limestone that weathers yellowish is tentatively identified as Happy Hollow. In drill hole near Coin, unit is about 2 feet thick. Underlies Cedar Vale shale; overlies White Cloud shale.

Type locality: Vicinity of Happy Hollow ravine, below mouth of Big Nemaha River, southeast of Rulo, Richardson County, Nebr. Moore (1936) gave type locality as Happy Hollow Creek, northeastern Doniphan County, Kans.

Haragan Shale[1] **or Limestone** (in Hunton Group)

Haragan Formation (in Kite Group)

Lower Devonian: Central southern Oklahoma.

Original reference: C. A. Reeds, 1911, Am. Jour. Sci., 4th, v. 32, p. 256–258.

R. A. Maxwell, 1936, Northwestern Univ. Summ. Doctoral Dissert., v. 4, p. 132–134. Basal formation in Kite group (new). Underlies Cravatt limestone (new); overlies Henryhouse formation. Helderbergian.

T. W. Amsden, 1947, Oklahoma Geol. Survey Circ. 44, p. 6 (fig. 3), 7, 35–38. Formation (in Hunton group) is fossiliferous, argillaceous, and silty calcilutite which is here called marlstone. It is thin bedded, the beds ranging up to 3 or 4 inches in thickness and commonly weathering with irregular, nodular appearance. Maximum thickness is in vicinity of old Hunton townsite where there is 230 feet of strata between Chimneyhill and Bois d'Arc formations; however, this includes a 100-foot covered interval just above Clarita member (new) of Chimneyhill formation and this could be in part Henryhouse. Thins to north, and on Lawrence uplift is only a few feet thick; in area of Wapanucka, largely replaced by Bois d'Arc cherty beds; in belt extending west to Reagan, the Haragan is thin or absent; thickness about 50 feet in most westerly area studied. Variation in thickness is probably result of its facies relationship with Bois d'Arc formation. Henryhouse and Haragan have been studied at numerous places, and no reliable field criterion, other than fauna, has been found for separating the two and in this report they are grouped under term Hunton marlstone. Reeds named Haragan from small creek in SW¼ sec. 17, T. 2 S., R. 3 E., short distance northwest of White Mound. This is good type area because formation is well exposed and is about 100 feet thick. Type section designated.

T. W. Amsden, 1958, Oklahoma Geol. Survey Bull. 82, p. 7–13. Stratigraphic and faunal evidence indicate that entire Bois d'Arc formation is facies of Haragan formation. Base of Bois d'Arc formation arbitrarily placed at base of lowest cherty bed of any appreciable thickness. Defined in this manner, the Haragan is almost chert free.

T. W. Amsden, 1958, Oklahoma Geol. Survey Bull. 78, p. 9–144. Formation conformably overlain by Cravatt member of Bois d'Arc formation, which is lithologically much like Haragan, being thin-bedded yellowish-gray argillaceous calcilutite. Cravatt carries varying amounts of chert, and on this basis Bois d'Arc is distinguished from Haragan. Formation carries prolific and well-preserved Lower Devonian fauna. Present report is study of Haragan articulate brachiopods.

Type section: SE¼NE¼ sec. 20, T. 2 S., R. 3 E., Carter County. Named for exposures on Haragan Creek.

Harbison Meta-Granodiorite

Age not stated: Northern South Carolina.

S. D. Heron and J. W. Clarke, 1958, South Carolina Div. Geology Mineral Industries Lab. Bull. 2, no. 10, p. 69–75. Medium-gray meta-granodiorite characterized by small phenocrysts of feldspar embedded in fine-grained ground mass. Surrounding rocks are felsic varieties of Carolina slate.

Occurs in small pluton, mostly in Irmo quadrangle, near Columbia. Named for occurrence in Harbison State Forest.

Harbison Quartz Diorite[1]

Late Mesozoic: Southern California.

Original reference: W. J. Miller, 1935, Calif. Jour. Mines and Geology, v. 31, no. 2, p. 115–141, map.

W. J. Miller, 1946, Geol. Soc. America Bull., no. 5, table 4. Shown in plutonic sequence as younger than Alpine quartz diorite and older than Descanso granodiorites.

Type is in north part of Harbison Canyon, Peninsular Range, San Diego and Imperial Counties.

Harbor Hill Stade, Drift

Harbor Hill Substage[1]

Pleistocene (Wisconsin): Southeastern New York.

Original reference: J. B. Woodworth, 1901, New York State Mus. Bull. 48, pl. 1, map.

U.S. Geological Survey currently recognizes the term Harbor Hill Drift for till and associated outwash from Harbor Hill moraine.

Named for the fact that gravels occur at Harborhill, near Roslyn, Long Island.

Hardesty Shale[1]

Pennsylvanian: Eastern Kansas, northwestern Missouri, and southeastern Nebraska.

Original reference: R. C. Moore, 1932, Kansas Geol. Soc. 6th Ann. Field Conf. Guidebook, p. 93, 97.

Derivation of name not stated.

Hardgrave Sandstone[1]

Lower Jurassic: Northern California.

Original reference: J. S. Diller, 1892, Geol. Soc. America Bull., v. 3, p. 370–394.

E. D. McKee and others, 1956, U.S. Geol. Survey Misc. Geol. Inv. Map 1–175. Age shown as Lower Jurassic.

Named for exposures on Hardgrave's Ranch, near Taylorsville, Plumas County.

Hardgrave Tuff[1]

Middle Jurassic: Northern California.

Original reference: C. H. Crickmay, 1933, Geol. Soc. America Bull., v. 44, no. 1, p. 81.

Mount Jura.

Hardin Sandstone Member (of Chattanooga Shale)[1]

Hardin Sandstone Member (of Dowelltown Formation)

Upper Devonian: Western Tennessee and northern Alabama.

Original reference: J. M. Safford and J. B. Killebrew, 1900, Elements of geology of Tennessee, p. 104, 136, 137.

Guy Campbell, 1946, Geol. Soc. America Bull., v. 57, no. 9, p. 881, 891, 892, 894. Basal member of Dowelltown formation (new). Fine-grained gray to black sandstone that weathers yellow or brown. Reaches maximum thickness of 16 feet in vicinity of Olive Hill and from there thins in all directions; 2 feet at Iron City, southwest Lawrence County; 1 to 3 feet in southern Hardin County; 1½ to 3 feet along Tennessee River; 7 to 10 feet northward from Olive Hill to near Wayne-Perry County line and eastward to Forty Eight Creek. Where the Hardin has been certainly identified, a conglomeratic base has never been mentioned.

W. H. Hass, 1956, U.S. Geol. Survey Prof. Paper 286, p. 15–16. Basal member of Chattanooga shale; underlies Dowelltown member. As much as 16 feet thick and consists chiefly of siliceous fine-grained sand and silt. Early Late Devonian although some part may be slightly older. Geographic extent and good exposures noted. Ulrich and Bassler (1926, U.S. Natl. Mus. Proc., v. 68, art. 12) considered Hardin to be widespread deposit of Mississippian age. They described conodonts collected from sandstone at Mount Pleasant, Tenn., and identified bed as Hardin sandstone. Believed now that sandstone bed from which Ulrich and Bassler's (1926) conodont fauna came is neither same age as Hardin sandstone member of present report nor of early Mississippian age.

Named for Hardin County, Tenn. Part of widespread basal sandstone of Chattanooga and restricted to vicinity of Wayne, Perry, Lawrence, and Hardin Counties, Tenn., and adjoining part of Alabama. Well exposed along secondary road by stone church, 0.15 mile south of U.S. Highway 64 at Olive Hill, Hardin County, Tenn.

Harding Sandstone[1] or **Quartzite**

Harding Formation

Middle Ordovician: Central Colorado.

Original reference: C. D. Walcott, 1892, Geol. Soc. America Bull., v. 3, p. 154–167.

Ogden Tweto, 1949, Colorado Soc. Proc., v. 15, no. 4, p. 152 (table 1), 166–169. Harding quartzite, in Pando area, unconformably overlies Peerless formation and unconformably underlies Parting quartzite member of Chaffee formation. Tan, white, and greenish quartzite and some greenish sandstone.

W. C. Sweet, 1954, Am. Assoc. Petroleum Geologists Bull., v. 38, no. 2, p. 284–305. Referred to as formation, dominantly fine-grained sandstone.

Thickness in Harding quarry section 120 feet; in Priest Canyon section 157 feet; maximum thickness 186 feet, 2½ miles north of Cotopaxi in Fremont County. On regional basis, overlies Manitou dolomite, but, in all sections south of Priest Canyon, rests directly on Precambrian; in Harding quarry section, overlies Precambrian Idaho Springs. Underlies Fremont formation.

M. G. Dings and C. S. Robinson, 1957, U.S. Geol. Survey Prof. Paper 289, p. 12–13. In Garfield quadrangle, 10 to 38 feet thick and extends entire length of belt of Paleozoic rocks. Almost entirely quartzite, white, pink, brown, gray, or bluish black. Unconformably overlies Manitou dolomite and unconformably underlies Fremont dolomite.

Named for exposures in Harding quarry, 1 mile northwest of State Penitentiary, at Canon City, Fremont County. Quarry now one of several pits operated under name of Bernite Gannister Quarries.

Hardinsburg Sandstone[1]

Hardinsburg Formation (in Stephensport Group)

Hardinsburg Sandstone (in Homberg Group)

Upper Mississippian (Chester Series): Western Kentucky, southern Illinois, southern Indiana, and northern Tennessee.

Original reference: A. D. Brokaw, 1916, Illinois Geol. Survey Extr. for Bull. 35; 1917, Illinois Geol. Survey Bull. 35.

J. M. Weller, 1939, Kansas Geol. Soc. Guidebook 13th Ann. Field Conf., p. 131, 135, 136; J. M. Weller and A. H. Sutton, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 5, p. 766 (fig. 1), 831–832. Assigned to Homberg group (new). Underlies Glen Dean limestone; unconformably overlies Golconda limestone. Absent from Chester section in Missouri.

A. C. McFarlan and others, 1955, Kentucky Geol. Survey, ser. 9, Bull. 16, p. 19. Overlies Haney (upper Golconda) limestone (new).

T. G. Perry and N. M. Smith, 1958, Indiana Geol. Survey Bull. 12, p. 26–27, pl. 1. Described in Indiana where it commonly consists of thin-bedded ripple-marked sandstone, shaly sandstone, and interbedded drab shale. Locally massive and crossbedded. Thickness 25 to 45 feet; complete sections rare. Underlies Glen Dean limestone; overlies Golconda formation. Term Homberg group not applied in Indiana.

H. H. Gray, R. D. Jenkins, and R. M. Weidman, 1960, Indiana Geol. Survey Bull. 20, p. 36 (table 5), 39, pl. 1. Formation included in Stephensport group (redefined). Consists mostly of gray shales, siltstones, and mudstones and in places includes thin-bedded fine-grained sandstones, some of which are ledge forming. Thickness ranges from 62 feet in area where Hardinsburg is mostly sandstone to 43 feet in drill hole in which formation is mostly shale. Overlies Golconda limestone (restricted) with transitional contact; underlies Glen Dean limestone.

Named for Hardinsburg, Breckinridge County, Ky.

Hardin School Limestone (in Wichita Group) [1]

Permian: Central Texas.

Original reference: F. M. Bullard and R. H. Cuyler, 1935, Texas Univ. Bull. 3501, p. 254–255.

Well exposed on hills just north and west of Hardin School, in southwestern part of Coleman County.

†Hardiston[1] or Hardistonville Quartzite[1]

Lower Cambrian: Northern New Jersey and northeastern Pennsylvania.

Original references: J. E. Wolff and A. H. Brooks, 1898, U.S. Geol. Survey 18th Ann. Rept., pt. 2, p. 442–443, 454–456; H. B. Kummel and S. Weller, 1901, Geol. Soc. America Bull., v. 12, p. 149–150.

Exposed at brook section in Hardistonville, Sussex County, N.J., and on hill 1 mile south of Hardistonville.

Hardman Fire Clay (in Allegheny Formation)[1]

Pennsylvanian: Northern West Virginia, western Maryland, and southwestern Pennsylvania.

Original reference: R. V. Hennen and D. B. Reger, 1913, West Virginia Geol. Survey Rept. Marion, Monongalia, and Taylor Counties, p. 347.

J. B. McCune and others, 1948, West Virginia Geol. Survey [Repts.], v. 18, p. 16. Hardman clay (Allegheny series) occurs few feet below Upper Kittanning underclay.

Henry Leighton, 1941, Pennsylvania Geol. Survey, 4th ser., Bull. M–23, p. 210. Noted in Somerset County.

First described near Hardman, Preston County, W. Va.

Hardscrabble Limestone

Mississippian: Eastern Colorado.

J. C. Maher, 1950, U.S. Geol. Survey Oil and Gas Inv. Prelim. Chart 39; 1951, World Oil, v. 133 (Oct.), p. 89–91. Lower part of beds previously called Madison limestone along Front Range form lithologic unit bounded by unconformities. This unit here named Hardscrabble limestone. Characterized by light-buff to dark-brown, finely crystalline to dense limestone, upper layers of which contain red to orange dense chert and abundant medium-sized oolites. In Williams Canyon and Missouri Gulch, lower part of formation includes several beds of pink-gray-white dolomite and dolomitic limestone; tan to brown chert sparingly present locally; base marked by thin bed of conglomeratic limestone at South Hardscrabble and Beulah localities; spirifers common. Thickness at type locality 124 feet; 100 feet above Cave of the Winds; 41 feet in Missouri Gulch. Overlies Williams Canyon limestone; underlies Beulah limestone. Meramec(?).

Type locality: Almost vertical exposure on thrust block southwest of Wetmore on South Hardscrabble Creek about one-half mile west of North Creek Bridge in S½ sec. 11, T. 22 S., R. 69 W., Custer County.

Hardwick Granite[1]

Devonian: Northeastern Vermont.

Original reference: E. J. Foyles and C. H. Richardson, 1929, Vermont State Geologist 16th Rept., table opposite p. 288.

Quarried west of Hardwick, in Hardwick Township, Caledonia County.

Hardwick Granite[1]

Late Carboniferous or post-Carboniferous: Central Massachusetts and southwestern New Hampshire.

Original reference: B. K. Emerson, 1898, U.S. Geol. Survey Mon. 29, p. 239–241, 317–318, pl. 34.

Named for occurrence at and around Hardwick, Worcester County, Mass.

Hardwood Gneiss

Precambrian: Northern Michigan.

H. L. James, 1958, U.S. Geol. Survey Prof. Paper 314–C, p. 27, 30 (table 1), 32. Dark medium-grained gneiss composed of hornblende, plagioclase, and pyroxene, which is interlayered with dark fine-grained gneiss, beds of light-colored gneiss with light and dark laminae, garnet-quartz-mica schist, and light-colored rock that resembles quartzite. Layers are a fraction of an inch to a few feet in thickness; layering in general dips easterly at angles less than 40°. Known thickness, including metagabbro sills, possibly no more than several hundred feet. Separated by covered interval from strata of Dickinson group (new); may be equivalent to or part of group but exposures are inadequate to establish relationship.

Exposed principally in secs. 5 and 8, T. 41 N., R. 27 W., Dickinson County, a short distance west of Harwood for which unit is named.

Hardwood Point Shales and Flags (in Lower Marshall Sandstone)

Mississippian (Kinderhook): Southern Michigan.

Shown on map legend: H. M. Martin, 1936, The centennial geologic map of the southern peninsula of Michigan (1:500,000): Michigan Geol. Survey Div. Pub. 39, Geol. Ser. 33.

Hardy Creek Limestone

Hardy Creek Limestone Member (of Moccasin Formation)

Middle Ordovician: Southwestern Virginia.

R. L. Miller and J. O. Fuller, 1947, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map. 76 (2 sheets); R. L. Miller and J. O. Fuller, 1954, Virginia Geol. Survey Bull. 71, p. 104–106. Hardy Creek limestone member proposed for upper part of Moccasin limestone. Consists of even-bedded limestone and siliceous limestone, with abundant oval chert nodules in some beds. Thickness 141 to 154 feet. Overlies lower unnamed member consisting of buff-weathering highly fossiliferous argillaceous and shaly limestone 138 to 143 feet thick. Underlies Eggleston limestone.

R. L. Miller and W. P. Brosgé, 1950, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 104 (2 sheets). Rank raised to formation. Overlies Ben Hur limestone (new).

R. L. Miller and W. P. Brosgé, 1954, U.S. Geol. Survey Bull. 990, p. 32 (table 1), 33–34, 58–61, 121–122, pl. 1. Further described and type section given. Discussion of correlation problems and summarizes nomenclature of Middle Ordovician formations in Lee and Tazewell Counties.

G. A. Cooper, 1956, Smithsonian Misc. Colln., v. 127, pt. 1, p. 65–66. Underlies Cane Creek limestone (new).

Type section: In cut of a spur of Louisville and Nashville Railroad along headquarters of Hardy Creek near Hagan, Lee County.

Hardy Hill Quartzite Member (of Orfordville Formation)

Middle Ordovician(?): Western New Hampshire and eastern Vermont.

C. A. Chapman and others, 1938, Geologic map and structure sections of the Mascoma quadrangle, New Hampshire (1:62,500); J. B. Hadley and others, 1938, Geologic map and structure sections of the New Hampshire portion of the Mount Cube quadrangle (1:62,500): New Hampshire Highway Dept. Consists of gray to white quartzite and quartz conglomerate with some quartz-mica schist and mica schist. Outcrops are discontinuous. Middle member of formation. Occurs above Post-Pond volcanic member and below Sunday Mountain volcanic member (both new). Middle Ordovician(?).

C. A. Chapman, 1939, Geol. Soc. America Bull., v. 50, no. 1, p. 132–133. Occurs in middle of black schists near top of Orfordville formation. Maximum thickness 250 feet.

J. B. Hadley, 1950, Vermont Geol. Survey Bull. 1, p. 12, 15. Geographically extended to Vermont. Ordovician.

J. B. Lyons, 1955, Geol. Soc. America Bull., v. 66, no. 1, p. 112, 114, 116, pl. 1. Assigned stratigraphically lower position in Orfordville formation; placed below Post Pond volcanic member.

Mapped in several narrow belts in vicinity of Hardy Hill Brook in northwestern corner of Mascoma quadrangle, New Hampshire.

Hardyston Quartzite[1]

Hardyston Formation

Lower Cambrian: Northern New Jersey and northeastern Pennsylvania.

Original reference: J. E. Wolff and A. H. Brooks, 1898, U.S. Geol. Survey 18th Ann. Rept., pt. 2, p. 442–443, 454–456.

B. L. Miller and P. B. Myers *in* B. L. Miller, D. M. Fraser, and R. L. Miller, 1939, Pennsylvania Geol. Survey, 4th ser., Bull. C–48, p. 206–223, 227, pl. 1. In Northampton County, overlies Precambrian crystalline formations and underlies Tomstown formation (extended into this area as substitute for Leithsville).

B. F. Howell, Henry Roberts, and Bradford Willard, 1950, Geol. Soc. America Bull., v. 61, no. 12, p. 1361. Chickies quartzite used rather than Hardyston in Buckingham area, Pennsylvania. Hardyston reserved for those areas where Lower Cambrian quartzite can be closely correlated with type formation in New Jersey.

M. E. Johnson, 1950, Geologic map of New Jersey (1:250,000) : New Jersey Dept. Conserv. Econ. Devel. As mapped, underlies Cambro-Ordovician Kittattiny limestone.

Bradford Willard, 1955, Geol. Soc. America Bull., v. 66, no. 7, p. 821, 824–825, 826–827, 832. Base of Cambrian in eastern Pennsylvania. Thickness 25 to 300 feet. Underlies Leithsville formation with contact conformable at all but one locality where there is local disconformity; overlies Precambrian, contact changes from place to place but always nonconformable.

Carlyle Gray and others, 1960, Geologic map of Pennsylvania (1:250,000) : Pennsylvania Geol. Survey, 4th ser. Mapped as Hardyston formation.

Named for exposures at Hardistonville (now Hardyston), Sussex County, N.J.

Harebell Formation

Upper Cretaceous; Northwestern Wyoming.

J. D. Love, 1956, Am. Assoc. Petroleum Geologists Bull., v. 40, no. 8, p. 1899, 1900–1904. Succession of olive-drab to gray sandstone, conglomerate, claystone, and shale. Three facies present. In type area, lenses of quartzite pebble conglomerate present throughout sequence; in Blackrock Creek area quartzite pebble conglomerate lenses are in upper part; and in southernmost outcrops, conglomerate lenses are composed of rock fragments of Paleozoic and Mesozoic ages with lesser amounts of quartzite. Thickness about 5,000 feet in type area. Unconformable contacts with overlying Pinyon conglomerate and underlying Bacon Ridge sandstone.

Type locality: Extends from head of Snake River gorge southward over Big Game Ridge, about 2 miles east of Mount Hancock, and on across Wolverine Creek to north base of Pinyon Peak. Name derived from Harebell Creek, westward-flowing stream in Snake River drainage system along south margin of Yellowstone National Park. In Jackson Hole, Teton County.

Hares Valley Limestone and Shale Member (of Newton Hamilton Formation)

Middle Devonian: Central Pennsylvania.

F. M. Swain, 1958, Am. Assoc. Petroleum Geologists Bull., v. 42, no. 12, p. 2860 (fig. 2), 2864 (fig. 3), 2865, 2867–2868. Interbedded shale and argillaceous limestone with limestone generally increasing upward in section. Thickness about 21 feet. Overlies Beaverdam Run shale member (new); underlies Marcellus black shale. Willard (1939) applied name Selinsgrove to upper noncherty "Onondaga" limestones of central Pennsylvania, but without specific statement as to type locality or typical section. I. C. White (1883) used name Selinsgrove for five different subdivisions of Middle Devonian. Name seems too indefinite to be used in Mount Union quadrangle. Name Hares Valley applied to upper shale and limestone of Newton Hamilton formation where it occurs north of mouth of Hares Valley at Mapleton.

Type section: In Dowell sand pit 1½ miles north of Mapleton, Mount Union quadrangle, Huntingdon County.

Harg Shale Member or facies (of Portwood Formation)

Upper Devonian: Eastern Kentucky.

Guy Campbell, 1946, Geol. Soc. America Bull., v. 57, no. 9, p. 862–863, 866. Proposed for the tripartite facies of Portwood (new) in area between Berea and Olympia. Lower division of Harg is greenish, gray, or bluish-black argillaceous shale, 2½ feet thick and associated with layers of limestone at Harg, but typically represented with thickness of 10 feet at Witt Schoolhouse; middle division is carbonaceous-calcareous shale, 9½ feet thick at Harg, 23 feet at Witt Schoolhouse, and 13 feet at Rice Station; upper division is stony light-gray argillaceous shale, its layers varying in hardness, 3 feet thick at Harg, 5½ feet at Rice Station. The three divisions seldom have same relative representation at any two localities. Different levels of Harg rest on the Hamilton and commonly a layer of limestone belonging to the Harg is basal layer of the New Albany. Considered coeval facies with Duffin dolomite, and Ravenna shale facies (new). Replaces the Duffin dolomite in area where former appears and is transitional between the Duffin and Ravenna. Underlies Trousdale shale.

Type section: In cut on Louisville and Nashville Railroad, one-half mile north of Harg, 6 miles northwest of Irvine, Estill County. Lower and middle division typically represented at Witt Schoolhouse; upper division well exposed at Rice Station; all three divisions occur together at Harg.

Hargett Sandstone (in Chester Group)[1]

Hargett Sandstone or Shale Member (of Alsobrook Formation)

Mississippian (Chester Series): Northeastern Mississippi.

Original reference: W. C. Morse, 1935, Mississippi Geol. Survey Bull. 26, p. 9, 10.

W.C. Morse, 1936, Mississippi Geol. Survey Bull. 32, p. 11. Listed as middle member of Alsobrook formation. Overlies unnamed limestone; underlies Cripple Deer sandstone or shale member. Chester series.

Occurs in Tishomingo County.

Harkers Fanglomerate (in Salt Lake Group)

Pliocene: Central northern Utah.

L. W. Slentz, 1955, Utah Geol. Soc. Guidebook 10, p. 23, 24 (fig. 6), 28–30. Salt Lake group, in Lower Jordan Valley, divided into (ascending) Traverse volcanics, Jordan Narrows unit, Camp Williams unit, Harkers fanglomerate, and Travertine unit. Fanglomerate, tan to gray, poorly consolidated; occasional channels and lenses of reddish silts; torrential bedding and cut and fill structure common. Thickness at least 300 feet. Within Jordan Narrows proper, fanglomerate is in fault contact with Camp Williams unit or overlies it unconformably. Exact relationship to Travertine unit unknown; may be contemporaneous.

A. J. Eardley, 1955. Utah Geol. Soc. Guidebook 10, fig. 9. Contemporaneous with Huntsville fanglomerate in Morgan Valley and Mink Creek conglomerate in Cache Valley.

Type locality: Harkers Canyon, which cuts through northern part of Oquirrh foothills just south of Bacchus, Salt Lake County. Lower Jordan Valley is defined as that part of Jordan Valley northward from Traverse Mountains to great Salt Lake.

Harkness Lavas, Basalts, Flows.

Cenozoic: Northern California.

Howel Williams, 1932, California Univ. Pub., Bull. Dept. Geol. Sci., v. 21, no. 8, p. 272–280. Earliest Harkness lavas are generally pale-gray massive andesitic basalts that weather to whitish crust and are rich in conspicuous phenocrysts of bright-yellowish-green augite. Nearer the vent, the later lavas usually darker, often purplish, weathering to pinkish crusts, and more vesicular, whereas in the crater rim the flows are almost black. Cinders forming summit cone are black and scoriaceous. Younger than flat-lying Saddle Mountain lavas (new).

Mount Harkness is in Plumas County in southeastern part of Lassen Volcanic National Park.

Harlan Sandstone

Harlan Formation

Harlan Sandstone (in Pottsville Group)[1]

Pennsylvanian: Southeastern Kentucky and southwestern Virginia.

Original reference: M. R. Campbell, 1893, U.S. Geol. Survey Bull. 111, p. 28, 31.

H. R. Wanless, 1946, Geol. Soc. America Mem. 13, p. 114–118, 142. Harlan sandstone (or formation) is uppermost division of Pennsylvanian in Black Mountains, Harlan and Letcher Counties, Ky., and Wise and Lee Counties, Va. Overlies Wise formation. Includes massive cliff-forming conglomeratic sandstone at base (probably Campbell's original Harlan sandstone). Base commonly stated to be 5 to 50 feet above High Splint coal. Although it contains shales and coals, the formation has commonly been called Harlan sandstone. May be lower Allegheny in age.

Named for Harlan County, Ky.

Harlem Clay (in Conemaugh Formation)[1]

Harlem clay or underclay member

Pennsylvanian (Conemaugh Series) : Eastern Ohio.

[Original reference] : Wilber Stout and others, 1923, Ohio Geol. Survey, 4th ser., Bull. 26, p. 458.

N. K. Flint, 1951, Ohio Geol. Survey, 4th ser., Bull. 48, p. 71. Harlem clay included in Harlem cyclothem, Conemaugh series. Not recognized with certainty in area of report [Perry County]. Within the cyclothem, position of clay is below Harlem coal and above unit termed Harlem shale and (or) sandstone.

M. T. Sturgeon and others, 1958, Ohio Geol. Survey Bull. 57, p. 95 (table 11), 133. Underclay member of Harlem cyclothem in report on Athens County. Average thickness 2¼ feet. Above Rock Riffle limestone member (new).

Named for association with Harlem coal.

Harlem cyclothem

Pennsylvanian (Conemaugh Series) : Southeastern Ohio.

N. K. Flint, 1949, Ohio Acad. Sci. [Guidebook] 24th Ann. Field Conf., p. 15. Incidental mention in road log.

N. K. Flint, 1951, Ohio Geol. Survey, 4th ser., Bull. 48, p. 71–72, table 1, geol. map. Includes (ascending) Harlem shale and (or) sandstone, 25 feet; Harlem clay and coal (not recognized with certainty in Perry County) ; unnamed shale; and Ames limestone, 1 to 2½ feet. Occurs above Barton cyclothem and below an unnamed cyclothem. In area of this report, Conemaugh series is described on cyclothemic basis; seven cyclothems named. [For sequence see Mahoning cyclothem.]

M. T. Sturgeon and others, 1958, Ohio Geol. Survey Bull. 57, p. 95 (table 11), 129–134. In Athens County, comprises (ascending) Saltsburg, Round Knob, Rock Riffle, and Harlem members. In sequence, occurs above Upper Bakerstown cyclothem and below Ames cyclothem. In this report Conemaugh series described on cyclothemic basis; 15 cyclothems named, [For sequence see Mahoning cyclothem.]

Harlem Gneiss[1]

Precambrian : Southeastern New York.

Original reference : R. P. Stevens, 1867, New York Lyc. Nat. History Annals, v. 8, p. 116–120.

Along southern shore of Spuyten-Duyvel Creek and Harlem River, Manhattan Island.

Harlem shale and (or) sandstone member

See Harlem cyclothem.

Harlow Bridge Quartzite Member (of Cram Hill Formation)

Middle Ordovician : Central Vermont.

L. W. Currier and R. H. Jahns, 1941, Geol. Soc. America Bull., v. 52, no. 9, p. 1493, 1495. Buff to pale-green platy to massive quartzite beds with intercalated siliceous schists. Basal member of formation. Thickness approximately 300 to 800 feet. Overlies unnamed Ordovician (?) schists.

Type locality : Vicinity of large railroad bridge (Harlow Bridge) 2.4 miles south-southwest of Northfield, Barre quadrangle.

Harmon Formation (in Maysville Group)[1]

Upper Ordovician: Southeastern Indiana.

Original reference: E. R. Cumings and J. J. Galloway, 1913, Indiana Dept. Geology and Nat. Resources 37th Ann. Rept. p. 359.

Probably named from Harmon's Station, Dearborn County.

Harmon Hill Gneiss[1]

Precambrian: Southwestern Vermont.

Original reference: C. E. Gordon, 1914, Vermont State Geologist 9th Rept. p. 345, 349.

In vicinity of Bennington, Bennington region, Vermont.

Harmony Formation

Upper Cambrian: North-central Nevada.

R. J. Roberts, 1951, Geology of the Antler Peak quadrangle, Nevada: U.S. Geol. Survey Geol. Quad. Map [GQ–10]. Described as chiefly greenish-brown sandstone, arkose, grit, and green, red, or black shale, calcareous shale, and limestone. Lower beds interbedded sandstone, arkose, grit, and shale. Upper beds principally sandstone, shale, limy shale, and thin limestone beds. Thickness estimated to exceed 3,000 feet. In thrust contact with Scott Canyon, Comus, and Valmy formations; overlain unconformably by Battle formation. Mississippian(?).

H. G. Ferguson, S. W. Muller, and R. J. Roberts, 1951, Geology of the Winnemucca quadrangle, Nevada: U.S. Geol. Survey Geol. Quad. Map [GQ–11]. Thickness at type locality may exceed 5,000 feet.

R. J. Roberts and others, 1958, Am. Assoc. Petroleum Geologists Bull., v. 42, no. 12, p. 2827–2828. Harmony formation, previously regarded as Mississippian(?) now known to be of latest Cambrian age. Determination based on trilobites.

Type locality: Harmony Canyon, Sonoma Range, Winnemucca quadrangle.

Harmony Hill Formation (in Ancell Group)

Middle Ordovician: Northern Illinois.

J. S. Templeton and H. B. Willman, 1952, Tri-State Geol. Soc. Guidebook 16th Ann. Field Conf., p. 21, figs. 3, 12. Consists of green platy shale about 6 feet thick. Shown on columnar section as uppermost formation of Ancell group (new). Underlies Hennepin member (new) of Pecatonica formation; overlies Loughridge formation (new).

Occurs in Dixon-Oregon area.

Harmony Hills Tuff Member (of Quichapa Formation)

Oligocene: Southwestern Utah and eastern Nevada.

J. H. Mackin, 1960, Am. Jour. Sci., v. 258, no. 2, p. 90, 92 (fig. 2), 94–95. Uppermost member of formation. At type locality, overlies Bauers tuff member (new); underlies Rencher formation; elsewhere lava flows or other volcanic rocks, local in origin and extent, at contacts. Characteristically tan to light red brown. Only moderately indurated, but does not show signs of welding. May be an ignimbrite or may be an airfall tuff. Thickness 300 to 350 feet. Zircon age of Leach Canyon tuff member is 28 million years; this suggests that Quichapa formation is Oligocene. Discussion of ignimbrites of area.

E. F. Cook 1960, Intermountain Assoc. Petroleum Geologists Guidebook 11th Ann. Field Conf., p. 138 (fig. 3). Geographically extended into eastern Nevada.

Type locality: Harmony Hills specifically south side of Right Quichapa Canyon, Mount Stoddard quadrangle, Iron Springs district, Utah.

Harney Formation[1]

Pliocene(?) : Southeastern Oregon.

A. M. Piper, 1936, Geol. Soc. Oregon County News Letter, v. 2, no. 8, p. 10. Includes massive basaltic tuff and breccia, sandstone and siltstone, and some incoherent gravel. Thickness about 750 feet. Overlies Danforth formation (new) with angular and erosional nonconformity; underlies an extensive plain of intermediate altitude in west-central part of Harney Basin. Outliers occur along all margins of central district except northern Pliocene(?).

A. M. Piper, T. W. Robinson, and C. F. Park, Jr., 1939, U.S. Geol. Survey Water-Supply Paper 841, p. 38–41, pl. 2. Detailed description. Thickness 468 feet at type section herein designated. [This is reference cited in Wilmarth Lexicon as "in press"].

W. D. Wilkinson, [1939], Geologic map of Round Mountain quadrangle, Oregon (1:96,000): Oregon Dept. Geology and Mineral Industries. Mapped in Round Mountain quadrangle, Crook County.

Type section: East face of Dog Mountain, along boundary between secs. 20 and 28, T. 25 S., R. 30 E., Harney County.

†Harney Granite[1]

Precambrian: Southwestern South Dakota.

Original reference: H. G. Ferguson and F. N. Turgeon, 1908, Harvard Coll. Mus. Comp. Zoology Bull., v. 49, p. 273–281.

Occurs in northern Black Hills.

Harney Peak Granite[1]

Precambrian: Southwestern South Dakota.

Original reference: C. R. Van Hise, 1898, Geol. Soc. America Bull., v. 9, p. 311.

G. L. Taylor, 1935, Am. Jour. Sci., 5th ser., v. 29, no. 171, p. 281. Dikes of Harney Peak fine-grained granite cut Game Lodge granite (new).

L. R. Page and others, 1953, U.S. Geol. Survey Prof. Paper 247, p. 6–7. Discussed in pegmatite investigations in Black Hills 1942–1945.

Present in Black Hills region.

Haro Formation[1]

Upper Triassic: Northwestern Washington.

Original reference: R. D. McLellan, 1927, Washington Univ. Pub. in Geology, v. 2, p. 93, 112–113.

Composes peninsula known as Davidson Head at northern extremity of San Juan Island.

Harold Formation

Pleistocene upper (?) : Southern California.

L. F. Noble, 1953, Geology of the Pearland quadrangle, California: U.S. Geol. Survey Geol. Quad. Map [GQ–24]. Well-stratified variable sequence of interbedded deposits; gravel, coarse arkosic sand with pink feldspar, in part lime-cemented and resembling travertine; buff sand and silt; whitish nodular marly clay in lower part of formation; brown gypsiferous clay beds locally at base of formation wherever it overlies gypsiferous Anaverde formation. Thickness generally 100 feet or less, 200 feet in some areas, but top is eroded. In some areas not easily differentiated from Nadeau gravel (new).

L. F. Noble, 1954, U.S. Geol. Survey Geol. Quad. Map GQ–50. Described in Valyermo quadrangle where it underlies Shoemaker gravel (new). Formation gently folded; most dips less than 20°.

Type locality: Hills one-half mile southwest of San Andreas fault and 1 mile southeast of Harold Siding on Southern Pacific Railroad.

Harper Siltstone (in Nippewalla Group)

Harper Sandstone (in Cimarron Group)[1]

Harper Sandstone (in Nippewalla Group)

Permian: Central southern Kansas and northern Oklahoma.

Original reference: F. W. Cragin, 1896, Colorado Coll. Studies, v. 6, p. 3, 18–20.

G. H. Norton, 1937, Am. Assoc. Petroleum Geologists Bull., v. 21, no. 12, p. 1557. Includes (ascending) Ninnescah shale (new), Stone Corral, Chikaskia sandstone (new), and Kingman sandstone (new) members.

W. A. Ver Wiebe, 1937, Wichita Municipal Univ. Bull., v. 12, no. 5, p. 11. Typical Harper redbeds overlie Afton limestone member (new) of Wellington formation.

G. H. Norton, 1939, Am. Assoc. Petroleum Geologists Bull., v. 23, no. 12, p. 1782–1786. Assigned to Nippewalla group (new) and restricted below to exclude Ninnescah shale and Stone Corral formations.

R. C. Moore, J. C. Frye, and J. M. Jewett, 1944, Kansas Geol. Survey Bull. 52, pt. 4, p. 159. Includes (ascending) Chikaskia member and Kingman sandstone member. Thickness about 220 feet. Overlies Stone Corral dolomite of Sumner group; underlies Salt Plain formation; northward is overlapped by Cenozoic rocks. Outcrops are in Harper, Kingman, Reno, and Rice Counties. Included in Nippewalla group, Leonard series.

J. M. Jewett, 1959, Graphic column and classification of rocks in Kansas: Kansas Geol. Survey. Harper siltstone comprises (ascending) Chikaskia siltstone and Kingman siltstone members. Overlies Stone Corral formation; underlies Salt Plain siltstone. Nippewalla group.

Named for exposures in Harper County, Kans.

Harpers Shale[1] **Schist,**[1] **Slate,**[1] **Phyllite,**[1] **or Formation** (in Chilhowee Group)

Lower Cambrian(?): West Virginia, Maryland, southeastern Pennsylvania, and Virginia.

Original references: A. Keith, 1893, as reported by G. H. Williams and W. B. Clark, in Maryland, its resources, industries, and institutions, chap. 3, p. 68; 1894, U.S. Geol. Survey 14th Ann. Rept., pt. 2, p. 333–335, pls. 22–23.

G. W. Stose, 1906, Jour. Geology, v. 14, p. 207. In southern Pennsylvania, Harpers schist includes Montalto quartzite member (new).

P. B. King, 1950, U.S. Geol. Survey Prof. Paper 230, p. 15 (fig. 5), 19–20, pl. 1. Formation in Chilhowee group. In Elkton area, Virginia [this report], shale constitutes only small part of unit, remainder being largely siltstone and fine-grained sandstone; hence, unit designated as formation.

Thickness about 900 feet. Overlies Weverton formation; underlies Antietam quartzite.

D. M. Scotford, 1951, Geol. Soc. America Bull., v. 62, no. 1, p. 49–51, pl. 1. Discussion of structure of Sugarloaf Mountain area, Maryland. Phyllites of area, which have been considered volcanic members of Glenarm series (Stose and Stose, 1946) are Harpers phyllite. This conclusion based on structural evidence that local stratigraphic section is reverse of that previously reported—that is, anticlinal not synclinal. Stose and Stose divided this phyllite into Ijamsville and Urbana phyllites largely on basis of color and lack of calcareous bands in the Ijamsville. Although this division may be valid, it is difficult to map the contacts accurately and the Ijamsville and Urbana are herein considered part of the Harpers. Lower Cambrian age of Harpers is based on its position conformably below Antietam quartzite on Catoctin Mountain west of Sugarloaf area. Overlies Weverton quartzite.

A. J. Stose and G. W. Stose, 1951, Geol. Soc. America Bull., v. 62, no. 6, p. 697–699. Discussion of Scotford article. Stose and Stose reiterate their conclusions that Sugarloaf Mountain quartzite is synclinal and not anticlinal; the phyllites that surround the quartzite are not Harpers but phyllites of an eastern shale sequence containing volcanic flows and tuffs, which are Urbana and Ijamsville phyllites.

J. C. Whitaker, 1955, Geol. Soc. America Bull. v. 66, no. 4, p. 445–446. Studies indicate that Catoctin Mountain is not a syncline as previously interpreted but a tightly folded eastward-dipping sequence which forms upper and east limb of South Mountain anticlinorium. Strata formerly mapped as Loudoun along eastern border of Catoctin Mountain constitute a zone including upper Weverton quartzite and basal Harpers phyllite. The Harpers overlies Weverton quartzite in normal sequence along eastern slopes of Catoctin Mountain. Formation extends from northern end of area southward to 3 miles north of Leesburg, Va., where it is cut off by Triassic border fault. Underlies Antietam quartzite throughout most of area; between Thurmont and Mount St. Marys in northern Maryland, underlies Frederick limestone; just north of Potomac River, underlies Tomstown dolomite.

R. O. Bloomer and H. J. Wheeler, 1955, Geol. Soc. America Bull., v. 66, no. 5, p. 595–597, pl. 1. In Blue Ridge region, central Virginia, formation includes Snowden member (new). Transitional between Unicoi formation below and Antietam quartzite above. Thickness 800 to 1,200 feet.

Carlyle Gray and others, 1960, Geologic map of Pennsylvania (1:250,000): Pennsylvania Geol. Survey, 4th ser. Mapped as formation including Montalto member.

Named for exposures in gorges of Potomac and Shenandoah Rivers at Harpers Ferry, W. Va.

†Harpersville Formation (in Cisco Group)[1]

Pennsylvanian: Central and northern Texas.

Original reference: F. B. Plummer and R. C. Moore, 1921, Texas Univ. Bull. 2132; 1922, Jour. Geology, v. 30, p. 24, 31, 39.

Wallace Lee and others, 1938, Texas Univ. Bur. Econ. Geology Pub. 3801, p. 61–74, 128–132. In Brazos River valley, extends from top of Breckenridge limestone member of Thrifty formation to base of Pueblo formation, an interval of 233 feet. It is part of a chaotic series of thin limestones, relatively thin lenticular sandstone, variegated sandy and clay shales, and thin coals. This complex series of beds, interrupted by unconformities expressed in large and small channels, extends with progressive changes upward beyond limits of Harpersville to middle of Moran formation. Formation comprises (ascending) unnamed limestone and shale interval, Crystal Falls limestone, unnamed shale interval. "Upper Crystal Falls limestone," unnamed shale and limestone interval, Belknap limestone, unnamed interval, and Saddle Creek limestone. In Colorado River valley, includes Waldrip bed of Drake and Saddle Creek limestone member. Thickness 238 feet. Overlies Thrifty formation; underlies Pueblo formation.

M. G. Cheney, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 1, p. 66 (fig. 1), 91. Term abandoned. Pennsylvanian-Permian boundary is placed at disconformity in Harpersville formation. This boundary is 40 to 150 feet below Saddle Creek limestone. Harpersville beds below boundary are assigned to Obregon (new) and Chaffin formation of Thrifty group; those above the systemic boundary to Saddle Creek formation of expanded Pueblo group.

F. B. Plummer and H. B. Bradley, 1949, Texas Univ. Bur. Econ. Geology Pub. 4915, p. 5–23. Three clays, Quinn, Curry, and Craddock, named in this report. The Quinn is described as next to lowest clay in the Harpersville as defined in report and map by Plummer and Moore (1921). Curry clay occurs between upper and lower layers of Crystal Falls limestone.

L. F. Brown, Jr., 1960, Texas Univ. Bur. Econ. Geology Rept. Inv. 41, p. 21–26, pl. 1. Discussion of lower part of Harpersville formation in Stephens County. Here includes (ascending) Quinn clay, Crystal Falls limestone, and Curry clay members.

Named for Harpersville, 10 miles south of Breckenridge, Stephens County.

†Harpeth Shale[1]

Mississippian: Central Tennessee.

Original reference: P. M. Jones, 1892, Geology of Nashville and immediate vicinity; Nashville, Tenn., Univ. Press, June 1892, p. 14.

Named from fine presentation in picturesque bluffs, along Big Harpeth River, in Cheatham County.

†Harpeth and Tennessee River Group[1]

Silurian and Devonian: Western Tennessee.

Original reference: J. M. Safford, 1851, Am. Jour. Sci., 2d, v. 12, p. 353, 357–358.

Named for Harpeth River, Cheatham and Dickson Counties.

Harpole Mesa Formation

Pleistocene: Southeastern Utah.

G. M. Richmond, 1956, Dissert. Abs., v. 16, no. 6, p. 1127–1128. Consists of three unnamed members, lower two of which comprise till, alluvial gravel, and eolian deposits. Upper member comprises eight lithofacies, including till and several kinds of alluvial, colluvial, and eolian deposits. Tills form sheetlike deposits on high interfluves and broad valley surfaces. Alluvial gravel of lower member trends across present canyons. Similar very strongly developed soils occur on each member. Rarely distinguishable, they are jointly called the Spring Draw soil. Older than Placer Creek formation (new).

Located in La Sal Mountains area.

Harrell Shale (in Susquehanna Group)

Harrell Shale (in Portage Group)[1]

Harrell Member (of Fort Littleton Formation)

Upper Devonian: Central Pennsylvania and West Virginia.

Original reference: C. Butts, 1918, Am. Jour. Sci., 4th ser., v. 46, p. 523, 532, 536.

Bradford Willard, 1939, Pennsylvania Geol. Survey, 4th ser., Bull. G–19, p. 201, 217–218. Restricted at base to exclude Burket black shale and rank reduced to member status in Fort Littleton formation. Underlies Brallier member of Fort Littleton.

H. P. Woodward, 1943, West Virginia Geol. Survey, v. 15, p. 390–412. Rock previously called "Genesee black shale" by Maryland and West Virginia Geological Surveys appears to be continuous extension of Harrell shale of Pennsylvania. Believed that Pennsylvania name appropriate for outcrops in West Virginia. Shale thinnest in Eastern Panhandle, where it is 5 to 20 feet thick, and wholly absent from easternmost sections. Thickens westward, being about 300 feet along U.S. Highway 50 near Hampshire-Mineral County boundary. Overlies Hamilton formation; underlies Brallier shale.

U.S. Geological Survey currently classifies the Harrell Shale as a formation in the Susquehanna Group on basis of a study now in progress.

Named for exposures at Harrell, Blair County, Pa.

Harriett Formation

Silurian: Western Ohio.

Wilber Stout, 1941, Ohio Geol. Survey, ser. 4, Bull. 42, p. 90–91. Name tentatively applied to a limestone 21 feet thick that occurs below Cedarville dolomite and above Lilley dolomite.

Occurs in Harlan Skeen quarry located on Sinking Spring-Hillsboro Road (Route 124), three-fourths of mile northeast of Harriett, 2 miles south of Marshall, Highland County.

Harriman Chert[1]

Harriman Formation

Lower Devonian: Western and central Tennessee.

Original reference: C. O. Dunbar, 1918, Am. Jour. Sci., 4th, v. 46, p. 747.

G. A. Cooper and others, 1942, Geol. Soc. America Bull., v. 53, no. 12, pt. 1, chart 4. Age shown on correlation chart as Lower or Middle Devonian.

C. W. Wilson, Jr., Tennessee Div. Geology Bull. 56, p. 306–309, fig. 88. Harriman formation, locally referred to as Harriman limestone or Harriman chert depending upon phase represented, used to include both Dunbar's "Harriman novaculite and Quall limestone." The Quall considered unweathered phase of the Harriman. Formation consists of two contemporaneous lithologic phases of limestone and chert. Thickness 37 to 55 feet. Unconformably overlies Flat Gap limestone where present; elsewhere unconformably overlies either Ross limestone member or Birdsong shale member of Ross formation (new). Unconformably underlies Chattanooga shale, or, as in Decatur and Benton Counties, Camden formation.

Named for Harriman Creek, Decatur County. [Harriman Creek is called Herron Creek on Jeanette planimetric quadrangle, Tennessee Valley Authority, Wilson, p. 307.]

Harriman Shale Member (of Lykins Formation)

Permian: North-central Colorado.

L. W. LeRoy, 1946, Colorado School Mines Quart., v. 41, no. 2, p. 31–33. Name proposed to represent lowermost unit of Lykins formation. In Glennon Canyon, member consists primarily of red arenaceous thin-bedded shales and mudstones containing several thin layers of white massive fine to medium crystalline limestone in lower third. Limestone layers rarely exceed 6 inches in thickness and contain black brittle bituminous material along fractures and in minute vugs, Bituminous material also occurs sporadically throughout lower half of shale in thin discontinuous streaks along and transverse to bedding planes. Shales immediately adjacent to bituminous material are of bluish-green tints. Thickness 58 to 92 feet in area. Underlies Falcon limestone member (new); rests sharply on conglomeratic phase of Lyons formation.

Type section: In west tributary of Glennon Canyon, Golden-Morrison area, Jefferson County, where typically developed and well exposed. Named from Harriman irrigation canal, which receives water from Bear Creek at town of Morrison.

Harrington Formation[1]

Lower Triassic: Southwestern Utah.

Original reference: B. S. Butler, 1913, U.S. Geol. Survey Prof. Paper 80.

Type locality: Harrington-Hickory mine, southeast of Frisco district.

Harris Formation[1]

Miocene or Pliocene: Southern California.

C. F. Tolman, 1927, Econ. Geology, v. 22, no. 5, p. 459. Named in stratigraphic column. Described as massive diatomite 2,000 feet thick. Underlies Foxen formation and overlies Monterey formation.

W. P. Woodring and M. N. Bramlette, 1950, U.S. Geol. Survey Prof. Paper 222, p. 36. Harris formation is Sisquoc formation of current usage.

Occurs in Santa Maria district.

Harrisburg Coal Member (of Carbondale Formation)

Pennsylvanian: Southern and eastern Illinois.

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 34, 36, 47 (table 1), pl. 1. Assigned member status in Carbondale formation (redefined). In southern area, occurs above Hanover limestone member and below St. David limestone member; in eastern area, occurs above Summum coal (No. 4) member and below Herrin (No. 6) coal member. Coal named by Shaw and Savage (1912, U.S. Geol. Survey Geol. Atlas, Folio 185). Presentation of new rock-stratigraphic classification of Pennsylvanian strata in Illinois.

Type locality: In coal mines in vicinity of Harrisburg, Saline County.

Harrisburg Gypsiferous Member (of Kaibab Limestone)[1]

Permian: Southwestern Utah and northwestern Arizona.

Original reference: H. Bassler and J. B. Reeside, Jr., 1921, U.S. Geol. Survey Bull. 726–C, p. 90–92.

E. D. McKee, 1938, Carnegie Inst. Washington Pub. 492, p. 35. The α, or uppermost member of Kaibab, as described herein, has been referred to variously as the A member, the Super Aubrey, Bellerophon limestone, and Harrisburg gypsiferous member.

Named for occurrence in Harrisburg dome, 8 miles east of St. George, Washington County, Utah.

Harrisite Dolomite

Middle Silurian: Northwestern Utah.

F. W. Osterwald, 1953, U.S. Geol. Survey Trace Elements Inv. Rept. TEI-330, p. 105; M. H. Staatz and F. W. Osterwald, 1959, U.S. Geol. Survey Bull. 1069, p. 19 (fig. 2), 25–26, pl. 1. Massive dark-gray to black locally banded dolomite, containing as much as 20 percent black chert chiefly as nodules and discontinuous layers along the bedding; lower 10 feet has mottled appearance and is commonly limy. Thickness 110 to 174 feet. Overlies Bell Hill dolomite and underlies Lost Sheep dolomite (both new).

Type section: Steep west side of canyon 2,000 feet northeast of Harrisite mine, sec. 10, T. 13 S., R. 12 W., Juab County. Named for exposures that cap hill a short distance east of Harrisite mine.

Harrison Diorite[1]

Harrison Gneiss

Pre-Triassic: Southwestern Connecticut and southeastern New York.

Original reference: F. J. H. Merrill, 1898, New York State Mus. 15th Ann. Rept., v. 1, p. 30.

John Rodgers and others, 1956, Preliminary geological map of Connecticut (1:253,440): Connecticut Geol. Nat. History Survey. Redescribed as a dark-gray to greenish gneiss; composed of andesine, quartz, hornblende, and biotite. Augen structure locally present. Pre-Triassic.

Crops out extensively in town of Harrison, Westchester County, N.Y.

Harrison Formation

Harrison Member (of Pottsville Formation)[1]

Pennsylvanian: Southeastern Ohio.

Original references: W. Stout, 1916, Ohio Geol. Survey, 4th ser., Bull. 20, p. 481; 1927, Ohio Geol. Survey, 4th ser., Bull. 31, p. 67, 68.

N. K. Flint, 1951, Ohio Geol. Survey, 4th ser., Bull. 48, p. 20–21, table 1. Rank raised to formation in Pottsville series. Harrison formation conforms with contour of post-Mississippian-pre-Pottsville erosion surface. Formation overlapped by various strata of lower Pottsville age from Anthony shale up to Massillon sandstone.

Named for deposits in Scioto County. Formerly worked for iron smelting at Harrison Furnace.

Harrison Sandstone (in Arikaree Group)

†Harrison Beds[1]

Harrison Formation (in Arikaree Group)

Harrison Member (of Arikaree Formation)

Miocene, lower: Western Nebraska, southern South Dakota, and eastern Wyoming.

Original reference: J. B. Hatcher, 1902, Am. Philos. Soc. Proc., v. 41, p. 117.

C. B. Schultz, 1938, Am. Jour. Sci., 5th ser., v. 35, no. 210, p. 442–443, 444. Formation considered uppermost unit in Arikaree group. Overlies Monroe Creek formation; underlies Marsland formation (new). Harrison used here as defined by Hatcher. Peterson (1906, Annals Carnegie Mus., v. 4) applied term "Lower Harrison" to the whole of the already named Harrison beds of Hatcher, and "Upper Harrison" was used for the overlying buff-colored deposits which Hatcher miscalled the Nebraska beds of Scott. This has resulted in much confusion of what constitutes the Harrison. "Upper Harrison" beds here named Marsland formation.

A. L. Lugn, 1938, Am. Jour. Sci., 5th ser., v. 36, no. 213, p. 226, 227; 1939, Geol. Soc. America Bull., v. 50, no. 8, p. 1252, 1253–1254. Thickness of formation 200 feet. Harrison here used as defined by Hatcher. Overlying Marsland formation not included in Harrison of Hatcher. Application of name "Upper Harrison" to these beds by Peterson and others in recent years is unfortunate as these beds (Marsland) have no close stratigraphic or faunal relation to true Harrison (in Hatcher sense) and are separated from underlying Harrison by most significant and important structural and erosional unconformity in western Nebraska.

H. J. Cook and J. T. Gregory, 1941, Jour. Paleontology, v. 15, no. 5, p. 549–552. Described fauna from "Upper Harrison." States that Marsland as defined by Schultz includes two separable formations—"Upper Harrison" and higher previously unnamed deposits. Marsland is restricted to deposits at type locality and, as thus restricted, is equivalent to unnamed beds between "Upper Harrison" and the Sheep Creek as shown in columnar section of region by Cook and Cook (1953, Nebraska Geol. Survey Paper 5). New name is not proposed for "Upper Harrison".

R. C. Cady and O. J. Scherer, 1946, U.S. Geol. Survey Water-Supply Paper 969, p. 22–26, pls. 1, 7. Described as sandstone in Box Butte County where it is 85 to 130 feet thick. Unconformably overlies Monroe Creek sandstone and underlies Marsland formation.

S. G. Collins, 1959, Geology of the Martin quadrangle, South Dakota (1:62,500): South Dakota Geol. Survey. Considered member of Arikaree formation in South Dakota. Consists of light-pink to brown or grayish-buff poorly consolidated mostly calcareous very fine sand and silt with discontinuous zones of calcareous concretionary nodules increasing in abundance upward; upper part contains thin zones of white limy sandstone and local lenses of garnetiferous sandstone. Thickness as much as 150 feet. Overlies Monroe Creek member; contact gradational and difficult to locate precisely. Underlies Valentine formation.

J. C. Harksen, 1960, Geology of the Sharps Corner quadrangle, South Dakota (1:62,500): South Dakota Geol. Survey. Formation in Arikaree group. Consists of up to 125 feet of massive gray, partly crossbedded, poorly consolidated fine to very fine sands. Includes "Rosebud" facies. Overlies Monroe Creek formation.

S. G. Collins, 1960, Geology of the Patricia quadrangle, South Dakota (1:62,500): South Dakota Geol. Survey. Formation in Arikaree group. Maximum thickness estimated to be 60 to 80 feet. Overlies Monroe Creek formation. On regional scale, the Harrison and Monroe Creek become less distinct as separable units eastward from source area; believed that there is little practical value in attempting to map them separately eastward from Patricia and Martin quadrangles. Underlies Ogallala group (Valentine formation).

Well exposed in bluffs of all small streams that head near summit of Pine Ridge in vicinity of Harrison, Sioux County, Nebr. Named from exposures in vicinity of Harrison, Sioux County, Nebr.

†Harrison Series[1]

Precambrian: Southern Idaho and northwestern Utah.

Original reference: A. L. Anderson, 1931, Idaho Bur. Mines and Geology Bull. 14, p. 24.

V. E. Peterson, 1942, Econ. Geology, v. 37, no. 6, p. 470, 471 (table 1). Geographically extended to Ashbrook mining district, Utah. Generalized stratigraphic section of Ashbrook district shows Harrison series below Cambrian(?) Sentinell quartzite.

Best exposed on flanks of Mount Harrison, Cassia County, Idaho.

Harrodsburg Formation or Limestone

†Harrodsburg Limestone (in Meramec Group)[1]

Lower Mississippian: Indiana and northern Kentucky.

Original reference: T. C. Hopkins and C. E. Siebenthal, 1897, Indiana Dept. Geology and Nat. Resources 21st Ann. Rept., p. 296.

P. B. Stockdale, 1939, Geol. Soc. America Spec. Paper 22, p. 72–73, 75, 224, pl. 25. Harrodsburg limestone has become well established formation in Indiana since its introduction in 1897. Stockdale (1929, Indiana Acad. Sci. Proc., v. 38) divided unit into Upper Harrodsburg limestone and Lower Harrodsburg limestone consisting of (descending) Guthrie Creek, Leesville limestone, and Ramp Creek members. In Indiana from south side of Floyd County northward, there is lithologic contrast between top of Borden group and overlying Ramp Creek member; southward from Floyd County into Kentucky, cherty, impure limestone appears at successively lower horizons beneath upper boundary of Borden group until more than entire topmost Borden unit (Edwardsville of Indiana) is of siliceous calcareous facies identical with Ramp Creek member to north. Distinctive Warsaw fauna is feature of Upper Harrodsburg, which is pure limestone in most of southern Indiana. Hence basal Harrodsburg beds are placed with Borden group as part of uppermost unit herein named Muldraugh formation. "Upper" division referred to as Harrodsburg (restricted) formation in this report.

W. N. Melhorn and N. M. Smith, 1959, Indiana Geol. Survey Rept. Prog. 16, p. 8 (table 1), 14. Harrodsburg limestone, in Mount Carmel fault area, is 80 to 90 feet, and is divided into upper and lower units. Gradational into underlying Edwardsville formation through series of thin-bedded argillaceous limestones interbedded with layers of brown to blue-gray massive coarse-grained crinoidal limestone. Underlies Salem limestone.

Named for Harrodsburg, Monroe County, Ind.

Harshberger Limestone (in Conemaugh Formation)[1]

Pennsylvanian: Southwestern Pennsylvania.

Original reference: F. and W. G. Platt, 1877, Pennsylvania 2d Geol. Survey Rept. H_3, p. 222, 223, pl. 13.

Named for Harshberger quarries at Forwardstown, Somerset County.

Hart Limestone Member (of Stratford Formation[1] and Wichita Formation)

Permian: South-central Oklahoma.

Original reference: G. D. Morgan, 1924, [Oklahoma] Bur. Geology Bull. 2, p. 137–140.

H. D. Miser and others, 1954, Geologic map of Oklahoma (1:500,000): U.S. Geol. Survey. Hart limestone is at base of Wichita formation in southwest and central southern part of state; is member of Stratford formation of Pontotoc group in Pontotoc, Garvin, and Murray Counties.

Named for typical development near village of Hart, western part of Pontotoc County.

Harter Shale Member (of Frankfort Formation)

Upper Ordovician (Cincinnatian): Central New York.

G. M. Kay, 1943, Am. Jour. Sci., v. 241, no. 10, p. 601 (fig. 3). Name appears on stratigraphic diagram. Overlies Utica formation.

Marshall Kay, 1953, New York State Mus. Bull. 347, p. 64–66. Lowest member of Frankfort formation. Consists of greenish-gray laminated claystone grading imperceptibly into black shale of underlying Utica formation with which it has been mapped. Shale weathers into small conchoidally fractured chips in contrast to more platy, larger fragments of the weathered Utica. Thin cross-laminated siltstones or fine quartz sandstones, similar to sandstones in Moyer member (new), present locally near top. Thickness about 100 feet. Underlies Hasenclever member (new) with sharply defined contact useful as a mapping horizon. Typical exposures described and derivation of name stated.

Typical exposures in ravine south of Harter Hill, located along east-central border of Utica quadrangle.

Hartford Clay[1]

Pleistocene, upper: Central Connecticut.

Original reference: R. F. Flint, 1933, Geol. Soc. America Bull., v. 44, no. 5, p. 965–987.

W. D. Urry, 1948, Am. Jour. Sci., v. 246, no. 11, p. 689–700. Age about 18,000 years. Determination made on basis of study of radium content in varved clays.

Occurs in vicinity of Hartford, Hartford County.

Hartford Limestone[1]

Pennsylvanian: Western-central Kentucky.

Original reference: C. J. Norwood, 1884, Kentucky Geol. Survey Repts. on western coal field, Ohio County, p. 174.

Probably named for Hartford, Ohio County.

Hartford Limestone Member (of Topeka Limestone)

†Hartford Limestone (in Shawnee Formation)[1]

Pennsylvanian (Virgil Series): Eastern Kansas, southwestern Iowa, and northwestern Missouri.

Original reference: M. Z. Kirk, 1896, Kansas Univ. Geol. Survey, v. 1, p. 80.

R. C. Moore, 1948, Am. Assoc. Petroleum Geologists Bull., v. 32, no. 11, p. 2035 (fig. 5); 1949, Kansas Geol. Survey Bull. 83, p. 142 (fig. 29), 162; F. C. Greene and W. V. Searight, 1949, Missouri Geol. Survey and Water Resources Rept. Inv. 11, p. 18. Hartford limestone member of Topeka formation. Underlies Iowa Point shale member, overlies Calhoun formation. This is classification agreed upon by State Geological Surveys of Iowa, Kansas, Missouri, Nebraska, and Oklahoma, May 1947.

G. E. Condra, 1949, Nebraska Geol. Survey Bull. 16, p. 21. Condra and Reed (1937, Nebraska Geol. Survey Bull. 11, 2d ser.) were uncertain regarding relation of the Hartford of southern Kansas to lower member of the Topeka in northeastern Kansas, southeastern Nebraska, northwestern Missouri, and southwestern Iowa so proposed name Wolf River for basal member of Topeka in this area. Nebraska Survey will drop name Wolf River if it proves to be correlative with the Hartford, which was loosely defined by Kirk (1896) and may have priority if it does not include beds of Du Bois, Iowa Point, and Wolf River age. Type locality stated.

H. G. Hershey and others, 1960, Iowa Highway Research Board Bull. 15, p. 16–17, fig. 5. Commonly one bed of light- to blue-gray massive limestone; locally contains thin shale bed. Thickness 1 foot near Thurman, Fremont County; 0.5 foot near Howe, Adair County. Basal member of Topeka limestone; underlies Iowa Point shale member; overlies Calhoun shale. Called Wolf River in Nebraska.

H. G. O'Connor, 1960, Kansas Geol. Survey Bull. 148, pl. 1. In Douglas County, member is 6 to 8 feet thick and consists of two limestone beds separated by thin shale bed just below middle of member. Underlies Iowa Point Shale member; overlies Calhoun shale.

Type locality: Where member passes under Neosho River at Hartford, Coffee County, Kans. Well exposed just north of Hartford.

Hartford Hill Rhyolite Tuff

Oligocene(?): Western Nevada.

V. P. Gianella, 1934, Mining and Metallurgy, v. 15, no. 331, p. 299 (table 1). Name Hartford Hill rhyolite appears only on table. Miocene(?). Thickness 400 feet.

V. P. Gianella, 1936, Nevada Univ. Bull. 30, no. 9, p. 35 (table), 45–52. Described as biotite rhyolite with some quartz latite; occasional underlying lenses of dacite; in places rhyolite overlies fanglomerate or auriferous gravels. Exposures commonly buff to reddish-brown, although some dense glassy facies are lavender; usually light colored, commonly almost white on fresh surfaces. Attains thickness of 450 feet.

G. A. Thompson, 1956, U.S. Geol. Survey Bull. 1042–C, p. 50, pl. 3. Redescribed as light-pink to dull-purple vitric-crystal tuff, tuff-breccia, and welded tuff. Includes a few feet of conglomerate at its base on south slopes of Hartford Hill. Fragments of granitic and metamorphic rocks are common and, in a few places, constitute as much as 10 percent of the rock. Thickness at type locality about 1,000 feet. Some interbedding with overlying Alta formation. Type locality and geographic extent indicated.

Type locality: Hartford Hill, near Silver City. Extensively exposed in Comstock Lode district and south and southwest of Virginia City quadrangle.

Hartgrove Limestone Member (of Talpa Formation)[1]

Permian: Central Texas.

Original reference: W. Kramer, 1934, Am. Assoc. Petroleum Geologists Bull., v. 18, no. 12, p. 1579, 1582.

Named from exposure on Mack Hartgrove's Ranch, where it crops out 0.4 mile south of and 37 feet lower than the ground at Eugene Mays well, about 4.5 miles southeast of Paint Rock, Concho County.

Hartland Formation

Hartland Schist[1]

Paleozoic: Western Connecticut.

Original reference: H. E. Gregory, 1906, Connecticut Geol. Nat. History Survey Bull. 6, p. 96–100, map.

R. M. Gates, 1952, *in* R. M. Gates and W. C. Bradley, Connecticut Geol. Nat. History Survey Misc. Ser. 5. Termed a formation. Includes variety of rock types from mica quartzites to mica-quartz schists which are interlayered on scale of inches and feet. Locally characterized by crystals of garnet, staurolite, and kyanite. Color varies from metallic silvery gray to dark brownish black. Fine to coarse grained; very schistose to nearly massive. Individual beds few inches to 100 feet thick. Intruded by Mount Tom hornblende gneiss. Cambro-Ordovician.

John Rodgers and others, 1956, Preliminary geological map of Connecticut (1:253,440): Connecticut Geol. Nat. History Survey. Subdivided to include the Straits schist member. Age changed to pre-Triassic.

R. M. Gates, 1959, U.S. Geol. Survey Geol. Quad. Map GQ–121. Formation described and mapped in Roxbury quadrangle. Rock types in Hartland separated into three groups: group A, rocks composed of muscovite, biotite, quartz and feldspar without—or with subordinate—garnet staurolite, or kyanite; group B, rocks composed of micas, quartz, and feldspar with prominent garnet, staurolite, and kyanite; group C, various minor types. Intruded by Mount Tom hornblende gneiss. Stratigraphic position of Hartland uncertain. In the north, the Hartland forms east flank of Berkshire Hills, which are considered part of Precambrian core of Green Mountain anticlinorium, and must be Paleozoic in age. From Berkshire Hills southward, the Hartland separated from known Precambrian rocks to west by belt of marble or gneiss, or both, of unknown age—the Woodville marble of Rodgers and others (1956), and Waramung formation of Gates and Bradley (1952) respectively. Paleozoic.

M. H. Carr, 1960, Connecticut Geol. Nat. History Survey Quad. Rept. 9, p. 6–12, pl. 1. Described in Naugatuck quadrangle where it is divided into three parts arranged in probable order decreasing as follows: (1) The Straits schist member (2) undifferentiated Hartland (3) quartzitic member. In most places, intruded and interbanded with granites and granite gneisses of varied compositions. Occurs in belt west and south of Waterbury gneiss. Area here mapped as undifferentiated Hartland was formerly mapped as part of Prospect gneiss (Rice and Gregory, 1906). Prospect gneiss here restricted to dark-gray biotite augen gneiss and excludes interbanded schists which are considered to be part of undifferentiated Hartland. Prospect gneiss occurs between The Straits schist member and quartzitic member of Hartland. Orange phyllite is mapped to east of Hartland. Undifferentiated Hartland intruded by Ansonia granite. Pre-Triassic.

Named for development in Hartland [Township], Hartford County.

Hartland Shale Member (of Greenhorn Limestone)[1]

Upper Cretaceous: Western Kansas and southeastern Colorado.

Original reference: N. W. Bass, 1926, Kansas Geol. Survey Bull. 11, p. 33.

R. C. Moore and others, 1951, Kansas Geol. Survey Bull. 89, p. 25. Chalky shale, a few thin beds of chalky limestone and bentonite. Thickness 23 feet in Kearny County to 35 feet in Ellis County. Underlies Jetmore chalk member; overlies Lincoln limestone member.

T. G. McLaughlin, 1954, U.S. Geol. Survey Water-Supply Paper 1256, p. 115–116, 117 (fig. 42). In Baca County, Colo., consists almost entirely of light-gray chalky shale; locally contains one or more thin beds of dense chalky limestone and a few thin layers of bentonite. Thickness about 30 feet. Underlies Bridge Creek limestone member; overlies Lincoln limestone member.

Named for exposures along Arkansas River from a short distance west of Hartland, Kearney County, to Kendall, Hamilton County, Kans.

Hartley Augen Gneiss[1]

Precambrian: Northern Maryland and southeastern Pennsylvania.

Original reference: E. B. Knopf and A. I. Jonas, 1923, Am. Jour. Sci., 5th ser., v. 5, p. 43, 44.

Ernst Cloos, 1937, Maryland Geol. Survey [Rept.], v. 13, pt. 1, p. 80. Underlies and does not transgress Setters formation.

Named from outcrops at Hartley Mill on Long Green Creek, eastern Baltimore County, Md.

Hartley Shale and Sandstone (in Chinle Formation)

Upper Triassic: Southwestern Utah.

P. D. Proctor, 1953, Utah Geol. and Mineralog. Survey Bull. 44, p. 19, pl. 2. Predominantly deep red shales and lesser fine-grained sandstone beds mainly only a few inches in thickness. Towards top of section, small slumped areas in the red shales are indicative of salt which has been dissolved away. Minor gypsum also occurs in section. Thickness 280 feet. Prominent cliff-forming bed of arkosic sandstone at top of Hartley beds is 5–15 feet thick and weathers light brown to white. Underlies Fire Clay Hill bentonitic shale (new); overlies Shinarump formation.

Named from exposures measured northwest of Leeds Cemetery, Silver Reef (Harrisburg) Mining District, Washington County.

Hartline Chert

Upper Mississippian: Southern Illinois.

J. M. Weller, 1944, Illinois Geol. Survey Bull. 68, p. 99. Incidental mention.

J. M. Weller *in* J. M. Weller and G. E. Ekblaw, 1940, Illinois Geol. Survey Rept. Inv. 70, p. 7, 19–20. In Dongola quadrangle, consists of about 50 feet of massive gray novaculitic chert in well-defined beds 1 foot or more thick; chert appears to thin and change in character northwestward. Appears to unconformably overlie Springville shale; relation of Hartline to overlying beds not known because contact was not observed; general succession of strata in outcrops along bluff west of Ullin suggests that Hartline grades upward into cherty Osage limestone.

Well exposed in face of bluff west of Ullin in sec. 21, T. 14 S., R. 1 W., Dongola quadrangle, Union County.

Hartmann Limestone[1]

Hartmann Group

Middle Cambrian: Central northern Utah.

Original reference: James Gilluly, 1932, U.S. Geol. Survey Prof. Paper 173.

J. K. Rigby, 1959, Utah Geol. Soc. Guidebook 14, p. 14 (table 1), 17–21. Rank raised to group. In southern Oquirrh Mountain area, includes Teutonic limestone below, and Herkimer limestone above. Dagmar dolomite, which normally separates the Teutonic and Herkimer, not recognized in area. Constant difference in lithology used as contact. Overlies Ophir group; underlies Bowman limestone.

Named from exposures on western side of Hartmann Gulch (sometimes called Graveyard Gulch), just north of Ophir, Tooele County.

Hartridge Shale (in New River Group)

Hartridge Shale (in Pottsville Group)[1]

Pennsylvanian (Pottsville Series): Northern West Virginia.

Original reference: D. B. Reger, 1918, West Virginia Geol. Survey Rept. Barbour and Upshur Counties, p. 288.

P. H. Price and E. T. Heck, 1939, West Virginia Geol. Survey Greenbrier County, p. 216, 229. Dark to black argillaceous laminated shale containing plant fossils. Thickness as much as 5 feet. Underlies lower Guyandot sandstone; separated from underlying Welch sandstone by Sewell coal and unnamed shale interval. Included in New River group, Pottsville series.

Exposed at Hartridge, Randolph County.

Hart School Bed (in Moran Formation)[1]

Permian: Central northern Texas.

Original reference: F. B. Plummer and R. C. Moore, 1922, Texas Univ. Bull. 2132, p. 179, 180.

Crops out on road at Hart School, sec. 2969, T. E. and L. survey, 6 miles north of Putnam, Callahan County.

Hartselle Sandstone[1]

Upper Mississippian: Northern, central, and eastern Alabama.

Original reference: E. A. Smith, 1894, Alabama Geol. Survey geol. map of Alabama with explanatory chart.

S. W. Welch, 1958, U.S. Geol. Survey Oil and Gas Inv. Chart OC–58. In northwestern Alabama, overlies Green Hill member of Pride Mountain formation (both new); underlies Bangor limestone. Thickness about 140 feet in central Colbert County; thins eastward to 10 feet at Monte Sano, Madison County. Consists chiefly of fine-grained sandstone; a few beds of siltstone and shale present at most localities; asphaltic at many places. Contains marine fossils and plant fossils.

Named for exposures at Hartselle, Morgan County.

Hartshorne Sandstone[1] (in Krebs Group)

Pennsylvanian (Des Moines Series): Eastern Oklahoma and western Arkansas.

Original reference: J. A. Taff, 1899, U.S. Geol. Survey 19th Ann. Rept., pt. 3, p. 436.

M. C. Oakes and M. M. Knechtel, 1948, Oklahoma Geol. Survey Bull. 67, p. 21–26. Described in Haskell County where it is 100 to 200 feet thick, overlies Atoka formation and underlies McAlester formation. Two coal beds, Upper and Lower Hartshorne coals, associated with the sandstone. Common usage has placed upper boundary of formation at top of first sandstone below Upper Hartshorne coal. Hitherto unrecognized coalescence of the two coals, in northwestern Le Flore and Haskell Counties, requires redefinition of upper boundary of the Hartshorne; proposed here to include both coals in Hartshorne sandstone. Underlies McAlester formation; overlies Atoka formation.

M. C. Oakes, 1953, Am. Assoc. Petroleum Geologists Bull., v. 37, no. 6, p. 1523, 1524. Basal formation in Krebs group (new).

E. W. Reed, S. L. Schoff, and C. C. Branson, 1955, Oklahoma Geol. Survey Bull. 72, p. 63–65. Described in Ottawa County. Proposed that name Hartshorne be that of the formation which embraces rocks from top of Atoka to top of Upper Hartshorne coal. At type locality, formation consists of Upper Hartshorne coal, "Hartshorne sandstone", Lower Hartshorne coal and underclay, and shale tongues locally developed between those members. Specific sandstone bed called Hartshorne is given its older but seldom used name, Tobusky sandstone (Chance, 1890). In Ottawa County, formation consists of rocks from top of Mississippian to top of Riverton coal, or where coal is absent, to base of Warner sandstone member of McAlester formation.

J. A. Reinemund and Walter Danilchik, 1957, U.S. Geol. Survey Oil and Gas Inv. Map OM–192. Described and mapped in Waldron quadrangle, Arkansas. As much as 270 feet thick. Consists dominantly of sandstone in lenticular beds that collectively form first continuous sandstone unit below Lower Hartshorne coal bed. Stratigraphic equivalence of Hartshorne in Waldron quadrangle with Hartshorne in Fort Smith district and western Oklahoma is in doubt. It is possible that the true Hartshorne is absent in Waldron quadrangle and that unit herein called Hartshorne is facies of sandstone elsewhere identified as upper part of Atoka. Overlies Atoka formation; underlies McAlester formation.

Named for exposures near Hartshorne, Pittsburg County, Okla.

Hartsville Limestone[1]

Silurian (Niagaran): Southeastern Indiana.

Original reference: J. A. Price, 1900, Indiana Dept. Geol. and Nat. Res. 24th Ann. Rept., p. 84–85.

Charles Schuchert, 1943, Stratigraphy of the eastern and central United States: New York, John Wiley & Sons, Inc., p. 582. Abandoned.

Named for Hartsville, Bartholomew County.

Hartville Formation[1]

Mississippian(?), Pennsylvanian, and Permian: Southwestern Wyoming.

Original reference: W. S. T. Smith and N. H. Darton, 1903, U.S. Geol. Survey Geol. Atlas, Folio 91.

G. E. Condra, E. C. Reed, and O. J. Scherer, 1940, Nebraska Geol. Survey Bull. 13, p. 2–5. Condra and Reed (1935, Nebraska Geol. Survey Paper No. 9) subdivided the Hartville into six divisions (I–VI, descending). These divisions are herein named: Fairbank formation (VI), Reclamation group (V), Roundtop group (IV), Hayden group (III), Meek group and Wendover group (II), Broom Creek group and Cassa group (I). Nomenclature problems of Hartville uplift discussed. Term Minnelusa has priority over Hartville.

R. L. Bates, 1955, Am. Assoc. Petroleum Geologists Bull., v. 39, no. 10, p. 1986–1990. Smith (1903) applied name Hartville to rocks between Guernsey limestone below and Opeche shale above. Hartville as used in this report is restricted to exclude unit named Fairbank formation by Condra, Reed, and Scherer (1940). Thickness 1,123 feet in Sand Canyon, Platte County, Wyo. Early Permian (Wolfcamp), Pennsylvanian, and possibly Late Mississippian.

First described and mapped in area around Hartville.

Hartwell Sandstone[1]

Mississippian: Southern West Virginia.

Original reference: R. V. Hennen and R. M. Gawthrop, 1915, West Virginia Geol. Survey Rept. Wyoming and McDowell Counties, p. 244.

Exposed at Hartwell, McDowell County, and quarried one-half mile southeast of Hartwell.

Hartwell Sandstone[1]

Pennsylvanian: Western Arkansas.

Original reference: A. Winslow, 1896, New York Acad. Sci. Trans., v. 15, p. 51.

Derivation of name not known, but probably named for town of Hartwell, Madison County.

Hartwick dolomite[1]

Silurian (Niagaran): Central eastern Iowa.

Original reference: C. R. Keyes, 1912, Iowa Acad. Sci. Proc., v. 19, p. 149, 150.

Named for Hartwick, Poweshiek County.

Harvard Conglomerate Lentil (of Worcester Formation)[1]

Carboniferous: Eastern Massachusetts.

Original reference: W. O. Crosby, 1876, Rept. on geologic map of Massachusetts.

W. R. Hansen, 1956, U.S. Geol. Survey Bull. 1038, p. 1, 20–23, pl. 1. Reassigned to redefined Worcester formation. Lies at base of formation; underlies Vaughn Hills member (new). States type locality as designated by Emerson (1917).

Type locality: Pin Hill in town of Harvard, Worcester County.

†Harvard Granite[1]

Late Carboniferous: Massachusetts.

Original reference: B. K. Emerson, 1889, Geol. Soc. America Bull., v. 1, p. 560.

Harvest Home shale member[1]

Mississippian: Northwestern Pennsylvania.

Original reference: K. E. Caster, 1934, Bulls. Am. Paleontology, v. 21, no. 71, p. 134, table opposite p. 61.

Well exposed along Rock Creek, Greenwood Township, Crawford County, especially at Peterson's Falls on edge of which is located the Harvest Home Grove.

Harvey Conglomerate Lentil (in Sewell Formation)[1]

Harvey Sandstone (in New River Group)

Pennsylvanian (Pottsville Series): Southern West Virginia.

Original reference: M. R. Campbell, 1902, U.S. Geol. Survey Geol. Atlas, Folio 77.

P. H. Price and E. T. Heck, 1939, West Virginia Geol. Survey Greenbrier County, p. 216, 226. Harvey (conglomerate) sandstone 20 to 60 feet thick; medium to coarse grained grayish white or light brown; lenticular, its interval locally occupied in part or entirely by sandy shale. Underlies Iaeger sandstone; locally apparently coalesces with Guyandot sandstone, cutting out intervening Sandy Huff shale and Castle coal.

Named for exposure at village of Harvey (now Bolt post office) on headwaters of Marsh Fork of Coal River, Raleigh County.

Harveyville Shale Member (of Emporia Limestone)

Harveyville Shale (in Wabaunsee Group)[1]

Pennsylvanian (Virgil Series): Eastern Kansas, southwestern Iowa, southeastern Nebraska, and northern Oklahoma.

Original reference: G. E. Condra, 1935, Nebraska Geol. Survey Paper 8, p. 10.

R. C. Moore and M. R. Mudge, 1956, Am. Assoc. Petroleum Geologists Bull., v. 40, no. 9, p. 2274 (fig. 1), 2276. Rank reduced to member status in Emporia limestone (redefined). Overlies Reading limestone member; underlies Elmont limestone member.

P. B. Greig, 1959, Oklahoma Geol. Survey Bull. 83, p. 57–58. Described in Pawnee County where it is 35 to 53 feet thick. Overlies Reading limestone member; underlies Elmont limestone member. Extends southward across Pawnee County into Payne County; southern extent not known.

H. G. Hershey and others, 1960, Iowa Highway Research Board Bull. 15, p. 13, fig. 5. Geographically extended into southwestern Iowa where it is classified as formation in Wabaunsee group. Where exposed in Fremont County consists of gray shale in lower part, limy nodules near center, and brown shale in upper part. Thickness 3 feet. Underlies Elmont limestone; overlies Reading limestone.

Type locality: Near Harveyville, southeastern Wabaunsee County, Kans.; well exposed in sec. 25, T. 15 S., R. 13 E.

Hasenclever Sandstone Member (of Frankfort Formation)

Upper Ordovician (Cincinnatian): Central New York.

Marshall Kay, 1953, New York State Mus. Bull. 347, p. 64, 66. Name proposed for middle member of formation. Composed of finely cross-laminated buff-weathering thin-bedded fine sandstones and interbedded greenish shales. Shale occurring in beds a few inches to 1 foot or more thick normally comprises one-third to one-half of unit's total thickness of 40 feet. Sandstones similar to those in overlying Moyer member (new). Overlies Harter shale member (new) with sharply defined contact.

Typically exposed south of Harter Hill, located near east-central border of Utica quadrangle. Also occurs on Hasenclever Hill about 2 miles southwest of Harter Hill.

Haskell Limestone Member (of Stranger Formation)[1]

Haskell Limestone Member (of Cass Formation)

Pennsylvanian (Virgil Series): Eastern Kansas, northwestern Missouri, and southeastern Nebraska.

Original reference: R. C. Moore, 1931, Kansas Geol. Soc. 5th Ann. Field Conf. Guidebook, correlation chart.

R. C. Moore, 1949, Kansas Geol. Survey Bull. 83, p. 130 (fig. 24), 135. In Kansas, commonly 2 to 4 feet thick. Underlies Robbins shale member; overlies Vinland shale member.

F. C. Greene and W. V. Searight, 1949, Missouri Geol. Survey and Water Resources Rept. Inv. 11, p. vii (fig. 3), 16, 17. In Missouri, overlies Vinland shale member and underlies Lawrence formation.

G. E. Condra, 1949, Nebraska Geol. Survey Bull. 16, p. 29. In Nebraska, uppermost member of Cass formation. Overlies Little Pawnee shale member (new); underlies Robbins shale. Thickness 12 to 15 feet.

Type locality: On 15th St., NE¼ sec. 5, T. 13 S., R. 20 E., at eastern edge of Lawrence, Douglas County, Kans. Named from Haskell Institute.

Haskew Gypsum Member (of Blaine Formation)[1]

Permian (Leonard Series): Northwestern Oklahoma and southern Kansas.

Original reference: N. Evans, 1931, Am. Assoc. Petroleum Geologists Bull., v. 15, no. 4, p. 402–432.

G. H. Norton, 1939, Am. Assoc. Petroleum Geologists Bull., v. 23, no. 12, p. 1798. Geographically extended into southern Kansas where it is about 1 foot thick and is exposed about 5 feet above Shimer gypsum member, red shales separating the beds.

A. J. Myers, 1959, Oklahoma Geol. Survey Bull. 80, p. 31–33. Uppermost member of Blaine. In Harper County, consists of 4 feet of gypsum underlain by 4 feet of brownish-red shale. Overlies Shimer member.

Named for exposures near old store known as Haskew Store, NE cor. sec. 2, T. 25 N., R. 19 W., Woodward County, Okla.

Hasmark Formation[1] or Dolomite

Upper Cambrian: Western Montana.

Original reference: F. C. Calkins and W. H. Emmons, 1913, U.S. Geol. Survey Prof. Paper 78.

Christina Lochman and Donald Duncan, 1944, Geol. Soc. America Spec. Paper 54, p. 13–14. Upper Cambrian section at Philipsburg correlated with section at Mount Helena and name Hasmark extended into area. Thickness about 500 feet. Underlies unit correlated with Red Lion formation.

W. T. Holser, 1950, Geol. Soc. America Bull., v. 61, no. 10, p. 1058 (table 1), 1061. Hasmark dolomite, in Philipsburg region, consists of limestone, light blue-gray to white weathering buff to white, aphanitic to fine-grained, massive; dolomitic. Average thickness about 900 feet, but thinning to 350 feet near intrusives. Overlies Silver Hill formation; underlies Red Lion formation.

L. L. Sloss and C. A. Moritz, 1951, Am. Assoc. Petroleum Geologists Bull., v. 35, no. 10, p. 2140 (fig. 5), 2144–2145. Formation described in extreme southwestern Montana. Name has priority over term Maurice which is considered equivalent. Unit is as much as 242 feet thick. Underlies Red Lion formation and is transitional into underlying Park shale.

Named for abandoned settlement southeast of Philipsburg, Granite County.

Hastings Creek Formation[1] or Limestone

Lower Ordovician: Northwestern Vermont, and southeastern Quebec, Canada.

Original reference: H. W. McGerrigle, [1931], Vermont State Geologist 17th Rept., p. 182, 184, 185.

J. A. Dresser and T. C. Denis, 1944, Quebec Dept. Mines Geol. Rept. 20, v. 2, p. 396, 398–399. Overlies Morgan Corner[s] dolomite; underlies Naylor Ledge limestone. Thickness 315 feet. Phillipsburg series. Beekmantown.

Exposed from northern part of St. Albans quadrangle, Vermont, across the international border for about 20 miles into Quebec.

†Hatbox Tongue (of Chandler Formation)

Lower Cretaceous: Northern Alaska.

George Gryc, W. W. Patton, Jr., and T. G. Payne, 1951, Washington Acad. Sci. Jour., v. 41, no. 5, p. 164, figs. 2, 3. Lower part of nonmarine Chandler formation (new) and lies between marine Tuktu and Topagoruk members (new) of Umiat formation (new). Approximately 3,000 feet thick at type locality and wedges out northward.

R. L. Detterman *in* George Gryc and others, 1956, Am. Assoc. Petroleum Geologists Bull., v. 40, no. 2, p. 237, fig. 4. Renamed the Killik tongue (new), and type locality changed because sequence is better exposed along Killik River than at Hatbox Mesa.

Type locality: Hatbox Mesa in Chandler River drainage, in northern Foothills section of Arctic Foothills province.

Hatch Shale Member (of West Falls Formation)

Hatch Formation (in Naples Group)

Hatch Shale[1]

Upper Devonian: Western and west-central New York.

Original reference: J. M. Clarke and D. D. Luther, 1903, New York State Mus. Bull. 69, p. 1005, map.

J. F. Pepper, Wallace de Witt, Jr., and G. W. Colton, 1956, U.S. Geol. Survey Oil and Gas Inv. Map OC–55. Luther (1903) applied name Hatch flags and shales to sequence of rocks below his Grimes sandstone and above his Rhinestreet shale. The sequence of rocks is here designated Hatch shale member of West Falls formation (new). Composed of medium-dark-gray and dark-gray silty shale containing many layers of even-bedded to crossbedded siltstones, ranging from laminae to beds 1½ feet thick, and some layers of black shale. Muddy limestone concretions and calcareous siltstone concretions present, mainly in lower part of member. Thickness about 160 feet at Calabogue Gulf; 342 feet in Conklin Gully on Hatch Hill; 370 feet in Big Gully; 400 feet in Urbana Glen. Underlies Grimes siltstone member; where Grimes is absent, Hatch cannot be distinguished from Gardeau shale member; overlies Rhinestreet shale member.

Wallace de Witt, Jr., and G. W. Colton, 1959, Am. Assoc. Petroleum Geologists Bull., v. 43, no. 12, p. 2826. Hatch shale member can be traced from type exposures near Naples at south end of Canandaigua Lake eastward to vicinity of Van Etten, south of Cayuga Lake. Hatch constitutes much of lower part of Cayuta shale member of Chemung formation (Williams, 1906) in area around Van Etten.

R. G. Sutton, 1960, New York State Mus. Bull. 380, p. 11, 19–20. Uppermost formation in Naples group. Overlies Rhinestreet black shale; underlies Grimes sandstone.

Named for Hatch Hill, at Naples, Ontario County.

Hatchetigbee Formation (in Wilcox Group)[1]

Eocene, lower: Southern Alabama and eastern Mississippi.

Original reference: E. A. Smith and L. C. Johnson, 1887, U.S. Geol. Survey Bull. 43, p. 39–43.

M. V. Foster, 1940, Mississippi Geol. Survey Bull. 41, p. 14, 61–66. Lowe (1933, Mississippi Geol. Survey Bull. 25) described unconformity between lignitic sands and clay-shales of typical Hatchetigbee and thick red sand which immediately underlies the claystone in Mississippi and limited formation to that section lying between basal Claiborne sands and the Bashi. It is in latter sense that term has since been used in Mississippi. In Lauderdale County, composed of lignitic sands, sandy silts, and silty or sandy clays interbedded one with the other. Commonly, basal part of formation is more sandy than upper part. In some areas, separable into two members: an upper composed of clay-shale, including one well-developed lignite bed 1 to 2½ feet thick, and a lower member composed of relatively fine- or medium-grained sand locally grading down into coarse grit-bearing sand. Thickness 75 to 150 feet. Overlies Bashi formation; underlies Meridian formation.

F. S. MacNeil, 1944, Southeastern Geol. Soc. [Guidebook] 2d Field Trip, p. 27–28. Proposed that Hatchetigbee be expanded to include Bashi marl at base.

F. S. MacNeil, 1946, U.S. Geol. Survey Strategic Minerals Inv. Prelim. Rept. 3–195, p. 21–22. Uppermost formation of Wilcox group in Alabama. At type locality is a fossiliferous exposure at crest of Hatchetigbee anticline, downdip from main outcrop. Unfossiliferous along main outcrop above Bashi marl member (restricted to exclude sands, shales, and lignites included in Tuscahoma sand). Thickness about 150 feet in western Alabama; thins to east to less than 15 feet at Chattahoochee River. Overlies Tuscahoma sand.

R. J. Hughes, Jr., 1958, Mississippi Geol. Survey Bull. 84, p. 178–188, pls. 1, 5. Described in Kemper County, where it consists of fine-grained gray and olive sands and brown or chocolate-colored carbonaceous clays more or less interbedded and containing lignite seams. Bashi marl member is primarily a glauconitic sand containing fossil prints. Thickness about 100 feet. Overlies Tuscahoma sand. Wilcox group. Historical summary of usage of name.

P. E. LaMoreaux and L. D. Toulmin, 1959, Alabama Geol. Survey County Rept. 4, p. 19–22, 141–145, pls. Described in Wilcox County, Ala., where it is about 250 feet thick. Includes Bashi marl member at base. Overlies Tuscahoma sand; underlies Tallahatta formation.

Named for exposures at Hatchetigbee Bluff, on Tombigbee River, in sec. 16, T. 18 N., R. 1 W., Washington County, Ala.

Hatchet Mountain Formation

Eocene, upper: Southwestern Washington.

M. H. Pease, Jr., and Linn Hoover, 1957, U.S. Geol. Survey Oil and Gas Inv. Map OM–188. Named on correlation chart. Overlies Cowlitz formation; underlies Toutle formation (new). Name credited to A. E. Roberts (in press).

A. E. Roberts, 1958, U.S. Geol. Survey Bull. 1062, p. 12 (chart), 19–24, pl. 1. Consists of lava flows, flow breccias, pyroclastic rocks, and tuffaceous sedimentary rocks. Thickness more than 2,750 feet. Overlies Cowlitz formation; unconformably underlies Toutle formation.

Typically exposed in vicinity of Hatchet Mountain in secs. 30 and 31, T. 11 N., R. 2 E., and secs. 25 and 26, T. 11 N., R. 1 E., Toledo-Castle Rock district. Exposed along both flanks of Napavine syncline.

Hatch Hill Formation

Upper Cambrian: Eastern New York.

George Theokritoff, 1959, New England Intercollegiate Geol. Conf. Guidebook 51st Ann. Mtg., p. 53, 55. Applied to unit consisting of sooty-black pyritic rusty-weathering shales interbedded with rotten-weathering bluish dolomitic sandstones. Locally crossbedded and characteristically traversed by numerous quartz veins. Overlies West Castleton formation; underlies Lower Ordovician Poultney formation. Contains graptolite fauna considered to be Upper Cambrian.

Type locality: Western flank of Hatch Hill in Thorn Hill quadrangle, Washington County.

Hat Creek Basalt

Recent: Northern California.

C. A. Anderson, 1940, Am. Jour. Sci., v. 238, no. 7, p. 477–492. Name applied to basalt erupted along a line of north-south fissures north of Lassen Peak.

Occurs in Hat Creek valley about 10 miles north-northeast of Lassen Peak.

Hat Creek Beds[1]

Oligocene, middle: Wyoming.

Original reference: H. F. Osborn, 1918, Am. Mus. Nat. History Mem., new ser., v. 2, pt. 1, p. 11.

Hathaway Formation

Middle Ordovician: Northwestern Vermont.

David Hawley, 1957, Geol. Soc. America Bull., v. 68, no. 1, p. 58, 68–77. Includes argillite and bedded radiolarian cherts, commonly intensely deformed, with included small fragments to large blocks of quartz sandstone, coarse graywacke, dolomite, limestone, and chert. Considered a submarine slide breccia. Thickness more than 100 feet. Overlies Iberville formation.

Named for Hathaway Point on southeastern St. Albans Point, St. Albans quadrangle. Also exposed on several nearby islands in Lake Champlain.

Hathaway Formation[1]

Pliocene, lower(?): Southern California.

Original reference: F. E. Vaughan, 1922, California Univ. Pubs., Dept. Geol. Sci., v. 13, no. 9, p. 344, 375, 376–378, 384, map.

C. R. Allen, 1957, Geol. Soc. America Bull., v. 68, no. 3, p. 324 (fig. 2), 325 (table 1), 326–327, pls. 2, 3. Redefined and restricted to exclude sedimentary rocks north of Banning (included by Vaughan in original description). Paleontological evidence shows these rocks to be much younger than type Hathaway in Lion Canyon, and they are assigned tentatively to San Timoteo formation. As redefined, consists of two unnamed members: a lower, 1,100 feet thick, consisting of tan to light-gray arkosic sandstone with subordinate siltstone and lenticular beds of conglomerate; and an upper, 650 feet thick, consisting of massive conglomerate and breccia. Conformably underlies Imperial formation; map shows Hathaway in fault contact with San Gorgonio igneous-metamorphic complex. Type section designated.

Type section: In main branch of Lion Canyon, north of Cabazon, Riverside County. Named for Hathaway Creek, on and near which it is exposed.

Hato Puerco Tuff[1]

Upper Cretaceous(?): Puerto Rico.

Original reference: H. A. Meyerhoff and I. F. Smith, 1931, New York Acad. Sci. Scientific survey of Porto Rico and Virgin Islands, v. 2, pt. 3, p. 272.

R. C. Mitchell, 1954, Puerto Rico Univ. Agr. Expt. Sta. Tech. Paper 13, p. 36 (table 2), 40, 60 (table 7). Thickness 4,000 feet. Underlies Guaynabo formation; overlies Guzman formation. In some areas, the tuffs are in juxtaposition with Lower Cretaceous Río de la Plata series.

C. A. Kaye, 1959, U.S. Geol. Survey Prof. Paper 317–A, p. 7 (table), 9 (fig. 3), 10 (fig. 4), 11–12, pl. 2. Recognized in San Juan area, although Guzman formation does not outcrop, and Guaynabo is herein redefined. Consists characteristically of massive pyroclastic rocks with thick sections of flow rocks; some well-bedded to obscurely bedded tuffs, prevailingly green to dark blue. Shows somewhat higher degree of regional metamorphism than later rocks. No estimate of thickness made owing to massiveness of formation. Unit probably formed main mass of volcanic cone or complex. No fossils found. Meyerhoff and Smith thought entire older complex of Puerto Rico to be within Upper Cretaceous. Recent work has revealed that Paleocene or early Eocene faunas, as well as Late Cretaceous faunas occur in older complex (Kay, 1956, Am. Assoc. Petroleum Geologists Bull., v. 40, no. 1). At present time, age of Hato Puerco is designated Late Cretaceous(?).

Named for Barrio Hato Puerco situated on Río Canovanillas midway between Barrio Guzman Abajo and Trujillo Bajo, Fajardo district.

Hatter Limestone, Formation, Group

Middle Ordovician: Central Pennsylvania.

L. C. Craig, 1941, (abs.) Geol. Soc. America Bull., v. 52, no. 12, pt. 2, p. 1964. In Cumberland Valley, Mercersburg limestone (new) is separated from Shippensburg limestone (new) by Hatter limestone and Snyder member of Benner limestone.

G. M. Kay, 1941, (abs.) Geol. Soc. America Bull., v. 52, no. 12, pt. 2, p. 1969. Dark siliceous limestone, 96 feet at type section. Underlies Loysburg formation. "Carlim group", Chazyan(?) series.

G. M. Kay, 1943, Econ. Geology, v. 38, no. 3, p. 191 (fig. 2), 193; 1944; Jour. Geology, v. 52, no. 1, p. 3 (fig. 2), 6–14. Subdivided into (ascending) Eyer, Grazier, and Hostler members (all new). Thickness 102 feet at Union Furnace. Overlies Clover member of Loysburg formation; underlies Snyder member of Benner limestone. Chazyan.

Marshall Kay, 1947, (abs.) Geol. Soc. America Bull., v. 58, no. 12, pt. 2, p. 1198–1199. Hatterian, lower part of Bolarian series (new), comprises in Virginia: Ward Cove, Peery, and Benbolt limestones; and in Pennsylvania: Eyer, Grazier, and Hostler limestones. In New York and Ontario, the Pamelia is thought to be facies of the higher Hatterian. Upper Bolarian is Hunterian (new).

Marshall Kay, 1948, Am. Assoc. Petroleum Geologists Bull., v. 32, no. 8, p. 1406–1407. Rocks between Lincolnshire limestone, or in its absence, the Five Oaks or Clover calcilutite and top of Hostler, or correlated Benbolt limestone, form rather constant time-stratigraphic unit that loses older beds northward along east side of Allegheny synclinorium. Name Hatter was applied to rocks in this sequence in Pennsylvania as formational name. Subsequently the Hatter was divided into three members: Eyer, Grazier, and Hostler; these can be classed as formations in a group. About the same time, Ward Cove, Peery, and Benbolt formations were described in Tazewell County, Va., the first two assigned to Cliffield group. Relations of the two sequences were not considered; the three Virginia units were thought to be represented in the Hatter, though the lower incomplete. Proposed that Hatter be considered a group or subseries comprising rocks younger than post-Lincolnshire regional unconformity, and older than top of Hostler and Benbolt formations, though essentially synchronous. The Hatterian forms lower and older part of Bolarian series-epoch. Older than Hunterian group or subseries.

Marshall Kay, 1956, Geol. Soc. America Bull., v. 67, no. 1, p. 82. Name Hatter formation can be applied in Pendleton County, W. Va., to rocks between Lincolnshire and McGlone limestone (new) where it is not possible to recognize Ward Cove, Peery, and Benbolt formations; also referred to Hatterian stage. Bolarian series.

G. A. Cooper, 1956, Smithsonian Misc. Colln., v. 127, pt. 1, p. 7. Name Bolarian includes two divisions—Hatterian and Hunterian. These terms are unsatisfactory to show relationships as understood in this report. Hatter formation, whose time designation is Hatterian, appears to be same as Hunterian if, as shown in this report, the Hatter is equivalent to Ridley formation.

Carlyle Gray and others, 1960, Geologic map of Pennsylvania (1:250,000): Pennsylvania Geol. Survey, 4th ser. Mapped as Hatter formation.

Type section: Hatter Creek, north of Roaring Spring, Blair County, Pa.

Hatterian Subseries or Stage

See Hatter Limestone or Group.

Hattiesburg Clay[1]

Miocene, lower and middle: Coastal Plain of Alabama, Mississippi, Louisiana, and Texas.

Original reference: L. C. Johnson, 1893, Science, v. 21, p. 90–91.

F. S. MacNeil, 1947, U.S. Geol. Survey Oil and Gas Inv. Prelim. Chart 29. Correlation chart of outcropping Tertiary formations of eastern Gulf region shows Hattiesburg clay above Catahoula sandstone and below Pascagoula clay. Exact equivalence of the Pascagoula and Hattiesburg clays with any of named formations of Florida has not been demonstrated.

Named for exposures at Hattiesburg, Forrest County, Miss.

Hatton Tuff Lentil (of Stanley Shale)[1]

Mississippian (Meramec): Southwestern Arkansas and southeastern Oklahoma.

Original reference: H. D. Miser, 1920, Geol. Soc. America Bull., v. 31, p. 125.

W. H. Hass, 1950, Am. Assoc. Petroleum Geologists Bull., v. 34, no. 7, p. 1582. Paleontological evidence suggests that Hatton tuff is Meramec in age.

Well exposed in cut of Kansas City Southern Railway half a mile south of Hatton, Polk County, Ark.

Hauns Bridge Group[1]

Upper Devonian: Central Pennsylvania.

Original reference: I. C. White, 1885, Pennsylvania 2d Geol. Survey Rept. T_3, p. 92.

Named for 1,000-foot exposure at Hauns' Bridge in Juniata Township, Huntingdon County.

Haupu Formation (in Waimea Canyon Volcanic Series)

Haupu Volcanic Series

Pliocene(?): Kauai Island, Hawaii.

H. T. Stearns, 1946, Hawaii Div. Hydrography Bull. 8, p. 85 (table), 87. Composed of an extra-caldera or lower member of thin-bedded primitive-type olivine basalts dipping 8° to 15° away from central vent and an upper member of horizontal massive basalts filling a caldera 1½ miles across. Upper and lower members separated by partly exhumed fault scarp and talus breccia. Series is remains of independent volcano about 2,300 feet high on side of ancient Waimea volcano. Separated from underlying Waimea volcanic series by zone of weathering and from overlying Koloa series by angular erosional unconformity.

G. A. Macdonald, D. A. Davis, and D. C. Cox, 1954. Volcano Letter 526, p. 2; D. A. Davis and G. A. Macdonald in Jacques Avias and others, 1956, Lexique Strat. Internat., v. 6, Océanie, fasc. 2, p. 87. Included in Waimea Canyon series. Caldera member designated Haupu formation; extra-caldera member unnamed. Maximum thickness formation 1,850 feet; base not exposed. Approximately coeval with Olokele formation (new) and later than most of Napali formation (new). Pliocene(?).

G. A. Macdonald, D. A. Davis, and D. C. Cox, 1960, Hawaii Div. Hydrography Bull. 13, p. 40–42, table facing p. 20, pl. 1. Haupu volcanic series (Stearns, 1946) herein restricted to rocks occupying small filled caldera in Haupu Ridge and named Haupu formation of Waimea Canyon volcanic series. Rocks of formation surrounded by lavas of Napali formation, and separated from them by buried caldera walls. Base not exposed; maximum exposed thickness 1,850 feet. Formation and filling of Haupu caldera believed to have taken place contemporaneously with eruption of upper portion of Napali formation, or Olokele formation. Probably Pliocene.

Type locality: Southern side of Haupu Ridge, between Haupu Peak and a point 0.3 mile east of Kamaulele Peak.

Havallah Formation

Pennsylvanian and Permian: North-central Nevada.

S. W. Muller, H. G. Ferguson, and R. J. Roberts, 1951, Geology of the Mount Tobin quadrangle, Nevada: U.S. Geol. Survey Geol. Quad. Map [GQ–7]; 1952, Geology of the Golconda quadrangle, Nevada: U.S. Geol. Survey Geol. Quad. Map [GQ–15]. Intertonguing chert, slate, and quartzite with some limestone lenses and quartzose grit; rare greenstone near base. Quartzite, light-brown, very fine and even-grained; locally crossbedded and conglomeratic near base. Limestone grades into calcareous slate or into coarse sandstone with calcareous matrix. Chert is evenly bedded, mostly light colored. Incomplete section at type locality exceeds 10,000 feet. Underlies Koipato formation with major angular unconformity and overlies Pumpernickel formation (new) with contact gradational. Permian(?) (Wolfcamp and possibly Leonard).

R. J. Roberts and others, 1958, Am. Assoc. Petroleum Geologists Bull., v. 42, no. 12, p. 2824 (fig. 5), 2847–2848. Pennsylvanian and Permian.

Type locality: On ridge south of Hoffman Canyon in Tobin Range, Golconda quadrangle. Named for Havallah Range which is Indian name for Tobin Range (40th Parallel Atlas).

Havasu Member (of Muav Formation)

Lower and (or) Middle Cambrian: Northwestern Arizona.

E. D. McKee, 1945, Carnegie Inst. Washington Pub. 563, p. 14 (fig. 1), 29, 109–110. Variable in lithology, consisting of mottled, aphanitic limestone in places, and mottled, fine-grained dolomite elsewhere. In general, limestone forms lower beds and dolomite forms upper, but relative positions and amount of each type not constant. Much of the dolomite is red or pink, mottled with tan. Upper limit marked by group of thin carbonate beds. At type locality, forms sheer cliff overlying narrow bench marked by flat-pebble conglomerate. Thickness throughout most of Grand Canyon about 100 feet but in extreme western part averages closer to 120 feet. Top member of formation in Grand Canyon area; younger than Gateway Canyon member (new).

Type locality: Near mouth of Havasu Canyon, in Grand Canyon.

Havasupai sandstones (in Aubreyan series)[1]

Carbonic: Northern Arizona.

Original reference: C. [R.] Keyes, 1922, Pan-Am. Geologist, v. 38, p. 251, 336.

Charles Keyes, 1936, Pan-Am. Geologist, v. 66, no. 3, p. 215 (chart), 223. Overlies Huethawali limestone. Carbonic age.

Probably named for Havasupai Point. Best exposed in rim wall near Bass Camp, west of El Tovar, Grand Canyon.

Havensville Shale Member (of Wreford Limestone)[1]

Permian: Eastern Kansas and southeastern Nebraska.

Original reference: G. E. Condra and J. E. Upp, 1931, Nebraska Geol. Survey Bull. 6, 2d ser., p. 32.

D. E. Hattin, 1957, Kansas Geol. Survey Bull. 124, p. 39–43. Middle member of formation; overlies Threemile limestone member; underlies Schroyer limestone member. Condra and Upp (1931) state that thickness of Havensville at type locality is 18 to 19 feet, but 5 feet of shale and limestone at base is not definitely assigned to either the Threemile or the Havensville. These questioned beds are here included in Havensville. Also, at type locality, a limestone bed and overlying shale unit, both included as lower 3 feet of Schroyer limestone by Condra and Upp, are lithologically and paleontologically part of the Havensville. Thus, thickness of Havensville at type locality is 27 feet. Thickness varies from north to south across State; minimum thickness 1½ feet in Chase County.

Type locality: In cuts on Highway 63 about 2 miles south of Havensville, Pottawatomie County, Kans.

Haverhill Granodiorite

Upper Devonian(?): West-central New Hampshire.

J. B. Hadley and others, 1938, Geologic map and structure sections of the New Hampshire portion of the Mount Cube quadrangle (1:62,500): New Hampshire Highway Dept. Described as medium-grained white or gray granodiorite, locally weakly foliated. Included in New Hampshire magma series.

J. B. Hadley, 1942, Geol. Soc. America Bull., v. 53, no. 1, p. 143, 148, pl. 1. Consists of two small stocklike masses of biotite granodiorite in Mount Cube area. Slightly finer grained aplite dikes are associated with northern body. Represents latest intrusions of New Hampshire magma series in this area. Structurally and petrographically similar to larger body south of town of Haverhill in Woodsville quadrangle.

Exposed in western part of Orford Township, Grafton County.

Hawaiiloa Volcanics[1] (in Honolulu Volcanic Series)

Pleistocene, upper: Oahu Island, Hawaii.

Original reference: H. T. Stearns, 1935, Hawaii Div. Hydrography Bull. 1.

G. A. Macdonald and D. A. Davis *in* Jacques Avias and others, 1956, Lexique Strat. Internat., v. 6. Océanie, fasc. 2. p. 87–88. Cinder cone and lava flow of melilite-nepheline basalt; lava appears to be subaerial. Flow more than 100 feet thick; cone 337 feet high above sea level, base not exposed. Unconformably underlies Ulupau tuff. Extent noted.

Named for Puu Hawaiiloa, cinder cone at source of flow. Covers about 0.75 square mile on western part of Mokapu Peninsula, on northeast coast of Oahu about 13 miles northwest of Makapuu Head.

Hawarden shale[1]

Upper Cretaceous: Northwestern Iowa.

Original reference: C. R. Keyes, 1912, Iowa Acad. Sci. Proc., v. 19, p. 148.

Probably named for Hawarden, Sioux County.

Hawi Volcanic Series

Pleistocene: Hawaii Island, Hawaii.

H. T. Stearns and G. A. Macdonald, 1946, Hawaii Div. Hydrography Bull. 9, p. 173 (table), 178–180; D. A. Davis and G. A. Macdonald *in* Jacques Avias and others, 1956, Lexique Strat. Internat., v. 6, Océanie, fasc. 2, p. 88. Lavas chiefly oligoclase andesites with several flows of trachyte and one of andesine andesite. Flows 10 to 150 feet thick and average about 40 feet. Total thickness about 500 feet. Separated from underlying Pololu volcanic series (new) by erosional unconformity. Overlain by Pahala ash and overlapped by lavas of Hamakua volcanic series.

Type locality: Kohala Sugar Co. quarry at 400 feet altitude in Kumakua Gulch, near Hawi, on north slope of Kohala Mountains. Covers summit area and part of slopes of Kohala Mountains. Name derived from Hawi, main town on mountain.

Hawkeye Granite Gneiss

Hawkeye Granite[1]

Precambrian: Northern New York.

Original reference: W. J. Miller, 1919, Jour. Geology, v. 27, p. 29; 1919, Econ. Geology, v. 14, p. 512.

A. W. Postel, 1952, U.S. Geol. Survey Prof. Paper 237, p. 8–10, 37 (table), pl. 1. Termed granite gneiss. Has pronounced phacoidal texture; strongly foliated. Miller described Hawkeye granite as facies of his Lyon Mountain granite, but it is here considered to be an older separate unit. Interpreted as having been intruded into original Grenville series.

A. W. Postel, C. L. Dodson, and L. D. Carswell, 1956, U.S. Geol. Survey Geol. Quad Map GQ–63. Granite gneiss described and mapped in Loon Lake quadrangle. Commonly a dark-greenish coarse well-foliated phacoidal-textured rock composed of quartz and feldspar, with lesser amounts of pyroxene, hornblende, and biotite. In some areas, lacks planar foliation and is rod or pencil gneiss. Locally fresh rock is pink instead of greenish.

Named for exposures just east of Hawkeye post office. Clinton County. Forms major anticlinal bodies in Lyon Mountain quadrangle.

Hawkhill Formation

Eocene, middle: Northern California.

Ralph Stewart, 1949, U.S. Geol. Survey Oil and Gas Inv. Prelim. Chart 34. Consists of four members: lower siltstone 110 feet thick, lower sandstone 160 feet thick, upper siltstone 650 feet thick, and upper concretionary fine sandstone 270 feet thick. Disconformable with underlying Cretaceous strata and with overlying Eocene strata referred to Domengine formation.

Type section: Exposed in roadcuts near Hawkhill in Mount Diablo Park on south side of Mount Diablo.

Hawkins Formation[1]

Pre-Jurassic(?): Central Washington.

Original reference: G. O. Smith, 1903, U.S. Geol. Survey Prof. Paper 19.

C. A. Lamey and P. E. Hotz, 1952, U.S. Geol. Survey Bull. 978–B, p. 30, pl. 9. Dark greenish-gray altered rock resembling greenstone. Pre-Jurassic(?).

R. C. Ellis, 1959, Dissert. Abs., v. 20, no. 3, p. 990. Rocks of Mount Stuart block, Dutch Miller Gap area, are exposed along east margin of map area and consist of Hawkins greenstone, Ingalls peridotite (new), and Mount Stuart granodiorite.

Makes up Hawkins Mountain, Mount Stuart quadrangle.

Hawkins limestone[1]

Cambrian: Southwestern New Mexico.

Original references: C. R. Keyes, 1915, Iowa Acad. Sci. Proc., v. 22, p. 257–259; 1915, Conspectus of geologic formations of New Mexico: Des Moines, Robert Henderson, State Printer, p. 4, 8.

Exposed in Grant County.

Hawkins Limestone Member (of Chimneyhill Limestone)

Lower Silurian: South-central Oklahoma.

R. A. Maxwell, 1936, Northwestern Univ. Summ. of Doctoral Dissert., v. 4, p. 132, 133. Basal member of formation. Thin-bedded brown limestone as much as 9 feet thick. Underlies Keel limestone member (new); unconformably overlies Sylvan shale.

T. W. Amsden, 1957, Oklahoma Geol. Survey Circ. 44, p. 9. Replaced by name Ideal Quarry member; name Hawkins preoccupied. States Maxwell's type locality for Hawkins.

Type locality: NE¼ sec. 8, T. 2 N., R. 6 E., about one-fourth mile southeast of Chimneyhill Creek, Pontotoc County.

Hawkins Creek Member (of Modin Formation)

Upper Triassic: Northern California.

A. F. Sanborn, [1953], Stanford Univ. Abs. Dissert., v. 27, p. 436. Lowest member of formation. Underlies Devils Canyon member (new); overlies Brock shale.

A. F. Sanborn, 1960, California Div. Mines Spec. Rept. 63, p. 6, 9–10, pl. 1. Formal proposal of name. Consists of series of beds of volcanic material in form of conglomerate, agglomerate, volcanic breccia, and tuff. Maximum thickness about 900 feet. Underlies Devils Canyon member: overlies Brock shale.

Type area: Section in Devils Canyon beginning at contact with overlying Devils Canyon member about 1 mile west of confluence of Devils Canyon and Alder Creek, extending west along Devils Canyon to contact with Brock shale, Big Bend quadrangle. Shasta County. Named from exposures near head of Hawkins Creek in vicinity of Little Meadows.

Hawkins Point Clays[1]

Lower Cretaceous: Northeastern Maryland.

Original reference: L. F. Ward, 1895, U.S. Geol. Survey 15th Ann. Rept., p. 334.

Occur at Hawkins Point on lower Patapsco, where they form extensive cliff 40 feet high, with width along shore of nearly one-half mile toward Swan Creek, Anne Arundel County.

Hawley Schist[1]

Ordovician: Northwestern Massachusetts and southeastern Vermont.

Original references: B. K. Emerson, 1898, U.S. Geol. Survey Geol. Atlas, Folio 50; 1898, U.S. Geol. Survey Mon. 29, p. 163–171, pl. 34, map.

Phillip Fowler, 1950, Vermont Geol. Survey Bull. 2, pl. 2. Shown on correlation chart of east Vermont above Savoy formation and below Shaw Mountain formation.

Named for exposures in Hawley Township, Franklin County, Mass.

Hawleyville Granite Gneiss[1]

Precambrian (?): Western Connecticut.

Original reference: W. M. Agar, 1934, Am. Jour. Sci., 5th, v. 27, p. 355.

Northwest of Hawleyville, Fairfield County.

Hawpatch (glacial) Gravel and Sand[1]

Pleistocene: Southeastern Indiana.

Original reference: M. N. Elrod, 1882, Indiana Dept. Geol. and Nat. History 11th Ann. Rept., p. 156–158.

Occurs in Bartholomew County from Flat Rock River on northwest and Haw Creek on southeast, and reaches from White River bottoms to Shelby County.

Hawthorn Formation (in Alum Bluff Group)[1]

Hawthorn facies (of Alum Bluff Stage)

Miocene, lower and middle: Central northern, northern, and southern Florida, southern and southeastern Georgia, and South Carolina.

Original reference: W. H. Dall, 1892, U.S. Geol. Survey Bull. 84, p. 81–82, 107–112, 157, 158, 326.

C. W. Cooke, 1943, U.S. Geol. Survey Bull. 941, p. 89–98, pl. 1. Name Hawthorn here applied to widespread formation, to different part of which Veatch and Stephenson (1911, Georgia Geol. Survey Bull. 26) applied names Alum Bluff formation, Marks Head marl, and Altamaha (Lafayette) formation (part). Thickness about 300 feet; thickest near Florida line, from which it extends northward as thinning sheet. Supposed to lie conformably on Tampa limestone, but overlaps beyond the Tampa on Suwannee limestone, Flint River formation, Cooper marl, and Barnwell formation.

C. W. Cooke, 1945, Florida Geol. Survey Bull. 29, p. 144–161. Formation, in northern Florida, consists chiefly of gray phosphatic sand and lenses of green or gray fuller's earth. Probably lies conformably on Tampa limestone and unconformably on older formations. Merges westward into Chipola formation and probably includes equivalents of Shoal River formation; unconformably underlies Duplin marl.

H. S. Puri, 1953, Florida Geol. Survey Bull. 36, p. 39, 45. Considered lithofacies of Alum Bluff stage.

M. H. Bergendahl, 1956, U.S. Geol. Survey Bull. 1030–B, p. 69–73, pl. 1. Formation, as used in this report [De Soto and Hardee Counties], includes all marine rocks in central and southern peninsular Florida that are younger than Tampa limestone, of early Miocene age, but older than lowermost sediments of late Miocene age. Lower and middle Miocene.

C. W. Hendry, Jr., and J. E. Yon, Jr., 1958, Florida Geol. Survey Rept. Inv. 16, p. 29, 31–32, 34. Hawthorn referred to as a formation and as a facies of Alum Bluff stage. Facies overlies Chattahoochee facies of Tampa stage.

K. B. Ketner and L. J. McGreevy, 1959, U.S. Geol. Survey Bull. 1074–C, p. 65–71. Hawthorn of this report [area between Hernando and Hardee Counties] includes formation as described by Cooke (1945), middle Miocene rocks in hard-rock phosphate belt including those generally assigned to Alachua formation, and middle Miocene rocks in land-pebble phosphate district including noncalcareous rocks which have not always been distinguished from Bone Valley formation. Middle Miocene.

Named for exposures at Hawthorn, Alachua County, Fla.

†Hawthorne Formation[1]

See **Hawthorn Formation,** the approved spelling.

Hawxby Shale Member (of Onaga Shale)

Hawxby Shale[1] (in Admire Group)

Hawxby Shale Member (of Chicago Mound Formation)

Permian: Southeastern Nebraska and northeastern Kansas.

Original reference: R. C. Moore and G. E. Condra, 1932, Kansas Geol. Soc. 6th Ann. Field Conf., classification chart.

G. E. Condra and E. C. Reed, 1943, Nebraska Geol. Survey Bull. 14, p. 37. Member of Chicago Mound formation (new). Underlies Falls City member; overlies Aspinwall member. Thickness 10 to 12 feet.

R. C. Moore and M. R. Mudge, 1956, Am. Assoc. Petroleum Geologists Bull., v. 40, no. 9, p. 2273, 2274 (fig. 1). Reallocated to member status in Onaga shale (new). Overlies Aspinwall limestone member; underlies Falls City limestone.

Type locality: Hawxby Farm, SE¼ sec. 7, T. 4 N., R. 15 E., about 5 miles west of Nemaha, Nemaha County, Nebr.

†Haybro Formation (in Mesaverde Group)[1]

Upper Cretaceous: Northwestern Colorado.

Original reference: M. R. Campbell, 1931, Tentative correlation of named geologic units of Colorado, compiled by M. G. Wilmarth, U.S. Geol. Survey, separate chart.

Campbell report was not published. Name Haybro Formation appeared in bold face in Wilmarth Lexicon on basis of Wilmarth's correlation chart. Cobban and Reeside (1952, Geol. Soc. America Bull., v. 63, no. 10) used name Haybro Formation on Cretaceous correlation chart and cited Wilmarth Lexicon. U.S. Geological Survey has abandoned the name Haybro Formation.

Named for exposures at coal-mining village of Haybro, in Yampa coal field.

Hay Creek Formation[1]

Lower Cretaceous: Western South Dakota and northeastern Wyoming.

Original reference: W. P. Jenney, 1899, U.S. Geol. Survey 19th Ann. Rept., pt. 2, p. 593, fig. 122, map.

Probably named for Hay Creek, Crook County, Wyo., and Butte County, S. Dak.

Hayden Group

Pennsylvanian (Des Moines): Eastern Wyoming and southwestern South Dakota.

G. E. Condra, E. C. Reed, and O. J. Scherer, 1940, Nebraska Geol. Survey Bull. 13, p. 2 (fig. 2), 3, 22, 45, fig. 10. Consists mostly of dark-gray to black sandstones, shales, and dolomites. Some red sandstone. Comprises Division III of Hartville "formation" (Condra and Reed, 1935). Thickness 120 feet. Underlies Meek group (new); overlies Roundtop group (new).

Type locality: Hayden Cliff, sec. 22, T. 27 N., R. 66 W., Platte County, Wyo.

Hayden Branch Formation

Upper Pennsylvanian: Southwestern Indiana and southeastern Illinois.

C. A. Malott *in* K. A. Payne, 1937, Jour. Paleontology, v. 11, no. 4, p. 276, 277, 279. At type locality, includes 6 inches of underclay, 1 inch of coal, 1 inch of very fossiliferous soft gray shale containing ostracodes, and 6 inches of dark fossiliferous limestone with black phosphatic concretions that weather white. Separated from overlying Merom sandstone by an interval of shales and sandstones; separated from underlying Murphys Bluff sandstone (new) by 4 feet of gray shale.

Type locality: In north-central part of sec. 10, T. 8 N., R. 10 W., Turman Township, Sullivan County, Ind. Crops out in bed of Hayden Branch about 100 yards south of section-line road which crosses Hayden Branch about three-fourths mile east of town of Dodds Bridge.

†Hayden Gulch Sandstone Member (of Haybro Formation)[1]

Upper Cretaceous: Northwestern Colorado.

Original reference: M. R. Campbell, 1931, Tentative correlation of named geologic units of Colorado, compiled by M. G. Wilmarth, U.S. Geol. Survey, separate chart.

Campbell report was not published. Name Hayden Gulch Member appeared in bold face in Wilmarth Lexicon on basis of Wilmarth's correlation chart. Cobban and Reeside (1952, Geol. Soc. America Bull., v. 63, no. 10) used name Hayden Gulch on Cretaceous correlation chart, and cited Wilmarth Lexicon. U.S. Geological Survey has abandoned the terms Haybro Formation and Hayden Gulch Sandstone Member.

Named for exposures in Hayden Gulch, Yampa coal field.

Hayden Peak Latite[1]

Tertiary: Southern Colorado.

Original reference: H. B. Patton, 1916, Colorado Geol. Survey Bull. 9, p. 21–63.

J. W. Gabelman, 1953, Econ. Geology, v. 48, no. 3, p. 195, 196. In Greater Bonanza district, the volcanics in order of succession are Rawley andesite, Bonanza latite, Squirrel Gulch latite, Porphyry Peak rhyolite, and Bremer [Brewer] Creek latite. In South Bonanza district, the volcanic sequence is roughly the same except Porphyry Peak rhyolite is missing and Bonanza latite is replaced by Hayden Peak latite.

Occurs on summit of Hayden's Peak and North Hayden's Peak, Saguache County.

Hayes Canyon Member (of Devils Gate Limestone)

Middle and Upper Devonian: Central Nevada.

T. B. Nolan, C. W. Merriam, and J. S. Williams, 1956, U.S. Geol. Survey Prof. Paper 276, p. 49–50, 51, pl. 2. Made up mostly of thick-bedded limestones containing biostromes of corals. Basal bed is dark-gray oolitic argillaceous ostracod bearing limestone that in most places weathers to shades of pink. Upper 150 feet or so consist of limestone beds that average about a foot in thickness, many of which contain stringers or lenses of dark chert. Thickness 780 feet in northern part of Newark Mountain. Contact with underlying Meister member (new) marked by basal oolitic limestone bed. Boundary with overlying Pilot shale is sharp, but no evidence of unconformity at contact.

Well exposed along crest of Newark Mountain and named from Hayes Canyon, which drains west slope of Mountain, vicinity of Eureka, White Pine County.

Hayes River Beds[1]

Tertiary: Southern Alaska.

Original reference: J. E. Spurr, 1900, U.S. Geol. Survey 20th Ann. Rept., pt. 7, p. 172–173, 184.

Named for exposures along Hayes River near junction with Skwenta.

Hayfield Limestone[1]

Devonian or Carboniferous: Northwestern Pennsylvania.

Original reference: G. H. Chadwick, 1925, Geol. Soc. America Bull., v. 36, p. 463, 464.

Type locality: Hayfield Township, Crawford County.

Hayfield monothem[1]

Devonian or Carboniferous: Northwestern Pennsylvania.

Original reference: K. E. Caster, 1934, Bulls. Am. Palentology, v. 21, no. 71, p. 103, 116–119.

Hayfield Shale[1]

Devonian or Carboniferous: Northwestern Pennsylvania.

Original reference: G. H. Chadwick, 1923, Geol. Soc. America Bull., v. 34, p. 69.

Wallace de Witt, Jr., 1946, U.S. Geol. Survey Oil and Gas Inv. Prelim. Chart 21. Name invalid because unit is found to be Bedford shale in present investigation; name Bedford has priority. Validity of included Littles Corners [Littles Corner] limestone as a unit questioned.

Type locality: In Hayfield Township, Crawford County.

Hay Flat Limestone (in Bisbee group)

Cretaceous (Albian): Southeastern Arizona.

A. A. Stoyanow, 1937, (abs.) Geol. Soc. America Proc. 1936, p. 296, 297 (table). Consists of massive limestone. Younger than Mural limestone; older than Molly Gibson formation (new).

Hay Fork Beds[1]

Miocene: Northwestern California.

Original reference: J. S. Diller, 1902, U.S. Geol. Survey Bull. 196, p. 43–44.

Occurs near town of Hay Fork, Trinity County.

Hay Hollow Sandstone Lentil (in Tallant Formation)

Hay Hollow Sandstone Member (of Nelagoney Formation)[1]

Pennsylvanian (Missouri Series): Northeastern Oklahoma.

Original reference: M. I. Goldman and H. M. Robinson, 1920, U.S. Geol. Survey Bull. 686–Y, p. 362–363.

W. F. Tanner, 1956, Oklahoma Geol. Survey Circ. 40, p. 39. Reallocated to Tallant Formation. Described as a lens of little lateral extent near top of formation.

Named for occurrences along upper part of Hay Hollow in secs. 25 and 36, T. 28 N., R. 11 E., Osage County.

Haymaker Beds[1]

Upper Devonian: Western New York.

Original reference: G. H. Chadwick, 1934, Geol. Soc. America, Prel. list of titles and abstracts of papers to be offered at 47th Ann. Meeting, Rochester, N. Y., Dec. 27–29, 1934, p. 12.

G. A. Cooper and others, 1942, Geol. Soc. America Bull., v. 53, no. 12, pt. 1, chart 4. Shown as uppermost unit in Chadakoin formation. Underlies Panama conglomerate; overlies Tanner Hill [Tanners Hill].

Occurs on Genesee-Olean meridian in Genesee River region.

Haymeadow Creek Member (of Trenton Formation)

Middle Ordovician: Northern Michigan.

R. C. Hussey, 1952, Michigan Dept. Conserv. Geol. Survey Div. Pub. 46, Geol. Ser. 39, p. 13, 14. Uppermost member of formation. Overlies Groos Quarry member (new) although actual contact not observed. Underlies Bills Creek beds and formerly considered basal part of them. Consists of shale that differs from typical Bills Creek shale in that it is darker and does not weather with light-gray surface.

Probably named for exposures along Haymeadow Creek, near Rapid River, Delta County.

Haymond Formation[1]

Lower Pennsylvanian: Western Texas.

Original reference: J. A. Udden, C. L. Baker, and E. Böse, 1916, Texas Univ. Bur. Econ. Geology and Tech. Bull. 44, p. 46.

P. B. King, 1937, U.S. Geol. Survey Prof. Paper 187, p. 64–73, pls. 10, 15, 16, 23, 24. Consists mostly of layers of sandstone and carbonaceous shale a fraction of an inch to several inches thick, in regular rhythmic alternation; there are a few thicker sandstone beds at long intervals, and near base some thick bodies of shale. Upper part contains thick layers of massive arkose, and in syncline east of Haymond station are several members of boulder-bearing mudstone as much as 150 feet thick. Thickness locally exceeds 3,000 feet. Overlies Dimple limestone; underlies Gaptank formation. No exposure known where there is complete and uninterrupted sequence from base to top.

R. C. Moore and M. L. Thompson, 1949, Am. Assoc. Petroleum Geologists Bull., v. 33, no. 3, p. 289 (fig. 1). Chart shows Haymond formation in Atokan or Derryan stage.

Named for exposures northwest and southeast of Haymond, Brewster County. Exposed in two synclines; both are broad and open but overturned and faulted on southeast.

Haynesville Formation

Upper Jurassic: Subsurface in Louisiana, Alabama, Arkansas, Mississippi, and Texas.

T. H. Philpott and R. T. Hazzard, 1949, *in* Shreveport Geol. Soc. Guidebook 17th Ann. Field Trip. fig. 5 (correlation chart). Shown on chart with basal Buckner member. Unconformable below Bossier formation; overlies Smackover formation.

L. A. Goebel, 1950, Am. Assoc. Petroleum Geologists Bull., v. 34, no. 10, p. 1978–1979. Name proposed for red sands, shales, and anhydrite formerly included in basal part of Cotton Valley formation but separated from gray sands, silts, and variegated shales in upper part of that formation by major unconformity. Thickness varies from 400 feet in some wells to more than 2,000 feet as in Hunt Oil Co. No. 1, sec. 3, T. 23 N., R. 7 W., Claiborne Parish, La.

Type area; Wells in Haynesville oil field, northern Louisiana.

Haynies Limestone[1] Member (of Deer Creek Limestone)

Pennsylvanian (Virgil Series): Southwestern Iowa and southeastern Nebraska.

Original reference: G. E. Condra, 1927, Nebraska Geol. Survey Bull. 1, 2d ser., p. 40, 43, 49, 50.

G. E. Condra, 1949, Nebraska Geol. Survey Bull. 16, p. 22. Underlies Burroak shale member; overlies Larsh shale member. [Not treated as a subdivision of Deer Creek by Kansas Geological Survey].

F. C. Greene and W. V. Searight, 1949, Missouri Geol. Survey and Water Resources Rept. Inv. 11, p. 18. In Missouri, uppermost limestone of Deer Creek may include Haynies limestone member.

H. G. Hershey and others, 1960, Iowa Highway Research Board Bull. 15, p. 17–18, fig. 5. Well exposed in outcrops and quarries near Pacific Junction, Mills County, where it is a single massive bed, dark-gray, argillaceous, and fossiliferous. Thickness 1 foot or less. Underlies Burroak shale; overlies Larsh shale. Where Haynies is absent Burroak and Larsh shales coalesce and are difficult to differentiate.

Type locality: In Missouri River bluffs southeast of Haynies Station, Mills County, Iowa.

Hay Ranch Formation

Pliocene, middle, to Pleistocene, middle: Northeastern Nevada.

Jerome Regnier, 1960, Geol. Soc. America Bull., v. 71, no. 8, p. 1191, 1199–1203. Consists of lake deposits of clay, vitric tuffs (mostly altered to zeolites), limestone, and tan tuffaceous siltstones and sandstones, which interfinger with conglomerates and fanglomerates. Except for northern part of valley, where it dips about 15° E., formation is essentially undisturbed. Overlain by extensive deeply dissected pediment Structural evidence indicates formation is thick. By correlating outcrops in southern part of area, a 420-foot section was measured. Overlies Carlin formation (new).

Named for Hay Ranch in NW¼ T. 29 N., R. 52 E., vicinity of Carlin. Covers most of floor of Pine Valley.

†Hays Limestone Member (of Niobrara Formation)[1]

Upper Cretaceous: Western Kansas and eastern Colorado.

Original reference: S. W. Williston, 1893, Kansas Acad. Sci. Trans., v. 13, p. 108–109.

Named for old Fort Hays, a well-known landmark in western Kansas.

Haystack Gypsum Member (of Blaine Gypsum)[1]

Permian: Southwestern Oklahoma.

Original reference: C. N. Gould, 1902, Oklahoma Geol. Survey 2d Bien. Rept., p. 42, 55.

G. L. Scott, Jr., and W. E. Ham, 1957, Oklahoma Geol. Survey Circ. 42, p. 17 (fig. 3), 21–22, pls. 1, 2. Described in Carter area where it is the lowermost gypsum member of the Blaine. Separated from overlying Cedartop gypsum member by shale unit; overlies unnamed shale unit at top of Flowerpot shale; this shale unit overlies Kiser gypsum which is here removed from the Blaine and reallocated to Flowerpot shale. Type locality noted.

Type locality: Haystack Butte, in sec. 23, T. 7 N., R. 23 W., about 6 miles west of Moravia, Greer County.

Haystack Rhyolite[1]

Devonian(?): Northeastern Maine.

Original reference: H. E. Gregory, 1900, U.S. Geol. Survey Bull. 165, p. 107–109, 153–156.

Probably named for Haystack Mountain, Aroostook County.

Hayward sandstone member[1]

Permian: Central northern Oklahoma.

Original reference: F. L. Aurin, H. G. Officer, and C. N. Gould, 1926, Am. Assoc. Petroleum Geoligists Bull., v. 10, p. 786–799.

Named for exposures at Hayward, Garfield County.

Hazel Sandstone[1] or Formation

Precambrian: Western Texas.

Original reference: E. T. Dumble, 1902, Texas Acad. Sci. Trans., v. 4, pt. 2, no. 6, p. 1–3.

P. B. King, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 1, p. 144 (fig. 1), 145 (table), 148, 149–150. Restored to formal nomenclature. Millican formation (Richardson, 1914), divided into two formations and term Millican abandoned. Dumble's term Hazel sandstone is applied to upper of the two formations and Allamoore limestone is proposed for lower formation. Consists of conglomerate which passes upward into red sandstone. Thicknesses of conglomerate and sandstone not measured but estimated to be thousands of feet. At many places where conglomerate stands vertically it forms belts of outcrop nearly a mile wide (may be some duplication by folding). North of Hazel mine on Sierra Diablo escarpment exposed thickness of red sandstone is at least 2,000 feet, neither base nor top exposed. Succeeded by Van Horn sandstone.

P. B. King and P. T. Flawn, 1953, Texas Univ. Bur. Econ. Geology Pub. 5301, p. 23, 84–89. As used by Dumble, term Hazel was applied only to red sandstones, but since these are linked with conglomerate of almost equal volume term was extended to include conglomerate also. In this report, unit designated formation.

Named for Hazel mine, Diablo Mountains, El Paso County.

Hazel Slate (in Chilhowee Group)[1]

Precambrian: Western North Carolina and eastern Tennessee.

Original reference: Arthur Keith, 1895, U.S. Geol. Survey Geol. Atlas, Folio 16, p. 3.

P. B. King and others, 1958, Geol. Soc. America Bull., v. 69, no. 8, p. 958. Keith originally placed upper part of sequence here termed Great Smoky group in Hazel slate and Clingman conglomerate; these names now abandoned. Keith (1907, U.S. Geol. Survey Geol. Atlas, Folio 143) connected Hazel outcrops with those of Nantahala slate and assumed they were correlative. As mapped by Keith in northern Great Smoky Mountains, the Hazel corresponds to argillaceous rocks that are now placed in Anakeesta formation (new).

Named for outcrops on Hazel Creek, Swain County, N.C., on southern slope of Great Smoky Mountains.

Hazel Green Member (of Quimbys Mill Formation)

Middle Ordovician: Northern Illinois.

J. S. Templeton and H. B. Willman, 1952, Tri-State Geol. Soc. Guidebook 16th Ann. Field Conf., figs. 3, 9, 15C. Consists of massive whitish-weathering dolomite about 1 to 3 feet thick. Shown on columnar section as basal member of Quimbys Mill formation. Underlies Shullsburg member (new); overlies Everett member (new) of Nachusa formation (new).

Occurs in Dixon-Oregon area.

Hazelhurst [Formation]

Pleistocene: South Carolina and Middle Atlantic Coast.

G. E. Siple, 1957, Carolina Geol. Soc. Guidebook for South Carolina Coastal Plain Field Trip, Nov. 16–17, table 1, following p. 1. Name appears in list of Pleistocene formations. Occurs below Coharie formation.

Hazelton Group[1]

Jurassic(?): Southeastern Alaska, and British Columbia, Canada.

Original reference: W. W. Leach, 1910, Canada Geol. Survey Summ. Rept. 1909, p. 64.

F. M. Byers, Jr., and C. L. Sainsbury, 1956, U.S. Geol. Survey Bull. 1024–F, p. 126, pl. 13. Mapped in part of Hyder district.

Named for town of Hazelton, British Columbia. In Hyder district, Alaska.

Hazelton Bridge Formation

See Hazleton Bridge Formation.

Hazelwood Member (of Mifflin Formation)

Middle Ordovician: Northern Illinois.

J. S. Templeton and H. B. Willman, 1952, Tri-State Geol. Soc. Guidebook 16th Ann. Field Conf., figs. 3, 10, 16. Limestone, thick-bedded; dolomite, pure, nonshaly, medium-bedded. Thickness 5 to 7 feet. Shown on columnar section as underlying Briton member (new) and overlying Establishment member (new).

Occurs in Dixon-Oregon area.

†Hazlet Sands[1]

Upper Cretaceous: New Jersey.

Original reference: W. B. Clark, R. M. Bagg, and G. B. Shattuck, 1897, Geol. Soc. America Bull., v. 8, p. 315, 329.

Named for Hazlet, Monmouth County.

Hazleton Group[1]

Jurassic(?): Southeastern Alaska, and British Columbia, Canada.

See **Hazelton Group,** the correct spelling.

Hazleton Bridge Formation

Upper Pennsylvanian: Southwestern Indiana.

C. A. Malott, 1939, (abs.) Indiana Acad. Sci. Proc., v. 48, p. 114; 1947, v. 57, p. 130, 134, 135, 136 [1948]. Consists of 20 to 25 feet shale, locally containing one or more thin coals, a thin limestone, and black shale; locally fossiliferous. Underlies Dicksburg Hills sandstone (new); overlies Merom or Inglefield sandstone.

Type locality: At road level in White River bluff just south of White River bridge west of Hazleton on U. S. Highway, northern Gibson County.

Head Member (of Day Point Formation)

Middle Ordovician (Chazyan): Northwestern Vermont and northeastern New York.

Philip Oxley and Marshall Kay, 1959, Am. Assoc. Petroleum Geologists Bull., v. 43, no. 4, p. 821, 824 (fig. 3), 825 (fig. 4), 826 (fig. 5), 844–845, geol. sections. Defined as 16 feet of dark-gray, greenish-tinged dense fine calcareous quartz sandstone to siltstone and interbedded silty argillite that disconformably overlies Bridport dolomite south of Scott Point, Isle La Motte; proportion of shaly argillite varies and is locally dominant. Thickness on Valcour Island 15 feet; on South Hero 11 feet. Near Vergennes, brown-weathering dolomite interbeds near base contrast with finer textured Bridport. Along Otter Creek 3 miles west of Ferrisburg, 3 feet of calcareous coarse quartz sandstone lies on an erosion surface on *Isoteloides*-bearing Bridport dolomite. Underlies Scott member (new).

Type locality: The Head, a bluff at south end of Isle La Motte, Vt.

Headquarters Granite[1]

Precambrian: Southwestern Oklahoma.

Original reference: C. H. Taylor, 1915, Oklahoma Geol. Survey Bull. 20.

C. A. Merritt, 1958, Oklahoma Geol. Survey Bull. 76, p. 28–33, pl. 1. Described in Lake Altus area as brownish-red finely crystalline granite containing local porphyritic phases. Geographically restricted to western part of Headquarters Mountain and to small hills north of mountain.

Probably named for occurrences near Headquarters Mountain, near Granite, Greer County.

Headquarters Schist[1] (in Snowy Range Series)

Precambrian: Southeastern Wyoming.

Original reference: E. Blackwelder, 1926, Geol. Soc. America Bull., v. 37, p. 620, 623, 627.

J. J. Runner, 1928, (abs.) Geol. Soc. America Bull., v. 39, no. 1, p. 202. Included in Snowy Range series (new).

R. S. Agatston, 1951, Wyoming Geol. Assoc. Guidebook 6th Ann. Field Conf., p. 130. Precambrian metamorphics consist of Anderson phyllite, Deep Lake metaquartzite, French slate, Heart metagraywacke, Headquarters schist. Nash marble series, Seminoe formation, and Towner greenstone.

Present in Medicine Bow Mountains, Headquarters Park located on outcrop.

Healing Springs Sandstone Member (of New Scotland Limestone)[1]

Healing Springs Sandstone

Lower Devonian: Central western Virginia and West Virginia.

Original reference: F. M. Swartz, 1930, U.S. Geol. Survey Prof. Paper 158–C.

P. H. Price and H. P. Woodward, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 11, p. 1986. South of latitude of Monterey, Va., the cherty New Scotland limestone apparently gives way to calcareous Healing Springs sandstone, which is well developed in Browns Mountain anticlinal area of Greenbrier County.

H. P. Woodward, 1943, West Virginia Geol. Survey [Rept.], v. 15, p. 89, pls. 10, 11. Healing Springs sandstone attains maximum thickness of 33 feet along Knapp Creek near Alvon, Greenbrier County. Because of general stratigraphic location the Healing Springs can be confused with Ridgeley sandstone of later age, or the older Clifton Forge member of the Keysers.

F. G. Lesure, 1957, Virginia Polytech. Inst. Bull., Engineering Expt. Sta. Ser. 118, p. 20 (table 2), 47–48. In Clifton Forge district overlies Coeymans limestone and underlies Licking Creek limestone, geographically extended into area to replace New Scotland and Becraft limestones as used by Butts (1940). Thickness as much as 25 feet.

Named for exposures in gap west of Healing Springs, Bath County, Va.

Healy Glaciation

Pleistocene: Central southern Alaska.

Clyde Wahrhaftig, 1953, *in* T. L. Péwé and others, U.S. Geol. Survey Circ. 289, p. 8, 13 (table 1); 1958, U. S. Geol. Survey Prof. Paper 293–A, p. 17–18, 32–33, pls. 2, 3, 5. Four distinct glacial advances separated by marked ice withdrawals recognized along Nenana River. Healy succeeded Dry Creek glaciation (new); preceded Riley Creek glaciation (new).

End moraine is prominent curved compound till-ridge. Modified lateral moraine ridges and patches of till, preserved on gentle sloping topography, identify position of upper surface of glacier. Outwash terrace about 470 feet above Nenana River near end moraine.

Moraine on terrace about 450 feet above Nenana River, 2 miles northeast of Healy, Nenana River valley area. Ice occupied U-shaped gorge between Healy and McKinley Park Railroad Station.

Heart Metagraywacke[1] (in Snowy Range Series)

Precambrian : Southeastern Wyoming.

Original reference: E. Blackwelder, 1926, Geol. Soc. America Bull., v. 37, p. 620, 623, 631.

J. J. Runner, 1928, (abs.) Geol. Soc. America Bull., v. 39, no. 1, p. 202. Included in Snowy Range series (new).

R. S. Agatston, 1951, Wyoming Geol. Assoc. Guidebook 6th Ann. Field Conf., p. 130. Precambrian metamorphics consist of Anderson phyllite, Deep Lake metaquartzite, French slate, Heart metagraywacke, Headquarters schist, Nash marble series, Seminoe formation, and Towner greenstone.

Present in Medicine Bow Mountains. Heart Lake is located on outcrop.

Heartwellville Schist[1]

Upper Cambrian(?) : Southwestern Vermont.

Original reference: G. D. Hubbard, 1924, Vermont State Geologist 14th Rept., p. 278–283, 291, 293, 315, map.

Named for fact that town of Heartwellville, Bennington quadrangle, lies on large area of the schist.

Heath Formation[1] **or Shale** (in Big Snowy Group)

Upper Mississippian : Central northern Montana.

Original reference : H. W. Scott, 1935, Geol. Soc. America Proc. 1934, p. 367.

E. S. Perry, 1937, Montana Bur. Mines and Geology Mem. 3, p. 16. In type locality, Big Snowy group comprises (ascending) Kibbey, Otter, and Heath formations. Consists of 450 feet of black petroliferous shale with sandstone lenses.

P. A. Mundt, 1956, Billings Geol. Soc. Guidebook 7th Ann. Field Conf., p. 46, 47; 1956, Am. Assoc. Petroleum Geologists Bull., v. 40, no. 8, p. 1918 (fig. 2), 1919–1920, 1923 (fig. 4). Upper limit of Heath formation as defined by Scott is not acceptable. Upper part of Scott's Heath includes prolific oil sands (Tyler sandstone), and unit is separated from lower nonsandy part of Heath by angular unconformity. Thus, Heath formation should be restricted to beds below the unconformity, and beds above, which were formerly included in the Heath, should be designated as separate unit and name Tyler (Freeman, 1922) is herein applied to this formation.

H. D. Hadley and P. J. Lewis, 1956, Billings Geol. Soc. Guidebook 7th Ann. Field Conf., p. 142. Underlies Cameron Creek formation (new).

L. S. Gardner, 1959, Am. Assoc. Petroleum Geologists Bull., v. 43, no. 2, p. 333 (fig. 2), 334 (fig. 3), 335, 340–341, 346–347. In revision of Big Snowy group, Heath formation overlies the Otter and underlies Cameron Creek formation. Thickness, at composite standard section of revised Big

Snowy group, 423 feet. Reasons presented for not using Tyler formation in this classification.

R. P. Willis, 1959, Am. Assoc. Petroleum Geologists Bull., v. 43, no. 8, p. 1942 (fig. 2), 1943–1948. In this report, Heath considered uppermost formation in Big Snowy group. Overlies Otter formation and underlies Tyler formation. Faunal data indicate a late Mississippian (probably Chester) age.

Type section: On north flank of Big Snowy Mountains, in sec. 6, T. 12 N., R. 20 E.

Heber limestone[1]

Carboniferous: Utah.

Original reference: C. R. Keyes, 1924, Pan-Am. Geologist, v. 41, p. 37.

Derivation of name not stated.

Hebron Formation

Hebron Gneiss[1]

Hebron Quartz Schist

Pre-Pennsylvanian: Eastern Connecticut.

Original reference: H. E. Gregory, 1906, Connecticut Geol. Nat. History Survey Bull. 6, p. 115, 121, 122, 140, 142, map.

W. G. Foye, 1949, Connecticut Geol. Nat. History Survey Bull. 74, p. 73–76, pl. 1. Referred to as a quartz schist; discussed under heading of Hebron, or Paxton quartz schist. Was earlier mapped in part as Woodstock quartz schist. Age designated Precambrian or early Paleozoic.

E. N. Cameron and others, 1954, U.S. Geol. Survey Prof. Paper 255, p. 20, 21. Paleozoic(?).

J. W. Aitken, 1955, Connecticut Geol. Nat. History Survey Quad. Rept. 6, p. 9–10, 18–20. Termed a formation. Epidote amphibolite gneiss and skarn occurring along Hebron-Bolton boundary in Rockville quadrangle are here transferred from the Bolton to the Hebron.

John Rodgers and others, 1956, Preliminary geological map of Connecticut (1:253,440): Connecticut Geol. Nat. History Survey. Gneiss redefined to include following geographic phases: Hebron gneiss of original definition, Scotland schist, Woodstock quartz schist, and Pomfret phyllite. Derivation of name given.

Frederick Stugard, Jr., 1958, U.S. Geol. Survey Bull. 1042–Q, p. 619. East of Middle Haddam, has indefinite contact with Monson gneiss.

Named for town of Hebron, Tolland County.

Hecla Sandstone (in Allegheny Fomation)[1]

Pennsylvanian: Southeastern Ohio.

Original reference: E. Orton, 1884, Ohio Geol. Survey, v. 5, p. 96, 124, 128, 1025, 1026.

Probably named for Hecla, Lawrence County.

Hedgehog Trachyte[1]

Devonian(?): Northeastern Maine.

Original reference: H. E. Gregory, 1900, U.S. Geol. Survey Bull. 165, p. 109–110, 161–162.

Forms Hedgehog Mountain, Aroostook County.

Hedges Shale (in Pocono Group)[1]

Lower Mississippian: Northeastern West Virginia and western Maryland.

Original reference: G. W. Stose and C. K. Swartz, 1912, U.S. Geol. Survey Geol. Atlas, Folio 179.

J. M. Weller and others, 1948, Geol. Soc. America Bull., v. 59, no. 2, chart 5 (column 101). Shown on correlation chart as shale in Pocono group. Underlies Myers shale; overlies Purslane sandstone. Kinderhookian series.

C. B. Read, 1955, U.S. Geol. Survey Prof. Paper 263, p. 1. In Meadow Branch syncline, Maryland and West Virginia, the Pocono includes only Rockwell formation, Purslane sandstone, and Hedges shale.

Named for occurrence on Hedges Mountain, Berkeley County, W. Va.

Hedwig Breccia Member (of Esmeralda Formation)[1]

Miocene, upper: Central Nevada.

Original reference: H. G. Ferguson, 1924, U.S. Geol. Survey Bull. 723.

Crops out in vicinity of Hedwig claim, Manhattan district.

Heebner Shale Member (of Oread Limestone)[1]

Pennsylvanian (Virgil Series): Southeastern Nebraska, southwestern Iowa, eastern Kansas, and northwestern Missouri.

Original reference: G. E. Condra, 1927, Nebraska Geol. Survey Bull. 1, 2d ser., p. 32, 33, 37.

R. C. Moore, 1948, Am. Assoc. Petroleum Geologists Bull., v. 32, no. 11, p. 2035 (fig. 5); 1949, Kansas Geol. Survey Bull. 83, p. 126 (fig. 22), 148–149. Heebner shale member of Oread formation; underlies Plattsmouth member; overlies Leavenworth limestone member. This is classification agreed upon by State Geological Surveys of Iowa, Kansas, Missouri, Nebraska, and Oklahoma, May 1947.

T. L. Welp, L. A. Thomas, and H. R. Dixon, 1957, Iowa Acad. Sci. Proc., v. 64, p. 418 (fig. 1), 419. Thickness about 3 feet in section measured near Winterset, Madison County.

H. G. O'Connor, 1960, Kansas Geol. Survey Bull. 148, p. 40–41, pl. 1. Thickness 5 to 8 feet in central and northern Douglas County; 14 to 18 feet in south-central part of county, south of Worden fault.

H. G. Hershey and others, 1960, Iowa Highway Research Board Bull. 15, p. 22, fig. 5. Characteristically olive clay shale split near base by black fissile shale. Thickness 2½ feet in Cass County; 3 feet in Adair County; 5 feet in Montgomery County. Overlies Leavenworth limestone member; underlies Plattsmouth limestone member.

Type locality: Two and one-half miles west and 1½ miles north of Nehawka, Cass County, Nebr. Named for Heebner Farm and Creek.

Hefty Formation[1]

Precambrian: Northwestern Montana, and southern British Columbia, Canada.

Original reference: R. A. Daly, 1912, Canada Geol. Survey, Dept. Mines Mem. 38, map 2.

C. L. Fenton and M. A. Fenton, 1937, Geol. Soc. America Bull., v. 48, no. 12, p. 1881. Correlates with Singleshot member of Appekunny formation.

Mapped just west of Mount Hefty, Mont.

Heglar Canyon Member (of Wells Formation)

Pennsylvanian (Derryan) : Idaho.

H. J. Bissell, 1960. Am. Assoc. Petroleum Geologists Bull., v. 44, no. 8, p. 1427 (chart). Name appears on correlation chart accompanying preliminary statement on eastern Great Basin Permo-Pennsylvanian strata. Underlies Sublett member (new) ; overlies Calder Creek member (new).

Present in Sublett Mountains area.

Hegler Limestone Member (of Bell Canyon Formation)

Upper Permian (Guadalupe Series) : Western Texas and southern New Mexico.

P. B. King *in* A. K. Miller and W. M. Furnish, 1940, Geol. Soc. America Spec. Paper 26, p. 9. Incidental mention.

P. B. King, 1942, Am. Assoc. Petroleum Geologists Bull., v. 26, no. 4, p. 582, 585 (fig. 7), pl. 2. Along foot of reef escarpment is a dark-gray lumpy, slabby limestone about 15 feet thick. In Delaware Mountains, straight-bedded, platy limestones occupy same position. Lies below Pinery limestone member; base of the Hegler marks lower boundary of formation; it is oldest bed to grade northwestward into the Capitan limestone. Overlies Manzanita limestone member of Cherry Canyon formation.

P. B. King, 1948, U.S. Geol. Survey Prof. Paper 215, p. 54–55, pl. 3 [1949]. In southeast part of southern Guadalupe Mountains, consists of 30 to 40 feet of dark-gray fine-grained limestone in beds a few inches thick, interbedded with platy sandstone. Mapped in New Mexico.

Named for Hegler Ranch, 6 miles east-northeast of Guadalupe Peak, near foot of Reef escarpment, Culberson County, Tex.

Heidlersburg Sandstone Member (of Gettysburg Shale)

Heidlersburg Member (of Gettysburg Shale)[1]

Upper Triassic: South-central Pennsylvania.

Original reference: G. W. Stose, 1929, U.S. Geol. Survey Geol. Atlas, Folio 225.

G. W. Stose and A. I. Jonas, 1939, Pennsylvania Geol. Survey, 4th ser., Bull. C–67, p. 115–118. Gettysburg shale, in York County, comprises red shale and sandstone with (1) thick, lenticular zone in which are numerous beds of hard red pebbly arkosic sandstone and conglomerate, called Conewago conglomerate member, near base, (2) a zone in which hard gray and red sandstones and coarse conglomerate predominate, called Heidlersburg member, near middle, and (3) quartzose fanglomerate and limestone conglomerate at top. In type area, Adams County, the Gettysburg is predominantly red shale and sandstone with interbedded hard gray to white sandstones in Heidlersburg member and coarse fanglomerate. called Arendtsville fanglomerate lentil at top. Thickness of Heidlersburg 3,000 to 4,800 feet.

Named for exposures in vicinity of Heidlersburg, Adams County.

Heights Fanglomerate[1]

Quaternary : Southern California.

Original reference: F. E. Vaughan, 1922, Calif. Univ. Pub., Geol. Sci. Bull., v. 13, no. 9, p. 344, 392–393, map.

C. R. Allen, 1957, Geol. Soc. America Bull., v. 68, no. 3, p. 324 (fig. 2), 325 (table 1), 331–332, pl. 1, 2, 3. Described in western San Gorgonio Pass area as tan to dark-brown ill-sorted conglomerate, dominantly dark clasts of gneissic rock. Maximum thickness 500 feet. Unconformably overlies Cabezon fanglomerate.

Best exposures are on west wall of San Gorgonio Canyon. Named for Banning Heights, Riverside County.

Heiskell Shale[1]

Lower Ordovician: Northeastern Tennessee and southwestern Virginia.

Original reference: E. O. Ulrich, 1911, Geol. Soc. America Bull., v. 22, pl. 27.

C. E. Prouty, 1946, Am. Assoc. Petroleum Geologists Bull., v. 30, no. 7, p. 1165. Type "Heiskell" appears to be part Benbolt and part Wardell. Ulrich did not define the Heiskell, and upper and lower limits cannot be definitely drawn. His application of the Heiskell at Speers Ferry, Va., indicates lower limit to be the "Holston" at Speers Ferry and upper limit to be the Bays (Moccasin). Because Bowen formation contains red claystone, like Moccasin claystone, Ulrich's basal Moccasin was most likely drawn below the Bowen which would then make the "Heiskell" equivalent to all the Benbolt, Gratton, and Wardell.

G. A. Cooper, 1956, Smithsonian Misc. Colln., v. 127, pt. 1, p. 66. Abandoned. Ulrich's (1911) reference is apparently only use of name. Shaly beds exposed in center of village of Heiskell contain fossils of the Benbolt formation; beds beneath are limestones and red beds. Thus, only rocks answering lithologically to Heiskell are Benbolt shales [of Middle Ordovician age]. Since name Heiskell was never established by definition or designation of type section, it cannot replace well-established and validly proposed name Benbolt.

Probably named for Heiskell, Knox County, Tenn.

Helderberg Group[1] or Limestone[1]

Lower Devonian: New York, western Maryland, New Jersey, eastern Pennsylvania, Virginia, and northern West Virginia.

Original reference: T. A. Conrad, 1839, New York Geol. Survey, v. 3, p. 62.

F. M. Swartz, 1939, Pennsylvania Geol. Survey, 4th ser., Bull. G–19, p. 29–91. Keyser limestone removed from group and assigned to Silurian. Units included in group: Coeymans limestone, New Scotland limestone, Mandata shale (new), Becraft limestone, and Port Ewen shale.

H. P. Woodward, 1943, West Virginia Geol. Survey, v. 15, p. 32–127. Group comprises (ascending) Keyser limestone, Coeymans limestone, New Scotland limestone, Port Ewen chert and shale, and Port Jervis limestone.

Ernst Cloos, 1951, Maryland Dept. Geology, Mines and Water Resources Washington County [Rept. 14], p. 81–85. In Maryland, Helderberg limestone comprises (ascending) Coeymans, New Scotland, and Becraft members. Overlies Keyser limestone; underlies Oriskany formation. Thickness 290 to 350 feet.

H. H. Arndt and others, 1959, Geol. Soc. America Guidebook Pittsburgh Mtg., p. 4, 13. Helderberg formation comprises (ascending) Mandata shale, New Scotland limestone, and Coeymans limestone members. Member units separable on faunal basis but not defined clearly enough for mapping purposes. Thickness 50 to 180 feet. Overlies Keyser formation; underlies Oriskany formation.

K. F. Bick, 1960, Virginia Div. Mineral Resources Rept. Inv. 1, p. 20–21, pl. 1. In Lexington quadrangle, group conformably overlies Keyser limestone and is conformably overlain by Ridgeley sandstone. Comprises (ascending) Coeymans, New Scotland, and Licking Creek limestones. Thickness 100 to 150 feet. Early Devonian (Ulsterian).

U.S. Geological Survey includes the following units in Helderberg Group: Alsen, Becraft, Coeymans, Kalkberg, Manlius, New Scotland, and Port Ewen.

Named for the fact that deposits form basal part of Helderberg Mountains in Albany County, N.Y.

Helderberg Stage

Lower Devonian: North America.

G. A. Cooper and others, 1942, Geol. Soc. America Bull., v. 53, no. 12, pt. 1, p. 1732–1733, chart 4. Devonian is subdivided into nine stages. Group term Helderberg is elevated to stage rank. Helderberg is lowermost stage and is succeeded by Deerpark stage (new). Ulsterian series.

Helderbergian Series

Helderbergian[1] Period or Group

Lower Devonian: New York and adjacent areas.

[Original reference]: J. M. Clarke and Charles Schuchert, 1899, Science, new ser., v. 10, no. 259, p. 876, 877.

L. V. Rickard, 1955, New York State Geol. Assoc. Guidebook 21st Ann. Mtg., p. 7–8. Helderbergian series consists of nine formations, five of which are in central New York: Cobleskill, Rondout, Manlius, Coeymans, and Kalkberg. New Scotland (restricted), Becraft, Alsen, and Port Ewen not present in central New York.

L. V. Rickard, 1956, Dissert. Abs., v. 16, no. 1, p. 102. Base of Devonian system in New York apparently not at base of Coeymans limestone of eastern New York where it has been placed for many years. Proposed that term Helderberg be elevated to series rank. Revised Helderbergian series would include all Lower Devonian strata from base of Cobleskill to top of Port Ewen.

Helena Dolomite (in Missoula Group)

Helena Limestone[1] (in Piegan Group)

Precambrian (Belt Series): West-central Montana.

Original reference: C. D. Walcott, 1899, Geol. Soc. America Bull., v. 10, p. 199–215.

C. E. Erdmann, 1944, U.S. Geol. Survey Water-Supply Paper 866–B, p. 48. Upper member of Siyeh limestone known as Helena limestone in some localities.

D. A. Andrews, G. S. Lambert, and G. W. Stose, 1944, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 25, sheet 1. Limestone shown on map legend as part of Siyeh group.

C. P. Ross, 1949, (abs.) Washington Acad. Sci. Jour., v. 39, no. 3, p. 112. Where limestone is recognizable, which at present is only in vicinity of Helena, it is regarded as upper formation of Piegan group.

Adolph Knopf, 1950, Am. Mineralogist, v. 35, nos. 9–10, p. 837–838. Marysville stock surrounded by late Precambrian rocks of Belt series (ascending): Empire formation; Helena limestone, here renamed Helena dolomite; Marsh formation; and Greenhorn Mountain quartzite (new). Helena consists largely of buff-weathering aphanitic dolomite. Thickness about 4,000 feet. This buff-weathering feature has been mentioned as being typical of the formation by investigators since Walcott, but no one has mentioned its dolomitic composition. Formation contains subordinate limestone, which weathers gray or "bluish" gray, some siliceous limestone oolite, and beds of edgewise conglomerate up to 2 feet thick. Contains *Collenia* biostromes, up to 10 feet thick, that occur at intervals from top to bottom of formation.

C. P. Ross, D. A. Andrews, and I. J. Witkind, 1955, Geologic map of Montana (1:500,000) : U.S. Geol. Survey. Shown on map legend as limestone at top of Piegan group.

U.S. Geological Survey currently classifies the Helena as a formation in Missoula Group on the basis of a study now in progress.

Exposed in upper part of city of Helena and on hill slopes to the east.

Helenan series[1]

Precambrian: Montana.

Original reference: C. R. Keyes, 1925, Pan-Am. Geologist, v. 44, p. 215, 217.

Helenmode Formation (in Chilhowee Group)

Helenmode Member (of Erwin Formation)

Helenmode Member (of Hesse Sandstone)

Lower Cambrian: Eastern Tennessee and western North Carolina.

P. B. King and others, 1944, Tennessee Div. Geology Bull. 52, p. 31–32, 33, fig. 6, pls. 3, 5, 6. Helenmode member of Erwin formation consists of so-called "transition beds" of earlier reports. They embrace yellow finely laminated clays, which evidently were originally calcareous shale, and soft mealy arkosic sandstones, some stained red and purple with iron, others of a greenish color, due to contained glauconite grains. At top are coarse grits of rounded quartz grains, from which the former calcareous cement has been dissolved leaving a porous layer or loosely coherent mass, in many places stained with manganese oxide or rusty with iron oxide. Thickness about 100 feet near Helenmode mine; elsewhere thinner; 67 feet on U.S. Highway 19E between Valley Forge and Hampton. Overlies unit termed upper quartzite member; underlies Shady dolomite.

S. S. Oriel, 1950, North Carolina Div. Mineral Resources Bull. 60, p. 15–16. Geographically extended into Madison County. N.C., where it is considered member of Erwin formation.

John Rodgers, 1953, Tennessee Div. Geology Bull. 58, pt. 2, p. 35 (table 3). Shown on table as member at top of Hesse sandstone and as member at top of Erwin formation. Cambrian.

P. B. King and others, 1958, Geol. Soc. America Bull., v. 69, no. 8, p. 964. Rank raised to formation at top of Chilhowee group. Cambrian.

P. B. King and H. W. Ferguson, 1960, U.S. Geol. Survey Prof. Paper 311, p. 28 (table), 43–44. In northeasternmost Tennessee, considered uppermost member of Erwin formation. Overlies Hesse quartzite member; underlies Shady dolomite. Unit mapped around whole periphery of Shady Valley and Stony Creek Valley where it has thickness of 100 feet or a little less; 67 feet thick in section on U.S. Highway 19E, south of Valley Forge. Coarse sandstone bed here placed at top of Helenmode has been variously classified; in southwest Virginia, a similar layer has been called initial deposit of Shady dolomite. Lower Cambrian.

R. B. Neuman and R. L. Wilson, 1960, U.S. Geol. Survey Geol. Quad. Map GQ–131. Formation described in Blockhouse quadrangle, Tennessee, where it is 100 feet thick. Overlies Hesse quartzite; underlies Shady dolomite. Most of Chilhowee group is questionably assigned to Early Cambrian because recoverable fossils of Early Cambrian age are confined to Helenmode, youngest formation of group.

Named for Helenmode pyrite mine near Sadie in Stony Creek district, Carter County, Tenn.

Hellam Conglomerate Member (of Chickies Quartzite)[1]

Lower Cambrian: Southeastern Pennsylvania.

Original reference: G. W. Stose and A. I. Jonas, 1922, Washington Acad. Sci. Jour., v. 12, p. 360–362.

B. F. Howell, Henry Roberts, and Bradford Willard, 1950, Geol. Soc. America Bull., v. 61, no. 12, pt. 1, p. 1361. Chickies quartzite is used rather than Hardyston in Buckingham area, Bucks County. In Buckingham Valley, the quartzite carries a basal conglomerate believed to be the Hellam.

Bradford Willard and others, 1959, Pennsylvania Geol. Survey, 4th ser., Bull. C–9, p. 10, 38, 40, pl. 2. There is confusion as to use of Hellam conglomerate as separate unit or member of Chickies quartzite. Latter use is followed in this report [Bucks County] as serving to distinguish Chickies quartzite from Hardyston quartzite. Thickness about 300 feet.

Named for exposures in Hellam Hills, 3 miles west of Chickies Rock, York County.

Hellam Quartzite[1]

Lower Cambrian: Southeastern Pennsylvania.

Original reference: P. Frazer, 1886, Am. Philos. Soc. Proc., v. 23, p. 396, 398–400.

Named for exposures in Hellam Township, York County.

Hell Creek Formation[1]

Hell Creek Member (of Lance Formation)

Upper Cretaceous: Eastern Montana, northwestern North Dakota, northwestern and northern South Dakota, and northeastern Wyoming.

Original reference: B. Brown, 1907, Am. Mus. Nat. History Bull., v. 23, art. 33, p. 829–835.

E. P. Rothrock, 1937, South Dakota Geol. Survey Rept. Inv. 28, p. 7, 10–11. In Harding County, Hell Creek member of Lance formation includes Bull Creek sand (new). Underlies Ludlow member.

G. G. Simpson, 1937, U.S. Natl. Mus. Bull. 169, p. 15 (table), 16–20. For purposes of present report [Fort Union of Crazy Mountain field. Montana], it is assumed that beds up to and including the true dinosaur-bearing Lance and Hell Creek and their equivalents belong to the Cretaceous and that overlying beds without dinosaurs (except by redeposition) and with mammals of Tertiary type (including carnivores, condylarths, and others) from the Puerco and its equivalents upward, are to be placed in the Tertiary. It is also assumed that Paleocene is accepted as separate epoch. Hell Creek formation underlies Bear formation (new).

A. J. Collier and M. M. Knechtel, 1939, U.S. Geol. Survey Bull. 905, p. 10–11, pls. 1, 3. In McCone County, Mont., Hell Creek beds, mapped as member of Lance formation, overlie Colgate sandstone member of Fox Hills formation and underlie Tullock member of Lance. Thickness about 135 feet. Footnote (p. 10) states that since the present report was written, Hell Creek and Tullock members have been raisd to rank of formations in official classification of the U.S. Geological Survey; Hell Creek is assigned to the Cretaceous and the Tullock to Cretaceous or Eocene. Lance of the present report is placed in Eocene(?).

Erling Dorf, 1940, Geol. Soc. America Bull., v. 51, no. 2, p. 213–236. Discussion of relationship between floras of type Lance and Fort Union formations. Lance formation (equivalent to Hell Creek formation) is placed in Upper Cretaceous; Tullock formation (equivalent to Ludlow formation and Cannonball marine member) is placed at base of Paleocene Fort Union group.

W. M. Laird and R. H. Mitchell, 1942, North Dakota Geol. Survey Bull. 14, p. 9–15. Described in Morton County where it is about 250 feet thick in complete exposures. Includes Breien member (new). Overlies Fox Hills formation; underlies Ludlow formation of Fort Union group.

O. A. Seager and others, 1942, Am. Assoc. Petroleum Geologists Bull., v. 26, no. 8, p. 1415, 1418. Youngest Cretaceous formation known in North Dakota. Consists largely of gray bentonitic sands and shales with which are lenticular beds of lavender-brown lignitic shale and rusty-brown to purplish-black ferruginous concretions. Thickness varies from 575 feet near Marmarth to less than 100 feet in Souris River area. Underlies Cannonball member-Ludlow member of Fort Union.

R. W. Brown, 1943, Geol. Soc. America Bull., v. 54, no. 1, p. 81. Laramie formation (redefined) is equivalent to the Lance, and thus becomes equivalent to the Hell Creek.

S. P. Fisher, 1952, North Dakota Geol. Survey Bull. 26, p. 17–20. Described in Emmons County where it is about 270 feet thick. Overlies Fox Hills formation and underlies Cannonball formation.

R. E. Curtiss, 1952, Areal geology of the Isabel quadrangle (1:62,500); 1954, Areal geology of the Firesteel Creek quadrangle (1:62,500): South Dakota Geol. Survey. Overlies Colgate sandstone member of Fox Hills. Thickness about 230 feet. Contains Isabel-Firesteel coal member [facies], 0 to 6 feet thick.

J. D. Love, J. L. Weitz, and R. K. Hose, 1955, Geologic map of Wyoming (1:500,000): U.S. Geol. Survey. Mapped in northeastern Wyoming. Consists of brown and gray sandstone and shale, thin coal, and carbonaceous shale beds.

W. J. McMannis, 1955, Geol. Soc. America Bull., v. 66, no. 11, pl. 7. Plate 7 shows that Livingston formation intertongues with Claggett, Judith River, Bearpaw, Lennep, Hell Creek, Tullock, and Lebo formations.

R. E. Stevenson, 1957, Geology of the McIntosh quadrangle (1:62,500): South Dakota Geol. Survey. Comprises a lower unit about 60 feet thick, at top of which is Isabel-Firesteel facies, and upper unit about 80 feet thick. Interfingers with overlying Ludlow formation; overlies Colgate member of Fox Hills formation.

Typically exposed on Hell Creek, north of Jordan, Garfield County, Mont., and nearby tributaries of Missouri River.

Heller Dacite[1]

Tertiary (may be upper Miocene): Central Nevada.

Original reference: J. E. Spurr, 1905, U.S. Geol. Survey Prof. Paper 42, p. 37.

Composes Heller Butte, near town of Tonopah, Tonopah district.

Hell Gate Dolomite

Early Paleozoic: Southeastern New York.

T. W. Fluhr, 1939, Municipal Engineers Jour., v. 25, p. 24, 25 (map), 29 (geol. profile). Named in list of formations in area of Triborough Bridge project. Occurs between Inwood limestone and Fordham gneiss.

T. W. Fluhr, 1957, Geol. Soc. America Eng. Case Histories No. 1, p. 2. Some workers regard this as one of larger interbedded limestone members in Fordham series, but it is herein interpreted as an infolded and infaulted belt of the Inwood, from which it is lithologically and chemically indistinguishable. Early Paleozoic. Discussion of geology of Queens midtown tunnel.

Derivation of name not given.

Hell Gate Glacial Substage

Pleistocene (Mankato): West-central Colorado.

R. L. Nelson, 1954, Jour. Geology, v. 62, no. 4, p. 333, fig. 2, table 4. Time of Wisconsin glaciation in Frying Pan Valley during which outwash deposits and Hell Gate moraines were deposited. Older than Chapman Gulch glaciation (new); younger than Ivanhoe glacial substage (new).

Type locality for deposits of Hell Gate advance is on Ivanhoe Creek, 1 mile above precipitous Hell Gate gorge. In Frying Pan River drainage just west of Continental Divide in Sawatch Range.

Hell Gate Porphyry[1]

Precambrian: Central Colorado.

Original reference: J. T. Stark and F. F. Barnes, 1932, Am. Jour. Sci., 5th, v. 24, p. 474.

Well exposed at Hell Gate Narrows, 5 miles west of divide on Lake Fork-Ivanhoe section, Lake Fork-Ivanhoe region.

Hellgate Quartzite Member (of Miller Peak Argillite)

Hellgate Formation[1]

Hellgate Quartzite (in Missoula Group)

Precambrian (Belt Series): Central western Montana.

Original reference: C. H. Clapp and C. F. Deiss, 1931, Geol. Soc. America Bull., v. 42, p. 679, figs. 2, 3.

F. S. Honkala, 1958, Soc. Vertebrate Paleontology Guidebook 8th Field Conf., p. 22. Hellgate quartzite is pink, weathers brown, massive. In Missoula group.

W. H. Nelson and J. P. Dobell, 1959, U.S. Geol. Survey Misc. Geol. Inv. Map I–296. Rank reduced to member status in Miller Peak argillite.

Type section: On north side of Mount Sentinel, in south wall of Hellgate Canyon, Missoula-Helena region.

Hell Inlet Glacial Stage

Pleistocene: North-central Colorado.

R. L. Ives, 1942, Geog. Rev., v. 32, no. 3, p. 450 (table 1). Name appears only on table giving late Pleistocene chronology of Monarch Valley. Older than Walden Hollow glacial stage (new).

Monarch Valley, Grand County.

Hell Roaring Formation

Paleocene-Eocene: Southwestern Montana and northwestern Wyoming.

C. W. Brown, 1958, Dissert. Abs., v. 18, no. 1, p. 194. Incidental mention.

In Yellowstone National Park.

Hell Roaring Member (of Altyn Formation)

Precambrian (Belt Series): Southern Alberta, Canada, and northwestern Montana.

C. L. Fenton and M. A. Fenton, 1937, Geol. Soc. America Bull., v. 48, no. 12, p. 1882–1883, fig. 2. Dolomite and dolomitic limestones, variably siliceous; blue gray to greenish gray, weathering to gray, buff, or cream; beds 2 to 24 inches thick. Many beds show laminae of limestone and dolomite and dolomite nodules. Thickness 1,200 to 1,300 feet. Underlies Carthew member (new); overlies Waterton member, contact gradational. This is "lower member" of Willis' Altyn descriptions.

Richard Rezak, 1957, U.S. Geol. Survey Prof. Paper 294–D, p. 137. Discussion of stromatolites of Belt series. Hell Roaring member of Fenton and Fenton is represented by *Collenia frequens* zone of Altyn limestone.

Type locality: Hell Roaring Falls, Waterton Lakes Park, Alberta. Well exposed on eastern slope of Mount Carthew.

Hells Canyon Formation (in Durst Group)

Hells Canyon Member (of Morgan Formation)

Pennsylvanian: Northwestern Colorado and northeastern Utah.

M. L. Thompson, 1945, Kansas Geol. Survey Bull. 60, pt. 2, p. 29, 31–34, geol. sections. Proposed for lithologic and faunal unit above Belden formation and below Youghall formation (new). About 294 feet thick at type locality where it is composed of highly fossiliferous limestones and gray shales, red to purplish shales, gray fissile shales, purplish siltstones, and thin beds of gray to red fine-grained sandstones.

Walter Sadlick, 1957, Intermountain Assoc. Petroleum Geologists Guidebook 8th Ann. Field Conf., p. 70, 71–75. Formation included in Durst group (new).

D. O. Peterson, 1960, Dissert. Abs., v. 20, no. 7, p. 2757. Rank reduced to member status in Morgan formation.

Type locality: In Hells Canyon, west bluff Hells Canyon, sec. 31, T. 6 N., R. 102 W., a tributary canyon of Yampa River in Moffat County, Colo.

Hells Gate Rhyolite

Precambrian: East-central Arizona.

Gordon Gastil, 1958, Geol. Soc. America Bull., v. 69, no. 12, pt. 1, p. 1498 (table 1), 1506. Recrystallized rhyolite tuff. Some of rock is intrusive, as for example south of Tonto Creek it intrudes Houden formation (new) on large scale. But large parts, as northwest of Hell's Gate, display columnar structure, and some specimens display pyroclastic texture. Thickness more than 10,000 feet. No direct evidence for stratigraphic position of columnar rhyolite, but it probably belongs high in stratigraphic column of Precambrian rocks. Name given on table as Hells Gate rhyolite but unit described in text as rhyolite of the Hell's Gate area.

Covers area 25 to 50 miles square between Lost Camp Mountain and granite of the Payson area. Exposed northeast of Hell's Gate, Diamond Butte quadrangle.

Hells Mesa Member (of Datil Formation)

(?)Miocene, upper: Southwestern New Mexico.

W. H. Tonking, 1954, Dissert. Abs., v. 14, no. 2, p. 340. Welded and "semi-welded" rhyolite tuff. Underlies La Jara Peak member (new); overlies Spears member (new).

W. H. Tonking, 1957, New Mexico Bur. Mines Mineral Resources Bull. 41, p. 26, 29–30, fig. 2, 1 [preprint? 1954?]. Color of basal half of section in eastern and northern Bear Mountains ranges from pink below to white or light gray higher in section. Upper half of member is white to light gray, capped by about 25 feet of pink tuff. Thickness about 250 feet in northern Bear Mountains, approximately twice as thick southward along eastern mountain front, and may be more than 2,000 feet in Gallinas Mountains. Source of name given.

D. B. Givens, 1957, New Mexico Bur. Mines Mineral Resources Bull. 58. p. 15–18, pl. 1. Further described from Gallinas Mountains.

Named for conspicuous peak in secs. 17 and 20, T. 1 N., R. 4 W., popularly called Hells Mesa, Puertecito quadrangle, Socorro County.

Hell To Finish Formation

Age unknown: Southwestern New Mexico.

R. A. Zeller, Jr., 1958, Roswell Geol. Soc. Guidebook 11th Field Conf., p. 10 (chart). Name appears on chart only. Consists of red beds, including red shale, siltstone, sandstone, gypsum, and andesite. Thickness between 1,000 and 2,000 feet. Underlies U Bar formation (new) of Lower Cretaceous age and overlies rocks of Permian age—Concha limestone(?) of Naco group.

R. H. Weber and F. E. Kottlowski, 1959, New Mexico Bur. Mines Mineral Resources Bull. 68, p. 13. In Big Hatchet Mountains, several thick beds of gypsum occur in lower part of Lower Cretaceous strata. Gypsum beds are at top of red-bed sequence, Hell To Finish formation, and just below massive- to thin-bedded limestone of U. Bar formation.

In Big Hatchet Peak quadrangle, Hidalgo County.

Helmet Fanglomerate

Miocene, lower(?): Southwestern Arizona.

J. R. Cooper, 1960, U.S. Geol. Survey Bull. 1112–C, p. 77, 89, pl. 1. Deformed postmineralization formation. Predominantly coarse ill-sorted and ill-bedded conglomerate characterized by angular pebbles, cobbles, and boulders in silty matrix. Intercalated are lava flows of porphyritic andesites, thin beds of rhyolitic tuff and tuffaceous sediments, and lentils and tongues of monolithographic breccia. Thickness at least 10,000 feet. Along northwest side, in depositional contact on rhyolitic tuff and probably Cretaceous(?) rocks; to northeast, extends beneath Quaternary alluvium; other boundaries are fault contacts with Precambrian granite, Paleozoic sedimentary rocks, and granodiorite. No fossils; tentative correlations suggest that fanglomerate may be of early Miocene age.

No type section designated. Most continuous exposures are along north-trending line from point three-fourths mile southeast of Helmet Peak to point 1¼ miles north-northwest of Twin Buttes village, Pima mining district, Pima County.

Helmick Formation

Eocene: Northwestern Oregon.

J. A. Cushman, R. E. Stewart, and K. C. Stewart, 1947, Oregon Dept. Geology and Mineral Industries Bull. 36, pt. 5, p. 95–96. Term Helmick formation used in this paper for unit described as Helmick beds by M. J. Mundorff (unpub. thesis). Consists chiefly of micaceous sandstone with some clay shales and an occasional concretionary lens firmly cemented with calcite. Sandstones are typically medium-grained thin-bedded friable bluish-gray rocks which weather buff or brown. Concretions commonly contain organic material. Uppermost part of unit is clay shale of which at least 40 feet or more are exposed along river north of Buena Vista.

Typically exposed in highway roadcut at Helmick Hill and along Willamette River at Buena Vista, Polk County.

Helms Formation[1]

Mississippian: Western Texas and southeastern New Mexico.

Original reference: J. W. Beede, 1921, Texas Univ. Bull. 1852, p. 8, 30, 36.

L. R. Laudon and A. L. Bowsher, 1949, Geol. Soc. America Bull., v. 60 no. 1, p. 8–9, 16–17, 19–20, 23, 32, 35, 39. Beede designated all rocks between Silurian and Pennsylvanian systems in Hueco Mountains as Helms. Name here restricted to upper part of these strata. As thus restricted, consists of green shale, shaly sandstone, and impure limestone beds, containing Chester fossils. In type area, unconformably overlies Rancheria formation (new) and unconformably underlies Pennsylvanian rocks. Thickness 98 feet in Franklin Mountains, N. Mex.

Well exposed about 1 mile south of Helms Peak, Hueco Mountains, Hudspeth County, Tex.

Hely Member (of Grand Detour Formation)

Middle Ordovician: Northern Illinois.

J. S. Templeton and H. B. Willman, 1952, Tri-State Geol. Soc. Guidebook 16th Ann. Field Conf., fig. 3. Shown on columnar section as underlying Victory member (new) and overlying Clement member (new).

Occurs in Dixon-Oregon area.

Hemingford Group

Miocene: Nebraska and Wyoming.

A. L. Lugn, 1938, Am. Jour. Sci., 5th ser., v. 36, no. 213, p. 226, 227; 1939, Geol. Soc. America Bull., v. 50, no. 8, p. 1253–1254. Includes Marsland below and Sheep Creek formations. Thickness 250 to 350 feet. Unconformable above Arikaree group (redefined) and below Ogallala group (redefined). Name suggested by C. B. Schultz.

Town of Hemingford is in Box Butte County, Nebr.

Hemingfordian Age

Miocene: North America.

H. E. Wood 2d and others, 1941, Geol. Soc. America Bull., v. 52, no. 1, p. 12, pl. 1. Provincial time term, based on the Hemingford group, including the Marsland and, especially, the limited or lower Sheep Creek fauna (Cook and Cook, 1933), and not on the formation limits as extended upward (Lugn, 1939). Covers interval between Arikareean and Barstovian ages. Report defines 18 provincial time terms, based on mammal-bearing units, for North American continental Tertiary. [For sequence see under Puercan.]

Hemlock Formation (in Baraga Group)

Hemlock Greenstone[1]

Precambrian (Animikie Series): Northern Michigan.

Original reference: J. M. Clements, 1899, U.S. Geol. Survey 19th Ann. Rept., pt. 3, p. 45–63, pl. 9.

J. E. Gair and K. L. Wier, 1956, U.S. Geol. Survey Bull. 1044, p. 14 (table 2), 41–51, pl. 1. Name Hemlock formation reinstated because term greenstone is too restricted to include all its units. Mainly greenstone; predominantly metabasalt in southwestern part, basic schist in northeastern part, and metarhyolite (including sericite slate) in southeastern part of Kiernan quadrangle. Formation completely surrounds Amasa oval (uplift). Thickness ranges from about 2,300 feet on east side of oval to about 20,000 feet on west side of oval (in region including type locality). Underlies Fence River formation; overlies Goodrich quartzite.

H. L. James, 1958, U.S. Geol. Survey Prof. Paper 314–C, p. 30 (table 1), 36. Includes Mansfield iron-bearing slate member near base and newly defined Bird iron-bearing member about 1,300 feet below top. Assigned to newly defined Baraga group.

Occurs in Crystal Falls district, Iron County. Named for the fact that Hemlock River flows through formation for a number of miles.

Hempfield shale member[1] (of Shenango monothem)

Mississippian: Northwestern Pennsylvania.

Original reference: K. E. Caster, 1934, Bulls. Am. Paleontology, v. 21, no. 71, p. 141.

R. E. Sherrill and L. S. Matteson, 1939, Pennsylvania Geol. Survey Bull. 122, p. 7. In Hillards quadrangle, a shale unit, 75 to 100 feet thick, underlying the Burgoon sandstone is referred to as Hempfield (Shenango) shale member. Occupies stratigraphic position of Shenango shale, renamed Hempfield shale by Caster, of Crawford County.

First described in vicinity of Greenville, Hempfield Township, Mercer County.

Hemphill Beds[1]

Pliocene, lower: Northwestern Texas.

Original reference: L. C. Reed and O. M. Longnecker, Jr., 1932, Texas Univ. Bull. 3231, p. 16–43, 70–83, map.

Hemphill County.

Hemphillian Age

Pliocene: North America.

H. E. Wood 2d and others, 1941, Geol. Soc. America Bull., v. 52, no. 1, p. 12, pl. 1. Provincial time term, based on Hemphill member of Ogallala, which includes both Hemphill local fauna from the Coffee Ranch Quarry and the Higgins local fauna, Hemphill County, Texas. Covers interval between the Oligocene Clarendonian (older) and Blancan ages. Report defines 18 provincial time terms, based on mammal-bearing units, for North American continental Tertiary. [For sequence see under Puercan.]

Hempstead Gravel Member (of Manhasset Formation)[1]

Pleistocene: Southeastern New York and islands of southern New England.

Original reference: M. L. Fuller, 1914, U.S. Geol. Survey Prof. Paper 82.

Lawrence Weiss, 1954, U.S. Geol. Survey Prof. Paper 254–G, p. 146. Top member of Manhasset; overlies Montauk member. Manhasset is considered to be of Wisconsin age.

Named for exposures in upper part of many large gravel pits along west side of Hempstead Harbor, Long Island. Present on Marthas Vineyard, Block Island, No Mans Land, and probably Nantucket Island and Cape Cod.

Henderson Gneiss

Henderson Granite[1] or Granite Gneiss

Ordovician to Devonian: Western North Carolina and northwestern South Carolina.

Original reference: A. Keith, 1905, U.S. Geol. Survey Geol. Atlas, Folio 124, p. 4.

G. W. Crickmay, 1952, Georgia Geol. Survey Bull. 58, p. 26. Intrudes Brevard schist.

J. L. Stuckey and S. G. Conrad, 1958, North Carolina Div. Mineral Resources Bull. 71, p. 16–17; J. L. Stuckey, 1958, Geologic map of North Carolina (1:500,000): North Carolina Div. Mineral Resources. As mapped, Henderson granite gneiss unit is essentially Henderson granite as named and described by Keith (1905) and further described by Keith (1907, U.S. Geol. Survey Geol. Atlas, Folio 143). Recently the Henderson has been mapped to near Linville Falls, McDowell County, where it makes contact with what is considered southern extension of Cranberry granite. Both units are considered to be metasedimentary in origin and stratigraphically equivalent. Henderson composed essentially of rocks with pronounced gneissoid structure. Mapped as Precambrian(?).

H. W. Jaffe and others, 1959, U.S. Geol. Survey Bull. 1097–B, p. 115. Paleozoic on basis of Lead-alpha age determination.

U.S. Geological Survey currently designates the age of the Henderson Gneiss as Ordovician to Devonian on the basis of a study now in progress.

Named for extensive exposures in Henderson County, N.C.

Hendricks Dolomite (in Burnt Bluff Group)

Hendricks Member (of Burnt Bluff Formation)

Hendricks Series[1]

Middle Silurian (Niagaran): Northern Michigan and eastern Wisconsin.

Original reference: R. A. Smith, 1916, Michigan Geol. Survey Pub. 21, p. 155.

C. K. Swartz, 1942, Geol. Soc. America Bull., v. 53, no. 4, chart 3. Burnt Bluff group in Michigan and Wisconsin includes Byron dolomite below and Hendricks dolomite above

G. M. Ehlers and R. V. Kesling, 1957, Michigan Geol. Soc. [Guidebook] Ann. Geol. Excursion, p. 2 (table), 11, 15–19. Hendricks dolomite, in type area, includes Fibron limestone member. Thickness about 60 feet. Overlies Byron dolomite; underlies Schoolcraft dolomite of Manistique group; contact marked by disconformity.

Type section: Abandoned Hendricks quarry, NW¼ sec. 6, T. 44 N., R. 8 W., and NE¼ sec. 1, T. 44 N., R. 9 W., Mackinac County, Mich.

Hendricks Sandstone[1]

Upper Devonian: Northern West Virginia.

Original reference: D. B. Reger and W. A. Price, 1923, West Virginia Geol. Survey Rept. Tucker County, p. 103, 240, 241, 245–254.

P. H. Price and E. T. Heck, 1939, West Virginia Geol. Survey [Rept.] Greenbrier County, p. 303. Comprises upper member of Chemung series and marks lower limit of Catskill series in Greenbrier County. Commonly grayish brown to reddish brown, massive, and contains numerous flattened quartz pebbles. Thickness 10 to 50 feet.

Named for exposure 1 mile northeast of Hendricks, Tucker County, in Black Fork district.

Hendry Ranch Member (of Tepee Trail Formation)

Eocene, upper: Northwestern Wyoming.

H. A. Tourtelot, 1957, Smithsonian Misc. Colln., v. 134, pt. 1, p. 11–14, fig. 2. Name applied to gray and greenish-gray claystone and siltstone and tan siltstone rich in volcanic material that forms upper part of Tepee Trail formation in five areas along northern margin of Wind River basin. Maximum thickness about 550 feet. Overlies lower part of formation referred to as green and brown member.

Type section: Composite including three localities, all in Natrona County: NE¼ sec. 31, T. 39 N., R. 88 W., which includes contact with green and brown member; SW¼ sec. 14, T. 39 N., R. 89 W., which displays exposures of fossiliferous gray and greenish-gray rocks; NE¼ sec. 23, T. 39 N., R. 89 W., which contains tan siltstone that makes up upper part of member.

Henefer Formation

Upper Cretaceous: Northeastern Utah.

A. J. Eardley, 1944, Geol. Soc. America Bull., v. 55, no. 7, p. 824 (table 1), 840–842, 845, pl. 1. Red, pink, purple, and light-gray shales; red and gray sandstones with numerous lenses of pea and pebble conglomerate; gray, tan, brown, and red pebble and boulder conglomerate; 200-foot bed of volcanic tuff near base. Thickness 1,250 feet at Echo Dam; 10,000 feet in Harris Creek Canyon. Overlies Frontier formation; underlies Pulpit conglomerate [member] (new) of Almy conglomerate. Norwood tuff (new) is inlaid in the Henefer in Little East Canyon. Lower Paleocene, post-Montana or upper Montana. Probably equivalent to all or part of the Hilliard, Adaville, and Evanston.

A. J. Eardley, 1951, (abs.) Geol. Soc. America Bull., v. 62, no. 12, pt. 2, p. 1435. Henefer conformably underlies beds considered Almy, and is probably a lower member of the Almy.

L. A. Hale, 1960, Wyoming Geol. Assoc. Guidebook 15th Ann. Field Conf., p. 136 (chart 1), 142. Frontier formation redefined. Name Henefer as originally defined is preferred to term Wanship of Williams and Madsen (1959) in restricted sense. This opinion is based on premise that upper boundary of Frontier should be placed on basis of gross lithologic character. The Henefer would then be defined as lying between the highest white sandstone of the Frontier (Upton member, new) and Echo Canyon (formerly Pulpit) conglomerate.

Named for exposures in Harris Creek Canyon northeast of Henefer, Summit County. From Franklin County westward, forms both sides of Henefer Valley to marrows of upper Weber Canyon.

Henley Beds[1]

Cretaceous: Oregon.

Original reference: F. M. Anderson, 1902, California Acad. Sci. Proc., 3d ser., v. 2, p. 1–62.

In southern part of Oregon Basin.

Henley Shale Member (of Cuyahoga Formation)[1]

Henley Shale Member (of New Providence Formation)

Henley shale facies (of Cuyahoga Formation)

Mississippian (Kinderhook): Southern Ohio and northern Kentucky.

Original reference: J. E. Hyde, 1915, Jour. Geology, v. 23, p. 656, 657, 758, 760, 762, 769.

P. B. Stockdale, 1939, Geol. Soc. America Spec. Paper 22, p. 129, 130. Geographically extended into northern Kentucky where it is classed as member at base of New Providence formation; underlies Farmers siltstone member (new). In area of Bledstone facies, as much as 12 feet thick.

F. T. Holden, 1941, Illinois Acad. Sci. Trans., v. 34, no. 2, p. 172; 1942, Jour. Geology, v. 50, no. 1, p. 45. Henley shale facies includes Henley shale member.

Named for Henley, Scioto County, Ohio.

Hennepin Member (of Pecatonica Formation)

Middle Ordovician: Northern Illinois.

J. S. Templeton and H. B. Willman, 1952, Tri-State Geol. Soc. Guidebook 16th Ann. Field Conf., figs. 3, 12. Dolomite, argillaceous, silty, thin-bedded. Shown on columnar section as underlying Chana member (new) and overlying Harmony Hill formation (new).

Occurs in Dixon-Oregon area.

Hennessey Shale[1]

Permian: Central and southwestern Oklahoma.

Original reference: F. L. Aurin, H. G. Officer, and C. N. Gould, 1926, Am. Assoc. Petroleum Geologists Bull., v. 10, p. 786–799.

H. D. Miser and others, 1954, Geologic map of Oklahoma (1:500,000): U.S. Geol. Survey. Mapped with Cedar Hills sandstone member in upper part.

G. L. Scott, Jr., and W. E. Ham, 1957, Oklahoma Geol. Survey Circ. 42, p. 11–12, pl. 1. In southwestern Oklahoma overlies Wichita formation and underlies Duncan sandstone, or Flowerpot shale, where the Duncan is absent. Thickness in central Oklahoma 300 to 600 feet. In Carter area (this report), where only uppermost 40 to 50 feet is exposed, predominantly yellowish-gray to buff unfossiliferous shale; a few thin gray, blue-gray, or buff silty fine-grained calcareous sandstone stringers occur in the section as well as thin beds of bright red, brown, maroon, orange, yellow, and blue shales.

Named for exposures at Hennessey, Kingfisher County.

Hennessey Bayou Member (of Bucatunna Marl and Clay)

Oligocene (Vicksburg) : Central western Mississippi.

E. C. Tonti, 1955, Dissert. Abs., v. 15, no. 8, p. 1372. Proposed for lower Bucatunna transgressive unit heretofore included in Byram formation. Bentonite deposits occur in Bucatunna clays immediately above the marine Hennessey Bayou unit.

Typically exposed on Hennessey Bayou, 3 miles south of Vicksburg.

†Henrietta Formation[1] or Group[1]

Pennsylvanian (Des Moines Series) : Western Missouri, southern Iowa, and eastern Kansas.

Original reference: C. R. Keyes, 1897, Iowa Acad. Sci. Proc., v. 4, p. 23–24, 25.

L. M. Cline, 1941, Am. Assoc. Petroleum Geologists Bull., v. 25, no. 1, p. 26–27 (fig. 2). Columnar section shows group includes (ascending) Fort Scott limestone, Labette shale, Pawnee limestone, Bandera shale, Altamont limestone, and Nowata shale. Overlies Cherokee group; underlies Pleasanton group.

H. S. McQueen, 1943, Missouri Geol. Survey and Water Resources, v. 28, 2d ser., p. 95, 96. A sandstone (Squirrel) commonly included in Cherokee group here included at base of Henrietta group in Fort Scott formation.

R. C. Moore, 1948, Am. Assoc. Petroleum Geologists Bull., v. 32, no. 11, p. 2027; F. C. Greene and W. V. Searight, 1949, Missouri Geol. Survey and Water Resources Rept. Inv. 11, p. 5; G. E. Condra, 1949, Nebraska Geol. Survey Bull. 16, p. 43. Abandoned in favor of Marmaton.

Named for Henrietta escarpment, near Henrietta, Johnson County, Mo.

Henryhouse Shale,[1] **Limestone, or Formation** (in Hunton Group)

Silurian: Central southern Oklahoma.

Original reference: C. A. Reeds, 1911, Am. Jour. Sci., 4th, v. 32, p. 256–268.

R. A. Maxwell, 1936, Northwestern Univ. Summ. Doctoral Dissert., v. 4, p. 132, 134. Underlies Haragan formation in Kite group (new).

T. W. Amsden, 1957, Oklahoma Geol. Survey Circ. 44, p. 6 (fig. 3), 7, 26–35. Typical lithology is fossiliferous argillaceous and silty calcilutite, commonly referred to as marlstone. Thinly bedded, beds ranging up to 3 inches and commonly weathering with irregular or nodular appearance. Chert absent or extremely rare. Maximum thickness about 230 feet on Lawrence uplift; thins rapidly to south; absent at Coal Creek; about 180 feet at Henryhouse Creek. Overlies Chimneyhill formation. No reliable field evidence, other than fauna, has been found for separating Henryhouse from overlying Haragan formation. These two formations are here grouped under term Hunton marlstone. Included in Hunton group. Silurian fauna appears to be closely related in age to the Brownsport of Tennessee but its position in terms of eastern Silurian faunas is in question.

Named for Henryhouse Creek, Carter County, which crosses the outcrop about 3 miles east of Woodford (SE¼ sec. 30, T. 2 S., R. 1 E.).

Henrys Chapel Ball Clay (in Wilcox Group)

Eocene, lower: Eastern Texas.

H. B. Stenzel, 1950, Texas Univ. Bur. Econ. Geology Pub. 5019, p. 15 (fig. 4). Shown on stratigraphic section as occurring at top of Wilcox group (undivided) in Troup district, Smith County.

H. B. Stenzel, 1953, Texas Univ. Bur. Econ. Geology Pub. 5305, p. 10 (fig. 3), 14–17, 30. Gray and black ball clay. Thickness 20.1 feet. Overlies silty clays of undifferentiated Wilcox group; underlies shaly silts of Carrizo formation, contact sharply defined.

Named for occurrences in Reliance Brick Co. quarry near Henrys Chapel, Smith County.

†Henrys Fork Group[1]

Upper Jurassic and Upper Cretaceous: Northeastern Utah and northwestern Colorado.

Original reference: J. W. Powell, 1876, Geology of eastern portion of Uinta Mountains, p. 40, 50, 153.

Type locality: South side of Henry's Fork, Uintah County, Utah, at and above where it unites with Green River.

Henryville Formation (in New Albany Shale)

Henryville Member (of New Albany Shale)

Mississippian (Kinderhookian): Southeastern Indiana.

Guy Campbell, 1946, Geol. Soc. America Bull., v. 57, no. 9, p. 835, 837, 851. Summit bed of New Albany formation. Overlies Falling Run member of Sanderson formation (both new), or Underwood formation (new) where it is present; underlies Jacobs Chapel shale (new). Consists of black fissile shale never more than 1 to 2 feet thick. Cannot be distinguished from Sanderson shale except by presence of Falling Run or Underwood between the two.

H. H. Murray and others, 1955, Indiana Geol. Survey Field Conf. Guidebook 8, p. 43, pl. 1. Mississippian part of New Albany has been divided into (ascending) Sanderson, Underwood, and Henryville "formations". Indiana Geological Survey uses these terms with rank of member.

Type section: On Caney Fork Creek, in Clark Grant 252, 1½ miles southwest of Henryville, Clark County.

Hensell Sand Member (of Travis Peak Formation)

Hensell Shale Member (of Pearsall Formation)

Hensell Sand (in Travis Peak Formation[1] or Glen Rose Formation)

Hensell Sand Member (of Shingle Hills Formation)

Lower Cretaceous (Comanche Series): Central Texas.

Original reference: R. T. Hill, 1901, U.S. Geol. Survey 21st Ann. Rept., pt. 7, p. 141–144, 152.

R. H. Cuyler, 1939, Am. Assoc. Petroleum Geologists Bull., v. 23, no. 5, p. 633–635. Referred to as member of Travis Peak; sand in lower part; conglomerate, sandstone, sandy limestone, and sandy shale in upper part. Thickness 40 to 183 feet. Overlies Cow Creek member.

R. W. Imlay, 1944, U.S. Geol. Survey Oil and Gas Inv. Prelim. Chart 3. Hensell shale is uppermost member of Pearsall formation (new) in subsurface. At type section of Pearsall, the Hensell is about 340 feet thick, and consists of calcareous black shale interbedded with considerable black to dark-gray shaly limestone and hard dense partly fossiliferous, black to light-brown limestone, or, less commonly, light-gray to white chalky limestone. Overlies Cow Creek limestone member. Occupies same stratigraphic position as Hensell sand member of Travis Peak.

V. E. Barnes, 1948, Texas Univ. Bur. Econ. Geology Rept. Inv. 2, p. 6, 6–7 (fig. 1), 8. Reallocated to member status in Shingle Hills formation (new). Underlies Glen Rose limestone member.

F. E. Lozo and F. L. Stricklin, Jr., 1956, Gulf Coast Assoc. Geol. Soc. Trans., v. 6, p. 68, 69, 70, figs. Referred to as Hensel sand. Overlies Cow Creek formation. Hensel considered correct spelling.

J. M. Forgotson, Jr., 1957, Am. Assoc. Petroleum Geologists Bull., v. 41, no. 10, p. 2336, figs. Hensell sand considered basal member of Glen Rose.

Named for Mr. Hensell's place, at Travis Peak post office, Burnet County.

Henshaw Formation[1]

Upper Pennsylvanian: Northwestern Kentucky.

Original reference: Wallace Lee, 1916, Geology of Kentucky part of Shawneetown quadrangle: Kentucky Geol. Survey.

Named for Henshaw, Union County.

Henson Formation (in Silverton Volcanic Group)

Henson Tuff (in Silverton Volcanic Series)[1]

Tertiary, middle and upper: Southwestern Colorado.

Original reference: W. Cross and E. Howe, 1907, U.S. Geol. Survey Geol. Atlas, Folio 153.

E. S. Larsen, Jr., and Whitman Cross, 1956, U.S. Geol. Survey Prof. Paper 258, p. 13, 80–81. Youngest member of Silverton volcanic series. Pyroclastic formation consisting chiefly of well-bedded fine-grained greenish- or brownish-gray sandy tuff composed of dark quartz latitic material. Thickness 100 feet. Older than lavas of Potosi volcanic series.

U.S. Geological Survey currently classifies the Henson as a formation in the Silverton Volcanic Group and designates the age as middle and late Tertiary on the basis of a study now in progress.

Named for exposures on Hensen Creek, Ouray quadrangle. Also exposed in parts of Silverton and Lake City quadrangles.

Hepler Sandstone (in Bourbon Group)

Hepler Sandstone (in Pleasanton Group)

Pennsylvanian (Missouri Series): Eastern Kansas and western Missouri.

J. M. Jewett, 1940, Kansas Geol. Survey Bull. 30, p. 8–9, fig. 2. A persistent sandstone, at base of Bourbon group generally not more than 3 or 4 feet thick but as much as 20 feet thick north of Pleasanton, Linn County, Kans., where it is asphalt bearing. Conformably underlies gray, yellow, and black shale; disconformably overlies upper layers of Marmaton group. Columnar section shows the Hepler overlying Memorial shale.

R. C. Moore, 1949, Kansas Geol. Survey Bull. 83, p. 73; R. C. Moore and others, 1951, Kansas Geol. Survey Bull. 89, p. 91. Reallocated to Pleasanton group which replaces Bourbon group (suppressed).

Type exposure is in center sec. 14, T. 27 S., R. 22 E., 1½ miles north of Hepler, Bourbon County, Kans.

Heppsie Andesite

Miocene(?) : Southwestern Oregon.

F. G. Wells, 1956, U.S. Geol. Survey Geol. Quad. Map GQ–89. Name applied to andesitic flows that are generally thick-bedded, massive though locally slightly platy, gray to blue-gray porphyritic rocks with a microcrystalline groundmass. Occurs above red agglomeratic andesitic horizon that delimits top of tuff of Wasson formation (new). Flows extend out of quadrangle for many miles to base of basalts of Pliocene and Pleistocene age; within quadrangle they are typical "andesites of the Western Cascades" of other writers.

Name derived from Heppsie Mountain, Jackson County, where andesites are well exposed.

Herald Beds

Ordovician: Subsurface in northwestern North Dakota, and southern Saskatchewan, Canada.

Saskatchewan Geological Society, 1958, Report of the Lower Palaeozoic names and correlations committee: Saskatchewan Geol. Soc., p. 6, 7, charts A and B [p. 18, 19]. Through the Williston Basin, interior beds comprise several cyclic or rhythmic sequences of fossiliferous dolomitic limestones, argillaceous dolomites, and evaporitic anhydrites reaching maximum known thickness of 130 feet in northwestern North Dakota. Evaporites absent from outlying areas of basin. Conformably overlies Yeoman beds (new).

Type locality: Imperial Herald No. 1–31 (Lsd. 1, sec. 31, T. 1, R. 20, W 2nd Mer., Saskatchewan) between 9,520 and 9,599 feet; Williston Basin.

Herat Shale Member (of Ochre Mountain Limestone)[1]

Upper Mississippian: Western Utah.

Original reference: T. B. Nolan, 1930, Washington Acad. Sci. Jour., v. 20, no. 17, Oct. 19, p. 421–432.

Named for exposures near Herat claims, Gold Hill quadrangle.

Herbert Conglomerate[1] Member (of Bon Air Sandstone)

Herbert Member (of Lee Formation)

Herbert Sandstone

Pennsylvanian (Pottsville Series) : Eastern Tennessee.

Original reference: W. A. Nelson, 1925, Tennessee Div. Geology Bull. 33–A, p. 49–50.

H. R. Wanless, 1939, (abs.) Geol. Soc. America Bull., v. 50, no. 12, pt. 2, p. 1941. Listed as member of Lee formation.

R. C. Moore and others, 1944, Geol. Soc. America Bull., v. 55, no. 6, chart 6 (column 17). Correlation chart shows Herbert sandstone underlying Eastland formation and overlying Whitwell [shale].

C. W. Wilson, Jr., J. W. Jewell, and E. T. Luther, 1956, Pennsylvanian geology of Cumberland Plateau. Tennessee Div. Geology [Folio], p. 4. The conglomeratic phase of Newton sandstone in southern Cumberland and northern Bledsoe Counties was the type "Herbert conglomerate" erroneously considered by Nelson (1925) to be older than Newton. Shale thought to be between sandstones and named "Eastland shale" by Nelson is actually Whitwell shale; therefore, names "Herbert" and "Eastland" are discarded.

First described on Glade Creek just north of where road from Herbert, Bledsoe County, to Sparta crosses stream.

†Herculean Shale Member (in Monterey Group)[1]

Miocene: Central western California.

Original reference: C. E. Weaver, 1909, California Univ. Pubs., Bull. Dept. Geol., v. 5, p. 251.

In San Pablo region.

Hercules Shale Member (of Briones Sandstone)[1]

Miocene, upper: Western California.

Original reference: A. C. Lawson, 1914, U.S. Geol. Survey Geol. Atlas, Folio 193.

C. E. Weaver, 1949, Geol. Soc. America Mem. 35, p. 17 (table 3), 69 (table 14), 75, 77, pl. 12. In Carquinez and Mare Island quadrangles, the Hercules is well-defined unit averaging 500 feet thick. Lithologically it is siliceous light-brownish-gray shale; in places sandy with abundant flakes of muscovite. Overlies a 1,100-foot sandstone in lower part of Briones and underlies an upper 850-foot sandstone.

Named for Hercules Station on San Pablo Bay, San Francisco region.

Hercules Tower Sandstone (in Lutie Member of Theodosia Formation)

Lower Ordovician: Southern Missouri and northern Arkansas.

J. S. Cullison, 1944, Missouri Univ. School Mines and Metallurgy, Tech. Ser., v. 15, no. 2, p. 29, 31, pl. 2. A massive red to reddish-brown medium-grained friable sandstone about 10 feet thick. Occurs near middle of Lutie and is separated from overlying Pocket Hollow oolite (new) by black and white chert and beds of finely crystalline dolomite and "cotton rock".

Well exposed on Missouri Highway 125 south of Brush Creek about midway between village of Hercules and Hercules fire lookout tower, Taney County, Mo.

Herendeen Limestone[1]

Lower Cretaceous: Southwestern Alaska.

Original reference: W. W. Atwood, 1911, U.S. Geol. Survey Bull. 467, p. 25, 39.

J. T. Dutro, Jr., and T. G. Payne, 1957, Geologic map of Alaska (1:2,500,000): U. S. Geol. Survey. Appears on map legend.

Exposed from Herendeen Bay to Port Moller, Alaska Peninsula.

Herington Limestone (in Chase Group)

Herington Limestone Member (of Nolans Limestone)

Herington Limestone (in Sumner Group)[1]

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

Original reference: J. W. Beede, 1909, Kansas Acad. Sci. Trans., v. 21, pt. 2, p. 253.

R. C. Moore and others, 1951, Kansas Geol. Survey Bull. 89, p. 41. Member of Nolans limestone. Consists of limestone and dolomite, yellowish-tan, soft and dense, more dolomitic in southern and central Kansas than in northern part of state. Outcrops characterized by siliceous and calcareous geodes and concretions and cauliflowerlike masses of drusy flint weathered from matrix; molluscan fauna abundant. Thickness 7 to 10 feet in northern part and about 30 feet in southern Kansas. Overlies Paddock shale member; underlies Wellington formation of Sumner group. Wolfcamp series.

H. D. Miser and others, 1954, Geologic map of Oklahoma (1:500,000): U.S. Geol. Survey. Mapped as Herington limestone in Chase group.

C. C. Branson, 1960, Oklahoma Geology Notes, v. 20, no. 9, p. 229–235. Term Lyon series (Lyonian epoch) proposed for Sakmarian rocks of Oklahoma. Series would include rocks from top of Brownville limestone to top of Herington limestone.

Named for Herington, Dickinson County, Kans.

Herkimer Limestone[1]

Herkimer Limestone (in Hartmann Group)

Middle Cambrian: Central northern Utah.

Original reference: W. Lindgren and G. F. Loughlin, 1919, U.S. Geol. Survey Prof. Paper 107.

H. T. Morris, 1957, Utah Geol. Soc. Guidebook 12, p. 5 (fig. 2), 7. Described in East Tintic Mountains where it is 350 to 450 feet thick; conformably overlies Dagmar limestone and underlies Bluebird dolomite. Subdivided into three members: lower, about 180 feet thick, composed of medium-bedded blue-gray limestone mottled by thin discontinuous layers and irregular splotches of yellowish-brown argillaceous material; middle, shale, about 20 feet thick; and upper, about 150 to 250 feet thick, composed of thin beds of limestone, limestone flat-pebble conglomerate, and calcareous oolite all separated by shale partings.

J. K. Rigby, 1958, Utah Geol. Soc. Guidebook 13, p. 14 (fig. 3), 17. In Stansbury Mountains, as much as 145 feet thick; underlies Bowman limestone, and overlies Dagmar dolomite (limestone).

J. K. Rigby, 1959, Utah Geol. Soc. Guidebook 14, p. 14 (table 1), 18–21, pl. 1. Assigned to Hartmann group in southern Oquirrh Mountains. Herkimer of this report includes upper half of what Gilluly (1932) mapped as Hartmann limestone. Where best exposed, along Lynch Ridge north of town of Ophir, 466 feet thick. Overlies Teutonic limestone with contract gradational; underlies Bowman limestone with contact conformable and gradational.

Named for occurrence near Herkimer shaft 1½ miles south-southwest of Eureka, Juab County.

Herkimer Sandstone[1] (in Clinton Group)

Middle Silurian: Central New York.

Original reference: G. H. Chadwick, 1918, Geol. Soc. America Bull., v. 29, p. 327–368.

Tracy Gillette, 1940, New York State Mus. Bull. 320, p. 22 (fig. 6), 35; 1947, New York State Mus. Bull. 341, p. 13, 15, 16, 23, 111–113, geol. secs. Top of Clinton group in section east of Cayuga County. Thickness approximately 75 feet. Underlies Lockport dolomite; overlies Willowvale shale; locally overlies Kirkland iron ore; equivalent to Rochester shale of west and west-central New York.

D. W. Fisher and L. V. Rickard, 1953, New York State Mus. Circ. 36, p. 10, fig. 1. In area of Vanhornesville, observed to unconformably underly Brayman shale.

D. W. Fisher, 1959, New York State Mus. Sci. Service Geol. Survey Map and Chart Ser. no. 1. Underlies Ilion shale (new).

Type locality: On Steeles Creek, 5 miles southwest of Herkimer village, Herkimer County.

Herman Creek Lava[1]

Pleistocene: Central northern Oregon and southwestern Washington.

Original reference: R. W. Chaney, 1918, Jour. Geology, v. 26, no. 7, p. 577–592.

Herman Creek is in Hood River County, Oreg.

†Hermansville Limestone[1]

Hermansville Formation

Upper Cambrian and Lower Ordovician: Northwestern Michigan.

Original reference: C. R. Van Hise and W. S. Bayley, 1900, U.S. Geol. Survey Geol. Atlas, Folio 62.

F. T. Thwaites, 1942, Michigan Acad. Sci., Arts and Letters Papers, v. 28, p. 488. Hermansville of Van Hise and Bayley is not clear. In view of this uncertainty of definition, name Hermansville could very well be dropped.

G. V. Cohee, 1945, U.S. Geol. Survey Oil and Gas Inv. Prelim. Chart 9. Hermansville limestone, as originally defined and later used in Northern Peninsula, included dolomite and sandstone of both Lower Ordovician and Cambrian age which can be traced in subsurface studies into northeastern Wisconsin. Jordan sandstone as recognized in this report forms part of Hermansville as currently used in Northern Peninsula.

W. K. Hamblin, 1958, Michigan Dept. Conserv., Geol. Div. Pub. 51, p. 6 (fig. 1), 116–117. Inasmuch as no type locality or type section was presented by Van Hise and Bayley or by any subsequent workers for term Hermansville, and since type of lithology and age of rocks referred to by that term has been vague and confused, name should be abandoned. Au Train formation is proposed for these rocks.

Named for exposures near Hermansville, Menominee County.

Hermit Shale (in Aubrey Group)[1]

Hermit Formation

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

Original reference: L. F. Noble, 1922, U.S. Geol. Survey Prof. Paper 131–B, p. 26, 28, 64.

E. D. Koons, 1945, Geol. Soc. America Bull., v. 56, no. 2, p. 154. Discussion of geology of Uinkaret Plateau. Hermit formation, 1,053 feet thick, overlies Supai formation and underlies Coconino sandstone. Lower 200 feet contains cross-laminated beds of sandstone; upper 800 feet composed of weak shales and sandstones.

A. H. McNair, 1951, Am. Assoc. Petroleum Geologists Bull., v. 35, no. 3, p. 515 (fig. 2), 526, 527–528. Referred to as formation. Designation shale is misnomer. Noble in description of type section used term sandstone for compact massive beds and shale for thinly laminated soft beds which are in reality fine-grained sandstones. Thickness: 933 feet at South Hurricane Cliffs; 700 feet at North Grand Wash Cliffs. Underlies Coconino sandstone; overlies Queantoweap sandstone (new) with contact transitional in interval ranging from 5 to 50 feet. If unconformity at base of Hermit at Bass Trail and at Jumpup Canyon on Kanab Creek, described by Noble (1922, and 1928, U.S. Geol. Survey Prof. Paper 150), is present in sections west of Kanab Creek, it would occur between the Queantoweap and Hermit; it may have been overlooked in present work.

Type locality: Hermit Basin, Arizona.

Hermitage Formation[1] or **Limestone** (in Lexington Group)

Hermitage Formation (in Nashville Group)

Middle Ordovician: West-central Tennessee and southern Kentucky.

Original reference: C. W. Hayes and E. O. Ulrich, 1903, U.S. Geol. Survey Geol. Atlas, Folio 95, p. 1.

D. K. Hamilton, 1948, Econ. Geology, v. 43, no. 1, p. 41, 42. Included in Lexington group. Overlies Curdsville limestone; underlies Jessamine limestone. Thickness 35 feet near Lexington, Ky.

C. W. Wilson, Jr., 1949, Tennessee Div. Geology Bull. 56, p. 81–107, measured sections. Basal formation in Nashville group (redefined). Includes Curdsville member (at base) and facies or members referred to as laminated argillaceous silty nodular limestone; *Dalmanella* coquina; granular phosphatic; *Ctenodonta*; and blue clay-shale. Maximum thickness 180 feet. Underlies Bigby-Cannon formation; unconformably overlies Carters limestone of Stones River group. Hayes and Ulrich referred to section in vicinity of Hermitage Station but did not locate or reproduce the section. Bassler (1932, Tennessee Div. Geology Bull. 38) stated location of section and gave thickness as 67 feet. In present study, several sections were measured in vicinity of Hermitage Station which together present complete succession of formation in type area. Thickness of 67 feet was measured in section in bed of Stoner Creek and northward up hill located just west of bridge on Central Pike over this creek. This is probably locality where section was measured by Ulrich and Bassler.

Type area: Near Hermitage Station on hill between Stoner Creek and Lebanon-Nashville and Central Pikes. Named for occurrence at Hermitage Station, Davidson County, Tenn.

Hermon Coal Member (of Spoon Formation)

Pennsylvanian: Western Illinois.

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 33, 45 (table 1), 63, pl. 1. Name applied to thin unit formerly termed Lower DeLong coal. Stratigraphically above Seville limestone member and below Brush coal member which name replaces unit formerly termed Middle Delong coal. Presentation of new rock-stratigraphic classification of Pennsylvanian of Illinois. Cyclical classification retained but is entirely independent of rock-stratigraphic classification.

Type locality: Along Brush Creek, secs. 6 and 8, T. 9 N., R. 2 E., Knox County. Named for village of Hermon about 2½ miles south of type outcrop.

Hermon cyclothem (in Spoon Formation)

Pennsylvanian: Northern and western Illinois.

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 42, 52 (table 1), pl. 1. Name applied to cyclothem formerly called Lower DeLong. In sequence, occurs above Seville cyclothem and below Seahorne cyclothem. Presentation of new rock-stratigraphic classification of Pennsylvanian strata in Illinois. Cyclical classification is independent of rock-stratigraphic classification.

Type locality: Along Brush Creek, secs. 6 and 8, T. 9 N., R. 2 E., Knox County. Named for village of Hermon, about 2½ miles southeast of type locality.

Hermon Granite Gneiss

Hermon type[1] granite

Precambrian: Northeastern New York.

Original reference: A. F. Buddington, 1929, New York State Mus. Bull. 281, p. 52–81.

A. F. Buddington, 1939, Geol. Soc. America Mem. 7, p. 142–145. Typical Hermon type of granite is moderately coarsely porphyritic augen gneiss, with phenocrysts of feldspar in coarse- to medium-grained ground mass. Borders Antwerp type granite. Granite occurs in sheet in Grenville belt.

Occurs in sheet extending from Hermon, St. Lawrence County, to Evans Mills.

Hermosa Formation[1]

Hermosa Group

Middle Pennsylvanian: Southwestern Colorado, northeastern Arizona, northwestern New Mexico, and southeastern Utah.

Original reference: W. Cross and A. C. Spencer, 1899, U.S. Geol. Survey Geol. Atlas, Folio 60, p. 8.

A. A. Baker, 1933, U. S. Geol. Survey Bull. 841, p. 18–23. Overlies Paradox formation (new).

W. S. Burbank and E. N. Goddard, 1937, Geol. Soc. America Bull., v. 48, no. 7, pl. 3. Discussion of thrusting in Huerfano Park region, Colorado. Stratigraphic column for region shows "type of sediments like Hermosa formation" underlying "type of sediments like Rico formation".

N. W. Bass, 1944, U.S. Geol. Survey Oil and Gas Inv. Prelim. Chart 7, accompanied by paper on Paleozoic stratigraphy as revealed by deep wells in parts of southwestern Colorado, northwestern New Mexico, northeastern Arizona, and southeastern Utah. Formation in Animas River valley is about 2,000 feet thick and consists of alternating thick beds of greenish tan-gray arkosic sandstone, grit, and locally conglomerate, thin beds of dark-blue-gray, dense, fossiliferous limestone, and at least one zone that contains beds of gypsum. Includes Paradox member which overlies and underlies unnamed parts of formation. Underlies Rico formation; overlies Molas formation.

S. A. Wengerd, 1951, Am. Assoc. Petroleum Geologists Bull., v. 35, no. 5, p. 1038–1051. Formation, exposed in San Juan Canyon where it transects Monument upwarp in southeastern Utah, contains several biostromal layers, one of which changes laterally into small bioherms with typical reef-limestone breccia making up greater part of deposit. At least eight bioherms have been breached by San Juan River, several of which are exposed on only one canyon wall. Reef limestones present through approximately two-thirds of Hermosa thickness below Hermosa-Rico gradational contact. Fossils suggest bioherms are Des Moines in age. Exposed thickness about 1,000 feet.

S. A. Wengerd and J. W. Strickland, 1954, Am. Assoc. Petroleum Geologists Bull., v. 38, no. 10, p. 2165–2166, 2167 (fig. 7), 2173–2174, 2188–2190. Described in Paradox salt basin, Four Corners region, Colorado and Utah. Original Hermosa included all beds from top of Rico member of Cutler formation to top of Leadville limestone. Devonian strata referred to by Spencer was actually the presently known Leadville limestone of Mississippian age. Section measured in this report is almost exactly the one designated as type section by Roth (1934, Am. Assoc. Petroleum Geologists Bull., v. 18, no. 7). Hermosa of this report is restricted to clastic facies and carbonate facies that occur above Paradox here treated as a formation. Fusulind control shows carbonate facies as Wolfcamp, Virgil, Missouri, Des Moines (Marmaton, and locally Cherokee) ; clastic facies is Wolfcamp, Virgil, and Missouri. Top of Hermosa has been recognized, in past, in beds ranging from Wolfcamp to Des Moines in age, throughout stratigraphic interval of at least 800 feet. Inconsistent definitions of gross sections and their lithologic character without paleontologic control are responsible for this situation. Research has led to establishment of "R" datum, commonly a sandy limestone found in or near base of marine Wolfcamp series and approximately equivalent to Mendenhall sandstone at Honaker Trail, San Juan Canyon, Utah. This datum believed to be almost true time surface whose position does not vary more than 100 feet from some, as yet unidentifiable, true time-stratigraphic surface. In parts of region, this datum is exactly on top of section commonly considered to be the true Hermosa section and for purposes of regional correlation is considered to mark top of Hermosa section as chosen by Roth in type locality. "R" datum plane is approximately base of Rico transition facies here treated as basal member of Cutler formation.

F. W. Cater, Jr., 1955, U.S. Geol. Survey Geol. Quad. Map GQ–71. Formation described in Davis Mesa quadrangle, Colorado, where it comprises two members: lower or Paradox, consisting largely of intrusive salt and gypsum; and the upper or limestone member. All known surface occurrences of Paradox member are intrusive and beds are complexly folded and contorted; undisturbed thickness of member not known. Wells drilled in Paradox Valley penetrated about 2,300 feet of beds belonging to limestone member and more than 10,800 feet of intrusive beds without reaching pre-Paradox strata. Base of section. Underlies Cutler formation.

F. W. Cater, Jr., 1955, U.S. Geol. Survey Geol. Quad. Map GQ–77. Described in Anderson Mesa quadrangle, Colorado, where it consists of Paradox member below and an upper limestone member. Base of section; unconformably underlies Chinle formation.

J. R. Clair, 1958, Rocky Mountain Assoc. Geologists Symposium on Pennsylvanian rocks of Colorado and adjacent areas, p. 31–46. Group, in subsurface, comprises (ascending) Lime Ridge formation (new), Pinkerton Trail formation, Barker Creek zone, Paradox formation, Ismay zone, and Honaker Trail formation.

S. A. Wengerd and M. L. Matheny, 1958, Am. Assoc. Petroleum Geologists Bull., v. 42, no. 9, p. 2056. Rank raised to group. Comprises (ascending) Pinkerton Trail, Paradox, and Honaker Trail (new) formations. Overlies Molas formation; underlies Cutler group.

D. W. Bolyard, 1959, Am. Assoc. Petroleum Geologists Bull., v. 43, no. 8, p. 1911. Discussion of stratigraphy in Sangre de Cristo Mountains between La Veta Pass and Westcliffe, Colo. Name Madera replaces Hermosa and Rico formations of Burbank and Goddard (1937) in south-central Colorado and restricts these terms to southwestern Colorado west of San Luis-Uncompahgre highland.

R. W. Fetzner, 1960, Am. Assoc. Petroleum Geologists Bull., v. 44, no. 8, p. 1377–1388. Formation used in this report [Pennsylvanian paleotectonics of Colorado Plateau] comprises lower Hermosa member, Paradox member, and upper Hermosa member. Nomenclature of Wengerd and Matheny (1958) not used in present report because Honaker Trail formation includes early Permian Cutler carbonate facies that occurs in northwestern Paradox Salt basin and present investigation requires Permo-Pennsylvanian division in order to define Pennsylvanian lithofacies.

Type section (Roth): Secs. 26 and 35, T. 37 N., R. 9 W., La Plata County, Colo. Named for Hermosa Creek, which flows into Animas River north of Durango. This is composite section measured across strata which dip gently southward into San Juan basin.

Hermosa Lens (in Newcastle Formation)

Upper Cretaceous: Western South Dakota.

R. M. Grace, 1952, Wyoming Geol. Survey Bull. 44, p. 14, 17. Predominantly sandstone. Thickness 16 feet at north end, about 8 feet in middle, and 54 feet at south end. In this report, seven lenses are named in the Newcastle.

Present in T. 2 S., R. 8 E., near town of Hermosa, Custer County.

Hernshaw Sandstone (in Kanawha Formation)[1]

Pennsylvanian: Southern West Virginia.

Original reference: R. V. Hennen and D. B. Reger, 1914, West Virginia Geol. Survey Rept. Logan and Mingo Counties, p. 155.

Named for Hernshaw, Kanawha County.

Hero Member (of Valcour Formation)

Middle Ordovician (Chazyan): Northwestern Vermont and northeastern New York.

Philip Oxley and Marshall Kay, 1959, Am. Assoc. Petroleum Geologists Bull., v. 43, no. 4, p. 825 (fig. 4), 826 (fig. 5), 834–836, 843, 846. In South Hero, lower 101 feet of the Valcour, the Hero member, is dark-gray silt-laminated calcarenite argillicalcisiltite, massive-bedded but weathering to nodular shaly rubble; *Solenoporo* sp. abundant in top 3 feet, and present sparingly with sponge *Zittelella varians* (Billings) and a few *Stromatocerium* masses below. At Chazy, N.Y., member has interbedded dolomite and calcilutite; calcilutites of lower 17 feet here are the dove limestone of authors, earlier mistaken for Beldens limestone. At Sheldon Lane, central Isle La Motte, Rockwell Bay, and Tiger Point, Valcour Island, member has *Glaphurus*-bearing reefs. Underlies Beech member (new); overlies Crown Point formation.

Type section: In South Hero, Vt., near Rutland Railroad station.

Herod Gravel Member (of Manhasset Formation)[1]

Pleistocene: Southeastern New York and islands of southeastern New England.

Original reference: M. L. Fuller, 1905, Geol. Soc. America Bull., v. 16, p. 367–390.

Lawrence Weiss, 1954, U.S. Geol. Survey Prof. Paper 254–G, p. 146. Basal member of Manhasset. Underlies Montauk till member; overlies Jacob sand. Manhasset is generally considered to be of Wisconsin age.

Occurs at nearly all points from Long Island to Boston.

Herrick Formation

Herrick Gravels

Pleistocene: Southeastern South Dakota.

R. E. Stevenson and L. A. Carlson, 1950, Areal geology of the Bonesteel quadrangle (1:62,500): South Dakota Geol. Survey. Fluvial coarse feldspathic sands and gravels on upland surface.

R. E. Stevenson, R. L. Hale, and H. C. Skogstrom, Jr., 1958, Geology of the Gregory quadrangle (1:62,500): South Dakota Geol. Survey. Formation consists of series of lensing crossbedded very coarse to medium-grained arkosic sands with local streaks of small pebbles of granite, quartz, schist, and petrified wood. Thickness as much as 54 feet; at paratype section, 35 to 40 feet. Lies on nearly flat surface developed on Ash Hollow formation.

Paratype section: In Burke Stone and Sand Company pit, 1½ miles west of Burke, Gregory County. Named for exposures near town of Herrick, 7 miles southeast of Burke.

Herrin Coal Member (of Carbondale Formation)

Pennsylvanian: Illinois.

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 34, 35, 36, 48 (table 1), 65, pl. 1. Assigned member status in Carbondale formation (redefined). In southern area, occurs above Vermilionville sandstone member and below Brereton limestone member; in northern and western area, occurs above Big Creek shale member and below Brereton limestone member; in eastern area, occurs above Harrisburg (No. 5) coal member and below Danville (No. 7) coal member. Thickness about 5 feet. Name Brereton limestone is extended to caprock of No. 6 coal to replace name Herrin, now restricted to the coal. Coal named by Worthen (1870, *in* Geology and Paleontology, v. 4, Illinois Geol. Survey). Presentation of new rock-stratigraphic classification of Pennsylvanian strata in Illinois.

Type locality: In mines in vicinity of Herrin, Williamson County.

Herrin Limestone (in Carbondale Group)

Herrin Limestone (in McLeansboro Formation)[1]

Pennsylvanian: Southern Illinois.

Original reference: G. H. Cady, 1926, Illinois Acad. Sci. Trans., v. 19, p. 262.

J. R. Ball, 1952, Illinois Geol. Survey Bull. 77, p. 27, 44. Included in Brereton cyclothem, Carbondale group. Overlies Herrin No. 6 coal.

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 35. Replaced by Brereton limestone member of Carbondale formation (redefined). Name Herrin now restricted to Herrin (No. 6) coal member.

Named because of its association with Herrin coal. First described in Saline County.

Herringa Flow or Tongue (of Clayton Basalt)

Late Cenozoic: Northeastern New Mexico.

Brewster Baldwin and W. R. Muehlberger, 1959, New Mexico Bur. Mines Mineral Resources Bull. 63, p. 112, 133, 134, 143 (fig. 20). East of type locality, Clayton basalt consists of many long tongues. For purpose of this report, these tongues have been named, from south to north, Carrizo, Herringa, Clayton Mesa, Apache, Seneca, Gaps, and Van Cleve flows. All basalts rest on sand and gravel of Ogallala-like material in ancient valleys. Vents that gave rise to these basalts are unknown.

Present in eastern Union County.

Herschel Quartzite[1]

Lower Cretaceous(?): Southeastern Arizona.

Original reference: J. A. Church, 1903, Am. Inst. Mining Engrs. Trans., v. 33, p. 3–37.

Tombstone district.

Hersey Red Shale Member (of Pembroke Formation)[1]

Upper Silurian: Southeastern Maine.

Original reference: E. S. Bastin and H. S. Williams, 1914, U.S. Geol. Survey Geol. Atlas, Folio 192, p. 6–7.

Named for exposures on Hersey Neck, Pembroke Township, Washington County.

Hershey Limestone

Middle Ordovician: Southeastern Pennsylvania.

Carlyle Gray, 1952, Pennsylvania Geol. Survey Prog. Rept. 140, p. 4–5; 1952, Pennsylvania Acad. Sci. Proc., v. 26, p. 86, 88. Dark-gray graphitic, shaly or silty limestone. Less pure and darker in color than typical Myerstown limestone below. Weathered exposures typically brownish gray and show well-developed cleavage. Bedding marked by shaly laminations. Beds of conglomerate occur at base in eastern part of mapped area; consist of angular to subrounded fragments of dolomite and magnesian limestone in matrix of dark-gray graphitic shaly limestone and are interbedded with normal Hershey limestone. Total thickness several hundred feet. Conglomerate zone may be more than 100 feet thick in Berks County where it is mapped as an unnamed member. Underlies Martinsburg formation. Unit formerly included in Leesport formation. Name credited to C. E. Prouty.

Carlyle Gray and C. E. Prouty, 1954, Field Conf. Pennsylvania Geologists 20th Ann. Mtg., p. 28–29; C. E. Prouty, 1959, Pennsylvania Geol. Survey, 4th ser., Bull. G–31, p. 20–28. Thickness about 435 feet at type section. Overlies Myerstown; underlies Martinsburg.

Type section: Near covered bridge across Swatara Creek, Dauphin County. Named for Hershey, Dauphin County. Maximum development north of Womelsdorf in Berks County. Poorly exposed in Lebanon County.

Hertha Limestone (in Kansas City Group)[1]

Hertha Limestone (in Bronson Group)

Hertha Limestone Member (of Kansas City Formation)[1]

Pennsylvanian (Missouri Series): Northwestern Missouri, southwestern Iowa, eastern Kansas, and southeastern Nebraska.

Original reference: G. I. Adams, 1899, Kansas Acad. Sci. Trans., v. 16, p. 58, 59.

R. C. Moore, J. C. Frye, and J. M. Jewett, 1944, Kansas Geol. Survey Bull. 52, pt. 4, p. 193. Hertha limestone, in Bronson group, includes (ascending) Critzer limestone, Mound City shale, and Sniabar limestone members. Thickness. featheredge to about 30 feet. Overlies Bourbon shale; underlies Ladore shale.

R. C. Moore, 1948, Am. Assoc. Petroleum Geologists Bull., v. 32, no. 11, p. 2028–2029, 2031 (fig. 4). Underlies Ladore formation; overlies Pleasanton group. Kansas City group redefined in Kansas and Nebraska; lower boundary placed at base of Hertha formation. Bronson reduced to subgroup of Kansas City group (revised). This is classification agreed upon by Geological Surveys of Iowa, Kansas, Missouri, Nebraska, and Oklahoma, May 1947.

F. C. Greene and W. V. Searight, 1949, Missouri Geol. Survey and Water Resources Rept. Inv. 11, p. 10, 11. In Missouri, Hertha includes (ascending) Critzer limestone, Mound City shale, and Sniabar limestone members.

T. L. Welp, L. A. Thomas, and H. R. Dixon, 1957, Iowa Acad. Sci. Proc., v. 64, p. 421. Thickness about 3 feet in Madison County, Iowa. Underlies Ladore shale; overlies Pleasanton shale.

H. G. Hershey and others, 1960, Iowa Highway Research Board Bull. 15, p. 28, fig. 5. Basal formation in Kansas City group. In Madison County, typically composed of three limestones with one thin shale separating the lower two. Middle limestone bed fragmental and fossiliferous; upper and lower limestones argillaceous and lenticular. Thickness about 4 feet in Madison County; about 9 feet in cores from Council Bluffs area. Underlies Ladore shale; overlies Pleasanton group.

Named for occurrence in vicinity of Hertha, Neosho County, Kans.

Hess Limestone Member (of Leonard Formation)

Hess (thin-bedded) Limestone Member (of Leonard Formation).

Permian: Western Texas.

Original reference: J. A. Udden, 1917, Texas Univ. Bull. 1753, p. 43, pl. 3.

P. B. King, 1937, U.S. Geol. Survey Prof. Paper 187, p. 98. Limestones northeast of Hess Ranch were named Hess formation in 1917 because they were thought to be separated by unconformity from Leonard beds above. Later work has shown that this unconformity does not exist, and evidence was presented (King, 1932, Am. Jour. Sci., 5th ser., v. 34) which indicated that limestones of typical Hess formation were largely equivalent to shales and thin limestones typical of Leonard formation. The two facies were interpreted as being separated by limestone reefs. In present report, the two units are brought together in single formation, the Leonard, in accordance with Udden's original definition, and the Hess is designated as Hess thin-bedded limestone member.

P. B. King, 1942, Am. Assoc. Petroleum Geologists Bull., v. 26, no. 4, p. 651, pl. 2. Term Hess limestone member used in this report.

C. A. Ross, 1959, Washington Acad. Sci. Jour., v. 49, no. 9, p. 299. Lenoxhills formation (new) is lower 200 to 300 feet of Hess formation of Udden (1917).

Well exposed on Hess Ranch, Glass Mountains, Marathon region.

Hesse Quartzite[1] or **Sandstone** (in Chilhowee Group)

Hesse Quartzite Member (of Erwin Formation)

Lower Cambrian: Eastern Tennessee and western North Carolina.

Original reference: A. Keith, 1895, U.S. Geol. Survey Geol. Atlas, Folio 16.

C. E. Resser, 1939, Geol. Soc. America Spec. Paper 15, p. 4, 5. Hesse sandstone abandoned; evidently synonym for Erwin quartzite.

S. S. Oriel, 1950, North Carolina Div. Mineral Resources Bull. 60, p. 12, 13 (table 3). Two sets of formation names for Lower Cambrian clastic rocks in use in eastern Tennessee and western North Carolina (table 3). Northeast Tennessee names Unicoi, Hampton, and Erwin are used in this report for same rocks which Keith (1904, U.S. Geol. Survey, Geol. Atlas, Folio 116) and Stose and Stose (1947, Am. Jour. Sci., v. 245, no. 10) named Cochran, Nichols, Nebo, Murray, and Hesse, all defined by Keith (1895) in Chilhowee Mountain area, Blount and Sevier Counties, Tenn. Hot Springs area lies midway between type localities for each group of names. Hampton and Erwin formations, as used in this report [Hot Springs Window area], include Hesse quartzite.

John Rodgers, 1953, Tennessee Div. Geology Bull. 58, pt. 2, p. 35 (table 3). Table shows Hesse includes Helenmode member at top.

P. B. King and others, 1958, Geol. Soc. America Bull., v. 69, no. 8, p. 964. Chilhowee group as whole is classed as Cambrian and Precambrian(?). Helenmode formation at top of group is Cambrian and remaining unfossiliferous formations [including Hesse quartzite] are termed Precambrian(?).

R. B. Neuman and R. L. Wilson, 1960, U.S. Geol. Survey Geol. Quad. Map GQ–131. Hesse quartzite described in Blockhouse quadrangle. Tennessee, where it is 500 feet thick. Overlies Murray shale; underlies Helenmode formation. Lower Cambrian(?).

P. B. King and H. W. Ferguson, 1960, U.S. Geol. Survey Prof. Paper 311, p. 28 (table), 43. In northeasternmost Tennessee, considered quartzite member of Erwin formation. In places, as many as three ledges, each 25 to 50 feet thick, are separated by beds of siltstone. Only uppermost persists throughout area. Overlies Murray shale member; underlies Helenmode member. Lower Cambrian.

Named for Hesse Creek, Blockhouse quadrangle, Blount County, Tenn.

Heumader Shale Member (of Oread Limestone)[1]

Pennsylvanian (Virgil Series): Northwestern Missouri, southwestern Iowa, eastern Kansas, and southeastern Nebraska.

Original reference: R. C. Moore, 1932, Kansas Geol. Soc. Guidebook 6th Ann. Field Conf., p. 94, 96.

R. C. Moore, 1948, Am. Assoc. Petroleum Geologists Bull., v. 32, no. 11, p. 2035 (fig. 5). Heumader shale member of Oread limestone; underlies

Kereford limestone member; overlies Plattsmouth limestone member. This is classification agreed upon by State Geological Surveys of Iowa, Kansas, Missouri, Nebraska, and Oklahoma, May 1947.

G. E. Condra, 1949, Nebraska Geol. Survey Bull. 16, p. 25. Thickness in southeastern Nebraska 2 to 4 feet.

T. L. Welp, L. A. Thomas, and H. R. Dixon, 1957, Iowa Acad. Sci. Proc., v. 64, p. 418 (fig. 1), 419. Thickness 7 feet in section measured near Winterset, Madison County.

H. G. Hershey and others, 1960, Iowa Highway Research Board Bull. 15, p. 21, fig. 5. Olive green, brown, black; locally black carbonaceous zones and black subfissile beds. Average thickness 3 feet. Overlies Plattsmouth limestone member; underlies Kereford member; where Kereford is missing, underlies Kanwaka shale.

Type locality: Heumader quarry, bluffs of Missouri River just north of St. Joseph, Buchanan County, Mo.

Heuvelton Member (of Tribes Hill Formation)

Heuvelton Sandstone[1]

Lower Ordovician: Northern New York.

Original reference: G. H. Chadwick, 1915, Geol. Soc. America Bull., v. 26, p. 289–291.

R. H. Wheeler, 1941, (abs.) Geol. Soc. America Bull., v. 52, no. 12, pt. 2, p. 1938–1939; 1942, Am. Jour. Sci., v. 240, no. 7, p. 518–524. Cambro-Ordovician correlations revised in Champlain, Hudson, Mohawk, and St. Lawrence valleys. Lower "typical" Theresa is physically and faunally separated from "Upper Theresa" (now Heuvelton member of Tribes Hill formation). Two marine cycles represented by Tribes Hill formation (containing Norton equivalent to Heuvelton, Fort Ann equivalent to Bucks Bridge, Benson equivalent to Ogsdenburg members) and Cassin formation, constitute Beekmantown series.

W. H. Twenhofel and others, 1954, Geol. Soc. America Bull., v. 65, no. 3, chart 2 (column 19). Heuvelton sandstone, shown on correlation chart as Lower Ordovician, occurs below Tribes Hill dolomite.

Probably named for Heuvelton, St. Lawrence County.

Hewetts Branch Sandstone (in Allegheny Formation)[1]

Pennsylvanian: Southeastern Ohio.

Original reference: E. Orton, 1884, Ohio Geol. Survey, v. 5, p. 116.

At Carbondale, Athens County.

Hewittville Calcilutites (or Beds)[1]

Lower Ordovician (Beekmantown): Northern New York.

Original reference: G. H. Chadwick, 1920, New York State Mus. Bull. 217, 218, p. 33.

Cap Bucks Bridge formation on west bank of Raquette River just below concrete dam of lower mills at Hewittville, Canton quadrangle.

Hex Formation

Upper Jurassic(?): Southern California.

O. T. Marsh, 1956, Dissert. Abs., v. 16, no. 1, p. 101; 1960, California Div. Mines Spec. Rept. 62, p. 6–8, pls. 1, 2. Brown and gray clay with bentonite at Hex Hill, grading westward into light-blue tuffaceous shale; abundant belemnites and some Foraminifera. Whitish, irregular limestone masses scattered throughout formation. Bedding has been destroyed by squeezing in core of Avenal Ridge piercement anticline. Because of plastic deformation, true thickness of formation cannot be determined. Contacts with other formations are everywhere discordant. Unit rests in fault contact against Badger shale, Risco formation, Serpiente sandstone, Moonlight formation, and probably Red Man sandstone (all newly named units). Fossils have been assigned tentatively to Late Jurassic.

Type locality: Hex Hill, just south of Devils Den, northwestern Kern County. Crops out east of Orchard Peak as single band about one-half mile wide and more than 4 miles long, paralleling base of scarp formed by Avenal Ridge. Occupies core of Avenal Ridge piercement anticline.

Hiawatha Graywacke (in Paint River Group)

Precambrian (Animikie Series): Northern Michigan.

H. L. James, 1958, U.S. Geol. Survey Prof. Paper 314–C, p. 30 (table 1), 38. Predominantly graywacke with considerable amounts of interbedded slate; lower part is commonly a breccia that consists of scattered angular chert fragments in a graywacke matrix. Ranges in thickness from 50 feet or less in eastern part of district to 400 feet more in western part. Underlies Stambaugh formation (new); overlies Riverton iron-formation (new).

Named for Hiawatha mine at Iron River, Iron County. Rocks are exposed in scattered outcrops and formation is crossed by extensive mine workings. Locally well exposed along course of Paint River at north edge of town of Crystal Falls.

Hiawatha Member (of Knight Formation)

Hiawatha Member (of Wasatch Formation)[1]

Paleocene and Eocene, lower: Northwestern Colorado, northeastern Utah, and southwestern Wyoming.

Original reference: W. T. Nightingale, 1930, Am. Assoc. Petroleum Geologists Bull., v. 14, no. 8, p. 1019–1040.

W. J. Morris, 1955, Dissert. Abs, v. 15, no. 3, p. 394. Name Knight formation extended from Bridger basin to include dominantly fluviatile Wasatchian deposits of Washakie basin. Hence, Hiawatha is considered member of Knight formation.

H. R. Ritzma, 1959, Utah Geol. and Mineralog. Survey Bull. 66, p. 40 (fig. 4), 41. Referred to as member of Wasatch. Geographically extended into Daggett County, Utah. Lower half, considered Paleocene, consists of drab claystone, shale, sandstone, coal, coaly shale, and conglomerate; upper half, considered Eocene, consists of varicolored claystone with minor amounts of coal, and coarse sandstone and conglomerate. Thickness as much as 3,500 feet. Underlies Tipton tongue of Green River formation; overlies Fort Union formation.

Names for development on Hiawatha and West Hiawatha domes, Tps. 12 N., Rs. 100 and 101 W., Moffat County, Colo.

Hickey Formation

Pliocene(?): Central Arizona.

C. A. Anderson and S. C. Creasey, 1958, U.S. Geol. Survey Prof. Paper 308, p. 56–58, fig. 2, pl. 1. Interbedded basaltic volcanic rocks and gravels. Volcanic rocks comprise chiefly olivine basalt and lesser amounts of olivine andesite, agglomerate, and basaltic sedimentary rock. Gravel beds consist of boulders and cobbles derived chiefly from local bedrock. Locally gravel is crudely bedded and cemented by lime. In one locality, thin bed of rhyolitic tuff intercalated between flows. Some flows more than 50 feet thick. Thickness about 1,400 feet along northern boundary of Mingus Mountain quadrangle, Jerome area. Erosion has removed top of formation in Jerome area. Unconformably underlies Verde formation; overlies Supai formation.

R. E. Lehner, 1958, U.S. Geol. Survey Bull. 1021–N, p. 549–556, pls. 45, 46, 47. In Clarkdale quadrangle, formation consists of much more volcanic than sedimentary rocks. Well exposed on Woodchute Mountain where there are about 1,400 feet of volcanic flows plus about 50 feet of gravel in minor channels at base of flows. Older than Perkinsville formation (new).

B. E. Sabels, 1960, Dissert. Abs., v. 21, no. 3, p. 596. Late(?) Miocene.

Named from exposures on Hickey Mountain, an upland area contiguous to Mingus Mountain, Jerome area, Yavapai County. Typically exposed on Mingus Mountain, but name Mingus preoccupied.

Hickman Group[1]

Pleistocene: Southwestern Kentucky.

Original reference: R. H. Loughridge, 1888, Kentucky Geol. Survey Rept. Jackson's Purchase Region, p. 37–41.

Named for bluffs of Mississippi River at Hickman, Fulton County, and to the south.

Hickory Sandstone Member (of Oil Creek Formation)

Ordovician: Oklahoma.

C. C. Branson, 1957, Oklahoma Geology Notes, v. 17, no. 11, p. 107. Abandoned by Oklahoma Geological Survey. Name used by Edson (1935, Am. Assoc. Petroleum Geologists Bull., v. 19, no. 8, p. 1127) for member at base of Oil Creek formation. Name preoccupied. No replacement of preoccupied name made, and none seems necessary.

Northeastern flank of Arbuckle Mountains.

Hickory Sandstone Member (of Riley Formation)

Hickory Sandstone[1]

Upper Cambrian: Central Texas.

Original reference: T. B. Comstock and E. T. Dumble, 1890, Texas Geol. Survey 1st Ann. Rept. p. lxi, 285, pl. 3.

P. E. Cloud, Jr., V. E. Barnes, and Josiah Bridge, 1946, Texas Univ. Bur. Econ. Geology Pub. 4301, p. 154 [1945]. Rank reduced to member status in Riley formation (new). Basal member of formation. Sandstone is noncalcareous, and color varies through different shades of brown. Upper boundary is placed at change from calcareous to noncalcareous sandstone. This restricts the member vertically as some quite sandy beds are thus allotted to overlying Cap Mountain limestone member. Thickness in Johnson City area 335 feet.

P. E. Cloud, Jr., and V. E. Barnes, 1948, Texas Univ. Bur. Econ. Geology Pub. 4621, p. 27, 29, 253 [1946]. In Riley Mountains, member rests nonconformably on varied but mostly dark and schistose metasedimentary rocks of Precambrian Packsaddle schist.

Named for Hickory Creek, Llano County.

Hickory Creek Shale[1] Member (of Plattsburg Formation)

Pennsylvanian (Missouri Series): Eastern Kansas, northwestern Missouri, and southeastern Nebraska.

Original reference: R. C. Moore, 1932, Kansas Geol. Soc. 6th Ann. Field Conf., Guidebook, p. 93, 97.

G. E. Condra, 1949, Nebraska Geol. Survey Bull. 16, p. 33. Thickness in Nebraska 1 to 3 feet or more; in Kansas 1 foot in a few places to maximum locally of 15 feet or more. Underlies Spring Hill limestone member; overlies Merriam limestone member. Type locality stated.

Type locality: In railroad cut near center east side sec. 14, T. 15 S., R. 23 E., southern Johnson County, Kans.

Hickory Ridge Member (of Oneota Formation)

Lower Ordovician: Southwestern Wisconsin.

G. O. Raasch, 1952, Illinois Acad. Sci. Trans., v. 45, p. 86–87, 89 (fig. 3), 92–93. Lower 35 to 40 feet of Oneota formation comprise natural unit that can be subdivided into two members and these further subdivided into a number of distinctive strata herein designated by numbers 1 to 9. Below base of stratum 4 (Chiton stratum), dolomites are for the most part arenaceous and are interbedded with sandstones, whereas little sand occurs above. On this basis, the unit is divided into Hickory Ridge member below and Mound Ridge member above. All oolite is confined to Hickory Ridge member, and "chitons" and most of chert are in Mount Ridge member. Overlies Sunset Point formation. Average thickness 24 feet. Fossils rare, but trilobite *Symphisurina* and small planospiral gastropods present locally.

Type section: Quarry and Mississippi bluff in NE¼SE¼ sec. 32, T. 13 N., R. 7 W., Stoddard quadrangle, 1 mile south of Genoa, Vernon County.

Hicks cyclothem (in McLeansboro Group)

Hicks cyclothem (in Modesto Formation)

Pennsylvanian: Northern Illinois.

C. L. Cooper, 1946, Illinois Geol. Survey Bull. 70, p. 12, 16 (fig. 2). Pennsylvanian succession between Gimlet and La Salle cyclothems, exposed in upper Illinois valley, contains several prominent but thin limestones which are basis for recognition of incomplete cyclothems to which names (ascending), Turner, Hicks, and Hall, have been applied by H. B. Willman.

H. R. Wanless and Raymond Siever, 1956, Illinois Geol. Survey Circ. 217, p. 11, pl. 1. Includes Hicks limestone. Type locality given.

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 52 (table 2), pl. 1. In Modesto formation (new). Occurs above Trivoli cyclothem and below Hall clothem. Presentation of new rock-stratigraphic classification of Pennsylvanian strata in Illinois; cyclical classification is independent of rock-stratigraphic classification.

Type locality: NW¼SW¼ sec. 33, T. 16 N., R. 11 E., Bureau County.

Hicks Formation[1]

Upper Cambrian: Western Utah.

Original reference: T. B. Nolan, 1930, Washington Acad. Sci. Jour., 5th, v. 20, no. 17, p. 421–432.

C. B. Bentley, 1958, Brigham Young Univ. Research Studies, Geology Ser., v. 5, no. 6, p. 17–18, 53–54. Thickness in Deep Creek Range 599 feet. Underlies Dunderberg shale; overlies Lamb dolomite. Because of lithic similarities and age relationships, it is recommended that Orr formation and underlying Weeks limestone be extended to other areas of similar lithology in preference to Hicks and Lamb formations.

K. F. Bick, 1959, Am. Assoc. Petroleum Geologists Bull., v. 43, no. 5, p. 1067. Evidence indicates that an unconformity is not present at top of Hicks formation; rather the Hicks thins depositionally, and the Cambro-Ordovician boundary lies within the Chokecherry dolostone.

Named for exposures in Hicks Gulch, in North Pass Canyon, Gold Hill district.

Hicks Limestone (in McLeansboro Formation)

Hicks Limestone (in McLeansboro Group)

Pennsylvanian: Northern Illinois.

R. C. Moore and others, 1944, Geol. Soc. America Bull., v. 55, no. 6, chart 6 (column 29). Shown on correlation chart as limestone in McLeansboro formation. Occurs below Hall limestone (new) and above Turner limestone (new).

H. R. Wanless and Raymond Siever, 1956, Illinois Geol. Survey Circ. 217, p. 11, pl. 1. Shown on correlation chart as limestone in McLeansboro group. Included in Hicks cyclothem. Type locality given.

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 38. Discontinued. Name Hicks preempted. No new name proposed.

Type locality: NW¼ SW¼ sec. 33, T. 16 N., R. 11 E., Bureau County.

Hidalgo Volcanics (in Bisbee Group)

Lower Cretaceous: Southwestern New Mexico.

S. G. Lasky, 1938, Am. Assoc. Petroleum Geologists Bull., v. 22, no. 5, p. 532, figs. 2, 4; 1947, U.S. Geol. Survey Prof. Paper 208, p. 20–21, pl. 1. Consists primarily of basaltic lava flows. Breccia common at the base in Little Hatchet Mountains, and a little pyroclastic material present at other horizons. Locally contains 200 feet of thin-bedded light-gray and red limestone, red and green shale, and some conglomeratic layers. Exposed thickness ranges from 900 to 5,000 feet, the wide range being due to disconformities at top and bottom. Underlies Howells Ridge formation (new); overlies Ringbone shale (new) and Broken Jug limestone (new). Trinity age.

Named from Hidalgo County, over which the formation seems to be widely distributed. In Eureka district of Little Hatchet Mountains.

Hidden Falls Member (of Platteville Formation)

Middle Ordovician: East-central Minnesota.

M. P. Weiss and W. C. Bell, 1956, Geol. Soc. America Guidebook for Field Trips Minneapolis Mtg., Field Trip 2, p. 58 (table 1), 60–61. Name applied to the argillaceous dolomitic limestone unit at about the middle of the Platteville in the Twin Cities area, where it is about 6 feet thick; includes bentonite or bentonitic shale at top. Thins to the east, grades into Magnolia lithology, and is not present at Ellsworth, Wis.; extends as far south as Faribault, where it is 17 inches thick, and Cannon Falls, where it is about 8 feet thick and is overlain directly by the Carimona member. In Twin Cities area, underlies Magnolia member and overlies Mifflin member.

R. E. Sloan, 1956, Am. Assoc. Petroleum Geologists Bull., v. 40, no. 12, p. 2955–2956. Formal proposal of name. Type section designated.

Type section: In Hidden Falls Park on Mississippi River half a mile south of Ford Motor Co. plant in St. Paul, Ramsey County.

Hidden Treasure Limestone[1]

Lower Mississippian: Central northern Utah.

Original reference: F. M. Wichman, 1920, Eng. Mining Jour., v. 110, no. 12, p. 563.

Probably named for Hidden Treasure mine, Ophir district.

Hidden Valley Dolomite

Silurian and Lower Devonian: Southern California.

J. F. McAllister, 1952, California Div. Mines Spec. Rept. 25, p. 3, 14 (fig. 6), 15, pl. 1, 2, 3. Uniformly consists of dolomite but contains nodular chert near base and a little silt and sand near top. In lowest and highest units dolomite is medium gray and weathers light olive gray and yellowish gray; middle is light gray or creamy; chert is light gray or light brown and weathers to dark brown; contains silicified fossils. Thickness 1,365 feet at type locality and in Andy Hills. Underlies Devonian Lost Burro formation (new); overlies Ely Springs dolomite. Lower fossiliferous part of Hidden Valley is Silurian; near upper boundary of formation is a 50-foot zone containing Lower Devonian fossils. Thus Silurian-Devonian boundary falls within uppermost part of the Hidden Valley; the persistent lithologic change is above the Lower Devonian fossils, and this distinctive formational boundary has been mapped over a broad area.

J. F. McAllister, 1955, California Div. Mines Spec. Rept. 42, p. 9 (fig. 3), 12, pl. 2. In Ubehebe Peak quadrangle, underlies Lippincott member (new) of Lost Burro formation.

Type locality: On eastern flank of mountain about 2½ miles north of Ubehebe Peak, and about three-fourths mile west of the road in Racetrack Valley. Named for good exposure on eastern side of Hidden Valley, about 3 miles east-southeast from bench mark 5980 near Lost Burro Gap, northern Panamint Range, Inyo County.

Higginsville Limestone Member (of Fort Scott Limestone)

Pennsylvanian (Des Moines Series): Western Missouri, southwestern Iowa, southeastern Kansas, and northeastern Oklahoma.

L. M. Cline, 1941, Am. Assoc. Petroleum Geologists Bull., v. 25, no. 1, p. 26–27 (fig. 2), 36, 63. Proposed for upper limestone of Fort Scott formation. Traced into Appanoose County, Iowa.

J. M. Jewett, 1941, Kansas Geol. Survey Bull. 38, p. 308, 309. Overlies Little Osage shale member (new). Underlies Labette shale. Average thickness in Kansas about 16 feet.

F. C. Greene, 1949, Missouri Geol. Survey and Water Resources Rept. Inv. 11, p. 6. Overlies Flint Hill sandstone bed (new) in Little Osage member of Fort Scott.

R. D. Alexander, 1954, Oklahoma Geol. Survey Circ. 31, p. 14, 16 (fig. 2). Reaches maximum thickness of 35 feet in Craig County and passes into shale in western Rogers County.

H. G. Hershey, and others, 1960, Iowa Highway Research Board Bull. 15, p. 33, fig. 5. Medium gray, finely crystalline, and massive. Somewhat more fossiliferous to southeast than in Madison County. Thickness 2 feet in Appanoose County; 1 foot in Madison County. Shale section underlies Higginsville; in Appanoose County, carbonaceous shale is found immediately below the limestone; in Madison County, this shale is reddish brown and contains large ostracodes. Shale interval between Higginsville and overlying Houx limestone member is about 15 feet in Appanoose and about 7 feet in Madison County.

Well exposed east of Higginsville, Lafayette County, Mo.

Higham Grit[1]

Triassic(?): Southeastern Idaho, northeastern Utah, and western Wyoming.

Original reference: G. R. Mansfield, 1915, Washington Acad. Sci. Jour., v. 5, p. 492.

J. S. Williams, 1945, Am. Jour. Sci., v. 243, no. 9, p. 473, 475–476, fig. 2. Use extended southward to Park City area and as far east as upper Weber River section, Utah, to replace part of Ankareh shale which is stratigraphically restricted.

G. R. Mansfield, 1952, U.S. Geol. Survey Prof. Paper 238, p. 17, 34, pl. 1. Mapped as Higham grit in Ammon and Paradise Valley quadrangles, Idaho. Underlies Deadman limestone; overlies Timothy sandstone. Type locality designated.

Bernhard Kummel, 1954, U.S. Geol. Survey Prof. Paper 254–H, p. 179–181, fig. 18. Timothy sandstone, Higham grit, Deadman limestone, and Wood shale are each distinct lithologically and are equivalent to Ankareh formation of Wasatch and Uinta Mountains and of western Wyoming. In present report, the Timothy is considered uppermost member of Thaynes formation. The Higham unconformably overlies Timothy sandstone member. Higham grit and Deadman limestone are recognized as independent formations, but Wood shale is considered westward extending tongue of Ankareh. Thickness of 105 feet at Cokeville, Sublette Range, Wyo. Age shown on table as Upper Triassic.

W. F. Scott, 1959, Intermountain Assoc. Petroleum Geologists Guidebook 10th Ann. Field Conf., p. 104. Discussion of stratigraphy of Triassic sequence in Wasatch and western Uinta Mountains. The thin conglomeratic sandstone unit above Ankareh formation in this area is litho-stratigraphic equivalent of Higham grit of southeastern Idaho and Shinarump(?) conglomerate of eastern Uinta Mountains. Use of names Higham and Gartra to refer to this unit in this region ignores rule of priority. Older name Shinarump conglomerate is recommended.

Type locality: Higham Peak, from which unit takes its name, in sec. 23, T. 3 S., R. 37 E., about 4 miles west of Paradise Valley quadrangle, Idaho.

†High Bluff Blue Sands[1]

Upper Cretaceous (Gulf Series): Southwestern Arkansas.

Original reference: R. T. Hill, 1888, Arkansas Geol. Survey Ann. Rept. 1888, v. 2, p. 72, 75–77, 188.

Named for exposures in High Bluff of Ouachita River, 1½ miles northeast of Arkadelphia, Clark County.

†High Bluff Greensand[1]

Upper Cretaceous (Gulf Series): Southwestern Arkansas.

Original reference: R. T. Hill, 1888, Arkansas Geol. Survey Ann. Rept. 1888, v. 2, p. 72–75, 188.

Named for exposures in High Bluff of Ouachita River, 1½ miles northeast of Arkadelphia, Clark County.

High Bluff Member (of Pendleton Formation)

Eocene, lower: Northwestern Louisiana and northeastern Texas.

Richard Wasem and L. J. Wilbert, Jr., 1943, Jour. Paleontology, v. 17, no. 2, p. 184 (fig. 4), 186, 187. Consists of basal section of fossiliferous glauconitic sand overlain by sand containing calcareous concretions. These sands grade upward into about 65 feet of thin-bedded lignitic silts and sands: uppermost 30-foot part consists of crossbedded sands. Approximately 130 feet thick. Overlies Slaughter Creek member (new); underlies Pierson [Pearson] glauconite bed (new) in Sabinetown formation.

Typically exposed at High Bluff on Sabine River, Sabine Parish, La. Traced from Geneva, Tex., to Hagewood, Natchitoches Parish, La.

High Bridge Gneiss[1]

Precambrian: New York.

Original reference: R. P. Stevens, 1867, New York Lyc. Nat. History Annals, v. 8, p. 116–120.

Along southern shore of Spuyten-Duyvel Creek and Harlem River.

High Bridge Limestone[1] or Group

Middle Ordovician: Central Kentucky.

Original reference: M. R. Campbell, 1898, U.S. Geol. Survey Geol. Atlas, Folio 46, p. 2.

A. C. McFarlan, 1943, Geology of Kentucky: Lexington, Ky., Kentucky Univ., p. 12–13; D. K. Hamilton, 1948, Econ. Geology, v. 43, p. 40–41. High Bridge group comprises (ascending) Camp Nelson, Oregon, and Tyrone limestones.

J. L. Rich, 1951, Geol. Soc. America Bull., v. 62, no. 1, p. 18. Refers to High Bridge limestone, with Camp Nelson, Oregon, and Tyrone members.

Named for exposures at High Bridge (Highbridge), Jessamine County.

High Cascade series

Pliocene, Pleistocene, and Recent: Northern California and Oregon.

Eugene Callaghan, 1933, Am. Geophysical Union Trans., p. 243–249. Discussion of volcanic sequence in Cascade Range in Oregon. Cascade Range south of Mount Hood divided into two parts, Western Cascades and High Cascades, on basis of pronounced unconformity in stratigraphic sequence of lavas. Rocks that form the High Cascades are characterized by large mass of gray olivine basalt, large cones composed mainly of hypersthene andesite, rhyolite and pyroclastics, and small cones, some of them quite recent, of andesite, calcic andesite, and basalt.

Howel Williams, 1949, California Div. Mines Bull. 151, p. 35–49. Most of Macdoel quadrangle occupied by volcanic rocks. These belong to two series: first, the Western Cascade series, Eocene to Miocene, and second, High Cascade series of Pliocene, Pleistocene, and Recent age. Named units in area include Plutos Cave, Butte Creek, Alder Creek, Whaleback, and Copco basalts and Goosenest flows.

High Falls Shale[1] or Formation[1]

Upper Silurian: Eastern New York, northern New Jersey, and northeastern Pennsylvania.

Original reference: C. A. Hartnagel, 1905, New York State Mus. Bull. 80, p. 342–357.

Freeman Ward, 1938, Pennsylvania Geol. Survey, 4th ser., Bull. G–10, p. 4, 5 (fig. 2), 6–7. High Falls formation mapped in Pennsylvania below Delaware Water Gap. Overlies Shawangunk formation; underlies Cayuga group (formation). High Falls (synonymous with Bloomsburg red beds) is shaly but contains some sandstone. Predominantly red with some dull greenish beds. Occurs in wide band on northern and lower slopes of Kittatinny Mountain.

Well exposed on farm of Patrick Winn at High Falls, Ulster County, N.Y.

Highgate Formation

Highgate Slate[1]

Lower Ordovician: Northwestern Vermont.

Original reference: Arthur Keith, 1923, Am. Jour. Sci., 5th ser., v. 5, p. 114–115.

Charles Schuchert, 1937, Geol. Soc. America Bull., v. 48, no. 7, p. 1015, 1021, 1047, 1048, 1070–1074. Referred to as formation. In type area, a tectonic limestone breccia underlies the limestones and slates. Hungerford formation named to distinguish some beds formerly included in this formation. Lower Ordovician. Type locality cited.

A. B. Shaw, 1958, Geol. Soc. America Bull. 69, no. 5, p. 523 (table 1), 532 (fig. 5), 550–553, pl. 1. Keith's first description of Highgate included rocks now assigned to Highgate as well as parts of Gorge formation, Hungerford slate, and Skeels Corners slate. Schuchert included certain Morses Line slates in Highgate. Formation, as herein defined, includes beds named Grandge slate by Schuchert. Beds exposed below Highgate Falls (Schuchert's type area) are now included in Gorge formation; hence, new type locality is designated. Lowest Highgate beds lie above Highgate Falls thrust in north and east walls of Highgate Gorge. These beds were inaccurately called Upper Gorge formation by Shaw (1951, Jour. Paleontology, v. 25; 1953, Jour. Paleontology, v. 27). Several angular unconformities present in formation. Section consists of lower limestone unit 500 to 1,000 feet thick; middle shaly unit about 1,500 feet thick and an upper conglomerate and limestone. These units are gradational vertically through several hundred feet. Overlies Gorge formation; underlies Morses Line formation.

Type locality (Shaw): Series of outcrops above Highgate Falls thrust and on western edge of Highgate Center. Formation lies in strip ½ to 1 mile wide trending about N. 20° E., from type locality. Type area (Schuchert): Upper sequence in gorge of Missiquoi River at Highgate Falls, Franklin County.

Highgate Springs sequence

See Highgate Springs Series.

Highgate Springs Series[1]

Lower and Middle Ordovician: Northwestern Vermont, and southern Quebec, Canada.

Original references: W. E. Logan, 1863, Geology of Canada: Canada Geol. Survey, p. 273–275, 855–859; H. W. McGerrigle, [1931], Vermont State Geologist 17th Rept., p. 179–192.

Charles Schuchert, 1937, Geol. Soc. America Bull., v. 48, no. 7, p. 1016, 1017. Highgate Springs sequence mentioned in report on Cambrian and Ordovician of northwestern Vermont. Sequence is overthrust by Winooski dolomites. Logan (1863) noted Highgate Springs series consisted of Trenton, Black River, and probably Chazy formations.

Marshall Kay, 1958, Am. Jour. Sci., v. 256, no. 2, p. 65–96. Ordovician rocks at Highgate Springs, Franklin County, Vt., are of a distinctive sequence that outcrops in scattered areas from east of St. Hyacinthe, Quebec, to southwest of St. Albans, Vt., for about 80 miles. Succession has been called Highgate Springs series by McGerrigle, the lower part being Division E of Quebec group of Logan (1863). Term Highgate sequence used in this report to avoid connotation that it is a formal stratigraphic series. At Highgate Springs, Vt., sequence includes Beldens limestone, Carman quartzite, Youngman formation, Isle La Motte limestone, Glens Falls limestone, and Canajoharie shale.

Most complete exposure at Highgate Springs, Franklin County, Vt.

Highland Gneiss[1]

Precambrian: Southeastern New York.

Original reference: D. S. Martin, 1888, Geologic map of New York City and vicinity.

T. W. Fluhr, 1950, New York Acad. Sci. Trans., ser. 2, v. 12, no. 6, p. 182, 185. At Somers, Highlands gneisses have been overthrust on the Inwood limestone, the fault plane dipping at 60° to northwest beneath the Highlands massive. Fordham gneiss has been correlated with the gneisses of the Highlands, but evidence which proves that the gneisses of the Highlands are Precambrian is not necessarily applicable to the Fordham. [Author may or may not have intended to use this term in a formal sense.]

Occurs in Highlands of the Hudson.

Highland Shale Member (of Wellington Formation)

Permian: Central Kansas.

W. A. Ver Wiebe, 1937, Wichita Municipal Univ. Bull., v. 12, no. 5, p. 5–6. Consists of soft clay, predominately greenish, and a few thin beds of claystone. Red clays infrequent in north, more frequent to south. Approximately 45 feet thick. Underlies Slate Creek limestone member (new); overlies Carlton limestone member.

Type locality: Highland Township, T. 22 S., R. 1 E.

Highland Boy Limestone Member (of Bingham Quartzite)[1]

Pennsylvanian: Central northern Utah.

Original reference: A. Keith, 1905, U.S. Geol. Survey Prof. Paper 38, p. 41, map.

C. H. Behre, Jr., 1937, Mining Technology, v. 1, no. 1, Tech. Pub. 767, p. 8. Mentioned in discussion of bedding-plane faults and their economic importance.

Occurs in vicinity of Highland Boy mine, Bingham district.

Highland Church Sandstone

Highland Church Sandstone Member (of Forest Grove Formation)[1]

Mississippian: Northeastern Mississippi.

Original reference: W. C. Morse, 1928, Jour. Geology, v. 36, p. 31–43.

Benjamin Gildersleeve, 1946, Tennessee Valley Authority Rept. 2, p. 8, 13. Referred to as Highland Church sandstone. Thickness 10 to 30 feet.

Forms cliffs about Highland Church, east of Tishomingo City, Tishomingo County.

Highlandcroft Granodiorite (in Highlandcroft Plutonic Series)

Upper Ordovician(?): Northwestern New Hampshire.

Original reference: M. P. Billings, 1935, Geology of Littleton and Moosilauke quadrangles, New Hampshire, p. 25, map.

M. P. Billings, 1937, Geol. Soc. America Bull., v. 48, no. 4, p. 499–500, pl. 1. Map bracket shows Highlandcroft granodiorite above Partridge formation and below Clough conglomerate. Late Ordovician?

Large estate called "Highlandcroft" on St. Johnsbury road, 1½ miles west-northwest of Littleton, located on largest body of this rock in Littleton and Moosilauke quadrangles.

Highlandcroft Plutonic Series

Highland Croft Magma Series [1] or Granodiorite

Upper Ordovician: West-central and northwestern New Hampshire and east-central Vermont.

Original reference: M. P. Billings, 1934, Science, v. 79, no. 2038, p. 55–56.

M. P. Billings, 1937, Geol. Soc. America Bull., v. 48, no. 4, p. 499. Magma series includes Highlandcroft granodiorite in Littleton-Moosilauke area, New Hampshire, Lost Nation quartz monzonite of Percy area, New Hampshire, and Fairlee quartz monzonite of Mount Cube quadrangle, New Hampshire-Vermont.

M. P. Billings, 1956, Geology of New Hampshire, pt. 2, Bedrock geology: Concord, New Hampshire State Plan. Devel. Comm., p. 46–48, 106–107, 121–122, 148, 186–187. Summary discussion. Plutonic series includes diorite, quartz diorite, granodiorite, quartz monzonite, and granite. Many are massive but locally show weak to strong secondary foliation. Rocks assigned to series correlated chiefly on basis of lithologic similarity. Type area given.

Type area: Body of plutonic rocks 2 miles northwest of Littleton, Grafton County, N.H. Named from a large farm about 1½ miles west-northwest of Littleton.

Highland Mills Member (of Esopus Formation)

Lower Devonian: Southeastern New York.

A. J. Boucot, 1959, Jour. Paleontology, v. 33, no. 5, p. 728, 731 (fig. 2), 732–733. Name applied to strata that overlie Connelly conglomerate and grade up into middle member (unnamed) of Esopus formation. Consists of interbedded yellow to gray sandstone and dark-gray shale. Sandstone beds thicken and thin rapidly and are not continuous along strike. Basal bed is layer of dark-bluish-gray paper-thin shale which makes abrupt contacts with Connelly conglomerate below and with sandstone above. Fossiliferous. Thickness about 50 feet.

Type section: West side of Thruway cut at Highland Mills, Orange County. Member is known definitely only in this vicinity. Section is located on eastern side of Green Pond-Schunemunk Mountain outlier.

Highland Peak Limestone[1]

Middle and Upper Cambrian: Eastern Nevada.

Original references: L. G. Westgate and A. Knopf, 1927, Am. Inst. Min. and Met. Engrs. Trans. 1647, p. 6; 1932, U.S. Geol. Survey Prof. Paper 171.

H. E. Wheeler and D. W. Lemmon, 1939, Nevada Univ. Bull., Geology and Mining Ser., no. 31, p. 33, 37–42, 45–47, fig. 10. Described in detail in Pioche district. Composite section given; parts derived from north end of Bristol Range in vicinity of Bristol mine; hills northeast of Panaca; west side of Highland Range in vicinity of Comet Peak. Seventeen lithologic units described (designated by letters A to Q). Total thickness 4,080 feet. Overlies Chisholm shale; underlies Mendha limestone. Middle and Upper Cambrian.

H. E. Wheeler, 1940, Nevada Univ. Bull., Geology and Mining Ser., no. 34, p. 12 (fig. 2), 13–14, 17–33. Two unconformities occur in lower part of Highland Peak as originally defined. Hence, Highland Peak is herein restricted to exclude units named (ascending) Peasley and Burrows. Base of restricted formation coincides with base of Highland Peak unit C, as defined by Wheeler and Lemmon (1939). Thickness as restricted about 3,325 feet.

H. E. Wheeler, 1948, Nevada Univ. Bull., Geology and Mining Ser., no. 47, p. 36–37, 42–43, fig. 5. Further restricted; includes only units H to Q of Wheeler and Lemmon (1939). Unit C is herein named Burnt Canyon limestone; units D–E and F–G are same as Dome and Swasey formations, respectively, of House Range, Utah. These names are extended into Nevada.

R. H. Robison, 1960, Intermountain Assoc. Petroleum Geologists Guidebook 11th Ann. Field Conf., p. 50 (fig. 4). In Pioche district, overlies Whirlwind formation (new). Restricted to Wheeler's units C-K.

Named for exposures on western slope of Highland Peak, in Highland Range, Pioche district.

High Park Lake Beds[1]

Miocene, upper, or Pliocene: Eastern Colorado.

Original reference: W. Cross, 1894, U.S. Geol. Survey Geol. Atlas, Folio 7.

Named for High Park, Pikes Peak region.

†High Point Sandstone[1]

Upper Devonian: West-central and southwestern New York.

Original references: H. S. Williams (High-point beds), 1883, Am. Jour. Sci., 3d ser., v. 25, no. 136, p. 100, 101; J. M. Clarke, 1885, New York State Geol. Rept. 1884, p. 22, map; 1885, U.S. Geol. Survey Bull. 16.

W. H. Bradley and J. F. Pepper, 1938, U.S. Geol. Survey Bull. 899–A, p. 15. Nunda sandstone overlies West Hill formation. Luther (1902, New York State Mus. Bull. 52) traced this sandstone from its type locality at Nunda eastward into Naples quadrangle and showed that it is same sandstone as that which caps High Point, a hill 2½ miles northwest of Naples. Name Nunda is used in this report [southwestern New York] in place of High Point sandstone (discarded) which Clarke and Luther (1904, New York State Mus. Bull. 63) later used in Canandaigua and Naples quadrangles.

Named for exposures on summit of High Point, in Naples, highest mountain in Ontario County.

High Rock Sandstone[1]

Pennsylvanian: Southwestern Indiana.

Original reference: G. H. Ashley, 1899, Indiana Dept. Geology and Nat. Resources 23d Ann. Rept. 1898, p. 113.

Daviess and Greene Counties.

High Rock Sandstone[1]

Pennsylvanian: Southeastern Kentucky.

Original reference: I. B. Browning and P. G. Russell, 1919, Kentucky Geol. Survey, 4th ser., v. 5, pt. 2, p. 15.

Named because it is found on several high points exposed in cliffs called High Rocks by natives.

High Tower Granite[1]

Cambrian(?): Northwestern Georgia.

Original reference: W. S. Bayley, 1928, Georgia Geol. Survey Bull. 43, p. 37, map.

G. W. Crickmay, 1952, Georgia Geol. Survey Bull. 58, p. 43. Name Hightower was applied by Bayley (1928) for granite in northwestern Forsyth County, but may be appropriately used for granite gneiss on southwestern side of Ashland belt in Dawson, Lumpkin, and White Counties. Intrusive into Carolina series.

Well developed around Hightower, Forsyth County.

Highway Limestone

Middle Pennsylvanian: North-central Nevada.

H. G. Ferguson, R. J. Roberts, and S. W. Muller, 1952, Geology of the Golconda quadrangle, Nevada: U.S. Geol. Survey Geol. Quad. Map [GQ-15]. Described as massive light-gray limestone. In places cherty near base; thin pebbly and sandy layers throughout. Thickness at type locality 200 feet. Overlies Battle formation at some localities; other places, overlies Preble formation with angular unconformity. Underlies Antler Peak limestone. Lower Pennsylvanian.

R. J. Roberts and others, 1958, Am. Assoc. Petroleum Geologists Bull., v. 42, no. 12, p. 2842. Highway limestone, about 200 feet thick, in Osgood and Edna Mountains, is facies of Battle formation composed of limestone and some interbedded conglomerate and calcareous clastics. Middle Pennsylvanian.

Type locality: East flank of Edna Mountain, north of Highway 40.

Highwood Syenite[1]

Eocene(?): Central northern Montana.

Original reference: W. H. Weed, 1899, U.S. Geol. Survey Geol. Atlas, Folio 55.

Southern part of Highwood Peak, Fort Benton quadrangle.

Hignite Formation (in Breathitt Group)

Hignite Formation (in Pottsville Group)[1]

Middle Pennsylvanian: Southeastern Kentucky and northeastern Tennessee.

Original reference: G. H. Ashley and L. C. Glenn, 1906, U.S. Geol. Survey Prof. Paper 49, p. 33, 43, pl. 40-A.

H. R. Wanless, 1946, Geol. Soc. America Mem. 13, p. 7, passim. Underlies Bryson formation; overlies Catron formation. Includes Reynolds sandstone member.

U.S. Geological Survey currently classifies the Hignite as a formation in Breathitt Group on the basis of a study now in progress. Term Pottsville Group not used in Kentucky.

Named for Hignite Creek, near Middlesboro, Bell County, Ky.

Hiirippo (Hirippo) Limestone

Aquitanian: Mariana Islands (Rota).

Risaburo Tayama, 1939, Correlation of the strata of the South Sea Islands: Geol. Soc. Japan Jour., v. 46, no. 549, p. 346 (correlation chart) [English translation in library of U.S. Geol. Survey]. Named on correlation chart. Correlated with Tapotchau limestone on Saipan and Raso limestone on Tinian. Miocene.

Risaburo Tayama, 1952, Coral reefs in the South Seas: Japan Hydrog. Office Bull., v. 11, p. 54, table 4 [English translation in library of U.S. Geol. Survey, p. 65]. Oligocene.

S. Hanzawa *in* Jacques Avias and others, 1956, Lexique Strat. Internat., v. 6, Océanie, fasc. 2, p. 39. The Hiirippo consists of pinkish hard compact limestone, red sandy limestone, and calcareous sandstone. Overlies Taihanom and Mariiru limestones. Aquitanian. Refers to S. Sugawara (unpub. ms., 1939) and K. Asano (1939, Jubil. Pub. Yabe's 60th Birthday).

Typically exposed in Hiirippo, Rota Island.

Hilina Volcanic Series

Pleistocene(?): Hawaii Island, Hawaii.

H. T. Stearns and G. A. Macdonald, 1946, Hawaii Div. Hydrography Bull. 9, p. 102, pls. 1, 20A. Comprises lava flows and pyroclastics laid down by Kilauea volcano prior to deposition of Pahala ash. At type locality, 1,000 feet of thin-bedded basalts and thin vitric tuff beds are capped by 30 feet of Pahala ash. Lowest tuff bed is 200 feet above base of cliff, and numerous thin tuff beds crop out between it and the top. Base not exposed. Series was formerly mapped as Pahala basalt, but name Pahala herein restricted to persistent ash formation.

D. A. Davis and G. A. Macdonald *in* Jacques Avias and others, 1956, Lexique Strat. Internat., v. 6, Océanie, fasc. 2, p. 89. Pleistocene(?).

Type locality: At Hilina Pali on south slope of Kilauea. Also exposed in windows in faces of fault cliffs on southern slope of Kilauea.

Hillabee Chlorite Schist[1]

Post-Carboniferous: Eastern Alabama.

Original reference: W. M. Brewer, 1896, Alabama Geol. Survey Bull. 5, p. 84, 89, 92.

E. W. Heinrich and J. C. Olson, 1953, U.S. Geol. Survey Prof. Paper 248–G, p. 404. Mentioned in discussion of mica deposits of southeastern Piedmont. Considered to be post-Carboniferous.

Named for exposures at Hillabee, on Hillabee Creek, Clay County.

Hill Creek Beds or Member (of Lazy Bend Formation)

Hill Creek Beds or Member (of Millsap Lake Formation)[1]

Pennsylvanian: North-central Texas.

Original reference: E. H. Sellards, 1933, Texas Univ. Bull. 3232, p. 106, 107. From manuscript report by G. Scott and J. M. Armstrong on geology of Parker County.

W. E. Russell, 1956, Soc. Econ. Paleontologists and Mineralogists, Permian Basin sec. [Guidebook] Spring Mtg. and Field Symposium May 11–12, p. 19–27. Referred to as Hill Creek beds in Lazy Bend formation.

Leo Hendricks, 1957, Texas Univ. Bur. Econ. Geology Pub. 5724, p. 13–16, pl. 1. Member of Lazy Bend formation. Consists of 277 feet of beds between base of Dennis Bridge limestone bed and top of Meek Bend limestone bed. Underlies Steussy shale member; overlies undifferentiated Pennsylvanian beds. Type section designated; derivation of name given.

Type section: Section measured across the strike south of Brazos River, Parker County. Outcrop of beds extends to Cretaceous on either side of Brazos River and from bridge at Dennis westward to a scarp west of Hill Creek. Name derived from Hill Creek, a small tributary flowing from southwest into Brazos River at point about midway of outer curve of Lazy Bend of river.

Hillen facies

See **Ludlow Member** (of Fort Union Formation).

Hilliard Formation[1] **or Shale**

Upper Cretaceous: Southwestern Wyoming and northeastern Utah.

Original reference: W. C. Knight, 1902, Eng. Mining Jour., v. 73, p. 721.

R. H. Peterson, D. J. Gauger, and R. R. Lankford, 1953, Utah Geol. and Mineralog. Survey Bull. 47, p. 16 (fig. 4), 17–18. Near Evanston, Wyo., Hilliard formation consists of 5,500 to 6,800 feet of gray to black sandy shales and shaly sandstones. Lenses of white sandstone 3,000 to 3,800 feet occur above base of formation. Overlies Frontier formation; underlies Adaville formation.

W. R. Hansen and M. G. Bonilla, 1954, Colorado Sci. Soc. Proc., v. 17, no. 1, p. 4 (fig. 1), 9, 10. Geographically extended into Daggett County, Utah, where it is 6,300 feet thick in Flaming Gorge area; underlies Blair formation and overlies Frontier formation. In Clay Basin, replaces Blair formation and intertongues with overlying Rock Springs formation.

W. R. Hansen, 1957, U.S. Geol. Survey Geol. Quad. Map GQ–101. In Clay Basin quadrangle, Utah, described as chiefly dark-gray soft silty, somewhat gypsiferous shale about 6,200 feet thick. Only upper part crops out in area. Intertongues with overlying Mesaverde group, contact with Rock Springs formation mapped arbitrarily.

Typical section: Shale beds west of Kemmerer, Lincoln County, and extending as far as east portal of Oregon Short Line tunnel, Wyoming. Town of Hilliard located on formation.

Hillier Member (of Cobourg Formation)

Middle Ordovician (Mohawkian): Ontario, Canada, northern Michigan, and western New York.

G. M. Kay, 1937, Geol. Soc. America Bull., v. 48, no. 2, p. 280–281, pl. 4. Upper Cobourg limestone of earlier reports. Light-gray marly limestones in central Ontario and northern Michigan; darker colored limestone with shaly interbeds in New York and southeastern Ontario. Near the base, beds are argillaceous limestones in contrast to massive and resistant crystalline limestones at top of underlying Hallowell member (new); transition zone is 20 feet thick. Thickness 60 to 70 feet; thins rapidly in Lewis County, N.Y. Underlies Collingwood formation in central Ontario with transitional contact; disconformably underlies Deer River shales in northwestern New York.

Exposed for several miles along northern shore of Lake Ontario, west of Wellington, Hillier Township, Prince Edward County, Ontario. Named for the township.

Hillman Gneissoid Tonalite

Precambrian (late Algoman) : Central Minnesota.

M. S. Woyski, 1949, Geol. Soc. America Bull., v. 60, no. 6, p. 1002, 1009, 1011, pl. 1. Gray; foliated medium granitoid, locally seriate; foliation in part primary mostly from lit-par-lit injection of schist; inclusions and schlieren of Thomson formation common, locally making more than half the rock surface; foliation strongest where inclusions are most abundant. One of five major intrusives in late Algoman; these cannot be shown to be members of a single magma series. Age relations of the named intrusive, St. Cloud gray granodiorite, Hillman tonalite, Freedhem tonalite, and Warman quartz monzonite are indeterminate because no contacts are exposed.

Crops out along Hillman Creek, Morrison County, in vicinity of Skunk and Little Skunk Rivers, and on Rum River.

Hillman Limestone[1]

Pennsylvanian: Northeastern Pennsylvania.

Original reference: C. A. Ashburner, 1886, Pennsylvania 2d Geol. Survey Rept. 1885.

Exposed in cut of Lehigh Valley Railroad, southwest of Hillman Colliery breaker, Luzerne County.

Hill Ridge Biotite Schist (in Tacoma Series)

Cambro-Ordovician(?) : Southwestern Maine.

L. W. Fisher, 1936, Am. Mineralogist, v. 21, no. 5, p. 323. Listed in table of formations. Belongs to Tacoma series (new). Older than Minwah limy gneiss (new) ; younger than Stetson Brook limestone (new).

Occurs in Lewiston area, Androscoggin County.

Hillsboro Plutonic Series

Devonian(?) : Southeastern New Hampshire.

M. P. Billings, 1956, Geology of New Hampshire, pt. 2, Bedrock geology: Concord, New Hampshire State Plan. Devel. Comm., p. 45, 65–69, 186–187. Name given to group of plutonic rocks. Consists of four units: Diorite and granodiorite (including Dracut diorite and Exeter diorite) ; granite, quartz monzonite and granodiorite; Ayer granodiorite; and another granite. Foliation is common. Treated as separate series, but may belong to New Hampshire plutonic series. Has many characteristic features of latter, but ages may be different.

Hillsboro Sandstone[1]

Silurian(?) : Southwestern Ohio.

Original reference: E. Orton, 1871, Ohio Geol. Survey Rept. Prog. 1870, p. 271, 301, 306–307.

J. K. Rogers, 1936, Ohio Geol. Survey, 4th ser., Bull. 38, p. 81–83. Occurs in two types of deposits: bedded sandstone resting on either Niagaran or Greenfield dolomites; masses of sandstone which are cavity fillings enclosed in either Niagaran or Greenfield dolomites. White or yellowish sandstone frequently stained to reddish brown.

Occurs near Hillsboro and a few other localities in Highland County.

Hillsdale Member (of Greenbrier Limestone)

Hillsdale Limestone (in Greenbrier Limestone[1] or Series)

Upper Mississippian: Southeastern West Virginia and southwestern Virginia.

Original reference: D. B. Reger, 1926, West Virginia Geol. Survey Rept. Mercer, Monroe, and Summers Counties, p. 451, 487.

B. N. Cooper, 1944, Virginia Geol. Survey Bull. 60, p. 157–159, pl. 15. Described in Burkes Garden quadrangle where it is about 55 feet thick and overlies Little Valley formation. Name Hillsdale used to replace name St. Louis, used by Butts (1940) for same succession in southwestern Virginia. Some geologists include so-called Warsaw, or Little Valley limestone, in the Hillsdale. Underlies "Ste. Genevieve" limestone.

R. H. Wilpolt and D. W. Marden, 1949, U.S. Geol. Survey Oil and Gas Inv. Prelim. Chart 38, sheet 1. Rank reduced to member status in Greenbrier limestone. Consists of dark-gray grayish-black to black cherty limestone. Lies about 50 to 100 feet below Taggard red member. Equivalent to St. Louis limestone as defined by Butts in southwestern Virginia. Does not extend into northeastern Kentucky. Upper Mississippian (Meramec).

Dana Wells, 1950, Am. Assoc. Petroleum Geologists Bull., v. 34, no. 5, p. 887–902. Hillsdale formation conformably underlies Denmar formation (new) from southern Mercer County to northern end of Pocahontas County. Overlies Maccrady, but nature of contact uncertain.

Type locality: In Monroe County, W. Va., in road just east of Hillsdale, on west limb of Hillsdale anticline.

Hillside Mica Schist

Precambrian (Yavapai Series): West-central Arizona.

C. A. Anderson, E. A. Scholz, and J. D. Strobell, Jr., 1955, U.S. Geol. Survey Prof. Paper 278, p. 1, 7, 11–12, pl. 3. Muscovite schist, quartz-muscovite schist, and muscovite quartzite, representing metamorphosed shale and impure sandstone. Minimum thickness 3,000 to 4,000 feet. Overlies Butte Falls tuff (new) with gradational contact. Intruded by Dick rhyolite and Lawler Peak granite, and Cheney Gulch granite (all new).

Most complete section exposed along Boulder Creek in vicinity of Hillside mine, for which this formation has been named; Bagdad area, Yavapai County.

Hills Pond Peridotite

Cretaceous(?): Southeastern Kansas.

H. C. Wagner, 1954, U.S. Geol. Survey Geol. Quad. Map GQ–49. Name proposed for a medium-grained peridotite; olive gray when fresh, grayish yellow when weathered. Occurs in sill-like intrusive bodies.

Type locality: Five hundred feet east and 100 feet south of center of north line of sec. 32, T. 26 S., R. 15 E., south of pond on Hill Farm in southern Belmont Township, Woodson County.

Hilltop Formation

Pennsylvanian (Missouri Series): Central Oklahoma.

W. F. Tanner, 1953, Am. Assoc. Petroleum Geologists Bull., v. 37, no. 8, p. 2046–2050; 1956, Oklahoma Geol. Survey Bull. 74, p. 6, 84–88, pls. 1, 2. Proposed for those beds in Seminole County that conformably overlie

Belle City limestone and its sandstone equivalents and unconformably underlie Vamoosa formation. Type section is sequence of dark-blue-gray shales grading upward into massive buff siltstones and fine-grained sandstones and containing thin limestone in lower part of formation. In southern part of county (Seminole), red shales or typical blue-gray shales, as much as 70 feet thick, occur locally as erosional remnants between the Belle City and the Vamoosa. Also in this part of county the Hilltop contains, about 22 feet above base, a single multicolored conglomerate of limestone cobbles, clay plates, and chert and jasper pebbles; this bed is white, yellow, and purple. Thickness ranges from featheredge to 200 feet; variations in thickness due primarily to post-Missouri, pre-Virgil erosion.

Type section: In sec. 11, T. 8 N., R. 7 E., in and near Wewoka Brick and Tile Company pit, north side of Wewoka Creek, in sec. 11, T. 8 N., R. 7 E., Seminole County, traced into Pontotoc County where it is truncated by unconformity at base of Ada formation.

Hilton Shale Member (of Portage Formation)[1]

Upper Devonian: Southwestern Virginia and northeastern Tennessee.

Original reference: J. H. Swartz, 1929, Am. Jour. Sci., 5th, v. 17, p. 436–448.

Named for exposures at or near Hilton, Scott County, Va.

Himes Member (of Cloverly Formation)

Lower Cretaceous: Northwestern Wyoming.

Ralph Moberly, Jr., 1960, Geol. Soc. America Bull., v. 71, no. 8, p. 1139 (fig. 1), 1143 (fig. 2), 1148–1149, 1151 (fig. 5), pl. 1. Comprises three principal lithologies: commonly at base is olive-gray and reddish-brown clay matrixed salt- and pepper sandstone; most of member is variegated reddish- and yellowish-brown and gray kaolinitic claystone and mudstone, containing veinlets and hardpans of iron oxides; clean quartz sandstones which filled fluvial channels are laced through the claystones. Thickness at type section 92 feet. Overlies Little Sheep mudstone member (new) with contact marked by channelling in many places and in others, a disconformable relationship, or at least a hiatus; underlies Sykes Mountain formation (new). In this report [northern Bighorn basin], Cloverly formation is redefined on lithogenetic basis.

Type section: Sec. 15, T. 55 N., R. 95 W., on Little Sheep Mountain. Well exposed between Himes and Lovell, Big Horn County.

Hinchman Sandstone[1]

Hinchman Formation

Upper Jurassic: Northern California.

Original reference: J. S. Diller, 1892, Geol. Soc. America Bull., v. 3, p. 370–394.

P. A. Lydon, T. E. Gay, Jr., and C. W. Jennings, 1960, Geologic map of California Westwood sheet (1:250,000): California Div. Mines. Formation consists of metamorphosed fossiliferous andesite tuff and conglomerate. Mapped with Jurassic and (or) Triassic metavolcanic rocks.

Named for exposures at Curtice Cliff, in lower part of Hinchman Ravine, Plumas County.

Hinckley Sandstone (in Keweenawan Group)

Hinckley Sandstone[1] (in Lake Superior Series)

Precambrian: Southeastern Minnesota.

Original reference: N. H. Winchell, 1886, Minnesota Geol. Nat. History Survey 14th Ann. Rept., p. 336–337.

C. R. Stauffer, G. M. Schwartz, and G. A. Thiel, 1939, Geol. Soc. America Bull., v. 50, no. 8, p. 1240–1241. Discussion of St. Croixian series of Minnesota. Hinckley sandstone not considered base of St. Croixian in Minnesota. Mount Simon, basil member of Dresbach, can be distinguished from underlying Hinckley, and over large areas microscopic studies of sedimentary rocks show that both Mount Simon and Hinckley are present between Eau Claire member of Dresbach and Red Clastic series. Atwater and Clement (1935) suggested that term Hinckley be applied only to sandstones that crop out in northeastern Minnesota. There is no structural or petrographic basis for such limitation. Believed in present study that exclusion of Hinckley from the St. Croixian (Stauffer, 1925) and its association with Red Clastic series is correct, but assumption that this implies correlation of Hinckley with Mount Simon (Atwater and Clement, 1935) is not warranted. Recent work indicates Hinckley is equivalent of Devils Island sandstone of Wisconsin.

C. R. Stauffer and G. A. Thiel, 1941, Minnesota Geol. Survey Bull. 29, p. 10, 15–23. Geologic column shows Hinckley sandstone as upper formation in Lake Superior series. Occurs above Fond du Lac beds. Contact with underlying Fond du Lac not exposed in east-central or southeastern Minnesota. Underlies Mount Simon member of Dresbach. Thickness about 102 feet at Sandstone, Pine County. Now that quarry at Hinckley has been abandoned, section at Sandstone is regarded as typical development of the formation.

F. F. Grout and others, 1951, Geol. Soc. America Bull., v. 62, no. 9, p. 1021 (table 3), 1061–1062. Included in upper part of Keweenawan group.

Type section: At Hinckley (T. 41 N., R. 21 W.), Pine County.

Hindostan Whetstone[1] or Beds (in Mansfield Sandstone)

Pennsylvanian: Southwestern Indiana.

Original reference: E. T. Cox, 1871, Indiana Geol. Survey 2d Ann. Rept., p. 81, 105; 1876, Indiana Geol. Survey 7th Ann. Rept., p. 6–8.

F. D. Spencer, 1953, U.S. Geol. Survey Circ. 266, p. 13, 14 (fig. 4). Series of thin fine-grained laminated beds in lower part of Mansfield sandstone.

Named for village which was once county seat of Martin County. Village abandoned since 1870.

Hindsville Limestone

Hindsville Limestone Member (of Batesville Sandstone)[1]

Upper Mississippian: Northern Arkansas, southern Missouri, and eastern Oklahoma.

Original reference: A. H. Purdue and H. D. Miser, 1916, U.S. Geol. Survey Geol. Atlas, Folio 202.

E. B. Branson, 1944, Missouri Univ. Studies, v. 19, no. 3, p. 263–265. Geographically extended into southern Missouri, where, in Cassville quadrangle, it is preserved in a down-faulted area. Essentially light- to dark-gray, fine- to medium-grained oolitic limestone with basal chert pebble conglomerate set in limestone matrix; thin mineral-gray to olive-drab calcareous shales, siltstones, and sandstones distributed irregularly through the limestone. Thickness about 47½ feet. Conformable and in places transitional with overlying Batesville; unconformable on Keokuk limestone and chert with limestone filling depressions in weathered Keokuk.

H. D. Miser and others, 1954, Geologic map of Oklahoma (1:500,000): U.S. Geol. Survey. Mapped as Hindsville limestone.

N. B. Degraffenreid, 1953, Tulsa Geol. Soc. Digest, v. 21, p. 163–165. Term "Grand River" (Brant, 1941) is preoccupied. Further, the "Grand River" limestone has been found to be the equivalent of Hindsville limestone member of Batesville formation of Arkansas. Accordingly, "Grand River" should be suppressed as facies term, and name Hindsville should be applied.

Named for exposure near Hindsville, Eureka Springs quadrangle, Madison County, Ark.

Hinkley Valley Complex

Paleozoic or older: Southern California.

W. J. Miller, 1944, California Jour. Mines and Geology, v. 44, no. 1, p. 77–79. Consists largely of metasediments, mostly crystalline limestone, together with some quartzites and schists; igneous material subordinate. Contact with Hodge complex not distinct, differentation made on basis of igneous material present. Considered oldest known rocks in Barstow and Victorville map areas. Paleozoic or older with early Precambrian most probable.

W. J. Miller, 1946, Geol. Soc. America Bull., v. 57, no. 5, p. 503–504. Faunal evidence indicates age may be wholly Paleozoic.

Named for outcrops in and around Hinkley Valley, Barstow quadrangle. Not recognized in Victorville area.

Hinsdale Formation[1]

Hinsdale Series

Pliocene(?): Southwestern Colorado and northwestern New Mexico.

Original reference: W. Cross, 1911, U.S. Geol. Survey Bull. 478, p. 22, 29, map.

E. S. Larsen, Jr., and Whitman Cross, 1956, U.S. Geol. Survey Prof. Paper 258, p. 11, 192–207, pl. 1. Subdivided into two members: latite basalt and rhyolite. In general, succession from bottom to top is local rhyolite and quartz latite flows and tuffs followed by flows of basalt that form great plateaus. Thickness commonly 200 feet, although latite basalt may be as much as 1,000 feet and rhyolite as much as 2,000 feet. Generally directly overlies older volcanic rocks, but in extreme southern part of Colorado overlies Los Pinos gravel, and some basalts are interlayered with the gravels. In most places, forms the surface rock, but in San Luis Valley and south into New Mexico gravels overlie the basalt.

Fred Barker, 1958, New Mexico Bur. Mines and Mineral Resources Bull. 45, p. 51–52, pl. 1. Hinsdale series redefined to include Cisneros basalt, Dorado basalt, and Servilleta formation (all new). Cisneros basalt overlies Cordito member (new) of Los Pinos formation with slight angular unconformity. [Proposed by Cross as Hinsdale volcanic series.].

Named for exposures in Hinsdale County, Colo.

Hinsdale Gneiss[1]

Precambrian: Connecticut and western Massachusetts.

Original reference: B. K. Emerson in 1892 used Hinsdale gneiss on U.S. Geol. Survey Hawley sheet, that is, proof sheets of geological maps and text intended for geological folio, but never completed and published in that form, although cited in U.S. Geol. Survey Bull. 191, 1902.

Named for occurrence at Hinsdale, Berkshire County, Mass.

+Hinsdale Limestone[1]

Precambrian: Western Massachusetts.

Original reference: B. K. Emerson, 1898, U.S. Geol. Survey Mon. 29, p. 18, 24–26.

Exposed 50 feet west of Hinsdale Station, Berkshire County.

Hinsdale Member (of Chadakoin Formation)

Hinsdale Sandstone[1]

Hinsdale Sandstone (in Conneaut Group or Chadakoin Group)

Upper Devonian: Southwestern New York and northwestern Pennsylvania.

Original reference: G. H. Chadwick, 1933, Pan-Am. Geologist, v. 60, p. 200, 203.

J. G. Woodruff, 1942, New York State Mus. Bull. 326, p. 17 (fig. 4), 33–37. Included in Conneaut group in Wellsville quadrangle, N.Y., where it is about 15 feet thick; overlies Wellsville formation (new), and underlies Whitesville formation (new).

I. H. Tesmer, 1955, New York State Mus. Sci. Service Circ. 42, p. 10 (fig. 1), 16. Rank reduced to member status in Chadakoin formation. Overlies Wellsville member; underlies Whitesville member.

L. V. Rickard, 1957, New York State Geol. Assoc. [Guidebook] 29th Ann. Mtg., p. 17 (table 2), 19. Hinsdale sandstone included in Chadakoin group. Inasmuch as Upper Devonian strata are still not thoroughly understood, a more or less permanent classification satisfactory to a majority of workers may not be obtained for some time.

Type locality: Ed Hull quarry on hill face east of Scott Corners and about 1 mile north of Hinsdale village, Cattaraugus County, N.Y.

Hinshaw sandstone[1]

Upper Cretaceous: Utah.

Original reference: C. R. Keyes, 1924, Pan-Am. Geologist, v. 41, p. 36, 280.

Derivation of name not stated.

Hinton division[1]

Upper Cambrian or Lower Ordovician: Central Texas.

Original reference: T. B. Comstock, 1890, Texas Geol. Survey 1st Ann. Rept., p. 301–306, pl. 3.

Named for Hinton Creek, San Saba County.

Hinton Formation[1] (in Pennington Group)

Hinton Group

Upper Mississippian: Southern West Virginia, eastern Kentucky, and southwestern Virginia.

Original reference: M. R. Campbell and W. C. Mendenhall, 1896, U.S. Geol. Survey 17th Ann. Rept., pt. 2, p. 487.

P. H. Price and E. T. Heck, 1939, Virginia Geol. Survey, Greenbrier County, p. 255–262. Hinton group consists of (ascending) Stony Gap sandstone, unnamed shales, Avis limestone, unnamed shales and sandstones. Thickness 500 to 850 feet. Underlies Princeton group; overlies Bluefield group.

J. M. Weller and others, 1948, Geol. Soc. America Bull., v. 59, no. 2, chart 5 (columns 98, 99). Shown on correlation chart as group. In Randolph County, W. Va., includes (ascending) Stony Gap sandstone, Avis limestone, and Falls Mills sandstone; in southern West Virginia, includes (ascending) Stony Gap sandstone, Payne Branch sandstone, Avis limestone, and Falls Mills sandstone. Chesterian.

R. H. Wilpolt and D. W. Marden, 1949, U.S. Geol. Survey Oil and Gas Inv. Prelim. Chart 38, sheet 1. Upper Mississippian.

L. D. Harris and R. L. Miller, 1958, U.S. Geol. Survey Geol. Quad. Map GQ–111. Assigned to Pennington herein raised to group rank.

R. H. Wilpolt and D. W. Marden, 1959, U.S. Geol. Survey Bull. 1072–K, p. 599–601. Basal formation in Pennington group. The Hinton is identical with Pennington formation as used by Cooper (1944) and with lower half of Pennington of southwestern Virginia as originally defined by Campbell (1896). Traced in surface exposures from Pennington Gap northeastward to Princeton, W. Va., and from Hurricane Gap, in Kentucky, northeastward along Pine Mountain to Blowing Rock Gap. In present report, divided into (ascending) Stony Gap sandstone member, middle red member, limestone member (Avis limestone of Reger), and upper red member. Overlies Bluefield formation; underlies Princeton sandstone.

Named for Hinton, Summers County, W. Va.

†Hinton Limestone (in Hinton Formation)[1]

Mississippian: Southeastern West Virginia.

Original reference: C. E. Krebs, 1916, West Virginia Geol. Survey Rept. Raleigh County, and western portions of Mercer and Summers Counties, p. 75, 76, 88.

Probably named for Hinton, Summers County.

Hinton (Upper) Limestone (in Hinton Formation)[1]

Mississippian: Southeastern West Virginia.

Original reference: C. E. Krebs and D. D. Teets, Jr., 1916, West Virginia Geol. Survey Rept. Raleigh and western parts of Mercer and Summers Counties, p. 167.

Occurs one-half mile southwest of Meadow Creek, Richmond district.

Hinton Sandstone[1]

Mississippian: Southern West Virginia.

Original reference: C. E. Krebs and D. D. Teets, Jr., 1916, West Virginia Geol. Survey Rept. Raleigh and western parts of Mercer and Summers Counties, p. 77.

Occurs at Hinton, Summers County.

Hiram Till

Pleistocene (Wisconsin): Northeastern Ohio and northwestern Pennsylvania

V. C. Shepps and others, 1959, Pennsylvania Geol. Survey, ser. 4, Bull. G-32, p. 10 (fig. 3), 13 (fig. 4), 41–42, pl. 1. Gray to bluish-gray, sparingly pebbly, calcareous, clay to silty clay till deposited during Hiram advance near close of Cary time. Hiram advance preceded by Lavery advance and followed by Ashtabula advance. Name credited to G. W. White (in press).

G. W. White, 1960, U.S. Geol. Survey Bull. 1121–A, p. 2 (table 1), 3 (fig. 1), 8–9. Thickness 10 to 30 feet. Generally underlain unconformably by Kent till. In Portage and Trumbull Counties, Ohio, Windham sand (new) intervenes between tills. Underlies Ashtabula till. Type section designated.

Type section: Northern Hiram Township, in roadcut 100 yards east of Silver Creek and one-half mile east of intersection of east-west road and Hiram-Welshfield Road, 1½ miles north of village of Hiram, Portage County, Ohio.

Hite Bed (in Church Rock Member of Chinle Formation)

Upper Triassic: Southeastern Utah.

J. H. Stewart and others, 1959, U.S. Geol. Survey Bull. 1046–Q, p. 518, 519, 520 (fig. 79). Composed of pale-red and light-greenish-gray very fine grained sandstone and many lenses of pale-reddish-brown siltstone. Thickness 10 to 50 feet. Occurs in upper part of member.

Well developed on exposures about 2 miles south of Hite, San Juan County.

Hitz Limestone Member (of Saluda Limestone)[1]

Hitz Limestone Member (of Whitewater Formation)

Upper Ordovician: Southeastern Indiana and north-central Kentucky.

Original reference: A. F. Foerste, 1903, Am. Geologist, v. 31, p. 347.

James Conkin, 1952, Kansas Acad. Sci. Trans., v. 55, p. 128 (fig. 2), 129, 130. Columnar section (Sleepy Hollow, Oldham County, Ky.) shows Hitz limestone as upper member of Whitewater formation; overlies Saluda limestone member. Thickness 4½ feet; lower 2 feet are silty; upper 2½ feet are dense bird's-eye type, magnesium limestone.

Named for Hitz Hill, near Madison, Jefferson County, Ind. Extends from near Floydsburg, Oldham County, Ky., to southern boundary of Ripley County, Ind.

†Hiwassee Slate[1]

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

Original reference: A. Keith, 1904, U.S. Geol. Survey Geol. Atlas, Folio 116, p. 5.

G. W. Stose and A. J. Stose, 1947, Am. Jour. Sci., v. 245, no. 10, p. 627, 629. In Hot Springs area, North Carolina, name Sandsuck shale is substituted for slate mapped as Hiwassee by Keith.

G. W. Crickmay, 1952, Georgia Geol. Survey Bull. 58, p. 27. Hiawassee [Hiwassee] included in Talladega series believed to be Precambrian.

John Rodgers, 1953, Tennessee Div. Geology Bull. 58, pt. 2, p. 27. Sandsuck shale as mapped northeast of Pigeon River corresponds roughly to what Keith mapped as Hiwassee slate in same area. In its type area along Hiwassee River, Hiwassee slate corresponds roughly to whole fine grained part of Ocoee series, and its correlation with units farther northeast is uncertain.

P. B. King and others, 1958, Geol. Soc. America Bull., v. 69, no. 8, p. 961 Walden Creek group (new) corresponds approximately to Wilhite slate, Citico conglomerate, and Pigeon slate, as mapped by Keith in Knoxville quadrangle (1895, U.S. Geol. Survey Geol. Atlas Folio 16), and also to the more inclusive Hiwassee slate of his later terminology. Name Hiwassee has been used so confusingly that it is properly abandoned.

Named for exposures on Hiwassee River, Polk County, Tenn.

Hoadley Formation

Precambrian (Belt Series) : Northwestern Montana.

Charles Deiss, 1943, Geol. Soc. America Bull., v. 54, no. 2, p. 211, 213 (table 1), 216–217. Dark-green-gray and maroon thick-bedded siliceous argillite and some vitreous fine-grained quartzite overlain by red and buff arenaceous calcareous argillite and fine-grained sandstone which grades upward into greenish-buff-weathering calcareous sandstone and much interbedded pink sandstone and argillite; upper part brilliant- and dark-red soft thin- and thick-bedded platy ripple-marked sandstone interbedded with some pale-red argillite. Overlies Cayuse limestone (new) ; underlies Ahorn quartzite (new). Miller Peak argillite, Cayuse limestone, Hoadley formation, and Ahorn quartzite are equivalent in age to lower and middle part of Missoula group of Clapp and Deiss (1931) in Sapphire and Garnet Ranges.

Named from Hoadley Reef, which is less than 1 mile southwest of largest exposure of these rocks in Saypo quadrangle.

Hoback Formation

Paleocene and Eocene, lower : Western Wyoming.

A. J. Eardley and others, 1944, Hoback-Gros Ventre-Teton Field Conf. [geologic map] ; privately printed. Interbedded gray sandstone and shale; several conglomerate lenses and fresh-water impure limestone beds; coal in lower part, Thickness about 15,000 feet. Unconformably overlies Frontier formation; unconformably underlies Pass Peak conglomerate (new).

J. A. Dorr, 1952, Geol. Soc. America Bull., v. 63, no. 1, p. 64–71, pls. 1, 3, 4. Described in detail. Chart shows age ranging from Paleocene (upper Puercan) into lower Eocene (Wasatchian). Type locality designated.

Type locality: Exposures on southeastern side Game Hill, opposite mouth of Cliff Creek, T. 38, N., R. 114 W., Sublette County. Along Hoback River and U.S. Highway 187.

Hobart Hill Andesite[1]

Devonian (?) : Northeastern Maine.

Original reference: H. E. Gregory, 1900, U.S. Geol. Survey Bull. 165, p. 113, 169, 172–173.

Forms Hobart Hill, Aroostook County.

Hobble Formation

Pennsylvanian : North-central Utah.

H. J. Bissell, 1963, Iowa Acad. Sci. Proc., v. 43, p. 240, 241–242. Predominantly limestone and sandstone. Thickness 1,751 feet. Overlies Kelly formation (new). Unit formerly referred to Oquirrh formation. Proposed in this report to elevate Oquirrh to rank of series in this region.

Type section: In Hobble Creek Canyon, east-central part T. 7 S., R. 3 E., east of Springville, Utah County.

Hobo Gulch Formation[1]

Middle Cambrian: Western central Montana.

Original reference: W. H. Weed, 1901, U.S. Geol. Survey 22d Ann. Rept., pt. 2, p. 434, 436, map.

Forms well-marked group of strata seen in railroad cuts near tailing dams and in Queen Gulch, Elkhorn region.

Hoboken Serpentine[1]

Precambrian (?): Northeastern New Jersey and southeastern New York.

Original reference: C. P. Berkey and J. R. Healy, 1912, Columbia Univ. Contr., v. 20, p. 1907–1912.

C. P. Berkey, 1948, Geol. Soc. America Guidebook 61st Ann. Mtg., pl. 1. Shown on map legend of Lower Manhattan. A metamorphosed basic intrusive cutting Manhattan schist.

Forms elevated portion of Staten Island, N.Y., and the Knob at Castle Point in Hoboken, N.J.

Hochelagan Formation[1]

Pleistocene: Canada, and New York and Vermont.

Original reference: J. B. Woodworth, 1905, New York State Mus. Bull. 84, p. 206–222, map.

Probably named for Indian settlement of Hochelaga, Canada.

Hockingport Sandstone

Upper Carboniferous: Southeastern Ohio.

W. D. Martin, 1955, Dissert. Abs., v. 15, no. 8, p. 1371. Relatively local sandstone occurring in parts of Washington, Athens, and Meigs Counties. Ohio, and adjacent parts of West Virginia. Previously considered as part of Waynesburg sandstone. Waynesburg sandstone here restricted in areal extent to southwestern Pennsylvania and northern West Virginia, and term Hockingport is applied to sandstone of southeastern Ohio.

Named for village of Hockingport, Athens County.

Hocking Valley conglomerate facies[1] (of Cuyahoga Formation)

Mississippian (Kinderhook): Central Ohio.

Original reference: J. E. Hyde, 1915, Jour. Geology, v. 23, p. 657, 669, 678.

F. T. Holden, 1941, Illinois Acad. Sci. Trans., v. 34, no. 2, p. 172; 1942, Jour. Geology, v. 50, no. 1, p. 43, 45–46. Here includes Black Hand conglomerate, Fairfield sandstone, and Lithopolis sandstone members. Lies between Granville shale facies to the northeast and the Henley shale facies to the southwest.

Occurs in Hocking Valley, Fairfield and Hocking Counties.

Hockley Mound Sand Member (of Willis Sand)[1]

Pliocene (?): Southeastern Texas and southern Louisiana.

Original reference: J. Doering, 1935, Am. Assoc. Petroleum Geologists Bull., v. 19, no. 5, p. 655, 656, 660–665.

G. R. Pinkley, 1958, South Texas Geol. Soc. Fall Field Trip, p. 35, geol. map. Text refers to Manning (Hockley) shales around Falls City, Hockley shale shown on geologic map.

Named for Hockley Mound, on Willis Plain, 4 miles southwest of Hockley, Harris County, Tex.

Hodge Complex

Paleozoic and (or) Mesozoic: Southern California.

W. J. Miller, 1944, California Jour. Mines and Geology, v. 44, no. 1, p. 79, 97–98. Igneous and metamorphic rocks consisting largely of dioritic and granitic rocks together with remnants of older Hinkley Valley metasediments. Not sharply separable from Hinkley Valley complex except that more igneous material is present in Hodge. Precambrian.

W. J. Miller, 1946, Geol. Soc. America Bull., v. 57, no. 5, p. 503–504. Diorite and granite of Hodge complex considered Late Paleozoic or Mesozoic; granite quite certainly is Late Mesozoic.

O. E. Bowen, Jr., 1954, California Div. Mines Bull. 165, p. 36–42. Renamed and redefined as Hodge volcanic series.

Exposed near Hodge, near Barstow, in Barstow quadrangle.

Hodge Volcanic Formation

Hodge Volcanic Series

Mesozoic or older: Southern California.

O. E. Bowen, Jr., 1953, *in* L. A. Wright and others, California Jour. Mines and Geology, v 49, no. 1, pl. 2. Shown on columnar section as sheared tuff and flow lava more than 10,000 feet thick; base not exposed.

O. E. Bowen, Jr., 1954, California Div. Mines Bull. 165, p. 16 (fig. 2), 34–36, pls. 1, 2, 3, 8. Originally included by Miller (1944) in Hodge complex, series is withdrawn, renamed, and redefined. As herein described, Hodge volcanic series is predominantly rocks of the andesite-dacite-rhyolite association. Lower half of the 10,000-foot-thick series consists principally of massive reddish-brown, purplish-brown, and dark-green rocks, chiefly weakly sheared quartz latites and dacites. Upper half consists of alternating variable thicknesses of black, white, and gray-green, strongly sheared metavolcanics and tuffaceous metasediments. Age-determining features of series are few, as series is not in contact with other units except where invaded by igneous intrusions considered Jura-Cretaceous in age. Best estimate is that series is post-Fairview Valley and pre-Sidewinder in age, probably Upper Permian. Figure 2 and plate 1 show age as Upper Paleozoic(?).

U.S. Geological Survey designates the age of the Hodge Volcanic Formation as Mesozoic or older on the basis of a study now in progress.

Named from a homoclinal section exposed north of Mojave River a few miles northwest of Hodge, San Bernardino County. Entire section is exposed on well-eroded hills and on partly dissected, exhumed pediment surfaces.

Hodgeman Shale Member (of Solomon Formation)

Cretaceous: Northwestern Kansas.

R. C. Moore, 1935, Rock formations of Kansas *in* Kansas Geol. Soc., Wichita: [Am. Assoc. Petroleum Geologists 20th Ann. Mtg., Mar. 21–23.] Named on chart. Occurs in lower part of formation below an unnamed sandstone. Unconformable above Rocktown sandstone member of Ellsworth formation (new).

Derivation of name not given. Solomon formation was mapped in 1937 along Solomon River.

Hodges Shale Member (of Bloomington Formation)[1]

Middle Cambrian: Northeastern Utah and southeastern Idaho.

Original reference: G. B. Richardson, 1913, Am. Jour. Sci., 4th, v. 36, p. 406–407.

G. B. Maxey, 1958, Geol. Soc. America Bull., v. 69, no. 6, p. 650, 651–653, 672, 673 (fig. 3). Described near Richmond, Utah, where it is 540 feet thick, and is separated from overlying Calls Fort shale member (new) by unnamed limestone interval about 720 feet thick; overlies Blacksmith formation.

Named for exposures in Hodges Canyon, Rich County, Utah.

Hoffman Flow

Recent: Northern California.

H. A. Powers, 1932, Am. Mineralogist, v. 17, no. 7, p. 276–278, 288, pl. 1; C. A. Anderson, 1941, California Univ. Dept. Geol. Sci. Bull., v. 25, no. 7, p. 373. Composed of dacite lava. About 75 feet thick. Partly buried by later flows. Probably older than Medicine flow.

Occurs in Modoc Lava-Bed quadrangle.

Hoffman Limestone (in Conemaugh Formation)[1]

Pennsylvanian: Western Maryland and northern West Virginia.

Original reference: C. K. Swartz, W. A. Price, and H. Bassler, 1919, Geol. Soc. America Bull., v. 30, p. 573.

Occurs in Georges Creek valley, Allegany and Garrett Counties.

Hoffman Quartz Monzonite

[Cretaceous]; Eastern California.

J. F. Evernden, G. H. Curtis, and J. Lipson, 1957, Am. Assoc. Petroleum Geologists Bull., v. 41, no. 9, p. 2122, 2123 (fig. 1). Shown on map in paper dealing with potassium-argon dating of igneous rocks. Age shown on map legend as 83.3 millions of years. Shows intrusive relationships toward older Cathedral Peak granite but does not come into contact with younger Johnson granite porphyry.

Occurs in Yosemite National Park.

Hoffman Sandstone (in Conemaugh Formation)[1]

Pennsylvanian: Western Maryland.

Original reference: W. A. Price and H. Bassler, 1919, Geol. Soc. America Bull., v. 30, p. 573.

Named for occurrence in Hoffman Drainage Tunnel, Allegany and Garrett Counties.

Hoffner Beds (in Ste. Genevieve Limestone)

Hoffner Member (of Ste. Genevieve Limestone)

Mississippian (Meramec Series): Southern Illinois.

J. M. Weller *in* Stuart Weller and F. F. Krey, 1939, Illinois Geol. Survey Rept. Inv. 60, p. 7, 8. Predominantly sandy shale and fine-grained sandstone that is locally massive. Associated with these strata are red shales at several horizons and in middle part of member one or more limestones. Thickness between 50 and 80 feet. Overlies Levias member; unconformably underlies Renault limestone.

J. M. Weller and others, 1948, Geol. Soc. America Bull., v. 59, no. 2, p. 152–153, chart 5 (column 73). Shown on correlation chart as Hoffner beds in Ste. Genevieve limestone, Meramecian series.

Well exposed along Swan Creek northeast of Anna in E½ sec. 17, T. 12 S., R. 1 W., and east of Hoffner School in W½ sec. 8, T. 13 S., R. 1 E., Union County.

Hogan Formation

[Cretaceous] : Montana.

G. W. Viele, 1960, Dissert. Abs., v. 21, no. 4, p. 853. Name applied to 2,477 feet of andesitic to latitic volcanic-rich sedimentary rocks which are stratigraphically equivalent to middle and upper Two Medicine formation. Locally divided into members ascending A through E which consist of A, basal breccias; B, welded tuffs; C, volcanic-rich mudstone, argillites, and shales; D, volcanic-rich graywackes; and E, volcanic-rich graywackes, mudstones, breccias, and tuffs. Disconformably overlies lower Two Medicine; underlies St. Mary River formation.

Report discusses Flat Creek area, Lewis and Clark County.

†Hogback Sandstone[1]

Upper Cretaceous: Southwestern Wyoming.

Original reference: J. W. Powell, 1876, Geology of eastern part of Uinta Mountains, p. 40, 48, 155.

Hogback Schist[1]

Precambrian or Precambrian (?) : South-central Maine.

Original reference: E. H. Perkins and E. S. C. Smith, 1925, Am. Jour. Sci., 5th ser., v. 9, 204–228.

J. M. Trefethen, 1937, Jour. Geology, v. 45, no. 4, p. 358–359. Age designated Precambrian (?).

Forms long ridge known as Hogback Mountain, including Frye Mountain Range, in town of Knox, Waldo County.

Hog Creek Formation (in Caddo Creek Group)

†Hog Creek Shale Member (of Caddo Creek Formation)

Pennsylvanian: Central and central northern Texas.

Original reference: N. F. Drake, 1893, Texas Geol. Survey 4th Ann. Rept., pt. 1, p. 387, 397.

C. O. Nickell, 1938, Texas Univ. Bur. Econ. Geology Pub. 3801, p. 115–116. Caddo Creek formation consists of Hog Creek shale member, whose type locality is in northern Brown County, and overlying Home Creek limestone of northern Brown County, which has been correlated with a limestone also called Home Creek occurring at same horizon in Brazos River basin in Palo Pinto County. At section on west side of Mukewater Creek half a mile above its junction with Home Creek, in southeastern Coleman County, the Hog Creek member is 39 feet thick, underlies Home Creek limestone member, and overlies Ranger limestone member of Brad formation.

M. G. Cheney, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 1, p. 66 (fig. 1). Shown on correlation chart as Hog Creek shale in Caddo Creek group. Underlies Home Creek limestone; overlies Ranger limestone of Brad group.

M. G. Cheney, 1948, Abilene Geol. Soc. [Guidebook] Spring Field Trip, June 11–12, p. 20. Proposed that name Hog Creek shale, misapplied by Drake and others, be dropped and that name Colony Creek shale be given to beds between Ranger and Home Creek limestones.

Named for Hog Creek, Brown County, Colorado River region.

Hogeye Tuff (in Garren Group)

Tertiary: Western Texas.

Hugh Hay-Roe, 1957, Texas Univ. Bur. Econ. Geology Geol. Quad. Map 21. Proposed for 195-foot sequence of tuff and tuff breccia with basalt member near base. Unconformably overlies Cretaceous rocks in most places; overlies Permian rocks along southern edge of Wylie Mountains and other prevolcanic highs; upper contact with Pantera trachyte (new) disconformable.

P. C. Twiss, 1959, Texas Univ. Bur. Econ. Geology Geol. Quad. Map. 23. Described in Van Horn Mountains. Overlies Buckshot ignimbrite; underlies Pantera trachyte. In northeastern Van Horns, the Hogeye lies on Permian and Cretaceous rocks (Hueco, Yearwood, Cox, Finlay, Benevides, and Loma Plata formations). Thickness 187 to 435 feet.

Type section: South tip of Hogeye Butte, Jeff Davis County.

Hog Mountain Sandstone (in Mineral Wells Formation)[1]

Hog Mountain Sandstone Bed (in East Mountain Formation)

Hog Mountain Sandstone Member (of East Mountain Formation)

Pennsylvanian (Strawn): Central northern Texas.

Original reference: F. B. Plummer, 1929, Texas Bur. Econ. Geology, geol. map of Palo Pinto County.

M. G. Cheney, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 1, p. 66 (fig. 1). Shown on correlation chart as member of East Mountain shale.

Leo Hendricks, 1957, Texas Univ. Bur. Econ. Geology Pub. 5724, p. 22, fig. 3. Referred to as sandstone bed in East Mountain formation. In area of this report [Parker County], 22 feet thick, fine to medium grained, poorly to well cemented, and ranges from thick bedded to flaggy.

Typically exposed on top of Hog Mountain, 3 miles southeast of Mineral Wells.

Hogshooter Limestone[1] (in Skiatook Group)

Pennsylvanian (Missouri Series): Northeastern, central northern, and central Oklahoma.

Original reference: C. N. Gould, D. W. Ohern, and L. L. Hutchinson, 1910, Oklahoma State Univ. Research Bull. 3, p. 1, 2.

M. C. Oakes, 1940, Oklahoma Geol. Survey Bull. 62, p. 39–47; 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 4, p. 720 (table 1), 723–725. Included in Skiatook group. As defined here, is substantially equivalent to Dennis formation of Kansas, as redefined by Jewett (1932, Kansas Geol. Soc. Guidebook 6th Ann. Field Conf.). As a formal formation name for this unit, Dennis is perhaps older, but Hogshooter is oldest name in Oklahoma for this formation and is firmly entrenched in literature and usage; therefore, name Dennis is rejected, and Hogshooter retained in Oklahoma. Underlies Nellie Bly formation; overlies Coffeyville formation. Includes (at various places) Winterset limestone, Stark shale, Canville limestone, and Lost City limestone members. Type locality stated.

E. R. Ries, 1954, Oklahoma Geol. Survey Bull. 71, p. 60–64. Described in Okfuskee County.

Type locality: Along Hogshooter Creek, T. 26 N., R. 14 E., Washington County.

Hogskin Member (of Lincolnshire Formation)

Middle Ordovician (Mohawkian) : Northeastern Tennessee.

G. A. Cooper, 1956, Smithsonian Misc. Colln., v. 127, pt. 1, p. 66–67, chart 1 facing p. 130). Proposed for yellow-weathering shale and cobbly limestone, both of "Ottosee type" and usually confused with that formation, lying between Eidson member (new) of Lincolnshire and Ward Cove or Rockdell formations. Name credited to B. N. Cooper and G. A. Cooper.

Well exposed along road to Thorn Hill to Washburn especially at Red Hill about 4 miles west-southwest of Thorn Hill, Grainger County.

Hoh Formation[1]

Miocene, middle: Northwestern Washington.

Original reference: C. E. Weaver, 1915, Am. Inst. Min. Engrs. Bull. 103, p. 1424–1427.

C. E. Weaver, 1937, Washington [State] Univ. Pubs. in Geology, v. 4, p. 17, 186–187. Type locality designated since none was given in original description. At newly designated type section, formation consists of at least 16,000 feet of coarse gray gritty sandstone; strata are involved in a westerly plunging, highly compressed syncline, which has been eroded and elevated, and upon their beveled surface rest nearly 3,000 feet of basaltic lavas, tuffs, and agglomerates of early and possibly middle Eocene age. Formations in western part of Olympic Mountains which originally were included in general term Hoh formation by Weaver (1915, 1916) are considered as consisting of two separate formations, one of Oligocene and Miocene age, the other, exposed south of Lake Crescent, as pre-Tertiary in age. The latter is included in Solduc formation originally defined by Reagan (1909). Hoh formation restricted to sandstones and shales in vicinity of mouth of Hoh River which contain fossil evidence indicating middle Miocene age.

S. L. Glover, 1940, (abs.) Geol. Soc. America Bull., v. 51, no. 12, pt. 2, p. 2022–2023. Restricted in coastal area of Jefferson County to exclude 5,000-foot unit of buff to gray arkosic sandstone and thin-bedded dark-gray mudstones here termed Browns Point formation.

Type section: Exposures occurring between north fork of Solduc River and Lake Crescent, Clallam County.

Hoing Sandstone[1]

Silurian: Central eastern Iowa.

Original reference: W. H. Norton, 1928, Iowa Geol. Survey, v. 33, p. 30–31, 431.

Hoko Formation[1]

Pliocene(?) : Northwestern Washington.

Original reference: A. B. Reagan, 1909, Kansas Acad. Sci. Trans., v. 22, p. 202.

Occurs from Hoko River in its lower course east to Clallam Bay.

Holbrook Sandstone[1] Member (of Moenkopi Formation)

Triassic: Eastern Arizona.

Original reference: D. Hager, 1922, Mg. and Oil Bull., v. 8, nos. 1, 2, 3, p. 26. 33–34, 73, 81–94.

E. D. McKee, 1951. New Mexico Geol. Soc. Guidebook 2d Field Conf., p. 86, 87 (fig. 1). Characterized by red beds—shaly siltstones and structureless mudstones—alternating with resistant thick-bedded sandstones. Estimated thickness 110 feet. Overlies Winslow member (new); underlies Shinarump conglomerate.

E. D. McKee, 1954, Geol. Soc. America Mem. 61, p. 18 (table 4), 19. Present classification of Moenkopi in Little Colorado River area is (ascending) Wupatki, Moqui (new), and Holbrook members.

Exposed in cliffs just north of railroad between Winslow and Holbrook.

Holcomb Quartz Monzonite

Cretaceous(?): Southern California.

L. F. Noble, 1954, U.S. Geol. Survey Geol. Quad. Map GQ–50. Light-gray to pinkish quartz monzonite, probably varying to granodiorite; cut by aplite and pink pegmatite. Texture normal granitic north of Hidden Springs and Holcomb faults; south of faults, limestone, granodiorite, and rocks of Pleasant View complex are injected by the quartz monzonite.

Type locality: Holcomb Ridge, Valyermo quadrangle. Monzonite is continuous with granitic rocks north of San Andreas Fault in Pearland quadrangle.

†Holden Group[1]

Pennsylvanian: Northwestern Missouri.

Original reference: G. C. Broadhead, 1873, Missouri Geol. Survey Prelim. Rept. on Iron Ores, pt. 2, p. 169, 194.

Named for exposures at Holden, Johnson County.

Holdenvillle Shale[1] (in Marmaton Group)

Pennsylvanian (Des Moines Series): Central Oklahoma, southeastern Kansas, and southwestern Missouri.

Original reference: J. W. Taff, 1901, U.S. Geol. Survey Geol. Atlas, Folio 74.

M. C. Oakes, 1952, Oklahoma Geol. Survey Bull. 69, p. 42–47, pl. 11. Memorial shale, by definition, extends upward from top of Lenapah limestone to base of Seminole formation, and, likewise, Holdenville shale extends upward from top of Wewoka to base of Seminole. As Lenapah has been traced into uppermost Wewoka, the Memorial and Holdenville lie between same stratigraphic limits and are equivalent. Holdenville has priority and is commonly used term. Thickness 40 to 200 feet in Tulsa County. Includes Sasakwa and Homer limestone [members]. In northern Oklahoma and in Kansas, unit occurs in thin ragged patches.

W. B. Howe, 1953, Missouri Geol. Survey and Water Resources Rept. Inv. 9, p. 14–16. Uppermost formation in Marmaton group. Lies between Lenapah formation and base of Hepler sandstone, basal Pleasanton, of Missouri series. Term Memorial, formerly applied to post-Lenapah, pre-Pleasanton beds in Missouri, has been dropped. Use of name Holdenville follows recent work by Oklahoma Geological Survey. Formation in western Missouri is predominantly gray shale. Thickness 0 to at least 15 feet.

J. M. Jewett, 1959, Graphic column and classification of rocks in Kansas: Kansas Geol. Survey. Shown on chart at top of Marmaton group. Overlies Lenapah limestone; underlies Hepler sandstone.

Named for Holdenville, Hughes County, Okla.

Holder Formation (in Magdalena Group)

Pennsylvanian (Virgilian) : Southeastern New Mexico.

L. C. Pray, 1954, New Mexico Geol. Soc. Guidebook 5th Field Conf., p. 93. Appears only on columnar section. Consists of limestone, gray and red calcareous shale, sandstone, and conglomerate. Bioherms at base locally. Thickness as much as 850 feet. Underlies Bursum formation; overlies newly named Beeman formation.

Carel Otte, Jr., 1959, New Mexico Bur. Mines Mineral Resources Bull. 50, p. 18–25, pl. 1. Revised to include strata that occur between top of Beeman formation and base of overlying Laborcita (new) or Abo formation. Holder includes Fresnal and Keller groups in classification of Thompson (1942). Thompson's detailed section of Fresnal forms upper 530 feet of Pray's Holder formation and is overlain by Laborcito formation. Thickness 900 feet north of La Luz Canyon. Type section and derivation of name given.

Type section: In NW¼NW¼ sec. 14, T. 17 S., R. 10 E., in central part of Sacramento Mountains. Name derived from Holder Ridge which is capped by basal limestone of formation. Widespread along fringe of Tularosa basin in north and south ends of Sacramento Mountains; in central area, occurs as isolated resistant caps on many high ridges at west front of mountains.

†Holderness Formation (in Mesaverde Group)[1]

Upper Cretaceous: Northwestern Colorado.

Original reference: M. R. Campbell, 1931, Tentative correlation of named geologic units of Colorado, compiled by M. G. Wilmarth, U.S. Geol. Survey, separate chart.

Campbell's report not published. The name Holderness Formation appeared in bold face in the Wilmarth Lexicon on the basis of Wilmarth's correlation chart. Cobban and Reeside (1952, Geol. Soc. Bull. v. 63, no. 10) used the name of Holderness on the Cretaceous correlation chart and cited the Wilmarth Lexicon. U.S. Geological Survey has abandoned the term Holderness Formation.

Well exposed in Holderness Gulch, Yampa coal field, Daton Peak quadrangle.

Holdrege Formation[1]

Holdrege Member (of Blanco Formation)

Holdrege Member (of Chase Channel Formation)

Pleistocene (Nebraska) : Southern Nebraska and western Kansas.

Original reference: A. L. Lugn and G. E. Condra, 1932, Geol. Soc. America Bull., v. 43, no. 1, p. 190.

O. S. Fent, 1950, Kansas Geol. Survey Bull 85, p. 64. Basal member of Chase Channel formation (new), a subsurface unit in western Kansas. Thickness 28 to 56 feet. Medium to fine gravel and sand with fragments of Cretaceous shells and fragments of red shale and siltstone where it overlies Permian rocks. Grades upward into Fullerton member.

G. E. Condra and E. C. Reed, 1950, Nebraska Geol. Survey Bull. 15–A, p. 12 (fig.), 17–18. Formation is coarse, gravelly to pebbly valley fill at high levels in South Platte, Lodgepole, Pumpkin Creek, and North Platte valleys where it originated from Rocky Mountain glaciers and from gravelly Tertiary deposits of High Plains. Occurs in lower course of Niobrara Valley and adjacent areas and on Holt and Springview plains; lies below flood plain of the Platte in vicinity of Grand Island and westward for some distance.

R. C. Moore and others, 1951, Kansas Geol. Survey Bull. 89, p. 15; J. C. Frye and A. B. Leonard, 1952, Kansas Geol. Survey Bull. 99, p. 52 (fig. 2), 59, 61. Member of Blanco formation in Kansas.

C. W. Hibbard, 1958, Am. Jour. Sci., v. 256, no. 1, p. 55 (fig. 1). Chart of revised classification of Kansas Pleistocene shows Holdrege as member of unnamed formation in Meade group. Occurs below Fullerton member and above Nebraskan till.

J. M. Jewett, 1959, Graphic column and classification of rocks in Kansas: Kansas Geol. Survey. Shown as formation in Kansas.

Named for Trees deep test for oil and gas near Holdrege, Phelps County, Nebr.

Hole-In-The-Wall Member (of Boulder Pass Formation)

Precambrian (Belt Series): Northwestern Montana.

Original reference: C. L. Fenton and M. A. Fenton, 1931, Jour. Geology, v. 39, no. 7, p. 670–679.

C. L. Fenton and M. A. Fenton, 1937, Geol. Soc America Bull., v. 48, no. 12, p. 1877. Name suppressed in favor of Spokane.

Derivation of name not stated but probably Hole-in-the-Wall Falls, Glacier National Park, Flathead County.

Hole-In-The-Wall Member (of Isom Formation)

Eocene(?) or Oligocene, lower(?): Southwestern Utah.

J. H. Mackin, 1960, Am. Jour. Sci., v. 258, no. 2, p. 90 (table 1), 92 (fig. 2), 99. Upper member of formation at type locality; overlies Baldhills member (new). Latite porphyry, lithoidal in texture and purplish gray in color, with light-gray lenticules. Thickness seldom more than 40 feet. Exhibits some features of ignimbrites of highly welded type but also has internal structural features indicative of viscous flow. Discussion of ignimbrites of area.

Named for occurrence at east end of Hole-in-the-Wall Pass, 2 miles north of type locality of Isom formation.

†Holiknuk Series[1]

Upper Cretaceous: Southern Alaska.

Original reference: J. E. Spurr, 1900, U.S. Geol. Survey 20th Ann. Rept., pt. 7, p. 159–161, 182.

Probably named for Holiknuk River.

Holitna Group

Ordovician(?), Silurian, and Devonian: Southwestern Alaska.

W. M. Cady and others, 1955, U.S. Geol. Survey Prof. Paper 268, p. 21 (table), 23–27, pl. 1. Includes various types of limestone that have been changed from an originally dense fine-textured rock to more coarsely crystalline types. Recrystallized facies partly dolomitic. Nondolomitic limestone is gray on freshly broken surface and weathers to lighter shades. Dolomitic facies characteristically buff colored. Massive rather than thin-bedded limestone predominates. Small reeflike masses in several places, Intraformational conglomerates and breccias, composed of limestone fragments in limestone matrix, common locally. Neither basal nor upper contacts are exposed in sections studied along Holitna and Chilnuk Rivers. Estimated thickness at least 5,000 feet and probably closer to 10,000 feet. In fault contact with overlying Kuskokwim group (new) along bluffs of Holitna River 9 miles northeast of Nogamut.

Type locality: On Holitna River in area where limestone crosses southwestward plunging major axis of geanticline. Typically exposed between mouths of Itulilik and Portage Creeks.

Holland Limestone (in Staunton Group)

Pennsylvanian: Southern Indiana.

H. R. Wanless, 1939, Geol. Soc. America Spec. Paper 17, p. 30, 87. In Ditney folio [84] area, Holland coal below Rock Creek coal is described as having Holland limestone as its roof. Recent field studies showed three locally mined coals cropping out near Holland, each with a limestone roof. It is not known to which of these coals name Holland was originally applied.

D. W. Franklin, 1944, Illinois Acad. Sci. Trans., v. 37, p. 89, 91. Name Holland applied to uppermost of the three limstones as it is most distinctive. Light-gray dense limestone with brown mottling on weathered surface. Thickness 2 feet. Occurs about 7 feet above base of group in exposure near Holland.

Exposed in SE¼NE¼NE¼ sec. 26, T. 3 S., R. 6 W., near Holland, Dubois County.

Holland Sandstone[1]

Lower Devonian: Northwestern Ohio.

Original references: E. Orton, 1888, Ohio Geol. Survey, v. 6, p. 20; 1890, Ohio Geol. Survey 3d Organization, 1st Ann. Rept. p. 24.

Named for Holland, Lucas County

Holland Patent Formation or Shale

Holland Patent Member (of Utica Shale)

Holland Patent[1] zone

Ordovician: Eastern New York.

Original reference: R. Ruedemann and G. H. Chadwick, 1935, Science, new ser., v. 81, no. 2104, p. 400.

G. M. Kay, 1937, Geol. Soc. America Bull., v. 48, no. 2, p. 286, pl. 4. Holland Patent formation or Holland Patent member of Utica formation is the "upper Utica, or zone of *Climacograptus pygmeus*" and *Glossograptus quadrimucronatus timidus* of Ruedemann. Consists of about 200 feet of black shales. Grades upward into arenaceous Frankfort shale; disconformably overlies lower Cobourg (Hallowell) limestone.

Holland Patent, Oneida County.

Holland Quarry Shale

Devonian: Northern Ohio.

J. E. Carman, 1960, Fieldiana: Geology, v. 14, no. 1, p. 1–5. Fossiliferous unit that occupies depression in Raisin River dolomite. Underlies Sylvania sandstone.

Occurs in Holland Quarry, 3 miles south-southwest of town of Holland, Monclova Township, Lucas County.

Hollenberg Limestone (in Sumner Group)[1]

Hollenberg Limestone Member (of Wellington Formation)

Permian (Leonard) : Eastern Kansas and southeastern Nebraska.

Original reference: G. E. Condra and J. E. Upp, 1931, Nebraska Geol. Survey Bull. 6, 2d ser., p. 63–66.

W. A. Ver Wiebe, 1937, Wichita Municipal Univ. Bull. 2, p. 5; R. C. Moore and others, 1951, Kansas Geol. Survey Bull. 89, p. 40–41. Included in Wellington formation.

Named for exposures along Little Blue River 3½ miles southeast of Hollenberg, Washington County, Kans.

Holliday shale[1]

Cambrian : Utah.

Original reference : C. R. Keyes, 1924, Pan-Am. Geologist, v. 41, p. 38.

Derivation of name not stated.

Hollis Member (of Deese Formation)

Pennsylvanian : Central Oklahoma.

C. C. Branson, 1955, The Hopper, v. 15, no. 10–11, p. 129. Shown on manuscript map by Guthrey and Milner in 1933. Name preoccupied by Hollis quartzite (Adams 1926) in Precambrian of Alabama. Renamed Natsy by Tomlinson (1937).

Type locality: On Hollis Farm in SW¼SW¼ sec. 8, T. 5 S., R. 2 E., Carter County.

Hollis Quartzite[1]

Hollis Quartzite (in Pine Mountain Group or Series)

Precambrian : Eastern Alabama and central western Georgia.

Original reference: G. I. Adams, 1926, Alabama Geol. Survey Spec. Rept. 14, p. 33–34, map.

G. W. Crickmay *in* L. M. Pringle, 1935, Georgia Geol. Survey Bull. 46, p. 32 Geographically extended into Georgia where it underlies Manchester formation (new). Included in Pine Mountain series.

D. F. Hewett and G. W. Crickmay, 1937, U.S. Geol. Survey Water-Supply Paper 819, p. 27–28, 30, pl. 1. In Warm Springs quadrangle, Georgia, overlies Sparks schist (new); underlies Manchester schist; in southeast corner of quadrangle, overlies Woodland gneiss (new). Thickness ranges from 275 feet at Dunn's Gap to nearly 800 feet along Flint River at the Cove; along Oak Mountain, seldom more than 300 feet. Chewacla marble, associated with Hollis in Alabama, is not present in Georgia.

J. W. Clarke, 1952. Georgia Geol. Survey Bull. 59, p. 6 (table), 11–14, pls. 3, 10. Described in Thomaston quadrangle where it is 800 to 1,100 feet thick. Underlies Manchester formation; unconformably overlies Woodland gneiss. Included in Pine Mountain group.

Named for exposures at and near Hollis, Lee County, Ala.

Holloway Prairie Formation or terrace

Recent: Southwestern Louisiana.

J. A. Doering, 1956, Am. Assoc. Petroleum Geologists Bull., v. 40, no. 8, p. 1822 (table 1), 1826 (fig. 2), 1830, 1831 (table 2), 1833 (fig. 3), 1837 (table 3), 1848 (fig. 8). In description of physiography of southwest Louisiana the following new formation names are introduced (descending): Sicily Island, Holloway Prairie, Eunice, and Oberlin. However, text discusses the Holloway Prairie as a terrace. Name is used for terrace areas given by Fisk (1938) as type localities of his "Prairie terrace;" new name is used to avoid extended correlations of the Prairie.

Well developed at Holloway Prairie, Marksville, Big Cane, Mansura, and Grand Prairie, in Rapides and Avoyelles Parishes.

Holly Creek Formation (in Trinity Group)

†Holly Creek Clay[1]

Lower Cretaceous (Comanche): Southwestern Arkansas and southeastern Oklahoma.

Original reference: H. C. Vanderpool, 1928, Am. Assoc. Petroleum Geologists Bull., v. 12, p. 1079–1080.

R. W. Imlay, 1944, U.S. Geol. Survey Oil and Gas Inv. Prelim. Chart 3. Referred to as Holly Creek formation; includes Ultima Thule gravel member. Underlies De Queen limestone; overlies Dierks limestone (rank raised). Subsurface equivalents discussed.

H. D. Miser and others, 1954, Geologic map of Oklahoma (1:500,000): U.S. Geol. Survey. Geographically extended into southeastern Oklahoma.

L. V. Davis, 1960, Oklahoma Geol. Survey Bull. 86, p. 16–17, 20–22, pl. 1. In McCurtain County [this report], Dierks limestone is absent, and name Holly Creek applies to the Cretaceous stratum below De Queen limestone. Thickness 30 to 100 feet in outcrop area; as much as 1,070 feet in subsurface. In eastern half of area, the Holly Creek is basal unit of Trinity age and rests unconformably upon Paleozoic rocks.

Named for exposures near Little Holly and Holly Creeks, southeast of Dierks, Howard County, Ark.

Hollycrest Formation

Miocene, middle: Southern California.

G. J. Neuerburg, 1953, California Div. Mines Spec. Rept. 33, p. 6 (table 1), 23–24, pl. 1. Consists of thin-bedded light-brown medium- and fine-grained arkose and white to gray silty clay shales. Composed of two unnamed members: a basal conglomerate and a sandstone, contact between the two is conformable and gradational; thin beds of conglomerate are present in lower 50 feet of the sandstone. Thickness about 1,700 feet. Underlies Modelo formation, but nature of contact uncertain, may or may not be a fault; unconformably overlies Topanga formation; locally overlies Cahuenga beds (new).

Occurs in Griffith Park area, city of Los Angeles. Exposed in Griffith, Cahuenga Peak and Cahuenga Pass fault blocks. Name Hollycrest taken from highest point in Cahuenga Pass.

Holly Springs Sand (in Claiborne Group)

Holly Springs Sand Member (of Tallahatta Formation)

Holly Springs Formation (in Wilcox Group)

Holly Springs Sand (in Wilcox Group)[1]

Eocene, middle: Mississippi, Kentucky, and western Tennessee.

Original reference: E. N. Lowe, 1913, Mississippi Geol. Survey Bull. 10, p. 23–25.

Tom McGlothlin, 1944, Am. Assoc. Petroleum Geologists Bull., v. 28, no. 1, p. 53. With exception of Bashi and Hatchetigbee in Lauderdale County, Miss., surface Wilcox deposits of the State might well be called undifferentiated Wilcox. It may be true that general zones can be traced locally, but wisdom of giving formational rank to "Ackerman" and "Holly Springs" is questioned. Exposures of typical "Ackerman" are plentiful in area that is supposed to be underlain by "Holly Springs" sand, and many of the exposures of Holly Springs are probably Pleistocene terrace deposits.

F. S. MacNeil, 1946, U.S. Geol. Survey Strategic Minerals Inv. Prelim. Rept. 3–195, p. 17. Type Holly Springs of northern Mississippi, formerly included in Wilcox and correlated with Tuscahoma sand of Alabama, is nonmarine equivalent of Tallahatta formation to south. Name Holly Springs abandoned in favor of Tallahatta for all of Mississippi.

F. S. MacNeil., 1947, U.S. Geol. Survey Oil and Gas Inv. Prelim. Chart 29. Correlation chart shows Holly Springs sand member of Tallahatta in Mississippi. Note states that nonmarine facies of Tallahatta formation in northern Mississippi was formerly called Holly Springs sand and placed in Wilcox group. For 1945 geologic map of Mississippi, Holly Springs was abandoned in favor of Tallahatta, but it should probably be retained for northern Mississippi, Tennessee, and Kentucky. Claiborne group.

J. S. Attaya, 1951, Mississippi Geol. Survey Bull. 71, p. 14, 20–21. Name Holly Springs should be dropped from literature inasmuch as sands included in formation are actually equivalents of three formations, the Meridian, Tallahatta, and Kosciusko. Discussion of Lafayette County.

Benjamin Gildersleeve, 1953, Kentucky Geol. Survey Spec. Pub. 1, p. 18 (fig. 1). Generalized section—embayment region of Tennessee and Kentucky—shows Holly Springs formation below Grenada formation and above Ackerman formation in Tennessee. Wilcox group. Lower Eocene.

Typically developed at and for several miles east of Holly Springs, Marshall County, Miss.

Holmesville Shale Member (of Doyle Shale)

Holmesville Shale (in Chase Group)[1]

Permian: Southeastern Nebraska and eastern Kansas.

Original reference: G. E. Condra and J. E. Upp, 1931, Nebraska Geol. Survey Bull. 6, 2d ser., p. 43.

K. L. Walters, 1954, Kansas Geol. Survey Bull. 106, p. 42 (table 10), 53–55, pl. 1. Member of Doyle shale. In Marshall County, consists of about 20 feet of green, gray, and maroon calcareous shale; lenticular limestone beds about 1 foot thick present in lower few feet of member. Underlies Towanda member; overlies Fort Riley member of Barneston limestone.

Type locality: One and one-half miles west and one-half mile north of Holmesville, Gage County, Nebr.

Holokuk Basalt

Eocene(?) to Miocene(?): Southwestern Alaska.

W. M. Cady and others, 1955, U.S. Geol. Survey Prof. Paper 268, p. 21 (table), 53–55, pl. 1. Chiefly flows, now disconnected but believed to have formed widespread and rather continuous plateau before stream dissection. Flows and less abundant water-deposited detritus of the flows made up almost exclusively of basalt. Dikes of similar composition well exposed and near valleys of Kolmakof River, upper Oskawalik River, and Vreeland Creek. Volcanic rocks are black on fresh surfaces: weather to browns and buffs. Basalt nearly everywhere porphyritic and little altered. Thickness at least 3,000 feet along southeast slopes of Horn Mountains; 1,500 feet in area east of Holokuk Mountain; and less than 1,000 feet on Kaluvarawluk Mountain. Unconformably overlies Kuskokwim group (new). Probably is older than and overlies Getmuna rhyolite group (new).

Typically exposed in Kaluvarawluk and Kiokluk Mountains east of Holokuk River. Also crops out in flanks of Horn Mountains, north of Kuskokwim River. Named for Holokuk River.

Holston Marble, Limestone, or **Formation**

Holston Marble or Limestone (in Blount Group)[1]

Middle Ordovician: Eastern Tennessee, northwestern Georgia, western North Carolina, and western Virginia.

Original reference: A. Keith, 1895, U.S. Geol. Survey Geol. Atlas, Folio 16, map.

Charles Butts, 1940, Virginia Geol. Survey Bull. 52, pt. 1, p. 148–154. With single exception, Holston limestone, wherever present in Virginia, succeeds Lenoir limestone. Northwest of Clinch Mountain, the Holston is directly overlain by Ottosee limestone with hiatus between, resulting from absence of Athens and Whitesburg. Southeast of Clinch Mountain, the Holston is overlain by Whitesburg limestone or Athens shale. Blount group. Chazyan series.

B. N. Cooper and C. E. Prouty, 1943, Geol. Soc. America Bull., v. 54, no. 6, p. 816–886. Lower Middle Ordovician succession of Tazewell County, southwestern Virginia, is subdivided into 29 distinctive zones grouped into eight formations. Study has led to recognition of inconsistencies in use of names Stones River, Murfreesboro, Mosheim, Lenoir, Blount, Holston, Ottosee, Lowville, and Moccasin. In proposed revised stratigraphic nomenclature, Cliffield formation includes beds which Butts (1940) has called Murfreesboro, Mosheim, Lenoir, Holston, and Ottosee. Some coarse-grained limestones which have been called Holston underlie beds carrying fauna of Murfreesboro limestone. Other so-called Holston beds overlie limestones containing fossils which are supposed to be valid guides to Ottosee and Lowville.

B. N. Cooper, 1944, Virginia Geol. Survey Bull. 60, p. 59–60. In Burkes Garden quadrangle, term Holston replaced by Effna limestone (new). Previous workers have identified the limestone as Holston though without adequate basis. Direct correlation on basis of fossils is impossible. Beds identified by Butts (1940) as Holston along northwest base of Clinch Mountain are facies of limestone which interfingers with the Blackford, Five Oaks, Lincolnshire, Ward Cove, and Peery members of Cliffield in Russell and Scott Counties, Va. This belt of so-called Holston continues southwest into Tennessee where it was mapped as lentils of marble in Chickamauga limestone by Keith. Because Keith's Holston marbles interfinger with beds of different ages, name should not be used to imply time equivalency of any similar appearing beds far away from Knoxville region in Tennessee.

C. E. Prouty, 1946, Am. Assoc. Petroleum Geologists Bull., v. 30, no. 7, p. 1156, 1182. Discussion of lower Middle Ordovician of southwest Virginia and northeast Tennessee. Measured sections compared with revised classification of Tazewell County, Va. Holston should be discontinued as definite formational name. "Holston" marble of Knoxville area is renamed Farragut limestone.

Charles Butts and Benjamin Gildersleeve, 1948, Georgia Geol. Survey Bull. 54, p. 28, geol. map. Holston marble occurs only in one narrow belt extending into Georgia from Tennessee just east of State Highway 71 to within 6 miles north of Dalton. Thickness 50 to 100 feet. Overlies Lenoir limestone. North of Dalton, underlies Ottosee (Sevier) shale. Blount group.

John Rodgers, 1952, Geology of the Athens quadrangle, Tennessee (1:24,000): U.S. Geol. Survey Geol. Quad. Map. Holston limestone, 400 feet thick, underlies Ottosee shale and overlies Athens shale. Athens has been mistakenly placed above Holston limestone instead of below. Name Tellico sandstone has been applied to Holston in this area.

John Rodgers, 1953, Tennessee Div. Geology Bull. 58, pt. 2, p. 68–75, pls. Name Holston marble was first used by Keith on maps in Knoxville (1895), Loudon (1896), and Morristown (1896) folios, but he did not mention it in text until Maynardville folio (1901). He apparently considered it a member or lentil in Chickamauga limestone and did not specify type locality, though clearly he named it for Holston River. Type locality herein proposed. In belt next southeast of Saltville fault, rocks above Knox group are continuous from about 3 miles west of New Market to 2 miles north of Athens. To northeast, a few small outliers extend past Jefferson City; to southwest, beyond a 30-mile break, the rocks reappear with virtually no change 4 miles south of Cleveland and continue to Georgia line and some miles beyond. Rocks are divided into (ascending) Lenoir limestone, Holston formation, Ottosee shale, and Bays formation. This sequence is here considered as standard of reference for rocks of this age, and belt is referred to as standard belt. Thickness of Holston 200 to 400 feet in standard belt. Holston formation of standard belt consists of several different kinds of rock that together form mappable unit. All are composed largely of calcite, and most contain large amount of finely divided hematite, which colors the rocks and derived soils pink to dark red. Dominant lithology is pink to red, coarsely crystalline limestone ("marble") showing crossbedding; this lime-sandstone (calcarenite) has furnished bulk of "Tennessee marble" of commerce, but it is neither the whole of the Holston nor confined to it. A second rock type is dark-red fine-grained limestone that contains algal heads, unbroken bryozoans, and crinoid bases; this lithology occurs as irregular masses and heads surrounded by limestones and clearly formed reef masses. A third rock type resembles the lime-sandstone but contains more quartzite; in many places, it overlies the other rock types. Keith and others have mapped this third rock type as Tellico sandstone. For present map, the rocks that Keith and others have mapped Tellico are included in the Holston. Holston in other belts differs slightly from that in standard belt. Overlies Athens shale in Blount County.

R. B. Neuman, 1955, U.S. Geol. Survey Prof. Paper 274–F, p. 157. In Tellico-Sevier belt, Chota formation (new) is same unit as sandstone lentil of Sevier formation of Keith and Holston formation of Rodgers (1953).

J. M. Cattermole, 1955, U.S. Geol. Survey Geol. Quad. Map GQ–76; 1960, Map GQ–126. In Shooks Gap and Bearden quadrangles, Tennessee, Holston formation overlies Lenoir limestone and underlies Chapman Ridge sandstone (new).

G. A. Cooper, 1956, Smithsonian Misc. Colln., v. 127, pt. 1, p. 67–68. Because of uncertainty and inaccuracy of present application of Holston, name should be dropped as a stratigraphic term.

Josiah Bridge, 1956, U.S. Geol. Survey Prof. Paper 277, p. 57. Term Blount group discarded.

Type locality (Rodgers): Along and near Holston River, 7 miles east-northeast of center of Knoxville where Holston River leaves standard reference belt just south of the John Sevier yards; includes quarry of Volunteer Portland Cement Co., just went of Holston River.

Holt Shale Member (of Topeka Limestone)[1]

Pennsylvanian (Virgil Series): Northwestern Missouri, southwestern Iowa, eastern Kansas, and southeastern Nebraska.

Original reference: G. E. Condra, 1927, Nebraska Geol. Survey Bull. 1, 2d ser., p. 42, 52, 53.

R. C. Moore, 1948, Am. Assoc. Petroleum Geologists Bull., v. 32, no. 11, p. 2035 (fig. 5); 1949, Kansas Geol. Survey Bull. 83, p. 128 (fig. 22), 164; F. C. Greene and W. V. Searight, 1949, Missouri Geol. Survey and Water Resources Rept. Inv. 11, p. 18. Holt shale member of Topeka formation; underlies Coal Creek limestone member; overlies Du Bois limestone member. This is classification agreed upon by State Geological Surveys of Iowa, Kansas, Missouri, Nebraska, and Oklahoma, May, 1947.

H. G. Hershey and others, 1960, Iowa Highway Research Board Bull. 15, p. 15, fig. 5. Fossiliferous dark- to light-gray shale with an underlying black fissile shale. Thickness 2 to 3 feet. Underlies Coal Creek member; overlies Du Bois limestone member; where Du Bois is absent, overlies Turner Creek shale member.

Type locality: In Missouri River bluff southeast of Forest City, Holt County, Mo.

Holtsclaw Sandstone[1]

Lower Mississippian: Western and northern Kentucky and southern Indiana.

Original reference: Charles Butts, 1915, Kentucky Geol. Survey, 4th ser., v. 3, pt. 2, p. 151.

P. B. Stockdale, 1939, Geol. Soc. America Spec. Paper 22, p. 143–144. Name abandoned. Holtsclaw Hill facies (new) off Brodhead formation (new) comprises the two units "Rosewood shale" and "Holtsclaw sandstone" proposed by Butts (1915).

Named for Holtsclaw Hill, Jefferson County, Ky.

Holtsclaw Hill facies (of Brodhead Formation)

Lower Mississippian: North-central Kentucky.

P. B. Stockdale, 1939, Geol. Soc. America Spec. Paper 22, p. 76, 139–145. Consists of silty shale that grades upward into massive siltstone. Thickness 200 to 220 feet. Lacks consistent horizons to justify its subdivision into smaller units of stratigraphic rank. Facies combines the Rosewood shale and Holtsclaw sandstone of Butts (1915) and is the equivalent of Locust Point formation, Spickert Knob facies, and Carwood formation, Knob Creek facies, in Indiana. At type area, underlies Floyds Knob formation and overlies Silver Hills facies of New Providence formation. Passes laterally eastward into Pilot Knob facies (new).

Typical exposure: At Holtsclaw Hill, 12½ miles south of Ohio River at Louisville, along winding road following ravine immediately west of hill, Jefferson County. Named for Holtsclaw Hill, just north of southern boundary line of Jefferson County.

Holts Summit Formation

Upper Devonian: Central Missouri.

M. G. Mehl, 1960, Denison Univ. Jour. Sci. Lab., v. 45, art. 5, p. 78–80. Alternating beds of sandstone and arenaceous shale. Average thickness about 4 feet with maximum not more than 8 or 10 feet. Unconformably overlies Snyder Creek or Callaway; unconformably underlies Massie Creek formation (new).

Type locality: NE¼SE¼SE¼ sec. 11, T. 45 N., R. 11 W., on major branch of Clifton Creek about 2½ miles northwest of Holts Summit, Callaway County.

Holy Cross Sandstone

Silurian: Central Kentucky.

W. R. Jillson, 1952, The Holy Cross sandstone: Frankfort, Ky., Roberts Printing Co., p. 5–14. Tawney fine-grained shaley fossiliferous sandstone 6 to 8 feet thick. Occurs above Crab Orchard shale and is separated from Middle or Upper Devonian strata by major unconformity.

Occurs about 0.8 miles south of village of Holy Cross, Marion County.

Holy Cross Schist[1]

Precambrian: Central Colorado.

Original reference: J. T. Stark and F. F. Barnes, 1935, Colorado Sci. Soc. Proc., v. 13, no. 8, p. 466–479, map.

The Mountain of the Holy Cross occurs in midst of mass mapped as Holy Cross schist and migmatite. The other schist seems to have been named for Sawatch Range.

Holyoke Basalt (in Newark Group)

Holyoke Diabase (in Newark Group)[1]

Holyoke Lava

Holyoke Lava Member (of Meriden Formation)

Upper Triassic: Central Massachusetts and central Connecticut.

Original reference: B. K. Emerson, 1891, Geol. Soc. America Bull., v. 2, p. 451–456.

G. W. Bain, 1941, Am. Jour. Sci., v. 239, no. 4, p. 266, 267–268, fig. 1. Referred to as lava. Overlies Sugarloaf arkose.

John Rodgers and others, 1956, Preliminary geological map of Connecticut (1:253,440): Connecticut Geol. Nat. History Survey. Rank reduced to member occurring between upper and lower sedimentary members of Meriden formation.

Robert Balk, 1957, Geol. Soc. America Bull., v. 68, no. 4, p. 486–494, pl. 1. Current description and summary discussion of diabase in Mount Holyoke quadrangle, Massachusetts.

E. P. Lehmann, 1959, Connecticut Geol. and Nat. History Survey Quad. Rept. 8, p. 8 (table 1), 12–14, pl. 1. Term Meriden not used in this report [Middletown quadrangle]; units given formational status in Newark group. Holyoke basalt crops out extensively along west edge of quadrangle in belt 3,000 to 5,000 feet wide, trending slightly east of north. Estimated stratigraphic thickness 450 to 500 feet. Represents two successive lava flows, the second being thinner. Overlies Shuttle Meadow formation (new); underlies East Berlin formation (new).

R. W. Schnabel, 1960, U.S. Geol. Survey Geol. Quad. Map GQ–134. Described in Avon quadrangle, Connecticut, where it is 250 to 350 feet thick. Lower contact not exposed in quadrangle. Conformably underlies East Berlin formation.

Named for occurrence in Mount Holyoke Range, Mass.

Holyoke Conglomerate[1]

Precambrian (middle Huronian): Northwestern Michigan.

Original reference: M. E. Wadsworth, 1893, Michigan Geol. Survey Rept. 1891 and 1892, p. 63–66.

Named for occurrence at Holyoke, in Cascade Range, Marquette district.

Holyoke Formation[1]

Precambrian (upper Huronian): Northwestern Michigan.

Original reference: M. E. Wadsworth, 1890 and 1891, Lake Superior along the south shore, by Julian Ralph, p. 77–99; 1st ed., 1890; 2d ed., 1891.

Named for occurrence at Holyoke, in Cascade Range, Marquette district.

Holz Shale Member (of Ladd Formation)

Upper Cretaceous: Southern California.

W. P. Popenoe, 1937, Jour. Paleontology, v. 11, no. 5, p. 380. Upper member of Ladd formation (new). Dark-bluish- to brownish-gray micaceous sandy shale or siltstone, with interbedded arkosic sandstones and nonpersistent coarse conglomerate lenses; fossiliferous in upper half. Thickness about 1,500 feet. Unconformably underlies Schulz member of Williams formation (both new); overlies Baker member of Ladd formation (both new).

W. P. Popenoe, 1942, Am. Assoc. Petroleum Geologists Bull., v. 26, no. 2, p. 166, 168 (fig. 2), 171–173. Type locality designated.

W. P. Woodring and W. P. Popenoe, 1945, U.S. Geol. Survey Oil and Gas Inv. Prelim. Chart 12. Shown on stratigraphic section as underlying Silverado formation (new).

Type locality: Holz Ranch on north side of Silverado Canyon just west of mouth of Ladd Canyon. Holz is most persistent and thickest member of Cretaceous sequence in Santa Ana Mountains; extends in virtually unbroken exposure from Santa Ana Canyon south to near Trabuco Canyon —about 15 miles.

Homberg Group

Mississippian (Chester Series): Southern Illinois and western Kentucky.

J. M. Weller, 1939, Kansas Geol. Soc. Guidebook 13th Ann. Field Conf., p. 131, 135. In southern Illinois and western Kentucky, consists of four formations (ascending): Cypress sandstone, Golconda limestone, Hardinsburg sandstone, and Glen Dean limestone. In this area, the sandstones are prominent and persistent formations; in Mississippi River counties, they thin, become shaly, and locally, the Hardinsburg sandstone is entirely absent. In Mississippi River counties, succession is Ruma formation at base and Okaw limestone. Underlies New Design group (new); overlies Elvira group (new).

J. M. Weller and A. H. Sutton, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 5, p. 829–830. Derivation of name given.

Name derived from village of Homberg, Pope County, Ill., near which group is well and typically developed.

Home Glacial Substage

Pleistocene (Wisconsin): Southern Rocky Mountains.

L. L. Ray, 1938. (abs.) Geol. Soc. America Proc. 1937, p. 314. Two stages of glaciation, believed to be of Wisconsin age, are recognized along northern Front Range. Older is designated Home stage and the younger Corral Creek stage.

L. L. Ray, 1939, (abs.) Geol. Soc. America Bull., v. 50, no. 12, pt. 2, p. 2007; Kirk Bryan and L. L. Ray, 1940, Smithsonian Misc. Colln., v. 99, no. 2, p. 30–33; L. L. Ray, 1940, Geol. Soc. America Bull., v. 51, no. 12, pt. 1, p. 1857–1860. Represents second of five substages in southern Rocky Mountains. Preceded by Twin Lakes (new) and followed by Corral Creek substage.

Named for Home post office where terminal moraine stretches almost completely across Cache la Poudre Canyon.

Home Creek Limestone Member (of Caddo Creek Formation)[1]

Home Creek Limestone (in Caddo Creek Group)

Upper Pennsylvanian: Central and central northern Texas.

Original reference: N. F. Drake, 1893, Texas Geol. Survey 4th Ann. Rept., pt. 1, p. 387, 398.

M. G. Cheney, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 1, p. 66 (fig. 1), 88. Rank raised to formation in Caddo Creek group. Redefined to include shales found locally above highest limestone member of Home Creek formation and below disconformity at base of the Cisco. Overlies Hog Creek shale; underlies Gonzales formation.

M. G. Cheney, 1948, Abilene Geol. Soc. [Guidebook] Spring Field Trip, June 11–12, p. 20. Overlies Colony Creek shale (new) which replaces Hog Creek shale.

D. H. Eargle, 1958, San Angelo Geol. Soc. Guidebook, Apr. 17–19, p. 51. Member consists of limestone, light-gray to nearly white, nodular to slabby to thick-bedded, fine-grained, locally cherty; middle part generally marly, contains "seaweed" structures and a few fusulinids. Contains reefs in vicinity of Colorado River. Thickness about 30 feet. Overlies Colony Creek shale member; underlies Bluff Creek shale member of Graham formation.

D. H. Eargle, 1960, U.S. Geol. Survey Prof. Paper 315–D, p. 67–68, pl. 27. Unusual thickening of limestone units in uppermost part of Canyon group near junction of Home Creek and Colorado River has resulted in confusion in correlation with limestone units in Caddo Creek and Brad formations as mapped elsewhere. Drake originally applied term "Home Creek bed" to upper noncherty limestone in walls of creek and name

"Cherty bed" to lower massive limestone, which contains abundant nodules of rounded nodules of chert. The chert bearing limestone is now included in Brad formation. Plummer and Moore (1921, Texas Univ. Bull. 2132) applied name "Home Creek" to prominent limestone at top of Canyon group in Brazos and Colorado River valleys. By tracing this member across northern McCulloch County to the type locality, and by studying stratigraphy of northern Brown County, Nickell (1938, Texas Univ. Bur. Econ. Geology Pub. 3801) found that limestone called Home Creek limestone by most geologists correlated with one higher on the slope than the one to which Drake had originally applied term "Home Creek" at type locality. Drake's Home Creek limestone, he found, was the one that Plummer and Moore had subsequently named Ranger. Other miscorrelations to north have been made in the past. Beds mapped as Home Creek across southern Brown County to outlier of Cretaceous rocks on which town of Bangs is located were mapped as Ranger limestone member of Brad formation (Plummer and Moore, 1921) north of outlier. Thus, Hog Creek shale of Drake (1893), named for creek north of outlier—in which Bluff Creek shale as used by Cheney (1948, Abilene Geol. Soc. Guidebook, Spring Field Trip, June 11–12) is exposed—was believed to lie below Plummer and Moore's Home Creek limestone. Actually, Hog Creek shale of Drake lies above the Home Creek. Because of this confusion, Cheney proposed name Colony Creek to replace term Hog Creek.

Named for Home Creek, Coleman County.

Homer Limestone Member (of Wayan Formation)[1]

Lower(?) Cretaceous: Southeastern Idaho.

Original reference: G. R. Mansfield, 1921, Geol. Soc. America Bull., v. 32, p. 249–266.

Named for exposures in valley of Homer Creek, Cranes Flat quadrangle.

Homer Limestone Member (of Holdenville Shale)[1]

Pennsylvanian: Central southern Oklahoma.

Original reference: G. D. Morgan, 1924, [Oklahoma] Bur. Geology Bull. 2, p. 104–105.

C. C. Branson, 1957, Oklahoma Geology Notes, v. 17, no. 11, p. 107. Abandoned by Oklahoma Geological Survey. Name preoccupied; no replacement of name made.

Named for exposures near Homer School, in sec. 25, T. 4N., R. 6E., Pontotoc County.

Homer Quartzite (in Kaweah Series)

Triassic(?): Southern California.

Cordell Durrell, 1940, California Univ. Dept. Geol. Sci. Bull., v. 25, no. 1, p. 15, 116, fig. 29, geol. map. Third in sequence (ascending) of four units. Younger than Lemon Cove schist and older than Three Rivers schist (both new). Consists predominantly of graphitic schists or phyllites and bedded siliceous rocks, which are interpreted in origin, as cherts. Thickest section, which occurs in central part of Dry Creek area, measures about 7,000 feet.

Named for Homer Ranch in Dry Creek Valley, in the southern Sierra Nevada, north-central Tulare County.

Homestake Formation[1]

Precambrian: Southwestern South Dakota.

Original reference: J. O. Hosted and L. B. Wright, 1923, Eng. and Min. Journal-Press, v. 115, p. 793–799, 836–843, maps.

T. A. Dodge, 1942, Geol. Soc. America Bull., v. 53, no. 4, p. 563–565. In Lead district, underlies Ellison formation and overlies Poorman formation. Consists chiefly of quartz carbonate schist, locally much altered. Thickness 200 to 300 feet. Unit tightly folded.

E. P. Rothrock, 1944, South Dakota Geol. Survey Bull. 15, p. 24. In vicinity of Homestake mine, underlies Ellison formation and overlies De Smet formation. Thickness 70 feet.

J. A. Noble and J. O. Harder, 1948, Geol. Soc. America Bull., v. 59, no. 9, p. 944, 945, 946–947. Term De Smet dropped; unit included in Poorman formation; hence, Homestake underlies Ellison formation and overlies Poorman formation. In Rochford district, where Northwestern formation is missing, Flag Rock formation cuts across Ellison and in some places rests on Homestake.

Derivation of name not stated but probably Homestake mine, Lead district, Lawrence County.

Homestake Limestone Member (of Carmel Formation)

Homestake Limestone[1]

Jurassic: Southwestern Utah.

Original reference: C. R. Leith and E. C. Harder, 1908, U.S. Geol. Survey Bull. 338, p. 24.

J. H. Mackin, 1954, U.S. Geol. Survey Mineral Inv. Field Studies Map MF–14. Limestone portion of Leith and Harder's Homestake limestone is redefined as Homestake limestone member of Carmel formation, Carmel being herein geographically extended into Iron Springs area. Member consists chiefly of gray, "blue," and black limestone, massive to thick-bedded, which ranges in thickness from 220 to 250 feet in Granite Mountain area. Grades upward through a few feet of mud-cracked and ripple-marked limy mudstone into Entrada sandstone. Jurassic.

First mapped and described in vicinity of Homestake mine, Iron Springs quadrangle.

Homewood Formation (in Pottsville Group)

Homewood Sandstone Member (of Pottsville Formation)[1]

Homewood Sandstone and Shale (in Mercer Formation)

Homewood sandstone member

Homewood shale and (or) sandstone member

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

Original reference: I. C. White, 1878, Pennsylvania 2d Geol. Survey Rept. Q, p. 67.

N. K. Flint, 1951, Ohio Geol. Survey, 4th ser., Bull. 48, p. 40–41. Homewood shale and (or) sandstone member of Brookville cyclothem in report on Perry County. Base of Homewood considered boundary between Pottsville and Allegheny series.

M. T. Sturgeon and others, 1958, Ohio Geol. Survey Bull. 57, p. 49 (table 7), 50–51. Homewood sandstone member of Brookville cyclothem in report on Athens County. At type exposure, the Homewood is reported to include coalesced sandstones of several cycles of deposition, but in Ohio, Homewood member is recognized as the sandstone immediately below the Brookville member and above Tionesta coal. Either Brookville underclay or marine Putnam Hill shale overlies the Homewood, contact, where observed, is thin gradational one. Thickness 30 feet.

E. G. Williams, 1960, Jour. Paleontology, v. 34, no. 5, p. 909, 910 (fig. 2). Homewood sandstone and shale is at top of Mercer formation.

Named for occurrence at Homewood Station, Beaver County, Pa.

Homewood (Lower) Sandstone (in Kanawha Formation)[1]

Pennsylvanian: Southern West Virginia.

Original reference: C. E. Krebs and D. D. Teets, Jr., 1916, West Virginia Geol. Survey Rept. Raleigh and western parts of Mercer and Summers Counties, p. 56.

†Hominy Formation[1]

Pennsylvanian and Permian: Central northern Oklahoma.

Original reference: C. N. Gould, 1905, U.S. Geol. Survey Water-supply Paper 148, map.

C. C. Branson, 1957, Oklahoma Geology Notes, v. 17, no. 11, p. 101. Abandoned by Oklahoma Geological Survey.

Named for Hominy, Osage County.

Homochitto Member (of Pascagoula Formation)

Miocene: Southwestern Mississippi.

G. F. Brown and W. F. Guyton, 1943, Mississippi Geol. Survey Bull. 56, p. 22, 23 (chart), 32–37. Proposed to replace preoccupied name Knoxville member. Consists of sand, blue-green clay, and silt; very coarse sand or fine gravel at base. Thickness 181 to 252 feet. Underlies Fort Adams member; overlies a shale, sandy shale, siltstone unit 362 to 466 feet thick in lower portion of formation.

Crops out in narrow belt across southwestern Franklin County.

Honaker Limestone[1] or **Dolomite**[1] (in Conasauga Group)

Middle Cambrian: Southwestern Virginia, western North Carolina, and northeastern Tennessee.

Original reference: M. R. Campbell, 1897, U.S. Geol. Survey Geol. Atlas, Folio 44, p. 2.

John Rodgers, 1953, Tennessee Div. Geology Bull. 58, pt. 1 (plates); pt. 2, p. 46 (fig. 3), 51–53. In eastern Tennessee, Conasauga [group] varies in lithology, and three phases are recognized; in southeastern phase sequence includes (ascending) Honaker dolomite, Nolichucky shale, and Maynardville limestone. Dolomite in Honaker includes all types—light and dark, fine- and coarse-grained, shaly and massive. Limestone is also present. Thickness about 1,300 feet. Overlies Rome formation.

Named for exposures at Honaker, Russell County, Va.

Honaker Trail Formation (in Hermosa Group)

Pennsylvanian and Permian: Southeastern Utah.

S. A. Wengerd and M. L. Matheny, 1958, Am. Assoc. Petroleum Geologists Bull., v. 42, no. 9, p. 2056, 2075, 2080, figs. 3, 17. Introduced to replace previously used phrase "Upper Hermosa" in Four Corners region. Comprises gray to reddish-gray fine-crystalline to coarsely granular limestone with gray and red chert, and reddish-gray to buff-gray calcareous sandy siltstones. This lithologic association, however, is typical of only one of the several high stable-shelf associations found in formation. Westward and northwestward high on the shelf, formation grades into dolomite, basinward into sandier arkosic facies, and near Uncompahgre uplift it contains massive lentils of greenish-gray mica-siltstones and arkosic granulite. Thickness ranges from 0 to 1,750 feet in a northeasterly direction toward Uncompahgre uplift. Underlies Rico formation; overlies Paradox formation. Late Cherokee, Marmaton, Missourian, and Virgilian age.

S. A. Wengerd, 1958, Intermountain Assoc. Petroleum Geologists Guidebook 9th Ann. Field Conf., p. 115, figs. 4, 5, table 1. Upper Des Moines, Missouri, Virgil, and Wolfcamp.

Type locality: At Honaker Trail in sec. 29, T. 41 S., R. 18 E., along San Juan Canyon in San Juan County, Utah. Isopachous map shows formation in northeastern Arizona, southwestern Colorado, northwestern New Mexico, and southeastern Utah.

Honda Formation

Upper Jurassic: Southern California.

T. W. Dibblee, Jr., 1950, California Div. Mines Bull. 150, p. 22, pls. 1, 2. Consists of several thousand feet of dark greenish-brown clay shale commonly containing buff-weathering calcareous concretions; poorly bedded and intensely sheared; locally contains thin layers of fine-grained sandstone. Unconformably underlies Espada formation (new); either overlies or is intruded by serpentinized pyroxenite to the north. Hondo shale may be equivalent to type Knoxville, but its highly sheared condition and unconformable relationship to Espada formation suggests that it may be shale member of Franciscan.

Type locality: North side of Canada Honda 3 miles east of Point Pedernales, Santa Barbara County.

Hondo Sandstone Member (of San Andres Limestone)

Hondo Sandstone Member (of Chupadera Formation)[1]

Permian: Southeastern New Mexico.

Original reference: W. B. Lang, 1937, Am. Assoc. Petroleum Geologists Bull., v. 21, no. 7.

P. B. King, 1942, Am. Assoc. Petroleum Geologists Bull., v. 26, no. 4, p. 542 (fig. 2), 687, pl. 2. Hondo sandstone reallocated to member status in San Andres herein rank raised to formation. Term Chupadera abandoned.

Crops out near bottom of valley of Hondo River and its tributaries.

Hondo Shale or Formation

See **Arroyo Hondo Shale Member** (of Lodo Formation).

Hondo Slate

Precambrian (Proterozoic): Central northern New Mexico.

Evan Just, 1937, New Mexico School Mines Bull. 13, p. 11, 13 (table 1), 23, pl. 2. Characteristically black carbonaceous slate, has well-developed schistosity. Weathers rusty color. In many places, particularly along Arroyo Hondo, the black slate grades into quartz-muscovite schist. Ranges up to a mile in thickness. Overlies Ortega quartzite (new).

Arthur Montgomery, 1953, New Mexico Bur. Mines Mineral Resources Bull. 30, p. 6, 19. Renamed Pilar phyllite member of Ortega formation because name Hondo preempted.

Most conspicuous occurrence is belt extending from near Dixon northeast to central part of drainage system of Arroyo Hondo. Smaller belt between Harding mine and Copper Hill. Also exposed along Dixon-Penasco Road a few miles east of Dixon.

Honesdale Sandstone Member (of Catskill Formation)

Honesdale Sandstone Group (in Catskill Formation)[1]

Upper Devonian: Northeastern Pennsylvania.

Original reference: I. C. White, 1881, Pennsylvania 2d Geol. Survey Rept. G_5, p. 66–68, 132, 140.

Bradford Willard, 1939, Pennsylvania Geol. Survey, 4th ser., Bull. G–19, p. 279 (table 30), 288–291, fig. 72. Honesdale sandstone included in Catskill facies.

Harry Klemic and R. C. Baker, 1954, U.S. Geol. Survey Circ. 350, p. 2. Willard's (1939) classification interpreted as Honesdale sandstone member of Catskill formation. Occurs above Damascus red shale member and below Cherry Ridge red beds member.

First described at Honesdale, Wayne County.

Honey Creek Formation (in Timbered Hills Group)

Honey Creek Limestone[1]

Upper Cambrian: Central southern Oklahoma.

Original reference: E. O. Ulrich, 1911, Geol. Soc. America Bull., v. 22, p. 624, 642, 661, 666, pl. 27.

C. E. Decker, 1939, Oklahoma Geol. Survey Circ. 22, p. 16 (table 1), 19–20, measured sections. Uppermost formation in Timbered Hills group. In most places, rests directly on Reagan formation; contact gradational in many areas. Along west edge of Blue Creek Canyon, overlaps the Reagan and rests directly upon Precambrian igneous rock. Underlies Fort Sill formation. Thickness 51 to 90 feet in Arbuckle Mountains; 44 to 226 feet in Wichita Mountains.

E. A. Frederickson, 1948, Am. Assoc. Petroleum Geologists Bull., v. 32, no. 7, p. 1349–1355. Redefined to include units termed Cap Mountain and "basal limestone" in Timbered Hills group by Decker (1939). Both units are equivalents of all or portions of Honey Creek formation.

W. E. Ham, 1949, Oklahoma Geol. Survey Circ. 26, p. 23 (fig. 2), 31–39. Formation in Mill Creek-Ravia area consists of sandy and nonsandy dolomite 63 to 234 feet thick, overlying Reagan sandstone and underlying, with slight disconformity Fort Sill limestone.

Named for Honey Creek, a tributary of Washita River which rises in Arbuckle Mountains and flows northeastward around west end of East Timbered Hills.

Honeycut Formation (in Ellenburger Group)

Lower Ordovician: Central Texas.

V. E. Barnes and P. E. Cloud, Jr., 1945, Texas Univ. Bur. Econ. Geology Mineral Resources Circ. 34, p. 1, 3–7, 31–41. Uppermost formation in group. Overlies Gorman formation (new). Limestone and dolomite.

Thickness at type section (Blanco County) 679 feet; Cherokee Creek section, San Saba County, 142 feet.

P. E. Cloud, Jr., V. E. Barnes, and Josiah Bridge, 1946, Texas Univ. Bur. Econ. Geology Pub. 4301, p. 146–147, pls. 4, 6 [1945]. All known Ellenburger strata above Gorman formation here termed Honeycut formation. Upper and lower parts consist of interbedded limestones and dolomites separated by prominent median sequence of microgranular to very fine grained dolomite; this tripartite division is fairly persistent laterally. Cannonballs of chert and siliceous limestone common. Due to post-Ellenburger truncation, Honeycut ranges in thickness from maximum of 678 feet at type section in southeast corner of Llano uplift to a feather edge, disappearing entirely in western part of uplift.

P. E. Cloud, Jr., and V. E. Barnes, 1948, Texas Univ. Bur. Econ. Geology Pub. 4621, p. 40–42, 197, 257, 314, 321–333, pls. 3, 13 [1946]. Type section and local stratigraphy described in detail.

V. E. Barnes, P. E. Cloud, Jr., and Helen Duncan, 1953, Am. Assoc. Petroleum Geologists Bull., v. 37, no. 5, p. 1033. Stratigraphic relations at base of Burnam limestone (new) uncertain. Whether these Upper Ordovician rocks rest directly on Honeycut formation, or whether other rocks intervene between Honeycut and Burnam cannot be determined without drilling, if then. In north-central and northwestern parts of area, Stribling rocks rest directly on flat Honeycut rocks. In northeastern part of same area, horizontal beds of Stribling formation directly overlap steeply dipping beds of Honeycut.

Type section: In reach of Pedernales River known as Honeycut Bend, about 5 miles east of Johnson City, Blanco County. Also present in Burnet and Llano Counties.

Honolua Volcanic Series

Pliocene, upper(?), or Pleistocene, lower: Maui Island, Hawaii.

H. T. Stearns *in* H. T. Stearns and G. A. Macdonald, 1942, Hawaii Div. Hydrography Bull. 7, p. 65 (table), 159 (table), 173–179, pl. 1. Andesites and soda trachytes characterized by platy cleavage. Individual flows range from 25 to 300 feet in thickness; some are 500 feet near vents. Lavas attain maximum thickness of 750 feet near Eke. Separated from underlying Wailuku volcanic series (new) by thin red soil.

G. A. Macdonald *in* H. T. Stearns and G. A. Macdonald, 1942, Hawaii Div. Hydrography Bull. 7, p. 320–325. Petrography discussed.

G. A. Macdonald and D. A. Davis *in* Jacques Avias and others, 1956, Lexique Strat. Internat., v. 6, Océanie, fasc. 2, p. 89. Late Pliocene(?) or early Pleistocene.

Named from village of Honolua West Maui Mountains on northwest coast Maui Island. Village is on bay bounded on both sides by cliffs of andesitic lavas 100 to 150 feet high.

Honolulu Volcanic Series[1]

Honolulu Series

Pleistocene and Recent: Oahu Island, Hawaii.

Original reference: H. T. Stearns, 1935, Hawaii Div. Hydrog. Bull. 1.

Horace Winchell, 1947, Geol. Soc. America Bull., v. 58, no. 1, p. 1–48. Termed Honolulu series. Units correlated with Pleistocene and Recent stands of sea.

G. A. Macdonald and D. A. Davis *in* Jacques Avias and others, 1956, Lexique Strat. Internat., v. 6, Océanie, fasc. 2, p. 90–91. Series of olivine basalt, nepheline basalt, melilite-nepheline basalt lava flows, and associated cinder cones and ash beds, and tuff cones. Overlies Koolau volcanic series, erosional unconformity. Correlated with successive stands of sea higher or lower than present stand during Pleistocene time.

Includes following named units (not in sequence) : Ainoni Volcanics, Aliamanu Basalt. Aliamanu Tuff, Black Point Basalt, Castle Volcanics, Diamond Head Tuff, Haiku Volcanics, Hawaiiloa Volcanics, Kaau Volcanics, Kaimuki Basalt, Kalama Volcanics, Kalihi Volcanics, Kamanaiki Basalt, Kaneohe Volcanics, Kaohikaipu Volcanics, Kaupo Basalt, Koko Volcanics, Makalapa Tuff, Makawao Breccia, Manana Tuff, Maunawili Volcanics, Mauumae Volcanics, Mokapu Basalt, Mokolea Basalt, Moku Manu Volcanics, Nuuanu Volcanics, Pali Volcanics, Punchbowl Volcanics, Pyramid Rock Basalt, Rocky Hill Volcanics, Salt Lake Tuff, Sugar Loaf Basalt, Tantalus Basalt, Training School Volcanics, and Ulupau Tuff.

Named for city and county of Honolulu, in which it occurs. Present as many small masses and valley-filling lava flows covering total of about 27 square miles on both southwest and northeast flanks of southeast end of Koolau Range.

Honomanu Volcanic Series

Tertiary, upper (?) : Maui Island, Hawaii.

H. T. Stearns *in* H. T. Stearns and G. A. Macdonald, 1942, Hawaii Div. Hydrography Bull. 7, p. 61, 63, 65 (table), 66 (table), 68–74, pl. 1. Oldest rocks in East Maui. Exposed over less than 1 percent of Haleakala but believed to form basement of entire mountain to an unknown depth below sea level. Underlies Kula volcanic series (new).

G. A. Macdonald and D. A. Davis *in* Jacques Avias and others, 1956, Lexique Strat. Internat. v. 6, Océanie, fasc. 2, p. 90–91. Late Tertiary (?).

Type locality: Northeast slope Haleakala (East Maui) volcano in Honomanu Valley, a gorge 1,300 feet deep. Basalts form lower 950 feet of cliff and are exposed northwestward in sea cliffs and in mouths of deeper gulches as far as Waipo Bay. Exposed eastward from type locality nearly to Nahiku and for 5½ miles up Keanae Valley.

Hood Glacial Epoch

Pleistocene : Central northern Oregon.

E. T. Hodge, 1938, Geol. Soc. America Bull., v. 49, no. 6, p. 836, 841 (table 1). Youngest of series of five glacial epochs in area. Preceded by Jeffersonian epoch.

Hoodoo Quartzite[1]

Precambrian (Belt Series) : Southern central Idaho.

Original references: C. P. Ross, 1932, Idaho correlation chart compiled by M. G. Wilmarth ; 1934, U.S. Geol. Survey Bull. 854.

C. P. Ross and J. D. Forrester, 1958, Idaho Bur. Mines and Geology Bull. 15, p. 7. Belt series in vicinity of middle Fork of Salmon River, includes Yellowjacket formation, at least 9,000 feet thick, overlain by Hoodoo quartzite over 3,560 feet thick.

Type locality: Hoodoo Creek, northwestern part of Casto quadrangle.

Hood River Conglomerate[1] or Formation

Miocene, upper, or Pliocene, lower: Northwestern Oregon and southwestern Washington.

Original reference: J. P. Buwalda and B. N. Moore, 1927, Science, new ser., v. 66, p. 236.

R. W. Chaney, 1938, Carnegie Inst. Washington Pub. 476, p. 208–212. Plant fossils from formation indicate Pliocene rather than Pleistocene age.

C. R. Warren, 1941, Am. Jour. Sci., v. 239, no. 2, p. 106–127. Conglomerate deeply weathered, moderately well indurated, fluvial conglomerate resting conformably or nearly so on Yakima basalt and deformed with it. Traced from type locality northeast past Golden, Wash., to Sunnyside. Contemporaneous with Dalles and Ellensburg formations, both of late Miocene and early Pliocene.

Type section: In cut immediately east of Columbia River Highway bridge across Hood River, east of town of Hood River, Oreg.

Hook Limestone Member (of Macy Formation)

Middle Ordovician: Southeastern Missouri.

E. R. Larson, 1951, Am. Assoc. Petroleum Geologists Bull., v. 35, no. 9, p. 2060–2061. Name applied to lower member of formation. Composed of yellowish-brown fucoidal, fine calcitite with irregular buff-weathering dolomitic partings, and layers of intraformational conglomerate. Thickness at type locality 55 feet; here contains a 6-inch bed of orange metabentonite at 27 feet and a 1-inch bed of metabentonite at 46 feet; generally thins northward; thickens southward to 69 feet in Perry County. Underlies Zell member (new); overlies Hagar formation (new).

Type exposure: Along Missouri Highway 25, east of Macy, Ste. Genevieve County.

Hooker Slate[1]

Lower Cambrian: West-central Vermont.

Original reference: Arthur Keith, 1932, Washington Acad. Sci. Jour., v. 22, p. 360, 402.

E-an Zen, 1956, (abs.) Geol. Soc. America Bull., v. 67, no. 12, pt. 2, p. 1829–1830. Revised stratigraphic sequence proposed for north end of slate belt, Taconic Range. Consists of basal Biddie Knob formation (new); intermediate Bull formation; and the Hooker, a black slate formation with subsidiary dolomite, limestone, and quartzite beds. Fossils in Bull and Hooker formations indicate bulk of section is early Cambrian although some Ordovician slate may be present at top.

Named for Hooker Hill 2 miles north of Castleton, Rutland quadrangle.

Hook Mountain Flow

See **Watchung Basalt or Lava Flows.**

Hookton Formation

Pleistocene, middle to upper: Northwestern California.

B. A. Ogle, 1953, California Div. Mines Bull. 164, p. 13 (fig. 3), 57–63, pls. 1, 2. Sediments include gravel, sand, silt, and clay; characteristically yellow-orange in color. Thickness as much as 400 feet. Stratigraphically below, though not in contact with, Rohnerville formation (new); unconformably overlies Carlotta formation (new). No positive age can be established for formation; inferences suggest that it is probably middle to upper Pleistocene. [Columnar section shows Pleistocene; map bracket shows upper Pleistocene.]

Name derived from Hookton-Table Bluff area where there are numerous, more or less typical, random exposures. Area of study, Eel River valley, Humboldt County. Exposed on north and south sides of Eel River syncline; passes over Tompkins Hill anticline where folding has been more intense.

Hooper Clay Member (of Rockdale Formation)

Hooper Formation

Eocene, lower (Wilcox) : East-central Texas.

W. W. Sharp, Jr., 1953, *in* Am. Assoc. Petroleum Geologists, Soc. Econ: Paleontologists and Mineralogists, Soc. Explor. Geolphysicists Guidebook Field Trip Routes Joint Ann. Mtg. March, p. 53 (geol. map) Black to gray carbonaceous clay and shale containing lignite, concentric concretionary clayironstone, and sand layers. Disconformably underlies Simsboro formation.

R. L. Folk (leader), 1960, Texas Univ. Geol. Soc. Tertiary Field Trip, Dec. 10, p. 5, strat. section. Shown on stratigraphic section as clay member of Rockdale formation. Underlies Simsboro member; overlies Caldwell Knob member of Seguin formation.

Mapped in northern Bastrop County.

Hoosac Schist[1]

Hoosac Formation

Lower Cambrian(?): Western Massachusetts, western Connecticut, and southern Vermont.

Original reference: J. E. Wolff, 1894, U.S. Geol. Survey Mon. 23, p. 23–107.

J. B. Thompson, Jr., 1952, *in* M. P. Billings, John Rodgers, and J. B. Thompson, Jr., Geol. Soc. America Guidebook for Field Trips in New England, p. 40–41. Formation subdivided in southeastern Vermont. Contains Bull Hill member near base and Turkey Mountain and Plymouth members in upper part. Underlies Pinney Hollow formation; overlies Tyson formation. Cambrian or Lower Ordovician.

Occurs on top of Hoosac Mountain, northwestern Massachusetts.

Hooser Shale Member (of Bader Limestone)

Hooser Shale (in Council Grove Group)[1]

Permian: Eastern Kansas and southeastern Nebraska.

Original reference: G. E. Condra and J. E. Upp, 1931, Nebraska Geol. Survey Bull. 6, 2d ser., p. 20, 25.

R. C. Moore, J. C. Frye, and J. M. Jewett, 1944, Kansas Geol. Survey Bull. 52, pt. 4, p. 166; R. C. Moore and others, 1951, Kansas Geol. Survey Bull. 89, p. 46. Member of Bader limestone. Consists of shale and impure limestones. Thickness across line of outcrop in Kansas about 10 feet. Underlies Middleburg limestone member; overlies Eiss limestone member.

M. R. Mudge and H. R. Burton, 1959, U.S. Geol. Survey Bull. 1068, p. 13 (table 2), 79–80, pls. Member described in Wabaunsee County, Kans., where it is 5½ to 15½ feet thick, overlies Eiss limestone member and underlies Middleburg limestone member.

Type locality: Highway cut and ravine just east of Hooser, Cowley County, Kans.

Hoover conglomerate unit (in Sycamore Canyon Member of Puente Formation)

Miocene, upper : Southern California.

C. J. Kundert, 1952, California Div. Mines Spec. Rept. 18, p. 6 (fig. 2), 7, pl. 2. Cobble-pebble conglomerate bed containing some boulders and a few intercalated sandstone lenses in a red sandy or earthy matrix. Thickness about 750 feet. Overlies Cental Fee sandstone unit (new).

Occurs in Whittier-La Habra area, south of Whittier fault, Los Angeles County.

Hoover division[1]

Upper Cambrian or Lower Ordovician : Central Texas.

Original reference: T. B. Comstock and E. T. Dumble, 1890, Texas Geol. Survey 1st Ann. Rept., p. lxii, 295–306, pl. 3.

Named for Hoover Valley, Burnet County.

†Hop Brook Limestone[1]

Precambrian : Massachusetts.

Original reference : B. K. Emerson, 1899, U.S. Geol. Survey Bull. 159, p. 52.

Exposed in bottom and steep banks of Hop Brook at Sodom, eastern part of Berkshire County.

Hope Gypsum (in Sumner group)[1]

Permian : Central Kansas.

Original reference: F. W. Cragin, 1896, Colorado Coll. Studies, v. 6, p. 10, 11.

Named for Hope, Dickinson County.

Hope Limestone[1]

Silurian (?) : Central southern Maine.

Original reference : C. T. Jackson, 1837, 1st Rept. Maine, p. 57–58.

Extensively quarried in Hope Township, Knox County.

Hope Valley Alaskite Gneiss

Mississippian (?) or older : Southern Rhode Island.

G. E. Moore, Jr., 1958, U.S. Geol. Survey Geol. Quad. Map GQ–105. Pinkish gray to flesh colored, generally coarse to medium grained but locally medium to fine grained. Characterized by low content of biotite and by flattened rod-shaped aggregates of quartz, commonly 15 to 20 mm long, that produce strong lineation. Foliation moderately strong in southern part of area; generally weak or absent elsewhere. Locally porphyritic, with somewhat granulated phenocrysts of pink feldspar as much as 20 mm long. Intrusive into and contains inclusions of the Blackstone series, Intruded by sills and dikes of fine-grained granite, aplite, and pegmatite.

U.S. Geological Survey currently designates the age of the Hope Valley Alaskite Gneiss as Mississippian (?) or older on basis of a study now in progress.

Named for exposures on low knobs 1 mile north of village of Hope Valley, Hope Valley quadrangle. Particularly well exposed on one of these knobs known as Goat Rock. Widespread in southern part of state.

Hopewell Series

Precambrian (Proterozoic) : Central northern New Mexico.

Evan Just, 1937, New Mexico School Mines Bull. 13, p. 10–11, 13 (table 1), 21–22, 42–43, pls. 2, 3. Succession of metamorphosed igneous flows, with which are interspersed metamorphosed sediments in Picuris and Petaca areas. Flows were principally andesite and basalt (Picuris basalts), most of which are now dark hornblende-chlorite schists. There are some flows of rhyolite and trachyte (Vallecitos rhyolites), most of which are but little changed. Contains some slates and arkosites. In Picuris area, the most conspicuous quartzite is mapped separately as Badito quartzite. In Petaca area, between Tusas and Kiawa Mountains a particularly prominent member is called Cleveland Gulch quartzite. As exposed up to 1½ miles in thickness, may be considerably thicker. Underlies Ortega quartzite.

Fred Barker, 1958, New Mexico Bur. Mines Mineral Resources Bull. 45, p. 14. Name has been applied previously to another formation and is therefore replaced by name Moppin metavolcanic series for greenschist amphibolite, schist, and other, much less abundant rock types exposed in northwest-trending belt extending from Hopewell to Cow Creek, American Creek, and in part, the southeast part of Kiawa Mountain.

Mapped in Picuris and Petaca areas between towns of Hopewell on northwest and Picuris on southeast, Rio Arriba and Taos Counties.

Hopkinton Dolomite[1]

Middle Silurian : Eastern Iowa.

Original reference : S. Calvin, 1906, Jour. Geology, v. 14, p. 572, 574.

E. H. Scobey, 1938, Jour. Geology, v. 46, no. 2, p. 207, 215, 216. About 70 feet of beds formerly referred to lower part of Hopkinton formation of Niagaran series are placed in Alexandrian series. Illinois formation names Edgewood and Kankakee are extended into Iowa sections. Hop kinton overlies Kankakee and in most areas grades conformably into it.

E. H. Scobey, 1940, Jour. Sed. Petrology, v. 10, no. 1, p. 34 (table 2), 35, table 3), 37, 38 (fig. 1). Consists of maximum of 180 feet of medium-bedded to massive, buff dolomite with zones containing beds and nodules of white chert. Text refers to underlying Gower, but tables and figures show Gower overlying Hopkinton.

C. K. Swartz and others, 1942, Geol. Soc. America Bull., v. 53, no. 4, chart 3. Correlation chart shows Hopkinton (restricted) below Gower dolomite and above Waucoma limestone.

C. E. Brown and J. W. Whitlow, 1960, U.S. Geol. Survey Bull. 1123–A, p. 43–44, pls. 1, 3. Described in Dubuque South quadrangle, Iowa-Illinois, where it is about 195 feet thick. The Hopkinton, as used in this report, includes all beds overlying Kankakee formation, as Gower dolomite of Norton (1899, Iowa Geol. Survey, v. 9) which overlies Hopkinton in eastern Iowa, has not been recognized in Dubuque South Quadrangle.

Named for Hopkinton, Delaware County.

Hopkintonian series

Silurian (Early Yorkic) : Missouri.

C. R. Keyes, 1941, Pan-Am. Geologist, v. 75, no. 2, p. 157 (chart). Name appears on chart of formations in Missouri. Includes (ascending) Noix limestones, unnamed interval, Bowling Green dolomites. In sequence, younger than Maquoketan series and older than Goweran series.

Hoppin Slate[1]

Hoppin Formation

Lower Cambrian: Eastern Massachusetts.

Original reference: B. K. Emerson, 1917, U.S. Geol. Survey Bull. 597, p. 36.

B. F. Howell and others, 1944, Geol. Soc. America Bull., v. 55, no. 8, chart 1. Referred to as formation.

Exposed at Hoppin Hill, North Attleboro and in Wrentham.

Hopwood Conglomerate

Lower Mississippian: Southwestern Pennsylvania.

W. M. Laird, 1941, Pennsylvania Topog. and Geol. Survey Prog. Rept. 126, p. 14. Name will probably be used, following more definitive study of area, for unit here termed Conglomerate F and described as sandstone and conglomerate member. Consists of two parts, a lower massive cliff-making brown-gray sandstone and an upper conglomerate composed of white vein-quartz pebbles in a matrix of coarse greenish-gray sandstone. Conglomerate is contorted into large boulderlike masses in zone near its base. Total thickness about 28 feet. Conformably underlies Sandstone G (Pine Knob sandstone); lower contact not exposed.

Type section: Cliff at highway scenic lookout about one-fourth mile below Summit Hotel on Route 40, east of Hopwood, Fayette County.

Hordes Creek Limestone Lentil (in Admiral Formation)[1]

See **Hords Creek Limestone Member** (of Admiral Formation)

Hords Creek Limestone Member (of Admiral Formation)

Hordes Creek Limestone Lentil (in Admiral Formation)[1]

Hords Creek Formation (in Admiral Group)

Permian (Wolfcamp Series): Central Texas.

Original reference: N. F. Drake, 1893, Texas Geol. Survey 4th Ann. Rept., pt. 1, p. 421, 422.

M. G. Cheney, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 1, p. 66 (fig. 1). Rank raised to formation in Admiral herein restricted and given group status. Underlies Fisk formation (new); overlies Coleman Junction formation in Putnam group.

R. C. Moore *in* A. K. Miller and Walter Youngquist, 1947, Kansas Univ. Paleont. Contr. 2, Mollusca, art. 1, p. 1 (footnote). Hords Creek limestone underlies Wildcat Creek shale member (new) of Admiral formation.

R. C. Moore, 1949, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 80, sheet 2. Columnar section shows Hords Creek limestone member underlying Wildcat Creek shale member and overlying Lost Creek shale member of Admiral formation.

Named for Hords (Hordes) Creek, Coleman County.

Hornbrook Formation

Upper Cretaceous: Northern California and southwestern Oregon.

F. G. Wells, 1955, U.S. Geol. Survey Mineral Inf. Field Studies Map MF-38. Named on map legend. Indurated uniform fine-grained greenish-gray arkosic sandstone with local lenses of coarse conglomerate and sandy shale; fossiliferous and calcareous in places.

D. L. Peck, R. W. Imlay, and W. P. Popenoe, 1956, Am. Assoc. Petroleum Geologists Bull., v. 40, no. 8, p. 1968–1984. Defined to include Upper Cretaceous sedimentary rocks in southwestern Oregon and northernmost

California. These rocks have generally been referred to as Chico group although they are more than 80 miles north of nearest exposures of Upper Cretaceous rocks in Sacramento Valley, near Redding, Calif., and more than 140 miles north of type locality of Chico. These upper Cretaceous rocks nonconformably overlie deformed and in part metamorphosed volcanic and sedimentary rocks, ranging in age from Paleozoic to Late Jurassic, and granitic intrusive rocks, of Late Jurassic or Early Cretaceous age, and are overlain disconformably by clastic sedimentary rocks and volcanic rocks of Eocene age; in Hornbrook area, unconformably overlie Triassic Applegate group. Comprises at least 2,500 feet of arkosic wacke sandstone, siltstone, mudstone, and conglomerate and contains fossils of Cenomanian, Turonian, and Campanian age. In Hornbrook area, formation consists of six unnamed members (numbered I to VI from oldest to youngest) ; which have been traced northward from south side of Klamath River to vicinity of Hilts, Calif. An unconformity of unknown magnitude occurs between members II and III. The 700 feet of nonfossiliferous rock above the unconformity and the 100 feet of nonfossiliferous rock below it could represent either much or very little of the Coniacian to early Campanian stages. If future mapping demonstrates that more than one formation name is necessary, it is suggested that term Hornbrook be restricted to members I and II. Comparisons of time span of the Hornbrook with the Chico at its type locality shows that most of the Hornbrook is either younger or older than the Chico and that the unconformity within the Hornbrook represents most and perhaps all of the time represented by the Chico. Also the Cretaceous sequence in Redding area, which lies between the Chico and Hornbrook areas, is mostly older than type Chico. Therefore, distinct formational names are needed for each area in order to avoid ambiguity of geologic discussions. Type locality designated.

Type section: Exposures near town of Hornbrook, Siskiyou County, Calif. Discontinuous exposures form a northwest-trending band that extends from near Yreka, Calif., along valleys of Cottonwood and Bear Creeks to Grave Creek, Oreg.

Horned Toad Formation

Pliocene, lower and middle: Southern California.

T. W. Dibblee, Jr., 1958, Am. Assoc. Petroleum Geologists Bull., v. 42, no. 1, p. 137 (fig. 1), 138 (fig. 2), 143. Name applied to sequence of stream-laid and lacustrine sediments. Composed of upper member of gray gypsiferous clay, middle member of indurated green muddy sandstone with several layers of white caliche, and lower member of gray-white arkosic sands and interbedded light-reddish sandy siltstone with a basal granitic conglomerate. Formation moderately deformed. Thickness 1,055 feet. Mammalian fossils indicate early or middle Pliocene age. Overlies quartz monzonite of pre-Tertiary age and intrusive quartz latite of Tertiary age; unconformably underlies light-reddish sand, siltstone, and fanglomerate of probable Plestocene age.

Type locality: Horned Toad Hills, 4 miles northwest of Mojave, Mojave quadrangle, Kern County. Crops out from Warren Station, southwestward about 3 miles.

Hornerstown Sand (in Rancocas Group)

Hornerstown Formation

Hornerstown Marl (in Rancocas Group)[1]

Paleocene: New Jersey and Delaware.

Original reference: W. B. Clark, 1907, Johns Hopkins Univ. Circ., new ser., 1907, no. 7, Whole No. 199, p. 3.

S. K. Fox, Jr., and R. K. Olsson, 1955, [abs.] Jour. Paleontology, v. 29, no. 4, p. 736. Stratigraphic evidence indicates an unconformity between Cretaceous and Tertiary formation in New Jersey. Hornerstown rests successively from northeast to southwest on Tinton, Red Bank and Navesink formations. In each case, the Hornerstown lies upon a weathered surface, and basal few feet contain fragments of the underlying formation.

H. W. Miller, Jr., 1956, Am. Assoc. Petroleum Geologists Bull., v. 40, no. 4, p. 722–736. Formation correlated with Midway stage (Paleocene) of Gulf Coast. Presence of "middle greensand" unit between Navesink (Cretaceous) and Hornerstown formation recognized, and it is suggested that this is southwestward extension of Red Bank formation (Cretaceous).

A. R. Loeblich, Jr., and Helen Tappan, 1957, Jour. Paleontology, v. 31, no. 6, p. 1113 (fig. 2), 1128 (fig. 5), 1129–1132. Paleocene (Danian-Landenian). Determination made on basis of foraminiferal studies. Overlies Monmouth group; underlies Vincentown formation. Report summarizes opinions of several workers and cites bibliography.

H.G. Richards, J. J. Groot, and R. M. Germeroth, 1957, Geol. Soc. America Guidebook Field Trips Atlantic City Mtg., p. 184 (table 1), 186 (table 3), 198–199, 201 (table 4). Marl (formation) lies disconformably on Navesink marl in southern New Jersey. In Monmouth County where Red Bank and Tinton formations are present, relationship may be conformable. Consists of glauconite with clay and sand; resembles parts of Navesink, but distinguished from it by its more sandy natures. Thickness at outcrop 30 feet; average dip 30 feet per mile. Exact age uncertain; recent work on microfossils has shown formation should be regarded as Paleocene. Geographically extended into Delaware.

R. K. Olsson, 1959, Dissert. Abs., v. 19, no. 8, p. 2063–2064. Units studied: Navesink, Redbank, Tinton, New Egypt (new), and Hornerstown formations. The New Egypt in outcrop is lateral equivalent of Tinton formation and in subsurface represents both Tinton and Hornerstown formations. Paleocene-Eocene boundary lies within a lithic unit [in subsurface] (Hornerstown and New Egypt formations).

J. P. Minard and J. P. Owens, 1960, U.S. Geol. Survey Prof. Paper 400–B, p. B184. Rancocas group includes (ascending) Hornerstown sand, Vincentown formation, and Manasquan formation.

Named for occurrence at Hornerstown, Monmouth County, N. J. Extends in belt across New Jersey from vicinity of Atlantic Highlands through Freehold, Hornerstown, Birmingham, Mullica Hill, Sewell, and Woodstown to Delaware River and then into Delaware.

Hornsboro Sandstone[1] or zone[1]

Upper Triassic: Northeastern South Carolina.

Original references: E. Sloan, 1905, South Carolina Geol. Survey geognostic map of South Carolina, advance copies; published in 1908, in South Carolina Geol. Survey, ser. 4, Bull. 2; 1907, Summary of mineral resources of South Carolina, p. 11, 12.

Named for exposures around Hornsboro, Chesterfield County.

Hornsilver Dolomite Member (of Minturn Formation)

Pennsylvanian: Northwestern Colorado.

Ogden Tweto, 1949, Colorado Sci. Soc. Proc., v. 15, no. 4, p. 152 (table 1), 199, 216–217. Massive gray dolomite 12 to 16 feet thick overlain by 8 to 14 feet of thin-bedded gray dolomite. About 2,900 feet above base of formation. Lies about 800 feet below base of Resolution dolomite member (new); about 300 feet above Wearyman dolomite member (new).

Named for outcrops on south slope of Hornsilver Mountain, Pando area, Eagle County.

Horquilla Limestone (in Naco Group)

Middle and Upper Pennsylvanian: Southeastern Arizona and southwestern New Mexico.

James Gilluly, J. R. Cooper, and J. S. Williams, 1954, U.S. Geol. Survey Prof. Paper 266, p. 16–18, 31–35. Series of thin-bedded blue-gray limestones with a few thicker beds, as much as 6 or even 8 feet thick. A few beds of reddish-weathering shaly limestone intercalated in upper half of formation. Most limestone is dense and pinkish gray on fresh fracture. Some beds, especially the thicker ones, are coarsely crystalline limestone consisting largely of crinoidal fragments. Base of limestone is obscure surface of disconformity which, north of Dragoon Mountains, appears to fall in weak zone of shale immediately above Black Prince limestone. No complete section exposed in Tombstone Hills or Dragoon Mountains, Pearce or Benson quadrangles. Total thickness estimated at 1,200 feet; type section 999 feet thick. Southward in Gunnison Hills, unfaulted section has thickness of 1,600 feet. Underlies Earp formation. Pennsylvanian.

James Gilluly, 1956, U.S. Geol. Survey Prof. Paper 281, p. 8, 36–39, pl. 5. Lower and lower Upper Pennsylvanian.

Elliot Gillerman, 1958, New Mexico Bur. Mines Mineral Resources Bull. 57, p. 31–35, tables 1, 2, pl. 1. Most widespread Paleozoic formation in Peloncillo Mountains, N. Mex., where it consists almost entirely of limestones. A 14-foot argillaceous sandstone layer about 250 feet above base. Incomplete section 819 feet thick at Silver Hill mine, total much thicker. Overlies Paradise formation. Rocks of all middle and lower Pennsylvanian series and of Wolfcamp series of Permian are present.

U. S. Geological Survey currently designates the age of the Horquilla Limestone as Middle and Upper Pennsylvanian on basis of a study now in progress.

Type section: On spur of east Horquilla Peak from which it takes its name, Tombstone Hills, central Cochise County, Ariz., about 1 mile southeast of Ajax Hill. Widespread in Tombstone Hills, also in Mule Mountains, Dragoon Mountains, and in Courtland and Gleeson districts. In Peloncillo Mountains, N. Mex.

Horry Clay

Pleistocene: Eastern South Carolina.

C. W. Cooke, 1937, Washington Acad. Sci. Jour., v. 27, no. 1, p. 1–5. Dark-brown clay containing plant fragments, woody tissues, and diatoms. Thickness 3 feet; covered by water at high tide. Cypress stumps and knees rotted at top. Some of the stumps extend a few inches above clay into overlying shell bed. Top of clay perforated by tubular holes, presumably made by boring creatures. Presence of rooted stumps beneath thick marine deposit that evidently accumulated in quiet water gives evidence that sea stood lower on land when they grew than in immediately succeeding epoch. Underlies Pamlico formation. Apparently represents early part of Peorian stage.

D. G. Frey, 1952, Am. Jour. Sci., v. 250, no. 3, p. 212–225. Thickness about 9 feet. Horry clay below section described by Cooke is fresh-water deposit. Nearby Myrtle Beach peat (new) is presumably younger than the Horry though stratigraphic relationship uncertain. No known unconformable relationship exists between Horry clay and Pamlico formation.

Named for Horry County. Section described is west of railway bridge across Intracoastal Waterway 2½ miles northwest of Myrtle Beach.

Horse Bench Sandstone Bed (in Evacuation Creek Member of Green River Formation)

Horse Bench Sandstone Lentil (in Green River Formation)[1]

Eocene: Northeastern Utah.

Original reference: W. H. Bradley, 1931, U.S. Geol. Survey Prof. Paper 168, p. 16.

C. H. Dane, 1954, Am. Assoc. Petroleum Geologists Bull., v. 38, no. 3, p. 409 (fig. 2). Shown on chart as Horse Bench sandstone bed in Evacuation Creek member of Green River formation.

Named for fact that it forms broad tableland between Minnie Maud Creek and Jack Creek known as Horse Bench in northeastern Carbon County.

Horse Creek Clay and Shale (in Strawn Formation)[1]

Pennsylvanian: Central Texas.

Original reference: N. F. Drake, 1893, Texas Geol. Survey 4th Ann. Rept., pt. 1, p. 374, 479.

D. A. Zimmerman and G. D. Glover, 1956, Soc. Econ. Paleontologists and Mineralogists, Permian Basin Sec. [Guidebook] Spring Field Trip, May 11–12, p. 70. Overlies Fox Ford bed; underlies Bull Creek sandstone. Strawn series.

D. H. Eargle, 1960, U.S. Geol. Survey Prof. Paper 315–D, p. 58, pl. 27. Drake (1893) separated rocks of Strawn group [division] into 20 units of alternating sandstone and shale beds. He gave local names to these units, or "beds," as he termed them, and numbered them from top to bottom, 4 to 23. Only Drake's name for upper unit, the Ricker, in common use today, and that name has been restricted to base of Drake's Ricker bed.

Named for Horse Creek, San Saba County.

Horse Creek Formation (in Moran Group)

†Horse Creek Limestone Member (of Moran Formation)[1]

Permian (Wolfcamp Series): Central Texas.

Original reference: N. F. Drake, 1893, Texas Geol. Survey 4th Ann. Rept., pt. 1, p. 387, 419.

M. G. Cheney, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 1, p. 66 (fig. 1). Rank raised to formation in Moran group. Overlies "Dothan" formation; underlies Sedwick formation Wolfcamp series.

R. C. Moore, 1949, U. S. Geol. Survey Oil and Gas Inv. Prelim. Map 80. Name Gouldbusk is here applied to limestone beds and included thin shale that were called Horse Creek limestone by Drake. Sellards (1933, Texas Univ. Bull. 3232) pointed out duplication by Drake in use of this name, as applied to beds in his Strawn division farther east in Colorado River valley and to limestone, now considered Permian(?) in age, exposed in Coleman County. Sellards restricted application of Horse Creek to beds in Strawn sequence but did not rename the upper beds, which confusingly have continued to be called Horse Creek (Cheney, 1940; King, 1942, Am. Assoc. Petroleum Geologists Bull., v. 26, no. 4).

Named for Horse Creek, Coleman County.

Horsehead Tongue (of Mancos Shale)

Upper Cretaceous (mid-Carlile) : Northwestern New Mexico.

W. S. Pike, Jr., 1947, Geol. Soc. America Mem. 24, p. 9, 11, 13, 35, pl. 12. Dark-gray marine shale. Thickness 40 feet in area of typical exposures and thins southward, and assumed to pinch out in that direction. Underlies lower part of Gallup member of Mesaverde and overlies Atarque member (new) of Mesaverde formation.

Named from typical exposures on east side of valley of Horsehead Creek, in Ts. 9 and 10 N., R. 17 W., McKinley County.

Horseshoe Bar Quartz Diorite

[Jurassic] : Northern California.

G. H. Curtis, J. F. Evernden, and J. Lipson, 1958, California Div. Mines Spec. Rept. 54, p. 6. Discussed in report dealing with potassium-argon age determinations. Age 142.9 million years. Rock dated was called gabbro by Lindgren and considered to be local variation of Rocklin granodiorite which surrounds it.

Dated samples collected from quarry in NE¼ sec. 18, T. 11 N., R. 8 E., MD., approximately 3 miles southeast of Loomis.

Horse Spring Formation[1]

Eocene(?) : Southeastern Nevada and northwestern Arizona.

Original references: C. R. Longwell, 1921, Am. Jour. Sci., 5th v. 1, p. 53; 1928, U.S. Geol. Survey Bull. 798.

C. R. Longwell, 1936, Geol. Soc. America Bull., v. 47, no. 9, p. 1423. Highly tilted strata near mouth of Bitter Spring Wash that include breccia, gray sandstone, and peculiar green volcanic tuff, in addition to clay and gypsum previously assigned to Horse Spring formation found to be conformable with overlying Muddy Creek deposits and now believed to belong in later unit.

T. B. Nolan, 1943, U.S. Geol. Survey Prof. Paper 197–D, p. 163. Probable that formation is of Upper Cretaceous age.

C. R. Longwell, 1952, Utah Geol. Soc. Guidebook 7, p. 34 (fig. 4), 35. Age probably either very Late Cretaceous or Early Cenozoic. Thickness probably exceeds 3,000 feet in Muddy Mountains where it unconformably overlies Overton fanglomerate and unconformably underlies Muddy Creek formation. In Frenchman Mountain area, unconformably overlies Thumb formation (new).

C. M. Tschanz, 1960, U.S. Geol. Survey Prof. Paper 400–B, p. B293. Assigned to Miocene on basis of potassium-argon (K–Ar) date of biotite from interbedded tuff. Horse Spring previously assigned to Cretaceous or early Tertiary on basis of plants, ostracodes, and snails.

U.S. Geological Survey currently designates the age of the Horse Spring as Eocene(?).

Well exposed on east side of Horse Spring Valley, near St. Thomas Gap, Clark County, Nev.

†Horsetail Creek Beds[1]

Horsetail Creek facies (of Chadron Formation)

Horsetail Creek Member (of White River Formation)

Oligocene, lower : Northeastern Colorado.

Original reference: W. D. Matthew, 1901, Am. Mus. Nat. History Mem., v. 1, pt. 7, p. 355–374, 444.

H. E. Wood 2d and others, 1941, Geol. Soc. America Bull., v. 52, no. 1, p. 22, pl. 1. Referred to as Horsetail Creek facies of Chadron formation, Chadronian age.

E. C. Galbreath, 1953, Kansas Univ. Paleont. Contr. 13, Vertebrata, art. 4, p. 12–14, 15 (fig 5), 24, 25, 27 (fig. 8). Referred to as member of White River formation. As herein described, based on exposures in Logan County where gray massive silts rest upon Cretaceous surface (Fox Hills sandstone and Pierre shale). Top grades upward into tan to pink silt of Cedar Creek member or is separated from it by erosional unconformity. Locally, member contains beds of olive-colored silt and freshwater limestone with interfingering beds of whitish-gray silt at top. Thickness at type locality 110 feet. Location of type section for Horsetail Creek beds, as described Matthew, is matter of debate; therefore, type locality is herein designated.

Type locality: Secs. 29, 31, and 32, T. 11 N., R. 53 W., Logan County. Named for Horsetail Creek, Logan and Weld Counties.

Horsethief Formation

Pliocene : California.

O. P. Jenkins, 1938, Geologic map of California (1 :500,000) : California Div. Mines, sheet 4. Shown on map legend.

Horsethief Sandstone (in Montana Group)[1]

Upper Cretaceous: Northwestern Montana, and southern British Columbia, Canada.

Original reference: E. Stebinger, 1913, Am. Inst. Mining Engrs. Bull. 81, p. 2337.

J. G. Bartram, 1937, Am. Assoc. Petroleum Geologists Bull., v. 21, no. 7, p. 910. Suggests abandonment of term and inclusion of unit in Fox Hills sandstone.

W. A. Cobban, 1955, Billings Geol. Soc. Guidebook 6th Ann. Field Conf., p. 108 (fig. 1), 118. Restricted to massive cliff-forming sandstone above slope-forming unit here termed Bearpaw-Horsethief transition beds. This unit had been included in Horsethief by Stebinger (1914, U.S. Geol. Survey Bull. 540). Near Blacktail Creek, where Horsethief sandstone is 90 feet thick, threefold division is apparent: lower 45 feet is cliff-forming massive fine-grained sandstone; 20 feet of soft fine-grained highly cross-bedded sandstone that contains large calcareous sandstone concretions weathering dark brown; and 25 feet massive cliff-forming crossbedded medium- to coarse-grained sandstone. On Blackfeet Indian Reservation, top few feet is titaniferous magnetite sandstone. West of South arch, upper 30 to 40 feet weathers dark brown and locally contains pebbles of igneous rocks. Underlies St. Mary River formation.

Type locality: Horsethief Ridge, Blackfoot quadrangle, Montana.

Horsetown Formation[1]

Horsetown Group

Horsetown Stage

Lower Cretaceous (Shasta Series): Northern California and southern Oregon.

Original reference: C. A. White, 1885, U.S. Geol. Survey Bull. 15, p. 19–32.

F. M. Anderson, 1938, Geol. Soc. America Spec. Paper 16, p. 38 (table 1), 61–68, table 2. Upper group of Shasta series. Overlies Paskenta group. Comprises Cottonwood beds (new) below and Hulen beds (new) above. Top of Horsetown indicated generally by basal beds of Chico series resting unconformably upon it. Group typically developed in Cottonwood district. Becomes progressively thicker southward from North Fork of Cottonwood Creek toward delta axis, increasing from thickness of 6,430 feet near Ono to more than 12,500 feet in its maximum section. No clearly marked stratigraphical break between Paskenta and Horsetown groups has been found here, although conglomerate beds extending south from Ono may be taken as such. Otherwise, only an arbitrary line has been drawn for it. Fauna of Ono zone at bottom of Horsetown group seems to represent a low Hauterivian horizon on scale of Europe and, for this reason, forms convenient reference plane, serviceable for correlation. Term Horsetown, as formational name for succession of strata to which it has been applied, is not a good choice. The area about the old mining camp of this name is detached from district in which group is most typically and completely represented and at best exposes not more than 500 feet of uppermost Shasta series, which beds are scarcely representative of great body of older strata included under the name by White, Stanton, and Diller, and later writers. Name retained in this report only because it is well established in literature. Term Cottonwood group would be more appropriate.

F. M. Anderson, 1943, California Div. Mines Bull. 118, pt. 2, p. 184 (fig. 68) [preprint 1941]. Underlies Pioneer group of Chico series.

J. M. Kirby, 1943, California Div. Mines Bull. 118, pt. 3, p. 606–608. Oldest strata exposed along axis of Sites anticline [north-central Colusa and central Glenn Counties] belong to Lower Cretaceous Shasta group. About 5,000 feet of beds belonging to Horsetown formation and consisting chiefly of well-bedded dark-gray to greenish drab siltstones and shales with interbedded hard thin sandstones and dense limestone layers form pronounced anticlinal valley and lowland west of lower Chico group rimrock. Formation underlies Golden Gate formation of Chico group. [Preoccupied name Golden Gate later replaced by Venado formation.]

N. L. Taliaferro, 1944, Am. Assoc. Petroleum Geologists Bull., v. 28, no. 4, p. 458–459. Anderson (1938) divided Lower Cretaceous in northern California into Paskenta and Horsetown groups. There is no justification for use of group as designation for these beds. It is believed that names Paskenta and Horsetown should be used as approximate faunal stages rather than group terms. Name Marmolejo formation proposed for Lower Cretaceous of Santa Lucia Range.

A. S. Huey, 1948, California Div. Mines Bull. 140, p. 16 (fig. 2), 23–24. Rocks of Horsetown formation occur in two fault-wedge blocks along Tesla fault zone in Tesla quadrangle. Thickness 0 to 500 feet. Eastern mass of Horsetown rocks is wedge between Franciscan and Panoche formations. In Corral Hollow, the shales have vertical attitude and are separated from Franciscan by Tesla fault zone. Contact with Panoche not exposed.

F. G. Wells, P. E. Hotz, and F. W. Cater, Jr., 1949, Oregon Dept. Geology and Mineral Industries Bull. 40, p. 14–15. Formation, in Kerby quadrangle, Oregon, crops out in southern part of Illinois Valley. To the south, unconformably overlies steeply dipping Galice formation. Covered by Recent alluvium to the west and north. Exposed thickness about 5,000 feet.

L. I. Briggs, Jr., 1953, California Div. Mines Bull. 167, p. 22. Name Wisenor formation proposed for strata of Horsetown age in Ortigalita Peak quadrangle.

F. G. Wells, 1955, U.S. Geol. Survey Mineral Inv. Field Studies Map MF–38. Formation mapped in southern Oregon.

M. A. Murphy, 1956, Am. Assoc. Petroleum Geologists Bull., v. 40, no. 9, p. 2100–2103, 2112–2119. Discussion of Lower Cretaceous stratigraphic units of northern California. District is type area for stratal unit previously called Horsetown "group" or "formation", here redefined as Horsetown stage. Eight biostratigraphic zones, ranging in age from Hauterivian to late Albian in European time scale, defined within this stage. Upper and lower boundaries of stage are defined by the bases of zones *Pervinquieria hulenana* and *Neocraspedites aguila*, respectively. As defined by Anderson (1938), "Horsetown group" is separated from units above and below by faunal criteria. At type section, "Horsetown group" lies within single formational unit here termed Ono formation. Since a group must contain two or more formations, Horsetown strata as restricted by Anderson cannot be designated properly by term "group". If Horsetown group were to be redefined to include Ono and Rector formations of this report, then obstacle to retention of term would be removed. However, such a redefinition would require that about 200 feet of strata above Anderson's "Horsetown group" be included in redefined group and that base of redefined group be lowered to coincide with unconformity at base of Cretaceous section. First requirement would include in the Horsetown younger strata than have been included in it before, and second requirement would lead to restriction or perhaps suppression of the Paskenta as stratal unit. Until more extensive mapping has been done, it does not seem wise to recommend further modification of use of stratigraphic unit named "Horsetown." As defined by Anderson, it is a stage which encompasses most of Neocomian, Aptian, and lower Albian of European authors. It seems best to continue to use it as defined by Anderson and to recognize that he misused term "group" as that term presently is defined.

W. P. Irwin, 1957, Am. Assoc. Petroleum Geologists Bull., v. 41, no. 10, p. 2284–2297. Franciscan group is widely held to be restricted to Late Jurassic age, the Knoxville formation to be an upper shaly phase of the group, and the two to be overlain by detrital strata of Cretaceous age. Paleontologic evidence indicates this view to be incorrect. Rather, Franciscan group seems mainly to have been deposited contemporaneously with Knoxville, Paskenta, Horsetown, and lower Upper Cretaceous strata.

R. W. Imlay and others, 1959, Am. Assoc. Petroleum Geologists Bull., v. 43, no. 12, p. 2783. Name Days Creek formation (new) replaces Horsetown formation and Cretaceous part of Knoxville formation, as used by Diller and Kay (1924, U.S. Geol. Survey Geol. Atlas, Folio 218).

Type district (Anderson, 1938): Cottonwood district, north of delta axis, Tehama County, Calif. Named for exposures at Horsetown, Shasta County, Calif.

Hortontown basic eruptives[1]

Age(?): Southeastern New York.

Original reference: C. E. Gordon, 1911, New York State Mus. Bull. 148, p. 11, 37–39.

Probably named for occurrences at Hortontown, Poughkeepsie quadrangle.

Hortonville Slate[1]

Middle Ordovician: West-central Vermont.

Original reference: Arthur Keith, 1932, Washington Acad. Sci. Jour., v. 22, p. 360, 369.

W. M. Cady, 1945, Geol. Soc. America Bull., v. 56, no. 5, p. 522 (fig. 3)-524 (strat. column), 558–561. In west-central Vermont, overlies Glens Falls limestone. An interbedded zone, in most places less than 5 feet thick, forms gradation between the Glens Falls and Hortonville east of Champlain thrust. Thickness about 400 feet.

Phillip Fowler, 1950, Vermont Geol. Survey Bull. 2, p. 13, 34–37, pl. 1. Includes all autochthonous black slate and phyllite previously included in Keith's Ira slate which had same stratigraphic position and is now abandoned. Maximum thickness in Castleton area at least 1,000 feet. Overlies Whipple marble (new).

E-an Zen, 1959, New England Intercollegiate Geol. Conf. Guidebook 51st Ann. Mtg., p. 2. Discussion of stratigraphy and structure at north end of Taconic Range and adjacent areas. "Hortonville formation" overlies the Glens Falls perhaps unconformably. This is a black slate or phyllite which resembles West Castleton formation (new) and also some of black slate of Poultney River group (new). Age of type Hortonville subject to question. Writer [Zen] suggests reviving Keith's (1932) name Ira formation for belt that runs from Florence south toward Dorset Mountain, a belt that cannot be traced into type Hortonville with certainty.

E-an Zen, 1959, (abs.) Geol. Soc. America Bull., v. 70, no. 12, pt. 2, p. 1705. Hortonville of west-central Vermont is largely black slate unit. Its Late Trenton age assignment was based on correlation with Snake Hill formation, separated from Hortonville by major faults, and underlying fossiliferous Glens Falls limestone near Hortonville village. Dale's graptolites in the black slate have not been authenticated, and localities yielded no new specimens. Recent mapping in Lower Cambrian allochthonous Taconic sequence immediately south of Hortonville shows that contact between type Hortonville and the Glens Falls may be a fault. Type Hortonville slate was traced into an outcrop from which Schuchert reported *Olenellus*(?) fragments. Stratigraphically and geometrically, type Hortonville corresponds to Lower Cambrian black slate of Taconic sequence, and in field no contact is discernible between them. Hortonville also reported as traceable into fossiliferous Upper Trenton black slate in Middlebury synclinorium. It is urged that name Hortonville not be used with time connotations.

Well exposed around Hortonville, Castleton quadrangle.

Hoskinnini Member or **Tongue** (of Moenkopi Formation)

Hoskinnini Member (of DeChelly Sandstone)

Hoskinnini Tongue or Member (of Cutler Formation)[1]

Triassic(?): Southeastern Utah and northeastern Arizona.

Original reference: A. A. Baker and J. B. Reeside, Jr., 1929, Am. Assoc. Petroleum Geologists Bull., v. 13, no. 11, p. 1422, 1423, 1441, 1443, 1446.

J. A. Momper, 1957, Four Corners Geol. Soc. Guidebook 2d Field Conf., p. 90. Reallocated to member status in DeChelly sandstone herein raised to formational rank.

J. H. Stewart, 1959, Am. Assoc. Petroleum Geologists Bull., v. 43, no. 8, p. 1852–1868. Recent work indicates unit originally defined as Hoskinnini tongue of Cutler formation extends into parts of southeastern Utah, where it has not been previously reported. Hoskinnini is correlated with part or all of unit defined as Tenderfoot member of Moenkopi formation in salt anticline region of east-central Utah and west-central Colorado. Hoskinnini redefined as member of Moenkopi. The Hoskinnini and laterally continuous strata in Tenderfoot member are exposed within a north-northeast oriented area about 180 miles long and 50 miles wide extending from Monument Valley area, in northeastern Arizona and southeastern Utah, to west-central Colorado. Thickness of Hoskinnini 0 to 126 feet; in most areas 50 to 120 feet. Overlies Organ Rock tongue of Cutler in most of southeastern Utah; overlies DeChelly sandstone member of Cutler near junction of Green and Colorado Rivers and southward into White River Canyon area. Problems of nomenclature discussed.

Named for exposures on north face of Hoskinini [Hoskinnini] Mesa, San Juan County, Utah. Exposed in elongate area extending from Monument Valley in Arizona to about 6 miles southwest of Moab, Utah. Gregory (1916, U.S. Geol. Survey Water-Supply Paper 380) shows Hoskinnini Mesa in southern part of San Juan County, Utah.

Hosmer Conglomerate[1]

Hosmer Run Conglomerate[1]

Devonian or Carboniferous: Northwestern Pennsylvania.

Original reference: J. F. Carll, 1883, Pennsylvania 2d Geol. Survey Rept. I_4, p. 250, 254, 259, 268.

On Hosmer Run, near east line of Spring Creek Township, Warren County.

Hospital Porphyry

Pliocene(?): Southwestern Arizona.

James Gilluly, 1946, U.S. Geol. Survey Prof. Paper 209, p. 44. Dark-gray fine-grained rock with phenocrysts of glassy plagioclase as much as 2 centimeters in length. Microscopic studies suggest that it is an augite andesite porphyry approaching a latite. Forms group of dikes which range in thickness from a few feet to 125 feet, and individual segments are from a few hundred feet to 2,500 feet long. Much younger than Cornelia quartz monzonite because it cuts Locomotive fanglomerate, which rests on eroded surface of the monzonite, and petrographically strongly resembles porphyritic latite of Childs latite flows; thus is probably related to this much younger regional volcanic activity rather than to Cornelia quartz monzonite.

Rocks named for good exposures on hill just west of Phelps Dodge Hospital at Ajo, where they form a group of dikes trending north-northwestward in region between Ajo and Black Mountain, western Pima County.

Hosselkus Limestone[1]

Upper Triassic: Northern California.

Original reference: J. S. Diller, 1892, Geol. Soc. America Bull., v. 3, p. 370–394.

A. F. Sanborn, 1960, California Div. Mines Spec. Rept. 63, p. 6, 7, pl. 1. Described in Big Bend quadrangle, Shasta County, where it is about 150 feet thick in Devils Canyon and 20 feet thick near Hawkins Creek. Overlies Pit formation; underlies Brock shale.

Named for fact it forms prominent ledges on divide between Genesee Valley and Hosselkus Creek, 1 mile northeast of Hosselkus Ranch, Plumas County.

Hosselkus Series[1]

Upper Triassic: Northern California.

Original reference: G. H. Ashley, 1923, Eng. Mining Jour.-Press, v. 115, p. 1106–1108.

Hosston Formation

Lower Cretaceous: Subsurface in Louisiana, Arkansas, and eastern and southern Texas.

R. W. Imlay, 1940, Arkansas Geol. Survey Inf. Circ. 12, p. 28–30. Name chosen by Shreveport Geological Society to designate Lower Cretaceous red and gray shales, dolomites, and sandstones above Cotton Valley formation and below Sligo formation. Replaces Travis Peak, as applied to beds older than real Travis Peak of Texas. Base of Hosston is placed above highest black shale unit of Cotton Valley formation; it is marked by a basal conglomerate in Arkansas and in northern Louisiana. Formation grades offshore, south of Shreveport area, into fossiliferous dark shales and limestones which contain minor amounts of interbedded red shale and sandstone. Thickness ranges from about 800 feet in Arkansas to over 2,000 feet in northern Louisiana and eastern Texas.

Type well: Dixie Oil Co. Robertshaw No. 92 (Dillion No. 92), in sec. 13, T. 21 N., R. 15 W., Caddo Parish, La. Named after town of Hosston located about 7 miles north of top of Pine Island anticline.

Hosta Tongue (of Point Lookout Sandstone)

Hosta Sandstone Member (of Mesaverde Formation)[1]

Upper Cretaceous: Northwestern New Mexico.

Original reference: J. D. Sears, 1934, U.S. Geol. Survey Bull. 860–A.

E. C. Beaumont, C. H. Dane, and J. D. Sears, 1956, Am. Assoc. Petroleum Geologists Bull., v. 40, no. 9, p. 2156. In revised nomenclature of lower part of Mesaverde, Point Lookout sandstone as a formation in Mesaverde group replaces Hosta sandstone member where that member is undivided, and also replaces upper part of Hosta sandstone member where its lower part is absent or is separated from its upper part by tongue of Mancos shale. Hosta tongue of Point Lookout sandstone replaces lower part of Hosta sandstone member where that is present.

Named for exposures on Hosta Butte, Gallup region.

Hostetter Limestone and Clay

Permian (Greene Series): Eastern Ohio.

A. T. Cross, W. H. Smith, and Thomas Arkle, Jr., 1950, Field guide for the special conference on the stratigraphy, sedimentation, and nomenclature of the Upper Pennsylvanian and Lower Permian strata (Monongahela, Washington, and Greene series) in the northern portion of the Dunkard basin of Ohio, West Virginia, and Pennsylvania: West Virginia Geol. and Econ. Survey, [pl. 1]. Hostetter limestone and clay shown on columnar section of names of strata applied in Ohio. Occurs above Fish Creek sandstone and below (Burton sandstone).

Hostler Formation (in Hatter Group)

Hostler Member (of Hatter Formation)

Middle Ordovician (Bolarian): Central and south-central Pennsylvania.

G. M. Kay, 1943, Econ. Geology, v. 38, no. 3, p. 193, 195. Uppermost member of formation. Lower part dark, tan-weathering, siliceous and argillaceous limestone, massive in fracture, richly fossiliferous, and less impure near base; upper part dark impure well-bedded, somewhat laminated limestone, sparsely fossiliferous. Thickness 63 feet in type section. Overlies Grazier member (new); underlies Snyder member of Benner limestone. Chazyan series.

G. M. Kay, 1944, Jour. Geology, v. 52, no. 1, p. 10–11. Lower limit of unit normally not sharply defined because lower beds become similar to Grazier member. Middle zone with brachiopod- and bryozoan-rich very siliceous, and argillaceous limestone or calcareous siltstone readily recognizable. Upper zone, well-bedded and containing fucoidal siliceous partings, is in places difficult to separate from less siliceous coarser, commonly cross-laminated ledges of lowest Snyder limestone. In type section, top of unit is at re-entrant beneath white-weathering sub-lithographic limestone ledges of the Snyder. Thickness 40 to 60 feet in most localities. Derivation of name.

Marshall Kay, 1948, Am. Assoc. Petroleum Geologists Bull., v. 32, no. 8, p. 1402 (fig. 2), 1407. Rank raised to formation in Hatter group or Hatterian subseries (of Bolarian series).

Marshall Kay, 1956, Geol. Soc. America Bull., v. 67, no. 1, p. 82, 102. Discussed as a member.

Type section: On two sides of Pennsylvania Railroad cut north of Union Furnace, Huntingdon County. Named for village of Hostler in Centre County, 9 miles northeast of Union Furnace.

Hotauta Conglomerate (in Unkar Group)[1]

Hotauta Formation

Precambrian (Grand Canyon Series): Northern Arizona.

Original reference: L. F. Noble, 1914, U.S. Geol. Survey Bull. 549.

Charles Keyes, 1938, Pan-Am. Geologist, v. 70, no. 2, p. 107 (table), 109–110. Basal formation in Grand Canyon series. Somewhat irregular formation; sometimes attains thickness of 50 feet. Underlies Newberry formation (new).

R. P. Sharp, 1940, Geol. Soc. America Bull., v. 51, no. 8, p. 1242–1243. Conglomerate is dark-reddish-brown, poorly bedded and poorly sorted sandstone or conglomerate, locally arkosic. Maximum thickness 30 feet, although average is between 2 and 6 feet. In Hotauta Canyon, underlies Bass limestone.

Named for Hotauta Canyon, Shinumo quadrangle, Grand Canyon region.

Hothouse Formation (in Great Smoky Group)

Precambrian: Central northern Georgia and southwestern North Carolina.

V. J. Hurst, 1955, Georgia Geol. Survey Bull. 63, p. 35–40, pl. 1, map. Interbedded metagraywacke, quartzite, and metaconglomerate at top; downward these beds become less and less prominent; base principally mica schist. Estimated thickness 8,000 to 11,000 feet; dip of bedding steep; no important repetition of beds recognized. Underlies Dean formation (new); hybrid character of rocks between the two makes position of boundary largely interpretative; overlies Hughes Gap formation (new).

Crops out in two parallel belts in Mineral Bluff quadrangle; each belt is limb of Murphy syncline; larger belt trends northeast-southwest across central part of quadrangle; second belt crosses southeastern corner of quadrangle. Named from Hothouse Creek which flows along central part of larger belt, Fannin County, Ga.

Hot Springs Formation[1]

Quaternary: Yellowstone National Park.

Original reference: W. H. Weed, 1896, U.S. Geol. Survey Geol. Atlas, Folio 30.

Named for Hot Springs, which formed deposit.

Hot Springs Formation (in Mud Springs Group)

Pennsylvanian (Derry Series): Central New Mexico.

M. L. Thompson, 1942, New Mexico Bur. Mines Mineral Resources Bull. 17, p. 27 (table 2), 37–39. Name applied to basal formation of Mud Springs group (new). At type locality, composed of dark- to light-gray massive to nodular highly cherty limestone and thick shale beds; at least six distinct limestone sequences present. Thickness at type locality about 85 feet; about 24 feet thick at Derry where it is composed almost entirely of limestone. Underlies Apodaca formation (new); overlies Cuchillo Negro formation (new); in northern part of area, overlaps on the Precambrian and there contains coarse clastics in its lower part.

M. L. Thompson, 1948, Kansas Univ. Paleont. Contr. 4, Protozoa, art. 1, p. 73. Replaced by Fra Cristobal formation (new). Term Hot Springs preoccupied.

Type locality: West end of Whiskey Canyon and just west of westernmost box canyon, near north end of Mud Springs Mountains, Sierra County. Name derived from town of Hot Springs on Rio Grande about 3 miles southeast of south end of Mud Springs Mountains.

Hot Springs Sandstone[1]

Mississippian: Southwestern Arkansas.

Original reference: A. H. Purdue, 1910, Jour. Geology, v. 18, p. 282–283.

W. H. Hass, 1950, Am. Assoc. Petroleum Geologists Bull., v. 34, no. 7, p. 1578, 1582. On basis of conodont studies, Stanley shale is regarded as ranging in age from the Meramec part of Mississippian into basal Pennsylvanian. Hot Springs sandstone which underlies Stanley shale in vicinity of Hot Springs is considered to be Mississippian (Meramec).

August Goldstein, Jr., 1959, *in* Geology of the Ouachita Mountains—a symposium: Dallas, Tex., Dallas Geol. Soc. and Ardmore Geol. Soc., p. 103. Exposed only in and near city of Hot Springs where it ranges in thickness up to about 200 feet. Unconformably overlies Arkansas novaculite; underlies Stanley shale, contact gradational.

First described in vicinity of Hot Springs, Garland County.

Houchen Creek Limestone Bed (in Hamlin Shale Member of Janesville Shale)

Houchen Creek Limestone[1] Member (of Hamlin Shale)

Permian: Southeastern Nebraska and northeastern Kansas.

Original reference: G. E. Condra, 1927, Nebraska Geol. Survey Bull. 1, 2d ser., p. 84, 89.

R. C. Moore, 1936, Kansas Geol. Survey Bull. 22, p. 50 (fig. 12). Permian.

R. C. Moore and M. R. Mudge, 1956, Am. Assoc. Petroleum Geologists Bull., v. 40, no. 9, p. 2273, 2274 (fig. 1). Rank reduced to bed in Hamlin shale herein reduced to member status in Janesville shale (new). Wolfcamp series.

M. R. Mudge and R. H. Burton, 1959, U.S. Geol. Survey Bull. 1068, p. 51. Suggested herein that Houchen Creek limestone bed be used as formal name. Recent work has shown that this bed of Hamlin shale cannot be correlated south of Pottawatomie County. Algal limestone identified as Houchen Creek in Chase County (Moore, Jewett, and O'Connor, 1951, Kansas Geol. Survey Rept., v. 11, pt. 1) does not correlate with type section of Houchen. Pottawatomie County, the Houchen Creek limestone bed does correlate northward with type section in stratigraphic position and lithologic and paleontologic characteristics.

Named for exposures on Houchens Creek, sec. 29, T. 6 N., R. 13 E., Nemaha County, Nebr.

Houden Formation

Precambrian: East-central Arizona.

Gordon Gastil, 1958, Geol. Soc. America Bull., v. 69, no. 12, pt. 1, p. 1498 (table 1), 1501–1502, pl. 1. Can generally be subdivided into three or four members: basal gravel conglomerate 40 to 100 feet thick; lower quartzite 380 to 1,200 feet thick, lower part of which is cross-laminated in beds 3 to 8 inches thick, upper part vitreous, faintly bluish or greenish; middle member distinguished by gray, purple, or brick-red, predominantly fine-grained quartzite in lower part and slate and graded wacke in upper part, thickest section 380 feet on Houden Mountain; and upper quartzite 390 to 420 feet thick divisible into three submembers in Board Cabin Draw. Unconformably overlies Flying W formation (new); conformably underlies Board Cabin formation (new).

Type section: On southwestern corner of Colcord Mesa and begins on boundary of section 18, one-quarter mile west of elevation marker 5687, from which it extended N. 25° W. for approximately one-half mile, or to elevation marker 5651. Other good sections on Board Cabin, Houden Mountain, and Spring Creek opposite Buzzard Roost Mesa. Name derived from Houden Mountain in south-central part of Diamond Butte quadrangle.

Houghton Conglomerate[1] (in Portage Lake Lava Series)

Precambrian (middle Keweenawan): Northern Michigan.

Original reference: A. R. Marvine, 1873, Michigan Geol. Survey, v. 1, pt. 2, p. 80–81, chart.

W. S. White, 1952, Jour. Sed. Petrology, v. 22, no. 4, p. 190–198. One of about 20 sedimentary beds included within Portage Lake lava series (new). At Allouez No. 3 shaft of Calumet & Hecla Consolidated Copper Co., the conglomerate lies about 3,750 feet stratigraphically below top of series. Separated by about 500 feet of lava flows from the next higher conglomerate bed, the Allouez, and by 850 feet of lava flows from the next lower, the Calumet and Hecla. At the shaft, the conglomerate is a lenticular body, 1,000 to 1,800 feet wide measured parallel to the strike, at least 4,000 feet long in direction of dip, and ranging in thickness from less than 1 foot as its lateral margins to as much as 25 feet along its principal axis.

Named for occurrences in Houghton County.

Hounsfield Bentonite[1]

Hounsfield Metabentonite

Middle Ordovician (Mohawkian): New York, Iowa, Kentucky, Minnesota, Missouri, Tennessee, and Wisconsin.

Original reference: G. M. Kay, 1930, Science, new ser., v. 72, p. 365.

G. M. Kay, 1937, Geol. Soc. America Bull., v. 48, no. 2, p. 252–253. Restudy of sequence at type section indicates that metabentonite occurs 3 feet above base of Selby member (new) of Rockland formation (Mohawkian). Previously was mistakenly believed to separate Leray and Watertown members of Chaumont formation. [Kay (1930, 1931) shows unit occurring in several named formations; assignment to formation depends on geographic area.]

Type section: In small quarry just north of Dexter-Brownville Road at foot of west slope of hill 2 miles east of Dexter, Jefferson County, N.Y.

House Limestone (in Pogonip Group)

Lower Ordovician (Canadian): West-central Utah.

L. F. Hintze, 1951, Utah Geol. and Mineralog. Survey Bull. 39, p. 9 (fig. 2), 12–13, 29 (fig. 4), 30–37. Lowermost formation of Pogonip group (restricted). Underlies Fillmore limestone (new); overlies Notch Peak limestone. At type locality, consists of 475 feet of typically medium-gray medium- to thin-bedded cherty silty calcilutite; limestone contains much fine quartz detritus. Chert nodules and stringers common in middle third of formation, becoming less prominent upwards. Southward from type section, the House limestone disappears below overlying strata in Yersin Ridge syncline, and upper beds reappear on south limb in Ibex section B.

R. E. Cohenour, 1959, Utah Geol. and Mineralog. Survey Bull. 63, p. 71–72. In Sheeprock Mountains area, conformably overlies Ajax limestone. House and Fillmore formations not differentiated. Thickness of House-Fillmore sequence 1,088 to 1,111 feet. House limestone probably represents lower 160 feet of 1,088-foot sequence measured in West Lookout Hills.

Type section: North side of small butte near mouth of westward-flowing wash, about one-half mile east of Tule Valley Grazing Service road, and approximately in sec. 23, T. 20 S., R. 14 W., Millard County, at south end of House Range where Ordovician beds, dipping from Notch Peak, approach valley level.

House Mountain Shales[1]

Upper Ordovician: Central western Virginia.

Original reference: J. L. Campbell, 1879, Am. Jour. Sci., 3d, v. 18, p. 29.

Houston Andesite[1]

Tertiary: Southwestern New Mexico.

Original reference: H. G. Ferguson, 1927, U.S. Geol. Survey Bull. 787.

Named for exposures in valley of Houston Canyon, in southeastern part of Mogollon district.

Houston Group[1]

Pleistocene: Coastal Plain of eastern Texas.

Original reference: F. B. Plummer, 1933, Texas Univ. Bull. 3232, p. 530, 780.

Crops out along coastal border of Gulf of Mexico. Named for city of Houston, Harris County.

Houston Marl[1]

Upper Cretaceous: Northeastern Mississippi.

Original reference: E. W. Hilgard, 1860, Mississippi Geology and Agriculture Rept., p. 96–97.

Houston, Chickasaw County.

Housum Member (of Mercersburg Formation)

Middle Ordovician (Trentonian): South-central Pennsylvania.

L. C. Craig, 1949, Geol. Soc. America Bull., v. 60, no. 4, p. 715 (fig. 1), 732–733. Name proposed for lower member of formation. Described at type section as tan to medium-gray fine-grained argillaceous slabby cream- to buff-weathering limestone with 10-foot interval of dark-gray thin crinkly gray-weathering limestone near top. Contains lowest metabentonite of formation. Buff-weathering beds not present in western belts of outcrop of formation. Maximum thickness 67 feet at type locality; thins northeastward. Conformably underlies Kauffman member (new); disconformably overlies Fannettsburg member (new) of Shippensburg formation. Beds originally included in Shippensburg formation.

Type section: Along Cumberland Valley Railroad 2 miles southwest of Marion, Franklin County. Named for small community 1.7 miles north of type section.

Houten sandstone[1]

Eocene: New Mexico.

Original references: C. R. Keyes, 1915, Iowa Acad. Sci. Proc., v. 22, p. 257; 1915, Conspectus of geologic formations of New Mexico: Des Moines, Robert Henderson, State Printer, p. 2, 8.

Derivation of name not stated.

Houx Limestone Bed (in Little Osage Limestone Member of Fort Scott Formation)

Houx Limestone Member (of Fort Scott Formation)

Pennsylvanian (Des Moines Series): Western Missouri, southern Iowa, and eastern Kansas.

L. M. Cline, 1941, Am. Assoc. Petroleum Geologists Bull., v. 25, no. 1, p. 36, 37. Northward from type locality, Fort Scott limestone has three limestone members termed by Missouri Survey: lower Fort Scott (Mulky cap rock), "Rhomboidal," and upper Fort Scott (Lexington bottom-rock). Term Houx limestone proposed for the "Rhomboidal." These limestones are herein named Blackjack Creek, Houx, and Higginsville. The limestones persist into Iowa.

J. M. Jewett, 1941, Kansas Geol. Survey Bull. 38, pt. 11, p. 306. In Kansas, occurs in Little Osage member (new) of Fort Scott. Thickness a few inches to little more than 1 foot.

F. C. Greene and W. V. Searight, 1949, Missouri Geol. Survey and Water Resources Rept. Inv. 11, p. v (fig. 1), 6. In Missouri, considered limestone bed in Little Osage member of Fort Scott. Underlies Blackwater Creek shale.

H. G. Hershey and others, 1960, Iowa Highway Research Board Bull. 15, p. 33, fig. 5. Houx limestone member is persistent and maintains its position from Madison County southward into Missouri. Consists of light- to dark-gray shale, characteristically earthy and very fossiliferous. Thickness varies from 8 inches in south to 4 inches in Madison County. Underlying Houx is shale that varies in thickness with greater development in the south. Shale interval between Houx and Higginsville is about 15 feet in Appanoose County and about 7 feet in Madison County.

Type locality: Well exposed at Houx Ranch, in sec. 15, T. 46 N., R. 27 W., Johnson County, Mo.

Houy Formation

Middle(?) Devonian to Lower Mississippian: Central Texas.

P. E. Cloud, Jr., V. E. Barnes, and W. H. Hass, 1957, Geol. Soc. America Bull., v. 68, no. 7, p. 807–816. Devonian-Mississippian transition outcrops of central Texas described summarily and assigned to new stratigraphic unit, the Houy formation. Beds included are mainly Upper Devonian but partly Lower Mississippian; locally a basal fraction may be Middle Devonian. Deposits are diverse, and their associations are complex. Maximum surface thickness about 17 feet. In more complete sections, formation characteristically includes (ascending) 1 to 3 feet of chert breccia, the Ives breccia member; 2 to 15 feet of black, fissile shale, the Doublehorn shale member (new); 2 feet or less of phosphoritic material of early Mississippian and, at places, of late Devonian age. King Creek marl member of Plummer's (1950) Chappel formation is an argillaceous limestone that has been surely identified only at its type site where it constitutes a few inches of the Houy. Underlies Chappel limestone and in places Barnett formation; overlies beds ranging in age from Middle or Lower Devonian to Lower Ordovician. The Houy is central Texas representative of the widespread Upper Devonian and Lower Mississippian black shale succession that includes such eastern and midcontinent deposits as Chattanooga, Ohio, New Albany, and Woodford shales.

W. H. Hass, 1959, U.S. Geol. Survey Prof. Paper 294–J, p. 366. Houy formation is early Late (and probably late Middle) Devonian to early Mississippian (early Kinderhook).

Type section: At juncture of Burnam Branch with Doublehorn Creek in an eastward extension of the R. M. Burnam Ranch, southeastern Burnet County. Name taken from reference section on Houy Ranch.

Howard Arkose[1]

Miocene(?): Central Washington.

Original reference: C. E. Weaver, 1912, Washington Geol. Survey Bull. 7, p. 34–50.

Named for Howard Creek, just below Howard Lake, Snohomish County.

Howard Limestone (in Wabaunsee Group)

Howard Limestone or Limestone Member (of Shawnee Group or Formation)[1]

Pennsylvanian (Virgil Series): Eastern Kansas, southwestern Iowa, northwestern Missouri, and southeastern Nebraska.

Original reference: Erasmus Haworth, 1898, Kansas Univ. Geol. Survey, v. 3, p. 67, 105.

R. C. Moore, 1932, Kansas Geol. Soc. Guidebook 6th Ann. Field Conf., p. 20, 21, 94, 96. Comprises (ascending) Bachelor Creek limestone, Aarde shale, Church limestone, Winzeler shale, and Utopia limestone members. Included in Wabaunsee group. Type locality given.

G. E. Condra, 1949, Nebraska Geol. Survey Bull. 16, p. 20–21. Bachelor Creek limestone missing in northeastern Kansas, southeastern Nebraska, northwestern Missouri, and southwestern Iowa where base of Church limestone member marks boundary between the Howard and Severy. Aarde shale missing in northeastern Kansas and southeastern Nebraska. Wabaunsee group.

F. C. Greene and W. V. Searight, 1949, Missouri Geol. Survey and Water Resources Rept. Inv. 11, p. 20–21. Church, Winzeler, and Utopia members distinguishable in Missouri. Bachelor Creek is possibly a sandy limestone previously included in Severy shale; Aarde shale member not identified in Missouri. Wabaunsee group.

R. C. Moore and others, 1951, Kansas Geol. Survey Bull. 89, p. 57 (fig. 22), 60. Consists of three limestone members and two shale members. Middle limestone [Church] is the most persistent. Thickness of formation ranges from about 8 to 40 feet. Underlies White Cloud shale; overlies Severy shale.

H. G. Hershey and others, 1960, Iowa Highway Research Board Bull., v. 15, p. 14, fig. 5. Forms caprock for persistent Nodaway coal and can be identified on that basis. In eastern part of area, the Howard is dark-gray to black coarsely crystalline limestone. To the west, fine-grained gray limestone occurs above this bed, and in some places a dark shale is present separating the limestone beds. Thickness seldom more than 1½ feet. In areas where development of Howard is complete, it is composed of three limestones and two shale units. Lowermost limestone missing in Iowa section, and lower shale unit and included Nodaway coal are considered part of underlying Severy shale. Wabaunsee group.

Type locality: Near Howard, Elk County, Kans., T. 30 S., R. 10 E.

†Howard Sandstone Member (in Tuscarora Sandstone)[1]

Silurian: Central Pennsylvania.

Original reference: F. M. Swartz, 1933, Geol. Soc. America Bull., v. 44, no. 1, p. 101.

Near Mount Union, Huntingdon County, and Lewistown, Mifflin County.

Howard Quarry Sandstone

Upper Devonian (Conewango): Northwestern Pennsylvania.

K. E. Caster, 1934, Bulls. Am. Paleontology, v. 21, no. 71, p. 81. Incidental mention. Name is synonymous with Panama conglomerate member of Venango stage.

K. E. Caster, 1939, Jour. Paleontology, v. 13, no. 5, p. 532. Represents basal part of Conewango series. Geographic location stated.

Occurs in old Howard quarry, Howard Falls, Erie County.

Howe Limestone[1] Member (of Red Eagle Limestone)

Permian: Southeastern Nebraska and northeastern Kansas.

Original reference: G. E. Condra, 1927, Nebraska Geol. Survey Bull. 1, 2d ser., p. 84, 86, 88.

R. C. Moore and others, 1951, Kansas Geol. Survey Bull. 89, p. 48. Member of Red Eagle limestone variable in lithology and thickness; contains foraminifera in central Kansas. Thickness ranges from less than 1 foot to maximum of about 15 feet. Overlies Bennett shale member; underlies Roca shale. Wolfcamp series.

M. R. Mudge and R. H. Burton, 1959, U.S. Geol. Survey Bull. 1068, p. 14 (table 2), 61–62. Thickness 2 to about 5 feet in Wabaunsee County, Kans. Overlies Bennett shale member; underlies Roca shale.

Named for exposures south of Howe in T. 4 N., R. 14 E., Nemaha County, Nebr.

Howell Formation[1]

Howell Limestone

Middle Cambrian: Western Utah.

Original reference: C. D. Walcott, 1908, Smithsonian Misc. Colln., v. 53, no. 1804, p. 9, 11.

Charles Deiss, 1938, Geol. Soc. America Bull., v. 49, no. 7, p. 1135–1138, 1141 (fig. 5), 1144–1145. Howell limestone (emended) overlies Tatow limestone (new) and underlies Dome limestone. Thickness 835 feet. Lower 275 feet consists of black and dark-gray fine-grained extremely thick- to thin-bedded limestone which contains buff clay flakes and nodules and numerous algae. Next 340 feet composed of pale-gray, pinkish, and light tan-gray massive fine-grained more or less argillaceous thick- and thin-bedded limestone which contains blebs of white calcite and tan clay flakes interbedded with pinkish zones near middle. Upper 225 feet composed of alternating thicker zones of dull- and black-gray fine-grained limestone which contains buff and reddish-tan clay flakes with thinner zones of gray and tan fissile shale. Walcott gave thickness 435 feet. Emended section approximately 5 miles south of Walcott's type locality.

H. E. Wheeler, 1948, Nevada Univ. Bull., Geology and Mining Ser. no. 48, p. 38. In House Range, Burnt Canyon limestone (new) consists of uppermost 225 feet of Howell limestone as emended by Deiss (1938).

R. A. Robison, 1960, Intermountain Assoc. Petroleum Geologists Guidebook 11th Ann. Field Conf., p. 50–51. Proposed that definition of Howell be further restricted to include only carbonate sequence of western Utah that underlies Chisholm formation and overlies Busby and Tatow formations or their equivalents. Further proposed that Millard limestone be rank reduced to member status to include *Girvanella* limestone facies of Howell when other carbonate lithofacies are also represented in the formation. Upper member of Howell in House Range left unnamed at present.

Type locality: Slopes of Howell Peak on west side of House Range, about 5 miles west of Antelope Springs.

Howells Ridge Formation (in Bisbee Group)

Lower Cretaceous: Southwestern New Mexico.

S. G. Lasky, 1938, Am. Assoc. Petroleum Geologists Bull., v. 22, no. 5, p. 533, figs. 2, 4; 1947, U.S. Geol. Survey Prof. Paper 208, p. 21–23, pl. 1. Lower part consists commonly of red beds of mudstone, shale, limestone, sandstone, and conglomerate; locally beds are gray to black. There is transition along the strike from one kind of rock to another within very short distances. Topmost part of formation in Eureka section consists of massive and thin-bedded black limestone and massive crystalline creamy white limestone. In Sylvanite part, the limestone at the top is much thinner than in the Eureka part. Locally the formation contains a layer of andesite flows and breccia whose thinner parts grade into purple shaly mudstone and arkosic volcanic grit. Thickness approximately 4,900 feet in Sylvanite section; may range from 1,100 feet to 5,200 feet in Eureka section. Conformably underlies Corbett sandstone (new); overlies Hidalgo volcanics (new).

Named from high cliff-capped ridge in Eureka section that is composed entirely of rocks of this formation, Little Hatchet Mountains.

†Howenstein Limestone (in Allegheny Formation)[1]

Pennsylvanian: Northeastern Ohio.

Original reference: G. F. Lamb, 1910, Ohio Nat., v. 10, p. 130.

M. T. Sturgeon, 1943, Ohio Jour. Sci., v. 43, no. 6, p. 236. Lamb, apparently the first to observe and mention Vanport limestone in this area [Columbiana and Mahoning Counties], described it in 1910 under name of Howenstein limestone on Ira Unger Farm along tributary to Meander Creek in NW¼ sec. 4, Green Township, Mahoning County.

Named for Howenstein (Howenstine), Stark County.

Howson Andesite[1]

Pliocene(?): Central Washington.

Original reference: G. O. Smith and F. C. Calkins, 1906, U.S. Geol. Survey Geol. Atlas, Folio 139.

R. J. Foster, 1960, Geol. Soc. America Bull., v. 71, no. 2, p. 110–111, pl. 1. Apparently youngest formation in area of this report [northern parts of Mount Stuart and Snoqualmie folios] and surrounding area. Overlies Swauk formation that has been intruded by Teanaway dikes. Howson, unlike other andesites in area, is unaltered and is very similar to hornblende andesite boulders in Ellensburg formation. Smith and Calkins suggested that it may be source of Ellensburg detritus. This may put upper limit on age of Howson, as age of Ellensburg, according to Waters (1955, Geol. Soc. America Bull., v. 66. no. 6) lies near Miocene-Pliocene border.

Named for exposures on Sasse Mountain north and northeast of Howson Creek, Snoqualmie quadrangle.

Hoxbar Formation[1]

Hoxbar Group

Pennsylvanian (Missouri Series): Central Oklahoma.

Original reference: W. L. Goldston, Jr., 1922, Am. Assoc. Petroleum Geologists Bull., v. 6, no. 1.

R. H. Dott, 1941, Am. Assoc. Petroleum Geologists Bull., v. 25, no. 9, p. 1667–1668. Restricted to exclude Confederate member which is assigned to underlying Deese formation. Disconformity at top of Confederate member taken as top of the Des Moines. Missouri beds of Ardmore basin are wholly represented by the Hoxbar as thus restricted. Where best developed south of Ardmore is about 4,000 feet thick. Named members include (ascending) Crinerville sandstone and limestone, 400 to 500 feet above base; Anadarche conglomerate and limestone, about the middle; Daube limestone; and Zuckerman sandstone about 500 to 1,000 feet below top.

R. C. Moore and others, 1944, Geol. Soc. America Bull., v. 55, no. 6, p. 697, chart 6 (column 37). Shown on correlation chart as Hoxbar group. Lower Hoxbar beds are Missourian in age; upper Hoxbar deposits, including

Zuckerman sandstone, are tentatively correlated with the Vamoosa and Ada formations and may be Virgilian in age.

C. W. Tomlinson and William McBee, Jr., 1959, *in* Ardmore Geol. Soc., Petroleum geology of southern Oklahoma—a symposium, v. 2: Tulsa, Okla., Am. Assoc. Petroleum Geologists, p. 6 (fig. 2), 40–44. Group, in Ardmore basin, includes (ascending) Confederate limestone, Crinerville beds, Anadarche beds, Daube member, and Zuckerman beds. Overlies Deese group; underlies Vanoss formation (Pennsylvanian).

B. H. Harlton, 1960, Am. Assoc. Petroleum Geologists Bull., v. 44, no. 2, p. 213 (fig. 3), 216–220. Group (in subsurface) in Cement Pool area, Caddo and Grady Counties, includes (ascending) Crinerville, Dolman, and No-Ho-Co (new) formations. Overlies Deese group; underlies Cisco group.

Named for exposures west of Hoxbar, Carter County.

Hoyt Dolomite[1]

Hoyt Limestone Member (of Theresa Dolomite)[1]

Hoyt Limestone Member (of Whitehall Formation)

Upper Cambrian: Eastern New York.

Original reference: J. M. Clarke, 1903, New York State Mus. Handb. 19, p. 16, chart.

R. H. Wheeler, 1941, (abs.) Geol. Soc. America Bull., v. 52, no. 12, pt. 2, p. 1938–1939. Cambro-Ordovician correlations revised in Champlain, Hudson, Mohawk, and St. Lawrence Valleys. Revisions involve definitions and succession of previously accepted Cambro-Ordovician formations: Potsdam, Theresa, Hoyt, and Little Falls of Upper Cambrian and Whitehall, Tribes Hill, and Beekmantown of Lower Ordovician. Hoyt fauna occurs in lower half of emended Whitehall formation above Little Falls dolomite. Each revised unit tied in with Divisions A through E of original "Calciferous" formation.

R. H. Wheeler, 1942, Am. Jour. Sci., v. 240, no. 7, p. 518–524. Base of Whitehall formation raised to coincide with contact of Little Falls dolomite and Hoyt limestone, and latter redefined as lower member of Whitehall formation. In corrected Skene Mountain section, Hoyt limestone member, about 40 feet thick, underlies Skene dolomite member (new).

D. W. Fisher and G. F. Hanson, 1951, Am. Jour. Sci. v. 249, no. 11, p. 795–813. Evidence is presented to substantiate radical change in interpretation of Paleozoic stratigraphy of Saratoga Springs region. Previously accepted sequence of beds (Potsdam sandstone, Theresa formation, Hoyt limestone, Little Falls dolomite, Amsterdam limestone, Trenton limestone, Canajoharie shale) is revised to read Potsdam sandstone, Galway formation, Hoyt limestone, Ritchie limestone (new), Mosherville sandstone (new), Gailor dolomite (new), Lowville limestone, Amsterdam limestone, Trenton limestone (Rockland?, Hull Sherman Fall representatives) and Canajoharie shale. Term "Theresa" not applicable in area; name Galway formation reintroduced for strata younger than Potsdam and older than Hoyt. Strata formerly classed as lower Hoyt are here included in redefined Galway. Wheeler (1942) classified the Hoyt as basal member of Whitehall formation and the Skene as upper member, the latter being a very late Upper Cambrian offlapping unit. It is evident that he mistook Ordovician Gailor dolomite for older Little Falls dolomite, for the Hoyt and his supposed "Little Falls" are in fault contact in his "unfaulted" area 4 miles west of Saratoga Springs. In some areas Hoyt underlies Mosherville sandstone, and in some areas Ritchie limestone.

Named for exposures at Hoyt's quarry, 3 miles west of Saratoga Springs, Saratoga County.

Hozomeen Series[1]

Carboniferous: Southern British Columbia, Canada, and central northern Washington.

Original reference: R. A. Daly, 1912, Canada Geol. Survey Dept. Mines Mem. 38, maps 14, 15.

C. E. Weaver, 1937, Washington [State] Univ. Pub. in Geology, v. 4, p. 16. Cherty quartzite together with greenstone and phyllite beds. Believed to be oldest rocks exposed on western side of summit of Cascades immediately south of international line.

Occurs in Hozomeen Range, British Columbia, and on Mount Hozomeen, Wash.

Hualalai Volcanic Series

Hualalai pyroclastic materials

Pleistocene and Recent: Hawaii Island, Hawaii.

C. K. Wentworth, 1938, Hawaiian Volcano Observatory 3d Spec. Rept., p. 88, 147. Ash and cinder formations of Hualalai Rift referred to as Hualalai pyroclastic materials.

H. T. Stearns and G. A. Macdonald, 1946, Hawaii Div. Hydrography Bull. 9, p. 139–148; D. A. Davis and G. A. Macdonald *in* Jacques Avias and others, 1956, Lexique Strat. Internat., v. 6., Océanie, fasc. 2, p. 92. Series includes all volcanic rocks of Hualalai volcano. All are basalts except Waawaa volcanics member (new) which consists of trachyte cone and flow. As defined, includes most series of ash beds named Kona tuff formation (Wentworth, 1938). Maximum thickness 500 feet; base not exposed. Interfinger with Kau volcanic series (new).

Type locality: Western slope of Hualalai volcano near Kailau. Eruption continued into historic time; series includes flows of 1800–1801.

Hualpai Limestone

Pliocene(?): Northwestern Arizona and southeastern Nevada.

C. R. Longwell, 1936, Geol. Soc. America Bull., v. 47, p. 1429–1431. Consists chiefly of white though gray to pink or light-brown limestone, in thin and rather regular beds, many of which have porous structure characteristic of travertine. Rock compact and nearly aphanitic between scattered openings. Contains scattered pebbles and sand near base, and locally includes thin beds of shale and siltstone. Also contains gray to pink or light-brown chert nodules and lenses. Degree of porosity varies considerably from bed to bed as well as laterally in any one layer. In some parts, openings occupy full fifty percent of the volume, and rock would be described as tufa. Opening diameters range from one-half inch down to limit of visibility. In most western outcrops, thickness varies up to 150 to 200 feet. Delmar Butte and Temple, north of Colorado River are capped by 80 to 100 feet of limestone. Original maximum thickness certainly exceeded 1,000 feet.

C. B. Hunt, 1956, U.S. Geol. Survey Prof. Paper 279, p. 16 (fig. 12), 33, 34, 35. Overlaps edges of underlying fanglomerate and extends onto Precambrian rocks along east and west sides of Grand Wash trough. Overlies Muddy Creek formation.

Displayed prominently along Hualpai Wash, Arizona, from which unit is named. Distributed over irregular area, measuring 25 miles east-west and comparable distance north-south, Mohave County, Ariz., and Clark County, Nev.

Hubbard Hill Member (of Littleton Formation)

Lower Devonian : Western New Hampshire.

M. T. Heald, 1950, Geol. Soc. America Bull., v. 61, no. 1, p. 45–50, 55, pl. 1. Lowermost part of Littleton formation in Lovewell Mountain quadrangle. Thickness about 6,000 feet. Composed chiefly of mica-quartz schist, sillimanite schist, pseudo-sillimanite schist, quartz conglomerate, and quartzite, interbedded lime-silicate granulite and schist, and amphibolite. Underlies May Pond member (new. In northern part of quadrangle, the two members are separated by a sill of Kinsman quartz monzonite.

C. A. Chapman, 1952, Geol. Soc. America Bull., v. 63, no. 4, p. 387–390, pl. 1. In Sunapee quadrangle, the Hubbard Hill underlies Dakin Hill member and overlies undifferentiated Littleton.

Hubbard Hill is in Cheshire County.

Hubbardston Granite[1]

Late Carboniferous or post-Carboniferous : Central Massachusetts.

Original reference: B. K. Emerson, 1917, U.S. Geol. Survey Bull. 597, p. 231–236, map.

Named for occurrence at Hubbardston, Worcester County.

Hubbardton Slate[1]

Lower Cambrian : Southwestern Vermont.

Original reference: A. Keith, 1932, Washington Acad. Sci. Jour., v. 22, p. 360, 401.

Named for occurrence in village of Hubbardton, Rutland County.

Huckleberry Andesites[1]

Cenozoic : Northern California.

Original reference: H. Williams, 1932, California Univ. Pub., Dept. Geol. Sci. Bull., v. 21, no. 8, p. 251, 252, 254.

O. P. Jenkins, 1943, California Div. Mines Bull. 118, pt. 4, p. 678. Cenozoic.

Named for occurrence near Huckleberry Lake, Lassen National Park.

Huckleberry Clay (in Pottsville Formation)[1]

Pennsylvanian (Pottsville series) : Northern Kentucky and southeastern Ohio.

Original reference: W. Stout and others, 1923, Ohio Geol. Survey, 4th ser., Bull. 26, p. 150–151.

N. K. Flint, 1951, Ohio, Geol. Survey, 4th ser., Bull. 48, p. 23 Included in Huckleberry cyclothem.

Type locality and derivation of name not given.

Huckleberry Conglomerate

Lower Cambrian : Northeastern Washington.

W. A. G. Bennett, 1941, Washington Div. Geology Rept. Inv. 5, p. 8. Pebble conglomerate of quartzite, argillite, and carbonate rocks. Coarseness of fragments increases northeastward concurrently with diminution in thickness, which ranges from a few hundred feet at north to approximately 3,000 feet at south. Generally schistose but in southwest becomes hard flinty hornfels. Apparently deposited on eroded surface of Deer Trial rocks [group]; overlain by what appears to be Lower Cambrian greenstone in overlapping relations.

Ian Campbell and J. S. Loofbourow, Jr., 1946, (abs.) Geol. Soc. America Bull., v. 57, no. 12, pt. 2, p. 1250. Included in Huckleberry group.

Crops out along east side of Huckleberry Mountain and north of Spokane Indian Reservation, Stevens County.

Huckleberry cyclothem

Pennsylvanian (Pottsville Series) : Southeastern Ohio.

N. K. Flint, 1949, Ohio Acad. Sci. [Guidebook] 24th Ann. Field Conf., p. 18. Incidental mention in road log.

N. K. Flint, 1951, Ohio Geol. Survey, 4th ser., Bull. 48, p. 22–23, geol. map, table 1. Includes Huckleberry shale and (or) sandstone, Huckleberry clay, and coal members. Occurs above Anthony cyclothem and below Quakertown cyclothem. In area of this report, Pottsville series is described on cyclothemic basis; 10 cyclothems are named. [For sequence see Anthony cyclothem.]

Most exposures are in Monday Creek Township and in vicinity of Junction City, Jackson Township, Perry County.

Huckleberry Greenstone

Lower Cambrian : Northeastern Washington.

H. E. Culver, 1939, Washington State Coll. Monthly Bull., v. 22, no. 7, pt. 1, p. 19. In sequence of formations named, Huckleberry greenstone underlies Addy quartzite and overlies a conglomerate.

W. A. G. Bennett, 1941, Washington Div. Geology Rept. Inv. 5, p. 8–9. Described as predominantly metamorphosed basaltic flows in which ferro-magnesiam minerals have been chloritized. Thickness ranges from about 3,000 feet on Stensgar Mountain to a few hundred feet at north and south ends of formation. Overlaps on underlying [Huckleberry] conglomerate and on upper part of Deer Trail group; appears to wedge out laterally beneath Addy quartzite.

Ian Campbell and J. S. Loofbourow, Jr., 1946, (abs.) Geol. Soc. America Bull., v. 57, no. 12, pt. 2, p. 1250. Included in Huckleberry group.

Crops out north of Colville Valley; main mass follows east slope of Huckleberry Mountain, crosses the divide west of Red Marble quarry, and wedges out to the south, Stevens County

Huckleberry Group

Precambrian (Belt Series) : Northeastern Washington.

Ian Campbell and J. S. Loofbourow, Jr., 1946, (abs.) Geol. Soc. America Bull., v. 57, no. 12, pt. 2, p. 1250. Named as group including Huckleberry conglomerate and Huckleberry greenstone. Unconformably overlies Deer Trail group; unconformably underlies Addy quartzite.

Report discusses magnesite belt, Stevens County.

Huckleberry Lavas

See Union Peak Lavas.

Hudson Formation,[1] Shales,[1] or Group[1]

See Hudson River Formation.

Hudson Grits or White Beds

See Poultney River Group.

Hudson Member (of Franconia Sandstone)[1]

Upper Cambrian: Western Wisconsin and southeastern Minnesota.

Original reference: A. C. Trowbridge and others, 1935, Kansas Geol. Soc. Guidebook 9th Ann. Field Conf., p. 81, 92, 134, 140, 159, 160, 431, 446, 449, 454.

C. R. Stauffer, G. M. Schwartz, and G. A. Thiel, 1939, Geol. Soc. America Bull., v. 50, no. 8, p. 1238 (table 2); C. R. Stauffer and G. A. Thiel, 1941, Minnesota Geol. Survey Bull. 29, p. 30, 40. In Minnesota overlies Taylors Falls member (new). Replaces name Minneiska member.

R. R. Berg, 1953, Jour. Paleontology, v. 27, no. 4, p. 553, 554, 555; 1954, Geol. Soc. America Bull., v. 65, no. 9, p. 858 (fig. 1), 869. Name abandoned. Franconia member names used by Twenhofel, Raasch, and Thwaites (1935) are geographic names applied to faunal zones. New member names proposed to designate rock types, as distribution of faunal zones in formation is largely independent of natural rock units. Hudson member is *Ptychaspis-Prosaukia* zone. This zone is represented in Reno and Mazomanie members.

First described at Hudson, St. Croix County, Wis.

†Hudson Schist[1]

Precambrian, Cambrian, and Ordovician: Eastern New York.

Original reference: F. J. H. Merrill, 1902, U.S. Geol. Survey Geol. Atlas, Folio 83.

Occurs along Hudson River.

†Hudson System[1]

Cambrian: Eastern New York.

Original reference: T. A. Conrad, 1839, New York Geol. Survey 3d Rept., p. 57–63.

Hudson River region.

Hudson trilobite beds[1]

Upper Cambrian: Western Wisconsin.

Original reference: L. C. Wooster, 1878, Wisconsin Geol. Survey Rept. 1877, p. 36–41.

Probably named for Hudson, St. Croix County.

Hudson Bridge Limestone (in Palo Pinto Formation)[1]

Pennsylvanian: North-central Texas.

Original reference: G. Scott and J. M. Armstrong, 1932, Texas Univ. Bull. 3224, p. 21.

Crops out about 3 miles southeast of Bridgeport, on south side of West Fork of Trinity River, in east end of Rebecca Coleman survey, along margin of Trinity River flood plain, and crosses road 200 yards south of Hudson Bridge, Wise County.

Hudson Highlands Complex

Precambrian: Southeastern New York.

K. E. Lowe, 1950, Geol. Soc. America Bull., v. 61, no. 3, p. 142–144, 150–157, pls. 2, 3. Term Hudson Highlands complex or Highlands complex includes entire sequence of crystalline rocks older than Storm King granite. Colony (1921, New York State Mus. Bulls. 249–250) considered Highlands complex synonymous with Highlands crystallines, that is, including Storm King granite. Complex is cut by a variety of pegmatities, and it is not always easy to relate individual ones to specific magmatic interval. Complex includes Grenville metasediments (oldest units of complex), Pochuck diorite phase, and Canada Hill granite phase.

Report discusses area around Bear Mountain, a prominent summit of Hudson Highlands, about 40 miles north of New York City. Complex, in this area, is a relatively broad syncline or synclinorium plunging about 40° NE. Storm King granite fills core of syncline.

†Hudsonian Substage (of Wisconsin Stage)[1]

Pleistocene, upper: Great Lakes region.

Original reference: M. M. Leighton, 1931, Jour. Geology, v. 39, p. 51–53.

Name derived from Hudson Bay about which the ice fields were developed.

†Hudson River Formation,[1] Beds,[1] Group,[1] Shales, or Phyllite

Cambro-Ordovician: Southeastern New York.

Original reference (Hudson River slate group): W. W. Mather, 1840, New York Geological Survey 4th Rept., p. 212, 256–258.

Sidney Paige, 1956, Geol. Soc. America Bull., v. 67, no. 3, p. 391, 392 (fig. 1), 393. Hudson River shales and phyllite mentioned in discussion of Cambro-Ordovician age of "Inwood" limestone and "Manhattan" schist near Peekskill. Hudson River shales and phyllite stratigraphically above Wappinger dolomite and limestone.

Southeastern counties of New York.

Hueco Limestone[1]

Permian (Wolfcamp Series): Western Texas and southern New Mexico.

Original reference: G. B. Richardson, 1904, Texas Univ. Min. Survey Bull. 9, p. 32–38.

C. O. Dunbar, 1953, Am. Jour. Sci., v. 251, no 11, p. 798–804. In Sierra Diablo, Trans-Pecos, Texas, includes Kriz lens in upper part.

M. L. Thompson, 1954, Kansas Univ. Paleont. Contr. 14, Protozoa, art. 5, p. 19, 20 (fig. 5). Fusulinid faunas indicate that upper part of Hueco, commonly referred to the Leonardian with question, is younger than type section of Wolfcampian. Proposed here that Wolfcampian series be defined to include upper Hueco limestone.

F. E. Kottlowski and others, 1956, New Mexico Bur. Mines Mineral Resources Mem. 1, p. 6 (table 2), 49–52. Summary description in San Andres Mountains area. Thickness 417 to 1,355 feet. Overlies Bursum formation; underlies Abo redbeds; in some areas, overlies Panther Seep formation (new). Wolfcampian.

Hugh Hay-Roe, 1957, Texas Univ. Bur. Econ. Geology Geol. Quad. Map. 21. As described in Wylie Mountains and vicinity, overlies Powwow conglomerate and underlies Victorio Peak formation. Well in area penetrated 1,240 feet of Hueco limestone.

G. O. Bachman and P. T. Hayes, 1958, Geol. Soc. America Bull,. v. 69, no, 6, p. 690 (fig. 1), 693 (fig. 2), 694 (fig. 3), 695. Described in Sand Canyon area, New Mexico. In most of mapped area, Hueco comformably overlies Danley Ranch tongue (new) of Abo sandstone into which it grades laterally northward; locally rests with angular unconformity on lower part of

Magdalena group; upper part grades laterally into, and is conformably overlain by sequence of red beds herein referred to as Lee Ranch tongue of Abo sandstone. Thickens from about 350 feet 1 mile north of map area to nearly 600 feet near Culp Canyon, a distance of about 5 miles; most of this gain is attributed to intertonguing with Abo. All but uppermost part is probably Wolfcamp; at south end of Sand Canyon area, uppermost beds are known to be lateral equivalents of part of Lee Ranch tongue of Abo, which is apparently early Leonard.

Named for exposures in Hueco Mountains, El Paso County, Tex.

†Huehue Flow

Recent: Hawaii Island, Hawaii.

H. T. Stearns and G. A. Macdonald, 1946, Hawaii Div. Hydrog. Bull. 9, p. 148. Olivine basalt flow. Contains partly charred wood.

Believed to have been erupted from last activity of Hualalai in 1801.

Huelster Formation (in McCutcheon Volcanic Series)

Tertiary: Southwestern Texas.

G. K. Eifler, Jr., 1951, Geol. Soc. America Bull., v. 62, no. 4, p. 342–345, pl. 1. Composed almost entirely of tuff, with thin layers of sandstone and conglomerate, lenses of fresh-water limestone, and trachydoleritic lava. At type locality approximately 400 feet thick; thins eastward,. Includes Jeff conglomerate member (new) at base. Forms lower part of series. Overlies marine Upper Cretaceous; underlies Star Mountain rhyolite (new).

Type locality: Near head of deep ravine about 1½ miles south of ruins of Huelster ranchhouse in northwestern part of Barrilla Mountains, Reeves County.

Huerfano Formation[1]

Eocene, lower and middle: Southeastern Colorado.

Original reference: R. C. Hills. 1888, Colorado Sci. Soc. Proc., v. 3, pt. 1, p. 148–164.

R. B. Johnson and J. G. Stephens, 1954, U.S. Geol. Survey Oil and Gas Inv. Map OM–146. Formation, deposited during Wasatch and early Bridger time, unconformably overlies Cuchara formation at southern end of Huerfano Park. Consists of lower member of red and tan semiconsolidated sandstone and red, green, and gray shale and upper member of rust-colored granule and pebble conglomerate and tan shale.

R. B. Johnson and G. H. Wood, Jr., 1956, Am. Assoc. Petroleum Geologists Bull., v. 40, no. 4, p. 709 (fig. 2), 717–718. In Raton basin, formation unconformably overlaps Cuchara formation, Poison Canyon formation, and Pierre shale. Thickness as much as 2,000 feet. Consists mainly of variegated maroon shale beds with gray and green zones, and red, white, and tan sandstone beds. Underlies Farisita conglomerate (new), which unit has been mapped as Huerfano by Burbank and Goddard (1937, Geol. Soc. America Bull., v. 48, no. 7).

Typical exposure occurs on drainage of Muddy Branch of Huerfano River, Huerfano County.

†Huerfano Series[1] or Beds

Eocene: Southeastern Colorado.

Original references: R. C. Hills, 1888, Colorado Sci. Soc. Proc., v. 3, pt. 1, p. 148–165; 1893?, Colorado Sci. Soc. Proc., v. 4, p. 7–9.

Well exposed in Muddy Branch of Huerfano River.

Huerto Quartz Latite or Formation (in Potosi Volcanic Group)

Huerto Andesite (in Potosi Volcanic Series)[1]

Tertiary, middle or upper: Southwestern Colorado.

Original reference: E. S. Larsen, 1917, Colorado Geol. Survey Bull. 13, p. 20, 36.

E. S. Larsen, Jr., and Whitman Cross, 1956, U.S. Geol. Survey Prof. Paper 258, p. 13, 93 (table 18), 143–144. Huerto quartz latite proposed to replace Huerto formation [andesite]. Defined as that body of quartz latites that lies between Alboroto rhyolite below and Piedra rhyolites above. Lower contact regular; upper contact irregular. Thickness in central part about 2,500 feet.

U.S. Geological Survey currently designates the age of the Huerto Quartz Latite or Formation as middle or late Tertiary. This designation made on the basis of age change of Potosi Volcanic Group.

Named for occurrences on Huerto Peak in southern part of San Cristobal quadrangle, west of Huerto Creek.

Huethawali limestones[1] (in Aubreyan series)

Carbonic: Northern Arizona.

Original reference: C. [R.] Keyes, 1922, Pan-Am. Geologist, v. 38, p. 251, 336.

Charles Keyes, 1936, Pan-Am. Geologist, v. 66, no. 3, p. 215 (chart), 223. Underlies Havasupai sandstones; overlies Chiquito sandstones. Carbonic.

In Grand Canyon region. Derivation of name not stated, but probably Huethawali Peak, which is just west of head of Bass Canyon.

Huevo member (of Serpiente Sandstone)

See Serpiente Sandstone.

Hughes Creek Shale Member (of Foraker Limestone)

Hughes Creek Shale[1]

Permian: Southeastern Nebraska, northeastern Kansas, and Oklahoma.

Original reference: G. E. Condra, 1927, Nebraska Geol. Survey Bull. 1, 2d ser., p. 84, 85, 89.

R. C. Moore, J. C. Frye, and J. M. Jewett, 1944, Kansas Geol. Survey Bull. 52, pt. 4, p. 168. Reallocated to member status in Foraker limestone. In northern Kansas comprises light-gray to nearly black shale and thin limestone beds containing fusulines, and in lower part, a brachiopod fauna; in southern Kansas is a nearly continous limestone section, massive in lower part and containing much light-blue flint. Thickness about 40 feet. Underlies Long Creek limestone member; overlies Americus limestone member. Wolfcamp series.

P. B. Greig, 1959, Oklahoma Geol. Survey Bull. 83, p. 82–83, pl. 1. Described in Pawnee County, Okla., where it is classified as member of Foraker limestone. Thickness 30 to 43 feet. Overlies Americus limestone member; underlies Long Creek limestone member. Wolfcamp.

Named for Hughes Creek, Nemaha County, Nebr.

Hughes Gap Formation (in Great Smoky Group)

Precambrian: Central northern Georgia and southwestern North Carolina.

V. J. Hurst, 1955, Georgia Geol. Survey Bull. 63, p. 9, 21–35, pl. 1, map. Characterized by garnet-mica schist, staurolite schist, metaquartzconglomerate, quartzite, and pseudodiorite with beds of metagraywacke and mica shist near base. Strata range in thickness from fraction of inch to more than 50 feet; commonly less than 10 feet thick; changes in thickness and lithology common along strike. Thickness difficult to determine as present outcrop pattern is due partly to facies changes in original sediments and partly to local structures, but repetition of beds is not common; estimated thickness 4,000 to 6,000 feet.Underlies Hothouse formation (new); overlies Copperhill formation (new) with transistion zone a few hundred feet thick.

Named from Hughes Gap, Mineral Bluff quadrangle, Fannin County, Ga., where an almost complete section is exposed. Formation crops out in a belt that enters Mineral Bluff quadrangle near Franklin Mountain, N.C., and leaves the quadrangle in vicinity of Gravelly Gap, Ga.

Hughes River Flint (in Conemaugh Formation)[1]

Pennsylvanian: Northwestern West Virginia.

Original reference: R. V. Hennen, 1911, West Virginia Geol. Survey Rept. Wirt, Roane, and Calhoun Counties, p. 258.

Probably named for occurrence on South Fork of Hughes River.

Huginnin Porphyrite[1]

Precambrian: Northern Michigan.

Original reference: A. C. Lane, 1898, Michigan Geol. Survey, v. 6, pt. 1, p. 98, 141, 205–206, 207, 209, 212, pls. 1, 13.

Named for exposures in bed of Huginnin Creek, about 50 feet from shore of Huginnin Cove and about 200 feet from mouth of the creek, in Isle Royale.

Huichica Formation

Pleistocene: Northwestern California.

C. E. Weaver, 1949, Geol. Soc. America Mem. 35, p. 16 (table 3), 98, pl. 11. Terrace deposits composed of poorly stratified gravels, conglomerates, sands, and clays; nonmarine. Basal deposits consist of reworked tuffs, pebbly conglomerates, and poorly consolidated clayey sandstone; upper beds largely pebbly sandstone and conglomerate. Thickness 250 to 500 feet. Unconformably overlies tilted andesites and rhyolites. May be contemporaneous with Glen Ellen formation (new).

Named from Huichica Creek at head of San Pablo Bay in northern part of Mare Island quadrangle, Napa County. Exposed around margins of Napa and Sonoma Valleys.

Hulah Sandstone Member (of Tallant Formation)

†Hulah Sandstone Member (of Nelagoney Formation)[1]

Pennsylvanian (Missouri Series): Northeastern Oklahoma.

Original reference: M. I. Goldman and H. M. Robinson, 1920, U.S. Geol. Survey Bull. 686–Y, p. 362, 365.

W. F. Tanner, 1956, Oklahoma Geol. Survey Circ. 40, p. 37–38. Reallocated to Tallant formation. Well exposed north of Caney River, Osage County, where it is a fossiliferous yellow or orange sandstone about 4 feet thick. South of Caney River, the Hulah appears in upper part of Revard sandstone member and would therefore seem to be an equivalent of the latter. The Hulah mapped at type locality by Goldman and Robinson (1920) is believed to be the Bigheart, and elsewhere in same township the bed named Hulah appears as a lens between the Bigheart and Revard members; unit was given a name in this report because of its distinctive appearance north of Caney River.

Type locality: Top of small ridge at east edge of Hulah, near center SE¼ sec. 5, T. 28 N., R. 12 E., Osage County.

Hulen Beds (in Horsetown Group)

Lower Cretaceous (Shasta Series) : Northern California.

F. M. Anderson, 1938, Geol. Soc. America Spec. Paper 16, p. 32 (fig. 1), 38 (table 1), 67–68, table 2. Name applied to upper part of Horsetown group. Beds contain succession of distinctive faunal zones. Underlies lowest beds of Chico series or Tehama formation; overlie Cottonwood beds (new) of Horsetown group; boundary is more one of paleontological distinction. In type area, lower part of beds consists of dark argillaceous shales with only occasional layers of sandstone and sandy shales and zones of fossiliferous calcareous concretions. Thickness (fig. 1), 2,645 feet.

Type area; North fork of Cottonwood Creek [Shasta County]. Area is traversed by eastern branches of Hulen Creek, hence the name.

Hulett Sandstone Member (of Sundance Formation)

Hulett Sandstone Member (of Rierdon Formation)

Upper Jurassic: Northwestern Wyoming and southwestern South Dakota.

R. W. Imlay, 1947, Am. Assoc. Petroleum Geologists Bull., v. 31, no. 2, p. 255–257, geol. sections. Includes 25 to 120 feet of marine sandy beds consisting mainly of grayish, moderately hard thin- to thick-bedded, fine-grained, calcareous, glauconitic, ripple-marked sandstone. Thickness at type section 82 feet. Grades into underlying Stockade Beaver member and overlying Lak member (both new).

J. A. Peterson, 1954, Am. Assoc. Petroleum Geologists Bull., v. 38, no. 4, p. 466 (table 2), 475, 482. Reallocated to member status in Rierdon formation herein assigned to Sundance group.

Type section: On north side of Bush Canyon about 2½ miles north of Hulett, Crook County, Wyo., in secs. 25 and 36, T. 55 N., R. 65 W.

Huling Tongue (of Ono Formation)

Lower Cretaceous: Northern California.

M. A. Murphy, 1956, Am. Assoc. Petroleum Geologists Bull., v. 40, no. 9, p. 2101 (fig. 2), 2104 (fig. 3) 2106–2107 (fig. 4), 2111–2112. Mostly graywacke; mudstone and thick extremely lenticular conglomerate units interbedded in lower part. Lowest unit, about 500 feet thick, is lenticular cobble conglomerate with well-rounded clasts, predominantly granitic, volcanic, and argillaceous rocks, which are uniform in size and roundness. About 200 feet of sandy mudstone and thinly bedded graywacke overlies the conglomerate. Next in sequence is interbedded graywacke and conglomerate unit. Next 200 feet of section starting at upper end of gorge along Huling Creek is a well-indurated massive non-bedded sandstone that grades into flaky weathering, very thickly bedded unit that comprises upper 500 feet of Huling tongue. Latter is fossiliferous in its upper half and zone of sandstone concretions. Lower contact usually very distinct and lower beds form north-facing cuesta-like escarpment overlooking less resistant mudstone of lower Ono. Upper contact gradational with overlying mudstones.

Named for exposures along Huling Creek, Shasta County.

Hull Agglomerate[1]

Middle Jurassic: Northern California.

Original references: C. H. Crickmay, 1933, Geol. Soc. America Bull., v. 44, no. 1, p. 81; no. 5, p. 895–903.

Occurs in lower end of Hinchman Ravine and many other places on slopes of Mount Jura.

Hull Limestone[1] or Formation

Middle Ordovician: Ontario and Quebec, Canada, and northern New York.

Original reference: P. E. Raymond, 1914, Canada Geol. Survey Summ. Rept. 1912, p. 348.

G. M. Kay, 1937, Geol. Soc. America Bull., v. 48, no. 2, p. 261–262. In southeastern Ontario and New York, formation extends from top of *Triplecia cuspidata*-bearing Napanee member (new) of Rockland formation to base of Sherman Fall limestone, in which *Prasopora orientalis* Ulrich is abundant. *Parastrophina hemiplicata* (Hall), normally abundant in basal Hull in New York, is rare in top of Rockland and recurs at higher horizons; thus, its presence aids in distinguishing Hull from Rockland. Thickness 85 to 110 feet. Formation enters New York at Sackets Harbor, forms narrowed belt south and west of Black River as far as Boonville, and then thins rapidly toward Mohawk Valley where it constitutes Larrabee member (new) of Glens Falls formation. In its original usage, term Kirkfield limestone was synonymous with Hull formation, but term Kirkfield later was applied as provincial name for Trenton group of central Ontario.

G. M. Kay, 1943, Am. Jour. Sci., v. 241, no. 10, p. 598, 599. Discussion of West Canada Creek area, New York. Term Kirkfield used in preference to term Hull for unit overlying Rockland limestone and underlying Shoreham limestone. Term Kirkfield has priority over term Hull.

Named for exposures at Hull, Quebec, Canada.

Hull Meta-Andesite[1]

Hull Formation

Upper Jurassic: Northern California.

Original reference: J. S. Diller, 1908, U.S. Geol. Survey Bull. 353.

P. A. Lydon, T. E. Gay, Jr., and C. W. Jennings, 1960, Geologic map of California Westwood sheet (1:250,000): California Div. Mines. Formation consists of metaandesite tuff and breccia. Mapped with Jurassic and (or) Triassic metavolcanic rocks.

Named for exposures east of Hull diggings (called Taylor diggings on Taylorsville map).

Hull porphyry[1]

Precambrian: Northwestern Iowa.

Original references: C. R. Keyes, 1914, Iowa Acad. Sci. Proc., v. 21, p. 187; 1914, Science, new ser., v. 40, p. 144.

Probably named for Hull, Sioux County.

Hull Stage

Middle Ordovician (Trentonian): Eastern North America.

G. M. Kay, 1937, Geol. Soc. America Proc. 1936, p. 82. Rockland and Hull are early Trenton stages.

G. M. Kay, 1937, Geol. Soc. America Bull., v. 48, no. 2, p. 260–262, 293, 298. Discussion of stratigraphy of Trenton group. Hull limestone and Larrabee member (new) of Glens Falls formation are of Hull age. In late Rockland time, seas overlapped Adirondack arch in a narrow strait somewhat north of Mohawk Valley. Hull stage is essentially a continuation of this overlap.

Name derived from Hull, Quebec, Canada, for which Hull limestone was named.

Humboldt Formation[1]

Humboldt Limestone Member (of Syrena Formation)

Pennsylvanian: Southwestern New Mexico.

Original reference: H. Schmitt, 1933, Am. Inst. Mining Metall. Engineers Contr. 39, p. 2, 13.

M. L. Thompson, 1942, New Mexico Bur. Mines Mineral Resources Bull. 17, p. 23. Schmitt's term Humboldt is three times preoccupied. It is not used in this report as stratigraphic name for Pennsylvanian rocks in New Mexico.

P. F. Kerr and others, 1950, Geol. Soc. America Bull., v. 61, no. 4, p. 283 (fig. 5), 284–285. Syrena formation has been divided into two mapping units by Schmitt: lower is Mountain Home member and upper is Humboldt limestone (also called Don limestone). Consists of some 250 feet of alternating limestone and shale with several discontinuous quartz diorite sills. Underlies Beartooth quartzite.

Derivation of name not indicated.

Humboldt Formation[1]

Miocene and Pliocene(?): Northern Nevada.

Original reference: C. King, 1878, U.S. Geol. Expl. 40th Par., v. 1, p. 434–443.

R. P. Sharp, 1939, Jour. Geology, v. 47, no. 2, p. 133–160. Consists of 5,800 feet of continental deposits which range in grain size from coarse fanglomerate to fine shale and in composition from lake deposits of limestone and oil shale to stream-laid conglomerate sandstone, and mudstone interbedded with fine pyroclastics of water-laid and air-borne types. Beds divided into three members: lower, mostly lake beds; middle, characterized by ash and tuff beds; upper, mostly stream-laid deposits. As here defined consists of beds deposited chiefly in late Miocene and possibly early Pliocene. Lake Lahontan beds should not be included in Humboldt. Type section suggested.

R. H. Dott, Jr., 1955, Am. Assoc. Petroleum Geologists Bull., v. 39, no. 11, p. 2245. Overlaps Tomera formation (new) at Tomera Ridge.

T. G. Fails, 1960, Am. Assoc. Petroleum Geologists Bull., v. 44, no. 10, p. 1695 (fig. 1), 1699. Unconformably overlies Carlin Canyon formation (new).

Type section: Exposures along Huntington Creek, tributary of South Fork of Humboldt River, Elko County. Formation occupies basins separated by northward-trending fault-block mountains.

Humboldt Limestone[1]

Pennsylvanian: Southeastern Kansas.

Original reference: R. Hay, 1887, Kansas Acad. Sci. Trans., v. 10, p. 7.

Probably named for Humboldt, Allen County.

Humboldt Oolite (in Kinderhook Group)[1]

Mississippian: Central northern Iowa.

Original reference: F. M. Van Tuyl, 1925, Iowa Geol. Survey, v. 30, p. 109–114.

Occurs in east bank of West Fork of Des Moines River in southwestern part of town of Humboldt, Humboldt County.

Humbug Formation[1]

Upper Mississippian: Central northern Utah.

Original reference: G. W. Tower, Jr., and G. O. Smith, 1899, U.S. Geol. Survey 19th Ann. Rept., pt. 3, p. 625–626.

H. T. Morris, 1957, Utah Geol. Soc. Guidebook 12, p. 15 (fig. 4), 19–20, pl. 1. In East Tintic Mountains, overlies Deseret limestone (replaces Pine Canyon) and underlies Great Blue limestone. Thickness 600 to 675 feet.

A. E. Disbrow, 1957, U.S. Geol. Survey Mineral Inv. Field Studies Map MF–131. Mapped in Fivemile Pass quadrangle where it consists of alternating beds of brown crossbedded sandstone and light-gray weathering limestone interbedded with thin beds of dolomite and shale; about 600 feet thick. Underlies Great Blue limestone; overlies Deseret limestone.

J. K. Rigby, 1958, Utah Geol. Soc. Guidebook 13, p. 38 (fig. 5), 45–46. In Stansbury Mountains, overlies Pine Canyon formation and underlies Great Blue limestone. Thickness 710 to 900 feet. Pine Canyon used here in preference to Deseret.

H. J. Bissell, 1959, Utah Geol. Soc. Guidebook 14, p. 52–55. In southern Oquirrh Mountains, 635 feet thick; underlies Great Blue limestone and overlies Deseret limestone (restricted).

H. J. Bissell, 1959, Utah Geol. Soc. Guidebook 14, p. 158, 161–163, pl. 1. In Fivemile Pass and North Boulter Mountains quadrangles, conformably overlies Pine Canyon formation and underlies Great Blue limestone. Thickness 450 to 475 feet.

Named for exposures near Humbug tunnels, 1¼ miles southeast of Eureka.

†Humbug Limestone[1]

Mississippian: Utah.

Original reference: G. W. Crane, 1915, Am. Inst. Mining Engrs. Bull. 106, p. 2159–2151.

In Tintic district.

Humbug Sandstone[1]

Upper Mississippian: Utah.

Original reference: G. W. Crane, 1915, Am. Inst. Mining Engrs. Bull. 106, p. 2149–2151.

In Tintic district.

Hume Shale Member (of Perrysburg Formation)

Hume Shale (in Canadaway Group)

Hume Shale Member (of Canadaway Formation)

Upper Devonian: Western and west-central New York.

J. F. Pepper and Wallace de Witt, Jr., 1951, U.S. Geol. Survey Oil and Gas Inv. Chart OC–45. Name applied to about 70 feet of predominantly black, brown, and dark-gray shale exposed above Canaseraga sandstone member in stream and along banks of Wiscoy Creek at Mills Mills. Member rests on siltstone of upper part of Canaseraga along Wiscoy Creek and grades laterally eastward into siltstone of Canaseraga in area between Mills Mills and Dalton. In Genesee River Valley, overlain by Caneadea member.

I. H. Tesmer, 1955, New York State Mus. Sci. Service Circ. 42, p. 10, fig. 1, 16. Reallocated to member status in Canadaway formation.

L. V. Rickard, 1957, New York Geol. Soc. Guidebook 29th Ann. Mtg., p. 15, 17, 18. In Wellsville area, term Perrysburg formation not applied. Hume shale considered formation in Canadaway group.

Type locality: At Mills Mills, on Wiscoy Creek, Hume Township, Allegheny County.

Hummel facies (of Muldraugh Formation)

Lower Mississippian: Central Kentucky.

P. B. Stockdale, 1939, Geol. Soc. America Spec. Paper 22, p. 76, 214–217. Characterized by unit of gritty siltstone in lower part. Bounded by greenish-black bands of glauconitic silt and argillaceous limestone with bluish to greenish shaly partings in upper part. Thickness 35 to 50 feet or more. Contains Wildie siltstone member (new) at base. Merges with Maretburg facies (new) on the west and with Olive Hill facies (new) on the east. Underlies unclassified Upper Mississippian rocks; overlies Floyds Knob formation.

Well exposed at northwest end of tunnel of Louisville and Nashville Railroad 1½ miles south-southeast of Wildie, Rockcastle County. Section is in center of facies area. Name derived from Hummel, station on Louisville and Nashville Railroad, 4 miles northeast of Mt. Vernon, north-central Rockcastle County.

Humpback Gneiss

Precambrian (Archean?): Western North Carolina.

C. E. Hunter and P. W. Mattocks, 1936, TVA Div. Geology Bull. 4, p. 11–12. A light-gray rock of sedimentary origin composed mostly of fragments of feldspar and quartz in matrix of secondary micas, chlorites, and other metamorphic minerals. A thin yellowish clay schist commonly interbedded with the more coarse and thick-bedded materials.

Appears along Humpback Mountain in Linville Falls quadrangle.

Humphrey Shale (in Wabaunsee Group)[1]

Pennsylvanian: Northeastern Kansas, southwestern Iowa, and southeastern Nebraska.

Original reference: A. J. Smith, 1905, Kansas Acad Sci. Trans., v. 19, p. 151.

Named for exposures on Humphrey's Ford, 6 miles southeast of Emporia, Kans.

Humphrey Creek Shale (in Wabaunsee Group)[1]

Pennsylvanian: Kansas.

Original reference: R. C. Moore, 1932, Kansas Geol. Soc. Guidebook 6th Ann. Field Conf.

Hundred Sandstone (in Washington Formation)[1]

Permian: Northern West Virginia and southeastern Ohio.

Original reference: R. V. Hennen, 1909, West Virginia Geol. Survey Rept. Marshall, Wetzel, and Tyler Counties, p. 214.

Wilber Stout, Karl Ver Steeg, and G. F. Lamb, 1943, Ohio Geol. Survey, 4th ser., Bull. 44, p. 153, table facing p. 108. Geographically extended into Ohio where it is 17 feet thick and occurs below Upper Washington limestone and above Upper Marietta sandstone.

Thomas Arkle, Jr., 1959, Geol. Soc. America Guidebook Pittsburgh Mtg., p. 118 (table 1). Sandstone in Washington series. Above Hundred coal and below Upper Washington limestone.

Named for village of Hundred, Wetzel County, W. Va.

Hungerford Formation

Hungerford Slate (in Woods Corners Group)

Middle Cambrian: Northwestern Vermont.

Charles Schuchert, 1937, Geol. Soc. America Bull., v. 48, no. 7, p. 1045, 1047–1049, 1055. Chiefly blue-black to gray well-banded slates with local lentils of sandy dolomites also many white limestone bioherms. Hungerford beds formerly considered same as Highgate formation. Near Highgate Center, the name, Russell slate, is abandoned and beds are named Hungerford. Maximum thickness about 700 feet. Disconformably underlies Rockledge breccia (new) or Georgia formation; overlies Mill River breccia, St. Albans slate, or Parker slate.

B. F. Howell, 1939, (abs.) Geol. Soc. America Bull., v. 50, no. 12, pt. 2, p. 1964. Stratigraphically restricted. Lowermost fossiliferous beds named Skeels Corners formation; the sandstone disconformably overlying them named Saxe Brooke formation.

A. B. Shaw, 1958, Geol. Soc. America Bull., v. 69, no. 5, p. 523 (table 1), 532 (fig. 5), 547–548, pl. 1. Schuchert (1937) misinterpreted structures at type locality and believed that Hungerford slate lay below Rockledge conglomerate. Detailed mapping has proved that Rockledge plunges northward under slate at Hungerford Brook and that Hungerford slate is younger than Rockledge conglomerate. Because of this misinterpretation of stratigraphic position of Hungerford, Schuchert and subsequent workers have referred to Hungerford slate all beds now designated as Skeels Corners slate. Ruedemann (1947) referred to this formation as Russell slate. Consists almost entirely of black slate, commonly in beds 2 to 10 mm thick, alternating with beds of fine-grained white sandstone, commonly less than 3 mm. thick. Thickness about 400 feet at type locality; about 200 feet at international boundary. Overlies Rockledge conglomerate, contact gradational; overlies Skeels Corners slate where Rockledge is absent; underlies Gorge formation. Uppermost formation in Woods Corners group (new). Middle Cambrian.

Type area: Where Hungerford Brook crosses Highgate Road, about 1¼ miles south of Highgate, Franklin County. Thick sections also found west of Georgia Center and in Milton Township.

Hungry Run Sandstone Member (of Orangeville Shale)

Mississippian: Northwestern Pennsylvania.

Wallace de Witt, Jr., 1951, Geol. Soc. America Bull., v. 62, no. 11, p. 1347, 1351, 1364–1366; J. F. Pepper, Wallace de Witt, Jr., and D. F. Demarest, 1954, U.S. Geol. Survey Prof. Paper 259, p. 18 (fig. 9), 43–45. Name proposed for massive iron-stained coarse-grained sandstone and underlying massive siltstone. Sandstone is crossbedded, conglomeratic in upper part, and includes zone of clay galls and lens of petroliferous sandstone. Lenses of flattened discoidal pebbles occur in conglomerate. Thickness 12 feet. Overlying beds not exposed at type locality; in some Crawford County localities, underlies dark silty part of Orangeville shale. Overlies either siltstones of Corry sandstone or Cussewago sandstone. Lower Mississippian.

Type locality: Small quarry on a headwater of Hungry Run, 1 mile west of southeastern corner of Union Township, Erie County. Also exposed in Crawford County.

Hungry Valley Formation (in Ridge Basin Group)

Pliocene, upper: Southern California.

J. C. Crowell, 1950, Am. Assoc. Petroleum Geologists Bull., v. 34, no. 8, p. 1626 (fig. 4), 1629 (fig. 5), 1633–1637. Name applied to about 4,000 feet of nonmarine sandstone and conglomerate conformably overlying Peace Valley beds (new). Consists of five unnamed lithologic members (ascending): conglomerate-breccia, brown conglomerate, white sandstone, gray silty sandstone, and buff sandstone. Basal contact of formation in type area is gradational. Youngest exposed beds of formation crop out along San Andreas fault zone and Frazier Mountain thrust near northern boundary of area.

J. C. Crowell, 1954, California Div. Mines Bull. 170, map sheet 7. Shown on columnar section as the top 4,500 feet of Ridge Basin group.

Type section: Just east of Hungry Valley and along Freeman Canyon. Hungry Valley is in Transverse Ranges about 55 miles northwest of Los Angeles.

Hunt Beds (in Bluestone Group or Formation)

Hunt Member (of Bluestone Formation)

Mississippian (Chester Series): Southwestern Virginia and southeastern West Virginia.

B. N. Cooper, 1944, Virginia Geol. Survey Bull. 60, p. 185–186, pl. 15. Reger (1926) subdivided the 50 feet of the Bluestone into 3 units (ascending): Hunt shale, Hunt sandstone, and Hunt coal. These three units here considered the Hunt member of the Bluestone. In Burkes Garden quadrangle, member is 50 to 74 feet thick and consists of maroon-drab, apple-green, and reddish-buff shales; the redbeds are overlain by 12-foot zone of black carbonaceous shale, gray underclay, and coal. Underlies Bent Mountain member (new); overlies Bratton sandstone member. Relations indicate Hunt member is in trough of overturned syncline.

J. M. Weller and others, 1948, Geol. Soc. America Bull., v. 59, no. 2, chart 5 (columns 97, 98). Correlation chart shows Hunt beds in Bluestone group or formation.

Type locality: Near Hunt School, Mercer County, W. Va.

Hunt Sandstone (in Bluestone Formation)[1]

Hunt Shale (in Bluestone Formation)[1]

Mississippian (Chester Series): Southeastern West Virginia.

Original reference: D. B. Reger, 1926, West Virginia Geol. Survey Rept. Mercer, Monroe, and Summers Counties, p. 293, 317.

B. N. Cooper, 1944, Virginia Geol. Survey Bull. 60, p. 185. Hunt shale, Hunt sandstone, and Hunt coal, named by Reger (1926), here considered the Hunt member of Bluestone formation.

All units exposed in Stony Gap section, Mercer County, on north side of Big Ridge, about three-fourths mile south of Belcher School.

Hunt Creek Sandstone (in Mancos Shale)

Upper Cretaceous: Northwestern Colorado.

R. E. Kucera, 1959, Rocky Mountain Assoc. Geologists 11th Field Conf., Symposium, p. 42, fig. 3. Prominent sandstone sequence at base of upper Mancos shale consisting of three prominent yellowish-gray to light-gray fine-grained crossbedded sandstone units with intervening slope-forming sandy shale and thin sandstone zones, 240 to 260 feet thick.

Exposed in escarpment along Hunt Creek, 2 miles southwest of Phippsburg.

Hunter Group

Hunterian Subseries

Middle Ordovician (Bolarian): Pennsylvania, Maryland, New York, Virginia, and West Virginia, and Ontario, Canada.

Marshall Kay, 1947, (abs.) Geol. Soc. America Bull., v. 58, no. 12, p. 1198–1199. Upper Bolarian (Hunterian) comprises Snyder, Stover, and Curtin limestone, about 300 feet at Bellefonte, Pa., thinning by truncation to about 60 feet, predominantly Snyder, near Maryland, and to about 30 feet of Snyder at James River. The thickening Gratton, Bowen, Wardell, and basal Witten take the place of the Snyder west of New River, and Witten type section in Tazewell County seems to contain the Stover-Nealmont disconformity within the "*Camarocladia* zone." Lower Bolarian is the Hatterian (new).

Marshall Kay, 1948, Am. Assoc. Petroleum Geologists Bull., v. 32, no. 8, p. 1409–1410. Hunter group includes Snyder, Stover, and Curtin limestones of central Pennsylvania. First two described as members of Benner formation. Hunterian subseries is of rocks younger than base of Snyder and older than unconformity separating the Curtin and lower Trentonian Nealmont limestone. Inasmuch as the Curtin is thickening northwestward beneath an unconformity as it passes beneath the Appalachian Plateau, there are Hunterian sediments younger than those exposed.

Marshall Kay, 1956, Geol. Soc. America Bull., v. 67, no. 1, p. 97. Hunter group (Kay, 1948) is not significant, and Benner group should be applied to upper Bolarian.

G. A. Cooper, 1956, Smithsonian Misc. Colln., v. 127, pt. 1, p. 7. Bolarian includes two divisions—Hatterian and Hunterian. These names unsatisfactory to show relationships as understood in this report. Hatter formation, whose time designation is Hatterian, appears to be same as Hunterian if, as shown in this report, the Hatter is equivalent to Ridley formation.

Name derived from Hunter Park, on Bellefonte Central Railroad in Centre County, Pa.

Hunter Sandstone and Conglomerate (in Puente Formation)

Miocene, upper: Southern California.

M. L. Krueger, 1943, California Div. Mines Bull. 118, p. 363. Shown on structure section as underlying Peculiar shale (new) and overlying Cubierto shale (new).

A. O. Woodford, T. G. Moran, and J. S. Shelton, 1946, Am. Assoc. Petroleum Geologists Bull., v. 30, no. 4, p. 521. Sandstone, conglomerate, and clay shale 216 feet thick. Upper part of Puente. Measured section noted.

Exposed in Slaughter Canyon in southeastern Puente Hills, between Chino and Santa Ana River, San Bernardino County.

Hunter Canyon Formation (in Mesaverde Group)[1]

Upper Cretaceous : Western Colorado.

Original reference: C. E. Erdmann, 1934, U.S. Geol. Survey Bull. 851, p. 22, 33.

H. E. Wood 2d and others, 1941, Geol. Soc. America Bull., v. 52, no. 1, p. 22, pl. 1. Late Montanan to early Lance.

R. G. Young, 1955, Geol. Soc. America Bull., v. 66, no. 2, p. 187. Proposed to drop terms Mount Garfield and Hunter Canyon formations and to adopt term Neslen facies for all coal-bearing rocks of Price River formation and term Farrer facies for non-coal-bearing rocks above Neslen facies.

D. J. Fisher, C. E. Erdmann, and J. B. Reeside, Jr., 1960, U.S. Geol. Survey Prof. Paper 332, p. 11 (table), 20. Consists of massive brown-buff and gray sandstone and soft gray shale beds. Thickness 375 to 1,400 feet. Overlies Mount Garfield formation. Essentially equivalent to Tuscher formation.

Named for Hunter Canyon, Book Cliffs coal field.

Hunter Mountain Quartz Monzonite

Cretaceous (?) : Eastern California.

J. F. McAllister, 1956, U.S. Geol. Survey Geol. Quad. Map GQ-95. Name applied to map unit of plutonic rocks. Described as principally light-gray medium- to coarse-grained hornblende quartz monzonite but includes wide range of border facies (commonly syenodiorite, monzonite, syenite), pegmatite, aplite, and lamprophyre. Greatest topographic relief of an exposed part is about 4,000 feet in Nelson Range. Plutonic rocks intruded and metamorphosed Bird Spring (?) formation of Pennsylvanian and Permian age and lie nonconformably under continental deposits of late Pliocene or Pleistocene age.

Named for Hunter Mountain in Panamint Range. Exposed continuously from contact at least 8 miles east of quadrangle, across Hunter Mountain and for 17 miles along Nelson Range. Exposure is at least 10 miles broad across Hunter Mountain and southward to Darwin quadrangle.

Hunters Island Iron-Bearing Series[1]

Precambrian : Northeastern Minnesota.

Original reference: C. R. Van Hise and C. K. Leith, 1911, U.S. Geol. Survey Mon. 52, p. 118.

Occurs on east extension of north arm of Vermilion Range, Vermilion district.

Huntersville Chert (in Onodaga Group)

Huntersville Chert (in Oriskany Group)[1]

Lower or Middle Devonian : Southeastern West Virginia.

Original reference: P. H. Price, 1929, West Virginia Geol. Survey Rept. Pocahontas County, p. 106, 108, 233, 236–237, 397.

G. A. Cooper and others, 1942, Geol. Soc. America Bull., v. 53, no. 12, pt. 1, chart 4. Age shown on correlation chart as Lower or Middle Devonian.

H. P. Woodward, 1943, West Virginia Geol. Survey, v. 15, p. 256–278. Huntersville is rock unit for which it is difficult to find precisely descriptive lithologic term and to which name chert is only partly appropriate. Mostly it is highly silicified black shale which contains many beds that have been brecciated and recemented with amorphous silica; at least one prominent glauconitic-bearing sandstone and numerous other sandy phosphatic, or glauconitic, layers are commonly present; many layers of brittle clay-shale, but little or no limestone and less true chert than commonly supposed. Thickness 15 to nearly 100 feet. Unconformably overlies Ridgeley sandstone; where it underlies Needmore shale, the two formations grade into each other; where Needmore is absent, underlies Marcellus black shale. Present in southwestern Virginia. Included in Onondaga group, Middle Devonian.

J. M. Dennison, 1960, Dissert. Abs., v. 21, no. 3, p. 593. Includes Bobs Ridge quartz sandstone member (new). Needmore shale, Huntersville chert, and Onondaga limestone are contemporaneous facies of Onesquethaw stage.

Type locality: Vicinity of Huntersville, southeastern Pocahontas County.

Hunter Valley[1] Cherts (in Amador Group)

Middle or Upper Jurassic: East-central California.

Original reference: N. L. Taliaferro, 1933, Geol. Soc. America Bull., v. 44, no. 1, p. 149.

N. L. Taliaferro, 1943, California Div. Mines Bull. 125, p. 283, 303–323. Assigned to Amador group. Consist of red, chocolate, gray, green, and black radiolarian chert, both massive and thin-bedded with partings of red, lilac, purple, chocolate, gray-green, and black slates and tuffaceous slates; schistose green tuffs and thin flows; impure cherts and siliceous mudstones near top of section. In Merced River section, Hunter Valley cherts overlie pillow basalts and underlie Penon Blanco volcanics. Thickness 950 feet. Age of Amador group believed to be upper Middle to lower Upper Jurassic.

Occurs along Merced River in southern type section of Amador group. [Name probably derived from Hunter Valley, Mariposa County.]

Huntingdon Formation[1]

Eocene: Southern British Columbia, Canada, and central northern Washington.

Original reference: R. A. Daly, 1912, Canada Geol. Survey Dept. Mines Mem. 38, map 17.

H. A. Coombs, 1939, Geol. Soc. America Bull., v. 50, no. 10, p. 1498. Sedimentary sequence several thousand feet thick borders western margin of Mt. Baker. Various sandstones, shales, arkoses, and thin coal seams are known collectively as Chuckanut formation. Daly (1912) gave name Huntingdon formation to similar strata to the north, but this is only a provisional name to be used until definite correlation can be made with the Chuckanut.

Occurs at and north of Huntingdon, British Columbia, and in northern Washington.

Hunting Hill Greenstone (in Blackstone Series)

Precambrian (?) : Northeastern Rhode Island.

Alonzo Quinn, R. G. Ray, and W. L. Seymour, 1948 *in* Alonzo Quinn and others, Rhode Island Port and Indus. Devel. Comm. Geol. Bull. 3, p. 12–13, geol. map; A. W. Quinn, R. G. Ray, and W. L. Seymour, 1949, Bedrock geology of the Pawtucket quadrangle, Rhode Island-Massachusetts: U.S. Geol. Survey Geol. Quad. Map [GQ–1]. Dark-green to nearly black fine- to medium-grained greenstone, partly massive and partly schistose; includes several types of metamorphosed basaltic rocks. Fine-grained porphyritic andesite facies occurs one-half mile south of Olney

Pond. Contains several small serpentine and talc bodies, also inclusions and intercalated beds of schist, quartzite, and marble. In some areas, interbedded with Mussey Brook schist (new); locally intrudes Westboro quartzite; dikes and sills of Hunting Hill greenstone occur in Sneech Pond schist (new). Included in Blackstone series.

Named for Hunting Hill, Pawtucket quadrangle, Providence County. Numerous ledges of greenstone exposed on top and west side of this hill.

Huntington Dolomite[1]

Middle Silurian: Northeastern Indiana and west-central Ohio.

Original reference: E. M. Kindle, 1904, Indiana Dept. Geology and Nat. Resources 28th Ann. Rept., p. 408.

D. A. Busch, 1939, (abs.) Geol. Soc. America Bull., v. 50, no. 12, pt. 2, p. 1976. Huntington (restricted) represents that part of Huntington formation of northern Indiana which contains Guelph fauna. Lower 43 feet of 70-foot section of Huntington, as exposed at Ridgeville, Randolph County, Ind., relegated to underlying Cedarville formation. Huntington (restricted) and overlying New Corydon limestone are geographically extended into west-central Ohio.

J. B. Patton, 1949, Indiana Div. Geology Rept. Prog. 3, p. 12. Existence of Huntington as a formation has been questioned. Although dolomite identified as Huntington is exposed at numerous places throughout an area of more than 1,600 square miles, contact of base of Huntington on an older formation has not been observed. Many exposures termed Huntington are reefs or beds associated with reefs. Some reefs formerly called "Huntington" are now considered to be Liston Creek or even Mississinewa in age.

J. B. Sangree, Jr., 1960, Dissert. Abs., v. 21, no. 6, p. 1528. Revision of Silurian stratigraphy of northern Indiana proposed, including abandonment of Huntington dolomite of Cumings and Shrock [1928, Indiana Dept. Conserv., Div. Geology Pub. 75].

Type section (redefined): Along dredged rock channel of Little River from NE cor. SW cor. NE¼ sec. 13, T. 28 N., R. 10 E., eastward to west line of sec. 8, T. 28 N., R. 10 E., Huntington County, Ind.

Huntington Series[1]

Triassic(?): Northeastern Oregon.

Original reference: W. Lindgren, 1901, U.S. Geol. Survey 22d Ann. Rept., pt. 2, p. 579.

Occurs in vicinity of Huntington, Baker County.

Hunton Limestone[1] **or Group**

Silurian and Devonian: Southeastern Oklahoma.

Original reference: J. A. Taff, 1902, U.S. Geol. Survey Geol. Atlas, Folio 79.

R. A. Maxwell, 1936, Northwestern Univ. Summ. Doctoral Dissert., v. 4, p. 131–136. Taff gave name Hunton formation to series of limestones and shale that occur between Sylvan shale of Ordovician and Woodford chert of Mississippian(?) age. Reeds (1911, Am. Jour. Sci., 4th, v. 32) divided Taff's Hunton into four units of formational rank (ascending): Chimneyhill limestone (Silurian), Henryhouse shale (Silurian), Haragan shale (Devonian), and Bois d'Arc limestone (Devonian). Reeds (1926) added Frisco limestone (Devonian) above the Bois d'Arc. In this report, Hunton formation as defined by Taff and redefined and subdivided by Reeds is again redefined as follows: Silurian, Chimneyhill limestone with Hawkins, Keel, Cochrane, and Dillard members; Henryhouse formation; Devonian, Kite group with Haragan and Cravatt formations; Bois d'Arc limestone; and Frisco limestone.

T. W. Amsden, 1957, Oklahoma Geol. Survey Circ. 44, p. 1–57; 1959, Oklahoma Geol. Survey Bull. 84, pt. 6, p. 7–311 [1960]. Group consists of sequence of limestones and marlstones unconformably underlain by Sylvan formation and unconformably overlain by Woodford formation. Thickness ranges up to slightly more than 400 feet, but at most places it is much less, due in part to unconformities and facies changes. In areas where group is relatively thick and complete, typical sequence consists of basal series of calcilutites and calcarenites (Chimneyhill formation), overlain by marlstones (Henryhouse and Haragan formations), followed by cherty marlstones (lower Bois d'Arc formation) and calcarenites (upper Bois d'Arc formation) and, locally, Frisco formation. Interpretation of stratigraphic and faunal relationships within group differs from that given by previous workers. However, names introduced by earlier authors, even those proposed in abstract form, have been retained if they are not preoccupied.

Named for exposures near former townsite of Hunton (T. 1 S., R. 8 E.), Coal County. Well exposed within Arbuckle complex and known to have wide distribution in subsurface.

Huntsville Fanglomerate

Pliocene, upper: North-central Utah.

A. J. Eardley, 1955, Utah Geol. Soc. Guidebook 10, p. 39, fig. 9. Incidental mention in discussion of Tertiary history of north-central Utah. Deposited contemporaneously with Harkers fanglomerate in Jordan-Oquirrh area and Mink Creek conglomerate in Cache Valley. Name credited to B. Lofgren.

Recognized in Morgan area.

†Huntsville[1] (Formation)

Mississippian: Northeastern Alabama.

Original reference: E. A. Smith, 1892, Sketch of geology of Alabama: Birmingham, Roberts & Son, pamph.

Named for exposures at Huntsville, Madison County.

Huron Gritstone[1]

Mississippian: Michigan.

Original reference: A. Winchell, 1871, Am. Philos. Soc. Proc., v. 11, p. 73–82.

Probably named for outcrops along Lake Huron in Michigan.

†Huron Group[1]

Upper Devonian and Mississippian: Michigan.

Original reference: A. Winchell, 1861, Michigan Geol. Survey 1st Bienn. Rept. Prog., p. 71, 139.

Probably named for outcrops along Lake Huron in Michigan.

†Huron Group[1]

Mississippian: Indiana.

Original reference: T. C. Hopkins, 1902, Geol. Soc. America Bull., v. 13, p. 519–520.

Named for Huron, Lawrence County.

Huron Member (of Ohio Shale)

Huron Shale[1]

Upper Devonian: Northern Ohio.

Original reference: J. S. Newberry, 1870, Ohio Geol. Survey Rept. Prog. 1869, p. 18.

J. F. Pepper, Wallace de Witt, Jr., and D. F. Demarest, 1954, U.S. Geol. Survey Prof. Paper 259, p. 15–16. Member of Ohio shale. Consists of grayish-black shale which contains large septarian concretions in lower part and thin beds of cone-in-cone limestone in upper part. Cleveland and Huron members essentially identical in lithologic character, and in Erie and Lorain Counties contact between these black shales is drawn arbitrarily below lowest cone-in-cone layer and uppermost zone containing large concretions.

K. V. Hoover, 1960, Ohio Geol. Survey Inf. Circ. 27, p. 16–18. In northern Ohio, the Ohio shale regarded as consisting of three members (ascending): Huron, Chagrin, and Cleveland. Stratigraphic position of Ohio and Chagrin has been disputed. Some researchers regard the Huron as basal member and others the Chagrin. Huron and Cleveland members are for most part lithologically identical. Base of Huron taken as the black shale bed resting upon highest most gray shale (or limestone) bed of underlying formation or unit, which in different places is Plum Brook shale, Prout limestone, Ten Mile Creek dolomite, Olentangy shale, or locally, Silurian or Devonian limestone. Upper limit defined as uppermost black shale in area where gray carbonaceous Chagrin is present, or as top of uppermost layer of carbonate concretions, or base of cone-in-cone structure, if these are observable. Such an arbitrarily placed boundary leaves much to be desired. No divisions have been established in Huron shale. Generally supposed that shale termed "Huron shale" by Newberry comprises all of black shale which Andrews, later in same report, named "Ohio black shale." Newberry's Huron shale represented only the lower mass of black shale which occurs in northern part of State. Presently top of Ohio shale in southern Ohio is considered as corresponding to top of Cleveland shale. Andrew's Ohio shale is regarded equivalent to Newberry's Huron, Chagrin, and Cleveland shales of northern Ohio. Hass (1947, Jour. Paleontology, v. 21) found from study of conodonts that certain genera and species are common only to Huron shale (zone). These same conodonts are mutually present in south-central Ohio as well as in northern part of State. Hass referred to "Huron shale" of central and northern Ohio as the lower Ohio shale zone. Total thickness of Huron not seen in outcrop. Reported average thickness 410 feet.

Named for exposures on Huron River, Huron and Erie Counties. From Berea west to Norwalk, the Huron forms cliffs 5 to 70 feet high along many streams and along shore of Lake Erie.

Huron Bay Slates[1]

Age(?): Northeastern Michigan.

Original reference: T. B. Brooks, 1873, Michigan Geol. Survey, v. 1, pt. 1, p. 155.

Huron City Sandstones and Shales (in Lower Marshall Sandstone)

Mississippian (Kinderhook): Southern Michigan.

H. M. Martin, 1936, The centennial geological map of the southern peninsula of Michigan (1:500,000): Michigan Dept. Conserv., Geol Survey Div. Pub. 39, Geol. Ser. 33. Shown on map legend.

Huronian Series[1]

Precambrian: Great Lakes region.

Original references: W. E. Logan and T. S. Hunt, 1855, Esquisse géologique du Canada p. 29–31; F. D. Adams and others, 1905, Jour. Geology, v. 13, p. 103–104.

F. F. Grout and others, 1951, Geol. Soc. America Bull., v. 62, no. 9, p. 1070, 1072. In Minnesota classification, the Precambrian is divided into Earlier Medial, and Later. Later Precambrian includes Animikie and Keweenawan groups. Term Huronian not used, principally because only tentative correlations can be made with type Huronian. A further reason to avoid use of term Huronion for Animikie formations is based on original naming of Huronian. When Logan named formations north of Lake Huron, he thought (J. F. Alcock and Committee, 1934, Royal Soc. Canada Trans., v. 28, no. 4) the Animikie and Keweenawan were Paleozoic and excluded them from the Huronian.

Named for exposures on shores of Lake Huron.

Hurrah Slate[1]

Post-Ordovician(?): Northwestern Alaska.

Original reference: P. S. Smith, 1910, U.S. Geo. Survey Bull. 433, p. 50, 59.

Well exposed in Big Hurrah mine located at junction of Big and Little Hurrah Creeks, and on lower 2 or 3 miles of Big Hurrah Creek, Seward Peninsula.

Hurricane Graywacke

Precambrian (Ocoee Series): Western North Carolina, northern Georgia, and eastern Tennessee.

G. W. Stose and A. J. Stose, 1946, (abs.) Geol. Soc. America Bull., v. 57, no. 12, pt. 2, p. 1233. In list of formations, oldest unit in Ocoee series; underlies Great Smoky quartzite.

G. W. Stose and A. J. Stose, 1949, Geol. Soc. America Bull., v. 60, no. 2, p. 274–277, pl. 1. Name Hurricane graywacke is applied to oldest formation of Ocoee series because of its fine exposures on Little Hurricane Creek and at Hurricane settlement, North Carolina, 6 miles northeast of Hot Springs, N.C. Initial sediments of graywacke in this vicinity and northeastward rest on granite gneiss of injection complex. In Asheville and several folios, Keith (1904, folio. 116; 1905, folio 124; 1907, folio 151; Mount Guyot, unpub.) used name Snowbird formation for these beds which he assigned to Lower Cambrian. He included part of Great Smoky conglomerate in Snowbird formation at type locality and elsewhere. In 1904 and 1907, he applied name Snowbird also to well-established Lower Cambrian rocks. For these reasons, it is believed that name Snowbird is misleading, and new name Hurricane is applied to graywacke which underlies Great Smoky quartzite and is basal formation of Ocoee series. Hurricane is fine- to medium-grained grayish-black or grayish-green graywacke consisting principally of angular grains of glassy quartz and feldspar in matrix of mica and black, iron-oxide dust. On southeast side of belt of series, the Hurricane rests unconformably on Precambrian injection complex. On northwestern side of belt it is exposed in places along Great Smoky overthrust. Occurs in anticlines within the belt, and in Georgia surrounds early Precambrian rocks exposed in Fort Mountain, Corbin, and Salem Church anticlines. North of Blairsville, Ga., the Hurricane is basal part of Ocoee series that was mapped as Carolina gneiss by La Forge and Phalin (1913, U.S. Geol. Survey Geol. Atlas, Folio 187). Southwest of Cartersville, Ga., and in Alabama, the formation is green phyllite. In Georgia, Hayes (unpub. folio) called part of this phyllite Gilmer schist, and Crickmay (1936) included it in Talladega series. In Alabama, it was mapped as Talladega slate by Butts (1926, Paleozoic rocks of Alabama: Alabama Geol. Survey). In Corbin anticline, the Hurricane is thrust over Corbin granite. In Fort and Cohutta Mountains, overlies Fort Mountain gneiss.

S. S. Oriel, 1950, North Carolina Div. Mineral Resources Bull. 60, p. 26–27. Discussion of Hot Springs Window, Madison County. Term Snowbird considered preferable to Hurricane graywacke in this area.

Type locality: Exposures on Little Hurricane Creek and at settlement of Hurricane, N.C., at junction of the creek with Big Laurel Creek (Asheville quadrangle), 6 miles northeast of Hot Springs, N.C. Southeastern belt extends from 3 miles southwest of Erwin, Tenn., through type locality, and southwestward to northern Georgia and ends at Mount Oglethorpe.

Hurricane Marine Lentil (in Landrum Member of Cook Mountain Formation)

Eocene, middle: Eastern Texas.

H. B. Stenzel, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 9, p. 1665–1670. Fossilliferous, bentonite-bearing marine lentil about 25 feet thick in lower part of Landrum member [of middle Eocene age].

Probably named for occurrence near Hurricane Bayou, Houston County.

Hurricane Bridge Limestone

Middle Ordovician: Southwestern Virginia.

R. L. Miller and W. P. Brosgé, 1950, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 104 (2 sheets). Cryptocrystalline tan and gray thin-bedded limestone with prominent zones of massive-bedded cryptocrystalline birdseye limestone and zones of buff- and red-weathering argillaceous shaly limestone. Thickness 288 to 368 feet. Overlies Martin Creek limestone (new); underlies Woodway limestone (new). Same as redbed member of Lowville limestone on U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 76.

R. L. Miller and W. P. Brosgé, 1954, U.S. Geol. Survey Bull. 990, p. 32 (table 1), 33–34, 47–51, pl. 1. Further described, and type locality and type section given. Discussion of problems of correlation and summary of nomenclature of Middle Ordovician formations in Lee and Tazewell Counties.

Type locality: Vicinity of Hurricane Bridge and Hurricane Chapel on Powell River 2½ miles southwest of Jonesville, Lee County, Lee County, Va. Type section is along State Route 70 north of Sewell Bridge.

Hurricane Mesa Volcanics

Tertiary: Northwestern Wyoming.

R. D. Krushensky, 1960, Dissert. Abs., v. 21, no. 4, p. 849. Flows, tuffs, and tuff-breccias. Overlie unit referred to as post-Closed volcanics.

Hurricane Mesa area, Park County.

Hurwal Formation

Upper Triassic: Northeastern Oregon.

W. D. Smith and J. E. Allen, 1941, Oregon Dept. Geology and Mineral Industries Bull. 12, p. 6 (fig. 2), 13–14. Name applied to conformable series of argillaceous sediments that lies both stratigraphically and topographically above Martin Bridge formation. Grades within a few tens of feet from underlying Martin Bridge limestone through argillaceous limestone and calcareous shale, to shale and hornfels. Thickness 1,500 feet on Hurricane Divide and Sentinel Peak. Top not exposed although upper limestone interbedded in formation on Hurricane Divide may represent highest Mesozoic horizon in area.

Named from Hurwal Divide in center of Wallowa quadrangle, Wallowa County.

Hushpuckney Shale[1] Member (of Swope Limestone)

Pennsylvanian (Missouri Series) : Eastern Kansas, southwestern Iowa, and northwestern Missouri.

Original reference: R. C. Moore, 1932, Kansas Geol. Soc. 6th Ann. Field Conf. Guide Book, p. 85, 90, 97.

R. C. Moore, 1948, Am. Assoc. Petroleum Geologists Bull., v. 32, no. 11, p. 2031 (fig. 4) ; 1949, Kansas Geol. Survey Bull. 83, p. 68 (fig. 14), 88; F. C. Greene and W. V. Searight, 1949, Missouri Geol. Survey and Water Resources Rept. Inv. 11, p. 11. Hushpuckney shale member of Swope formation; underlies Bethany Falls limestone member; overlies Middle Creek limestone member. This is classification agreed upon by State Geological Surveys of Iowa, Kansas, Missouri, Nebraska, and Oklahoma, May 1947.

T. L. Welp, L. A. Thomas, and H. R. Dixon, 1957, Iowa Acad. Sci. Proc., v. 64, p. 418 (fig. 1), 421. Thickness about 4 feet in section measured near Winterset, Madison County.

H. G. Hershey and others, 1960, Iowa Highway Research Board Bull. 15, p. 28, fig. 5. Gray and fossiliferous above and black and fissile at base. Underlies Bethany Falls limestone member; overlies Middle Creek limestone member.

Typically exposed at railway cut, center north side sec. 13, T. 19, S., R. 23 E., Miami County, Kans. Named for creek south of Fontana.

Hutchinson Salt Member (of Wellington Formation)

Hutchison Salt Bed (in Sumner Group)[1]

Permian: South-central Kansas (subsurface).

Original reference: I. Perrine, 1918, Am. Assoc. Petroleum Geologists Bull., v. 2, p. 73–90.

R. C. Moore and others, 1951, Kansas Geol. Survey Bull. 89, p. 40–41. Occurs in middle part of Wellington; does not crop out.

J. M. Jewett, 1959, Graphic column and classification of rocks in Kansas: Kansas Geol. Survey. Shown on correlation chart as Hutchinson Saltstone Member of Wellington.

Probably named for Hutchinson, Reno County.

Hutchison limestones[1]

Devonian: Iowa.

Original reference: C. R. Keyes, 1931, Pan-Am. Geologist, v. 56, p. 318, 348.

Hyampom Lake Beds[1]

Miocene: Northwestern California.

Original reference: J. S. Diller, 1902, U.S. Geol. Survey Bull. 196, p. 41–43.

O. P. Jenkins, 1943, California Div. Mines Bull. 118, pt. 4, p. 41–43. Oligocene or Eocene.

Occurs in Hyampom Valley, Trinity County.

Hyco Quartz Porphyry[1]

Precambrian: South-central Virginia and central northern North Carolina.

Original reference: F. B. Laney, 1917, Virginia Geol. Survey Bull. 14, p. 15, 19, 20–23, map.

H. E. LeGrand, 1960, Virginia Div. Mineral Resources Bull. 75, p. 16–17. Underlies Aaron slate in Halifax County.

Named for exposures along Hyco River, Halifax County, Va.

Hyde Formation (in Izee Group)

Middle Jurassic: East-central Oregon.

R. L. Lupher, 1941, Geol. Soc. America Bull., v. 52, no. 2, p. 227 (table 1), 229, 255–259. More than 1,000 feet of massive blue-gray sandstones in lower part of Izee group. Underlies Snowshoe formation (new); overlies Warm Springs formation of Colpitts group (both new).

Type area: At South Fork Bridge, sec. 30, T. 17 S., R. 28 E., in bottom of South Fork Valley. Named for John Hyde Ranch at mouth of Poison Creek, Crook County.

Hyde Granite[1]

Precambrian: Northwestern New York.

Original reference: A. F. Buddington, 1934, New York State Mus. Bull. 296, p. 85, 86–88.

Occurs southwest of Hickory Lake in bend between Hickory Creek, Hammond quadrangle. Probably named for Hyde School.

Hyde Manor Limestone[1]

Middle Ordovician: West-central Vermont.

Original reference: Arthur Keith, 1932, Washington Acad. Sci. Jour., v. 22, p. 360, 368–369.

Phillip Fowler, 1950, Vermont Geol. Survey Bull. 2, p. 34. Keith (1932) named Hortonville slate from town off Hortonville, where it overlies Trenton "Hyde Manor limestone" (Orwell and Glens Falls).

Named for exposures at summer resort, called Hyde Manor, south of Sudbury, Brandon quadrangle.

Hyder Quartz Monzonite[1]

Jurassic or Cretaceous: Southeastern Alaska.

Original reference: A. F. Buddington, 1929, U.S. Geol. Survey Bull. 807, p. 29–39, 58–59, maps.

F. M. Byers, Jr., and C. L. Sainsbury, 1956, U.S. Geol. Survey Bull. 1024–F, p. 126, pl. 13. Mentioned in report on tungsten deposits of Hyder region. Hyder quartz monzonite and Boundary granodiorite are included in younger Coast Range intrusives.

Named for exposures at Hyder.

Hye Granite

Precambrian: Central Texas.

V. E. Barnes, R. F. Dawson, and G. A. Parkinson, 1947, Texas Univ. Bur. Econ. Geology Pub. 4246, p. 49, 50 (fig. 3). Mapped as Hye granite. Crops out as mass of weathered boulders and is part of old monadnock of

Precambrian peneplain which is surrounded by Cambrian sediments up to base of Wilberns formation.

Outcrops in area along Pedernales River at Blanco-Gillespie County line, about 22 miles from Fredericksburg.

Hygiene Sandstone Member (of Pierre Shale)[1]

Upper Cretaceous: Central northern Colorado.

Original reference: N. M. Fenneman, 1905, U.S. Geol. Survey Bull. 265.

G. R. Scott and W. A. Cobban, 1959, Rocky Mountain Assoc. Geologists 11th Ann. Field Conf. Symposium, p. 124–126, 129 (fig. 3). About 6 miles north of Boulder, consists of basal 240-foot thick light-olive- to yellowish-gray thin-bedded friable sandstone with large light-gray silty limestone concretions in upper part; a medial 38-foot dark-gray clayey shale with orange-brown iron-stained limestone concretions; and an upper 126-foot-thick ridge-forming dusky-yellow thick-bedded friable medium-grained sandstone. Three miles north of Kassler, member is 1,420 feet above base of Pierre, is 600 feet thick and consists of dusky-yellow soft shaly sandstone that contains, in lower part and at top, masses as much as 12 feet in diameter of gray rough hard crystalline limestone; beds of orange-brown ironstone present in upper half. Separated from younger Terry member by as much as 387 feet of olive-gray sandy shale. Marine invertebrate megafossils.

Typically developed in ridge which passes within 1½ miles of village of Hygiene, Boulder County.

Hyndman Formation[1]

Precambrian(?): Central Idaho.

Original reference: L. G. Westgate and C. P. Ross, 1930, U.S. Geol. Survey Bull. 814, p. 10–17.

C. P. Ross and J. D. Forrester, 1947, Geologic map of the State of Idaho (1:500,000): U.S. Geol. Survey. Precambrian(?)

C. P. Ross and J. D. Forrester, 1958, Idaho Bur. Mines and Geology Bull. 15, p. 3. Precambrian(?) rocks in Pioneer Mountains include Hyndman formation, about 6,600 feet thick, and East Fork formation, about 1,560 feet thick. Hyndman consists mainly of quartzite but includes green hornfels in upper part and schist member in lower part.

Well exposed in Hyndman Peak and in cirques at its southern base, Hailey quadrangle.

Hyrum Dolomite Member (of Jefferson Formation)

Devonian: Northern Utah.

J. S. Williams, 1948, Geol. Soc. America Bull., v. 59, no. 11, p. 1139, 1140. Predominantly black dolomite and limestone; minor amounts of calcareous sandstone. Thickness 840 to 1,200 feet. Underlies Beirdneau sandstone member (new), contact gradational; disconformably overlies Water Canyon formation (new).

Named for exposures in mouth of Blacksmith Fork Canyon, sec. 7, T. 10 N., R. 2 E., east of town of Hyrum, Logan quadrangle.

Iaeger Sandstones (in New River Formation[1] or Group)

Pennsylvanian: Southern West Virginia.

Original reference: R. V. Hennen and R. M. Gawthrop, 1915, West Virginia Geol. Survey Rept. Wyoming and McDowell Counties, p. 186–191.

P. H. Price and E. T. Heck, 1939, West Virginia Geol. Survey [Repts.] Greenbrier County, p. 215, 216, 224–226. Occurrence of Iaeger sandstones and shales discussed in Greenbrier County. Included in New River group, Pottsville series.

Named for occurrence at Iaeger, McDowell County.

Iatan Limestone (in Pedee Group)

Iatan Limestone (in Lansing Group)

Iatan Limestone or Limestone Member (in Douglas Group or Formation)[1]

Pennsylvanian (Missouri Series): Northwestern Missouri, southwestern Iowa, and eastern Kansas.

Original reference: C. R. Keyes, 1899, Am. Geologist, v. 23, p. 306.

H. S. McQueen and F. C. Greene, 1938, Missouri Geol. Survey and Water Resources, 2d ser., v. 25, p. 28. Included in Pedee group in Missouri.

L. W. Wood, 1941, Iowa Geol. Survey, v. 37, p. 294 (table), 295. Iatan and Weston formations included in Lansing group. Term Pedee dropped from Iowa nomenclature.

F. C. Greene and W. V. Searight, 1949, Missouri Geol. Survey and Water Resources Rept. Inv. 11, p. vi (fig. 2), 15. Overlies Weston shale. Youngest known formation of Missouri series in Missouri.

R. C. Moore, 1949, Kansas Geol. Survey Bull. 83, p. 121–122. Conformably overlies Weston shale and disconformably overlain by Stranger formation of Virgil series. Limestone is light bluish gray or nearly white, but parts are mottled brown after prolonged weathering. Thickness less than 5 feet to about 22 feet, maximum is short distance south of Iatan. In Kansas, occurs southward to vicinity of Baldwin, Douglas County. Limestone that has been called Iatan in country farther south is mostly a lower Virgilian unit, the Haskell, but some limestone outcrops may represent true Iatan. Pedee group.

Named for exposures at Iatan, Platte County, Mo.

Iberville Formation[1]

Middle Ordovician: Southern Quebec, Canada, and northwestern Vermont.

Original reference: T. H. Clark, 1934, Geol. Soc. America Bull., v. 45, no. 1, p. 5.

David Hawley, 1957, Geol. Soc. America Bull., v. 68, no. 1, p. 58, 63–68. Noncalcareous shale, rhythmically interbedded with thin quartz-silty dolomite beds; uniform, fine-grained dolomite beds; and in lower part, with calcareous shale. Thickness 1,000 to 2,000 feet. Underlies Hathaway formation (new); overlies Stony Point formation. Derivation of name given.

Named for wide outcrop belt in Iberville County, southern Quebec.

Ibex Limestone

Lower Permian: North-central Texas.

M. G. Cheney, 1948, Abilene Geol. Soc. [Guidebook] Spring Field Trip, June 11–12, p. 5. Proposed to replace preoccupied "Dothan" limestone. Normally 2 to 3 feet thick, between clays of Watts Creek shale. Resistant bed; outcrops characterized by large slabs at various angles.

Typical outcrops occur 500 feet east of northwest corner of Blind Asylum Survey No. 51, one-half mile southeast of Ibex townsite, and also just north and west of Ibex field along Hubbard Creek. Name derived from Ibex oil field in east-central Shackelford County.

Ice Box Shale

Middle Ordovician: Western South Dakota.

M. R. McCoy, 1952, Billings Geol. Soc. Guidebook 3d Ann. Field Conf., p. 45–46. Olive-green shale 30 to 45 feet thick. Conformably underlies Roughlock siltstone (new); conformably overlies Aladdin sandstone (new).

Type section: In secs. 14 and 23, T. 5N., R. 3 E., about one-half mile west of junction of U.S. Highways 14 and 85 [Lawrence County]. Named from Ice Box Gulch.

Ice Springs Craters Flow

Recent: Central Utah.

G. B. Maxey, 1946, Am. Jour. Sci., v. 244, no. 5, p. 328, pl. 1. Basalt flow. Occurred subsequent to disappearance of Lake Bonneville and probably at a time well into Recent. Covers small area on eastern edge of Pavant flow (new), earliest flow in area.

P. E. Dennis, G. B. Maxey, and H. E. Thomas, 1946, Utah State Engineer Tech. Pub. 3, p. 26, pl. 1. Basalt scoria, lapilli, and lava in flows having thickness of 30 feet or more. Maximum thickness 400 feet.

Occurs in Pavant Range, about 8 miles west of Fillmore, Millard County.

Iconium Member (of Wellington Formation)[1]

Permian: Central northern Oklahoma.

Original reference: J. M. Patterson, 1933, Am. Assoc. Petroleum Geologists Bull., v. 17, no. 3, p. 243, 249.

D. A. Green, 1937, Am. Assoc. Petroleum Geologists Bull., v. 21, no. 12, p. 1522 (fig. 2). Permian of Oklahoma divided into three major time divisions (ascending) Wanette, Minco, and Upper Red-Beds. Iconium shale is in Minco division.

Named for town of Iconium, near [S¼ cor. sec. 10,] T. 16 N., R. 1 E., Logan County.

Idaho Group

Idaho Formation[1]

Pliocene and Pleistocene: Western and southern Idaho and southeastern Oregon.

Original reference: E. D. Cope, 1884, Philadelphia Acad. Nat. Sci. Proc. 1883, v. 35, p. 135.

H. E. Wheeler and E. F. Cook, 1954, Jour. Geology, v. 62, p. 528. Discussion of structural and stratigraphic significance of Snake River capture, Idaho-Oregon. On basis of this study it is believed that Idaho formation as restricted by Lindgren (1898, U.S. Geol. Survey Ann. Rept., pt. 3) is essentially valid and that Idaho formation as redefined by Kirkham (1931 Jour. Geology, v. 39, no. 3) is composite and invalid.

C. P. Ross and J. D. Forrester, 1958, Idaho Bur. Mines and Geology Bull. 15, p. 16–17. Rocks shown on Idaho State map (Ross and Forrester, 1947) as Payette and related strata include beds that, although having many resemblances, have considerable range in age. Rocks so grouped have affinities to Payette formation (commonly regarded as Miocene), Latah formation (middle or upper Miocene), and Idaho formation (Pliocene). Early concept that Payette and Idaho formations represent two successive stages of large lake, with division between them at some horizon not definitely fixed, within sedimentary succession above Columbia River basalt (Lindgren, 1898) is so much at variance with facts now known that it must be abandoned. Kirkham (1931) restricted Payette to sedimentary rock that generally occurs interbedded with Columbia River basalt, commonly 600 feet below top of basalt unit—a suggestion that has much to commend it in areas in which he worked. In a general way, term Idaho formation is applied to Cenozoic sedimentary rocks in and near western part of Snake River Plain that have broad lithologic and genetic resemblance to Payette but are younger. Strata of Idaho formation as thus limited are, on the average, somewhat finer grained and less firmly consolidated than Payette, but this distinction not sufficient to be readily used in mapping. The unit [Idaho], probably several thousand feet thick, is most extensive of those grouped as Payette and related strata on State map. It is interbedded with Snake River basalt and overlies silicic and older rocks, in many places with appreciable unconformity. Name Idaho formation has not been applied in eastern Idaho although similar rocks exist there. In those places, the tendency has been to assign local names to strata of Idaho affinities, as for example, name Hagerman lake beds.

E. M. Baldwin, 1959, Geology of Oregon: Ann Arbor, Mich., Edwards Brothers, Inc., p. 108. Thick series of continental sediments that crop out along eastern margin of [Owyhee] reservoir have been referred to as Idaho formation in accordance with usage proposed by Kirkham (1931) in which he restricted Payette formation to pre-Owyhee basalt sediments and included remaining post-basalt Tertiary sediments in Idaho formation. Idaho formation as originally used by Cope referred to beds that are probably younger in age and somewhat different in lithology. Evidence indicates that several stratigraphic units are present in post-Owyhee continental sediments and term Idaho formation is not applicable. It is used here in broader sense as Idaho group.

Name was applied to sediments deposited in Lake Idaho.

Idaho Springs Formation[1]

Precambrian (Gunnison River Series) : Central northern Colorado.

Original reference: S. H. Ball, 1906, Am. Jour. Sci., 4th, v. 21, p. 374.

T. S. Lovering and E. N. Goddard, 1950, U.S. Geol. Survey Prof. Paper 223, p. 19–20, pls. Oldest known rocks in Front Range. Consists chiefly of quartz-biotite schists and quartz-biotite-sillimanite schists; quartzite, quartz schists, or quartz gneisses are common in some localities. Full thickness unknown; estimated thickness about 20,000 feet. Underlies Swandyke hornblende gneiss.

Richard Van Horn, 1957, U.S. Geol. Survey Geol. Quad. Map GQ–103. Described in Golden quadrangle where it is principally gneiss and schist; some quartzite; hornblende gneiss; and garnet gneiss. Intruded by pegmatite and biotite syenite dikes. Underlies Fountain formation, angular unconformity.

Typically exposed in hills surrounding Idaho Springs, Georgetown quadrangle.

†Idak Basalt

Tertiary and Quaternary: Southwestern Alaska.

F. M. Byers, Jr., and others, 1947, U.S. Geol. Survey Alaskan Volcano Inv. Rept. 2, pt. 3, p. 28, pl. 3. Thickness of about 2,000 feet of basalt flows and subordinate interbedded tuff-breccia. Individual flows from 10 to 100 feet thick. Flow rocks are gray basalt and range in texture from aphanitic to coarsely porphyritic. Lava flows composing peak of Mount Idak are intruded by closely spaced network of dikes comprising 20 to 30 percent of total rock.

F. M. Byers, Jr., 1959, U.S. Geol. Survey Bull. 1028–L, p. 309. Name abandoned. Unit included in Ashishik basalt (redefined).

Exposed on Mount Idak and ridges to the northeast, which are remnants of an ancient volcano, herein named Idak Volcano, on Umnak Island in eastern part of Aleutian Islands.

Idalia Clay[1]

Tertiary: Southeastern Missouri.

Original reference: C. F. Marbut, 1902, Missouri Univ. Studies, v. 1, no. 3, p. 18, 21, 32.

Named for exposures at Idalia, Stoddard County.

Ideal Quarry Member (of Chimneyhill Limestone)

Lower Silurian: South-central Oklahoma.

T. W. Amsden, 1957, Oklahoma Geol. Survey Circ. 44, p. 6 (fig. 2), 7, 9-11, fig. 4. Name introduced to replace Maxwell's (1936) Hawkins limestone which is preoccupied. Maximum thickness 5 feet; commonly 3 feet or less. Member actually represents basal part of the Keel and grades upward into it through transitional beds; upper contact arbitrary, but below this transitional zone the strata have a distinctive lithology and color which warrants their separation from the overlying Keel. Overlies Sylvan formation.

Type section: Ideal quarry of the Ideal Cement Company at Lawrence, sec. 36, T. 3 N., R. 5 E., Pontotoc County.

Idenbro Limestone Member (of Lenapah Limestone)

Pennsylvanian (Des Moines Series): Southeastern Kansas, south-central Iowa, western Missouri, and northeastern Oklahoma.

J. M. Jewett, 1941, Kansas Geol. Survey Bull. 38, pt. 11, p. 339, 340. Light-gray nodular crystalline algal limestone. Thickness about 3 feet. Overlies Perry Farm shale member (new); underlies Memorial shale.

J. M. Jewett, 1945, Kansas Geol. Survey Bull. 58, p. 69–70. Discussed as cyclothem in Lenapah megacyclothem.

L. M. Cline and F. C. Greene, 1950, Missouri Geol. Survey and Water Resources Rept. Inv. 12, p. 25; C. M. Cade 3d, 1953, Tulsa Geol. Soc. Digest, v. 21, p. 134. Idenbro limestone can be traced into Sni Mills limestone member in Jackson County, Mo.; therefore, name Idenbro is suppressed as a synonym of Sni Mills.

Type locality: SW¼ sec. 2, T. 32 S., R. 18 E., Labette County, Kans.

Iditarod Basalt

Lower(?) and Upper Cretaceous: Southwestern Alaska.

W. M. Cady and others, 1955, U.S. Geol. Survey Prof. Paper 268, p. 21 (table), 42, 47–50, pl. 1. Chiefly massive basalt lava flows underlain by comparatively thin but widely distributed basal zone of sedimentary breccia. Similar breccia zones, irregularly distributed, are interbedded with flows. Dense, uniformly fine-grained and massive, dark-colored basalt predominates. Fresh specimens commonly greenish black, though some are blue black and purplish black. Rock weathers brown. Breccia commonly mottled with dark shades against light background; weathers shades of brown and mottling does not show on weathered surface. Breccia composed of rock eroded chiefly from lava flows. Thickness estimated between 2,000 and 3,000 feet. Disconformably overlies Kuskokwim group (new) and possibly intertongues with group. Believed to be of middle or late Late Cretaceous age.

Typically and best exposed in wide tract northeast of Montana Creek in vicinity of DeCourcy Mountain. Forms range of hills southeast of Iditarod River, and named after the river. Range extends northeastward from Russian Mountains for nearly 50 miles.

Idlefornso Formation

See Ildefonso, correct spelling.

Ignacio Quartzite[1]

Upper Cambrian: Southwestern Colorado.

Original reference: W. Cross and A. C. Spencer, 1899, U.S. Geol. Survey Geol. Atlas, Folio 60, p. 8.

Harley Barnes, 1954, Am. Assoc. Petroleum Geologists Bull., v. 38, no. 8, p. 1780–1791. Heretofore Ignacio quartzite in southwestern Colorado has been thought to be Late Cambrian in age, disconformably overlain by Elbert formation of Late Devonian age, and everywhere underlain by eroded older rocks. Recent fieldwork suggests that the quartzite is Devonian in age, that it forms essentially continuous depositional sequence with overlying Elbert formation and Ouray limestone, and that, in Animas River valley, Ignacio has been intruded by granite porphyry of Devonian or younger age.

F. H. T. Rhodes and J. H. Fisher, 1957, Am. Assoc. Petroleum Geologists Bull., v. 41, no. 11, p. 2508–2518. Referred to Late Cambrian or Early Ordovician on basis of occurrence of oboloid brachiopods. This is contrary to recent conclusion of Barnes (1954) but in support of age provisionally assigned by earlier workers. Major unconformity occurs between Ignacio and overlying Elbert of Late Devonian age. Ignacio was deposited on essentially Precambrian terrane. Suggested that rocks underlying Ignacio in Animas Valley are not intrusive into the Ignacio. Thickness about 112 feet. Locally overlies Twilight granite.

Named for development on bench where Ignacio Lake is situated, Silverton quadrangle.

Ignek Formation[1]

Lower and Upper Cretaceous: Northern Alaska.

Original reference: E. D. Leffingwell, 1919, U.S. Geol. Survey Prof. Paper 109, p. 103, 120, map.

R. W. Imlay and J. B. Reeside, Jr., 1954, Geol. Soc. America Bull., v. 65, no. 3, pl. 1 (facing p. 246). Lower and Upper Cretaceous.

Type locality: On south side of Red Hill, in Ignek Valley at west end of Sadlerochit Mountains.

Iisa Beds or Formation

Pliocene: Caroline Islands (Kusaie).

Risaburo Tayama, 1952, Coral reefs in the South Seas: Japan Hydrog. Office Bull., v. 11, p. 70 (table 5) [English translation in library of U.S. Geol. Survey, p. 85]; S. Hanzawa *in* Jacques Avias and others, 1956, Lexique Strat. Internat., v. 6, Océanie, fasc. 2, p. 40. Conglomerate and gravelly agglomerate; resembles conglomerate of East Caroline beds. In contact with lower basalt and East Caroline beds. Some silicified wood and marine mammalian bones.

Kasaie Island.

Ijamsville Phyllite

Lower Paleozoic(?) (Glenarm Series): Western Maryland.

A. I. Jonas and G. W. Stose, 1938, Washington Acad. Sci. Jour., v. 28, no. 8, p. 346. Blue, green, or purple phyllitic slate probably of tuffaceous origin. Part of a volcanic series including green metabasalt, blue meta-andesite, and purplish-red aporphyolite flows. In part, contains flattened amygdaloidal blebs, but in many places close folding and metamorphism have obscured its volcanic character. In places, is infolded with Silver Run limestone (new). Lies to west of Marburg schist (new) and may be in part equivalent to it. Precambrian(?).

A. J. Stose and G. W. Stose, 1946, Maryland Dept. Geology, Mines and Water Resources [Rept. 12] Carroll and Frederick Counties, p. 66, 67, 121–126. In vicinity of Shriver's Mill, phyllite is bordered on southeast by Wissahickon albite-chlorite schist and west and southwest of Taylorsville by Marburg schist. From point near New Windsor westward to Bark Hill, band of phyllite follows north border of Sams Creek metabasalt (new) and Wakefield marble. In region southwest of Union Bridge, phyllite is folded with the metabasalt and [Libertyville] metarhyolite (new). Near Ijamsville and Moravia, the Ijamsville is surrounded by Urbana phyllite. Along western edge of Martic overthrust block, east of Frederick Valley, phyllite forms narrow belt that extends from vicinity of Ladiesburg, at border of Triassic rocks, southwestward to Monocacy River. Sugarloaf Mountain syncline encloses Urbana phyllite and associated quartzites, and Sugarloaf Mountain quartzite. Syncline is overturned to northwest and beds dip southeast.

D. M. Scotford, 1951, Geol. Soc. America Bull., v. 62, no. 1, p. 49. Phyllites of Sugarloaf area, which have been considered volcanic members of Glenarm series (Stose and Stose, 1946), are Harpers phyllite. This conclusion based on structural evidence that local stratigraphic section is reverse of that previously reported and therefore section shows same sequence of beds as known Cambrian section 8 miles to west. Stose and Stose, who considered area to be a syncline, divided phyllite [Harpers] into Ijamsville and Urbana phyllites. Although this division may be valid, it is difficult to map the contacts accurately and both units are considered to be part of the Harpers.

U.S. Geological Survey currently designates the age of the Glenarm Series as Lower Paleozoic(?)

Named from Ijamsville, Frederick County, Md., where it has been quarried.

Ilchester Granite[1]

Precambrian(?): Eastern Maryland.

Original reference: W. H. Hobbs, 1889, Am. Jour. Sci., 3d, v. 38, p. 225–228.

Occurs at Ilchester, Howard County.

Ildefonso Formation

Upper Cretaceous: Puerto Rico.

E. A. Pessagno, Jr., 1960, Geology of the Ponce-Coamo area, Puerto Rico: Puerto Rico Econ. Devel. Adm. and Princeton Univ. Dept. Geology, p. 24–44, geol. map. Consists of volcanic conglomerate, conglomeratic sandstone, tuffaceous siltstone, thin-bedded argillaceous limestone, and massive argillaceous limestone. The massive limestone occurs as lenses throughout formation; the two largest lenses are herein named Santa Ana and Jueyes. Total thickness difficult to calculate because of irregular structural trends imposed by Palmarejo stock and because top of formation is nowhere exposed. Lower part of formation (Santa Ana lens to base) is about 3,000 feet. Intruded by Pasto andesite (new). Formation includes part of Río Jueyes, Guayama, and Sierra de Cayey "series" of Hodge (1920) which could not be recognized in present study. Part of Hodge's Río Descalabrado[s] "series" also assigned to Ildefonso. Disconformably overlies Robles formation; unconformably underlies Jacaguas group; interfingers with Toa Vaca formation (new).

Type area: Barrio San Ildefonso to southeast of Coamo. Crops out largely in Coamo quadrangle but extends into Barranquitas, Orocovis, and Río Descalabrado quadrangles.

Iles Formation (in Mesaverde Group)[1]

Upper Cretaceous: Northwestern Colorado.

Original reference: Named by E. T. Hancock, but publication of report delayed so that name first appeared in U.S. Geol. Survey Press Memo. 16037, Oct. 1, 1923 on map of Hamilton and Seeping Spring Gulch domes and vicinity, Moffat County.

N. W. Bass, J. B. Eby, and M. R. Campbell, 1955, U.S. Geol. Survey Bull. 1027–D, p. 154–157, pl. 19. In lower part of Mesaverde group. Conformable with Mancos shale below and Williams Fork formation above. Lower two-thirds of formation, 1,000 to 1,100 feet, consists of massive ledge-forming beds of light-brown, light-gray, and white sandstone interbedded with gray sandy shale, shale, and, in its upper part, coal beds; upper one-third is shale sequence capped by cliff-forming sandstone, which together are about 600 feet thick. Contains four persistent sandstones: Tow Creek member at base, double ledge-forming sandstone sequence 400 feet or more above base; light-gray sandstone sequence of variable composition associated with upper (no. 3) coal of lower group and situated about 900 to 1,000 feet above base; and Trout Creek limestone member at top.

R. E. Kucera, 1959, Rocky Mountain Assoc. Geologists [Guidebook] 11th Ann. Field Conf., p. 43–44, figs. 3, 4. Described in Yampa district. Thickness 1,350 to 1,580 feet. Includes Tow Creek sandstone member at base, Oak Creek sandstone member (new) 920 feet above base, and Trout Creek sandstone member at top. Overlies Mancos shale; underlies Williams Fork formation.

Forms nearly all of Iles Mountain.

Ilion Shale

Middle Silurian (Lockportian): Central New York.

D. W. Fisher, 1959, New York State Mus. Sci. Service Geol. Survey Map and Chart Ser., no. 1. Consists of about 60 feet of sparsely fossiliferous calcareous gray-black shale with interbedded dolomite layers containing stromatoporoids. Overlies Herkimer sandstone; underlies Vernon shale.

Type section: Starch Factory Creek, 5 miles west-southwest of Ilion, Herkimer County.

Illahe Formation[1]

Oligocene, middle: Northwestern Oregon.

Original reference: T. P. Thayer, 1933, Pan-Am. Geologist, v. 59, no. 4, p. 317.

T. P. Thayer, 1936, Jour. Geology, v. 44, no. 6, p. 703, 704; 1937, Geol. Soc. America Bull., v. 48, no. 11, p. 1614. May be 2,000 to 3,000 feet thick. Middle Oligocene

T. P. Thayer, 1939, Oregon Dept. Geology and Mineral Industries Bull. 15, p. 6–7. Underlies Stayton lavas. Type locality designated. As geological mapping of Willamette Valley progresses, it may be advisable to drop name Illahe as synonym for either Eugene or Pittsburg Bluff formations.

Type locality: Illahe Hill, which crosses range line east of sec. 1, T. 8 S., R. 4 W., about one-half mile east of Willamette River, Marion County.

Illinoian Glaciation

Illinoian Drift,[1] Till

Illinoian Stage, Age

Illinoian stage of glaciation[1]

Pleistocene: Mississippi Valley.

Original reference: T. C. Chamberlain, 1896, Jour. Geology, v. 4, p. 872–876.

M. M. Leighton and H. B. Willman, 1950, Jour. Geology, v. 58, no. 6, p. 602 (fig. 2). Illinoian stage includes (ascending) Payson, Jacksonville, and Buffalo Hart substages.

J. C. Frye and A. B. Leonard, 1952, Kansas Geol. Survey Bull. 99, p. 35, 52 (fig. 2), 110. Illinoian age (stage) is glacial interval next following Yarmouthian. Followed by Sangamonian. Illinoian stage represented in Kansas by Crete and Loveland members of Sanborn formation. Crete and Loveland are classed as formations in Nebraska. In Iowa and Illinois, term Centralian used to include Illinoian and Sangamonian.

H. R. Wanless, 1957, Illinois Geol. Survey Bull. 82, p. 133–139. Illinoian stage subdivided into Loveland, Payson, Jacksonville, and Buffalo Hart substages. Illinoian drift forms principally till plains or ground moraines —the Buffalo Hart, which crosses Beardstown and Vermont quadrangles, and the Jacksonville, which crosses Beardstown quadrangle and is overridden by Buffalo Hart moraines in northeast part of quadrangle.

Name amended to Illinoian Glaciation to comply with Stratigraphic Code adopted 1961.

Named for development in Illinois.

Illipah Formation

Upper Mississippian: Nevada and Utah.

F. W. Christiansen, 1951, Utah Geol. Soc. Guidebook 6, p. 76. Mentioned in summary of structural history of Great Basin province in Utah and eastern Nevada. Referred to as tongues of sandstone and conglomerate that lense eastward into dark-gray marine shales.

H. J. Bissell, 1960, Am. Assoc. Petroleum Geologists Bull., v. 44, no. 8, p. 1427 (fig. 3), 1433 (fig. 9), 1434–1435 (fig. 10). As shown on correlation chart and diagrams, the Illipah underlies Ely, Callville, and Bird Spring formations and overlies Chainman, Rogers Spring, and Monte Cristo formations.

Walter Sadlick, 1960, Intermountain Assoc. Petroleum Geologists Guidebook 11th Ann. Field Conf., p. 81–82, 83 (fig. 1), 84. Discussion of aspects of Chainman formation. The Chainman is recognized as a valid stratigraphic unit. Rather than formally recognize Diamond Peak and Scotty Wash as distinct units, the writer [Sadlick] prefers to refer to these as facies within the Chainman. Term Illipah (Christiansen, 1951) is suppressed as synonomous with Diamond Peak, and term should not be used for limestone sequence in upper part of Chainman.

Grant Steele, 1960, Intermountain Assoc. Petroleum Geologists Guidebook 11th Ann. Field Conf., p. 99. Scotty Wash quartzite of Pioche district and Illipah sandstone of Hamilton district are same lithogenetic units. Scotty Wash quartzite has priority; recommended that name Illipah be abandoned.

Type locality and derivation of name not stated.

Illipah Formation

Eocene: Northeastern Nevada.

T. E. Eakin, 1960, Nevada Dept. Conserv. Nat. Resources Rept. 1, p. 26. Fresh-water limestone, conglomerate, and interbedded tuff. Thickness 1,500 feet or more. Unconformably underlies Lake Newark formation (new); unconformably overlies Newark Canyon formation. Name credited to F. L. Humphrey (in press).

F. L. Humphrey, 1960, Nevada Bur. Mines Bull. 57, p. 41–42, pl. 1. Formal proposal of name. Includes two members; lower consists of limestone and chert conglomerate, calcareous sandstone, and vuggy limestone which resembles tufa; and upper member contains well-bedded marl and fresh-water limestone with interbedded altered tuffs near middle. Total thickness, measured from partial sections, more than 1,500 feet. Unconformably underlies Lake Newark formation; overlies unnamed conglomerate and sandstone.

Named for exposures on Illipah Creek in northern part of White Pine mining district, White Pine County.

Ilmon Basalt

Miocene, lower(?); Southern California.

T. W. Dibblee, Jr., and C. W. Chesterman, 1953, California Div. Mines Bull. 168, p. 12 (fig. 2), 37–38, pls. 1, 2, 3. Dark-brown basic andesite lava. Thickness ranges from less than 1 inch to 100 feet. Conformably overlies Walker formation in Caliente Canyon. Underlies Bena gravels and sandstone (new). About 3 miles northwest of Bena, where lava is about 15 feet thick, it separates Walker formation below from Freeman-Jewett shale above.

Lava is traceable through series of isolated outcrops from point 2 miles west of Ilmon Station northwestward for about 3 miles to west border of map [Breckenridge Mountain quadrangle, Kern County].

†Ilo Formation[1]

Upper Cretaceous: Northwestern Wyoming.

Original reference: D. F. Hewett, 1914, U.S. Geol. Survey Bull. 541, p. 91, 103.

H. E. Summerford and others, 1947, *in* Wyoming Geol. Assoc. Guidebook 2d Ann. Field Conf., p. 19. Road log of Bighorn basin mentions Ilo Ridge member of Lance formation on east flank of Grass Creek anticline. Basal unit of formation; overlies Meeteetse formation.

Well exposed in open valley, in Park County, northwest of Ilo, settlement 50 miles southeast of Cody, hence the name.

Ilo Ridge Member (of Lance Formation)

See Ilo Formation.

Imperial Formation[1]

Miocene, lower : Southern California.

Original reference: G. D. Hanna, 1926, California Acad. Sci. Proc., 4th ser., v. 14, no. 18, p. 434–435.

L. A. Tarbet and W. H. Holman, 1944, (abs.) Am. Assoc. Petroleum Geologists Bull., v. 28, no. 12, p. 1782. Marine mudstone, siltstones, and sandstones unconformably overlying all older rocks. Thickness 0 to 3,600 feet. Overlies Alverson Canyon formation (new) ; underlies Palm Spring formation. Upper Miocene.

A. M. Keen and Herdis Bentson, 1944, Geol. Soc. America Spec. Paper 56, p. 21 (fig. 4), 22. Age in doubt. Latest evidence, unpublished, seems to suggest that Pliocene assignment of early workers is preferable to Miocene allocation adopted by some authors. Includes Latrania sand member.

J. W. Durham, 1950, Geol. Soc. America Mem. 43, pt. 2, p. 30–33. Believed that San Marcos and Imperial formations are best assigned to lower Pliocene.

T. W. Dibblee, Jr., 1954, California Div. Mines Bull. 170, chap. 2, p. 22, 23. Formation is series of marine clays and sandstones that lie with essential concordance on Alverson andesite or lava (new), Split Mountain formation, and Fish Creek gypsum (new), or in some areas, unconformably on basement rocks. Grades upward into Palm Spring formation. Canebrake conglomerate (new) is coarse marginal conglomerate facies of Imperial and Palm Spring formations. Fauna indicates upper Miocene or possibly lower Pliocene.

C. R. Allen, 1954, California Div. Mines Bull. 170, map sheet 20; 1957, Geol. Soc. America Bull., v. 68, no. 3, p. 327–328. In San Gorgonio Pass area, formation is about 300 feet thick; conformably overlies Hathaway formation (restricted and redefined) and conformably underlies Painted Hill formation (new). Considered to be early Pliocene(?).

Type locality: Coral reef exposed in Alverson Canyon on south side of Coyote Mountain [also called Carrizo Mountain], Imperial County.

Incarnacion Fire Clay[1]

Pennsylvanian : Central northern New Mexico.

Original reference : C. L. Herrick, 1904, Jour. Geology, v. 12, p. 242.

Occurs near Socorro, Socorro County. Named for mining district in which it occurs.

Incarnacion Granite[1]

Age(?) : Central New Mexico.

Original reference : C. L. Herrick, 1904, Jour. Geology, v. 12, p. 237–251.

Named for mining district in which it occurs.

Indart Sandstone

Eocene : West-central California.

N. L. Taliaferro, 1945, Geologic map of the Hollister quadrangle, California (1:62,500) : California Div. Mines Bull. 143, pls. 1, 2 [preprint?]. Shown on map legend as underlying Los Muertos Creek shales and unconformably overlying Cretaceous sandstones, shales, and conglomerates.

Present west of Tres Pinos fault, in southeastern part of quadrangle. Locality is west of Indart Ranch.

†Independence Limestone[1]

Pennsylvanian : Southeastern Kansas.

Original reference: E. Haworth and W. H. H. Piatt, 1894, Kansas Univ. Quart., v. 2, p. 115–117.

Named for Independence, Montgomery County.

Independence Shale

Independence Shale Member (of Wapsipinicon Limestone)[1]

Middle Devonian : Central eastern Iowa.

Original reference: S. Calvin, 1878, Am. Jour. Sci., 3d, v. 15, p. 460–462.

G. A. Cooper and A. S. Warthin *in* G. A. Cooper and others, 1942, Geol. Soc. America Bull., v. 53, no. 12, pt. 1, p. 1737 (fig. 1), 1766–1767, chart 4. Position and age of Independence shale have been subjects of debate for many years. One group holds that the Independence normally underlies the Cedar Valley and the other that the shale is not in its true stratigraphic position. Stainbrook (1935) maintains that the shale underlies the Cedar Valley conformably but overlies Davenport limestone of the Wapsipinicon unconformably and cites as supporting evidence the sinking of an artesian well at Shellsburg which showed Independence shale carrying typical fossils below 65 feet of Cedar Valley limestone. Writers hold that the Independence is not in normal position because (1) it fills sinks and caverns; (2) its occurrence is spotty, there being no definite outcrop belt; and (3) its fauna is that of the Nunda or High Point (Chemung) sandstone and the Frasnian (F) of Belgium.

M. A. Stainbrook, 1945, Am. Jour. Sci., v. 243, no. 1, p. 66–83; no. 2, p. 138–158. Discussion of age and stratigraphic position of Independence shale and summary of all available evidences noted in natural and artificial exposures and secured from deep and shallow well records. All evidence indicates that, normally, Independence lies immediately below Cedar Valley limestone and above Wapsipinicon formation. Fauna is definitely lower Upper Devonian.

Named for occurrence at Independence, Buchanan County.

Index Granodiorite[1]

Jurassic(?) : Central Washington.

Original reference: C. E. Weaver, 1912, Washington Geol. Survey Bull. 7, p. 34–50.

C. E. Weaver, 1937, Washington [State] Univ. Pubs. in Geology, v. 4, p. 19. Intrudes Gunns Peak formation.

Typically exposed near Index, Snohomish County.

Indian Conglomerate[1]

Eocene(?) : Southern California.

Original reference: R. N. Nelson, 1925, California Univ. Pub., Dept. Geol. Sci. Bull., v. 15, no. 10, p. 344, 350–352, pl. 46, map.

Well developed in and named for Indian Canyon, Santa Barbara County.

Indiana glaciation

Indiana till[1]

Pleistocene (pre-Nebraskan) : Illinois and Indiana.

Original reference: C. R. Keyes, 1932, Pan-Am. Geologist, v. 58, p. 203,217.

C. R. Keyes, 1938, Pan-Am. Geologist, v. 68, no. 2, p. 129. Referred to as glaciation.

Indianan till[1]

Pleistocene: Indiana

Original reference: C. R. Keyes, 1926, Pan-Am. Geologist, v. 45, p. 151.

Indian Bluff Group

Pennsylvanian (Pottsville Series): Eastern Tennessee.

C. W. Wilson, Jr., J. W. Jewell, and E. T. Luther, 1956, Pennsylvanian geology of the Cumberland Plateau: Tennessee Div. Geology [folio], p. 1, 6, pls. 2, 3, 4. Includes strata between top of Slatestone group (new) and base of Graves Gap group (new). Thickness at type section 455 feet; in southwestern part of Cumberland Mountains 300 to 470 feet; thins northwestward; on Cumberland Block, 150 to 200 feet. Includes (ascending) shale interval, Seeber Flats sandstone (new), shale interval, Stockstill sandstone (new), shale interval, Indian Fork sandstone (new), shale interval, and Pioneer sandstone. Indian Fork sandstone not present at type locality.

Type section: Cross Mountain, Lake City quadrangle. Named from Indian Bluff on eastern edge of Braden Flats, a short distance northeast of Graves Gap, Anderson County. Section begins at top of Jellico coal on Militia Hill and ends on top of Pioneer sandstone upon which Mountain View Church is located.

Indian Cave Channel Sandstone Bed (in Towle Shale Member of Onaga Shale)

Indian Cave Sandstone[1]

Indian Cave Sandstone Member (of Towle Shale)

Permian: Southeastern Nebraska and eastern Kansas.

Original reference: R. C. Moore, 1936, Kansas Geol. Survey Bull. 22, p. 50 (fig. 12), 201.

G. E. Condra and E. C. Reed, 1943, Nebraska Geol. Survey Bull. 14, p. 37. Gives areal distribution and derivation of name.

R. C. Moore and others, 1951, Kansas Geol. Survey Bull. 89, p. 52. Member of Towle shale. Consists of sandstone, siltstone, and locally conglomerate in part; occurs as local channel fillings that grade upward into basal part of the unnamed upper member of the Towle. Reported maximum thickness about 200 feet. Type locality in Nebraska. Wolfcamp series.

R. C. Moore and M. R. Mudge, 1956, Am. Assoc. Petroleum Geologists Bull., v. 40, no. 9, p. 2273, 2274 (fig. 1). Rank reduced to bed in Towle shale member of Onaga shale.

Occurs at Peru, in southeastern Nemaha County (at Indian Cave), and near Falls City, Richardson County, Nebr., and at places in Kansas.

Indian Creek Bed (in Strawn Formation)[1]

Pennsylvanian: Central Texas.

Original reference: N. F. Drake, 1893, Texas Geol. Survey 4th Ann. Rept., pt. 1, p. 374, 386.

D. A. Zimmerman and G. D. Glover, 1956, Soc. Econ. Paleontologists and Mineralogists Permian Basin Sec. [Guidebook] Spring Mtg., p. 74. Shaly sandy clay. Overlies Antelope Creek bed or, where that is absent, Comanche Creek bed; underlies Ricker bed. Strawn series.

D. H. Eargle, 1960, U.S. Geol. Survey Prof. Paper 315–D, p. 58, pl. 27. Drake (1893) separated rocks of Strawn group [division] into 20 units of alternating sandstone and shale beds. He gave local names to these units, or "beds" as he termed them, and numbered them from bottom to top, 4 to 23. Only Drake's name for upper unit, the Ricker, is in conmmon use today, and that name has been restricted to base of Drake's Ricker bed.

Named for Indian Creek, Brown County.

Indian Creek Granite

Precambrian : Central Colorado.

M. F. Boos and E. J. Aberdeen, 1936, (abs.) Geol. Soc. America Proc. 1935, p. 67; 1940, Geol. Soc. America Bull., v. 51, no. 5, p. 699, 728, pl. 1. Name applied to granite in Indian Creek pluton. In field relationships, physical appearance, and crystalline character, closely related to granite of Silver Plume batholith.

Named for Indian Creek Park. Crops out as a group of plutons which make four belts of subparallel, slightly en echelon, granite bodies concentrically aligned along north and east margins of Rosalie lobe of Pikes Peak batholith.

Indian Creek Shale Member (of Admiral Formation)[1]

Permian : Central Texas.

Original reference: N. F. Drake, 1893, Texas Geol. Survey 4th Ann. Rept., pt. 1, p. 421, 423.

R. C. Moore *in* A. K. Miller and Walter Youngquist, 1947, Kansas Univ. Paleont. Contr. 2, Mollusca, art. 1, p. 1, 2; R. C. Moore, 1949, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 80, sheet 2. Renamed Wildcat Creek shale. Name Indian Creek preoccupied by Indian Creek of Pennsylvanian age.

Named for Indian Creek, Coleman County.

Indian Fields Formation[1]

Silurian : East-central Kentucky.

Original references: A. F. Foerste, 1905, Kentucky Geol. Survey Bull. 6, p. 145; 1906, Kentucky Geol. Survey Bull. 7, p. 10, 60.

Named for Indian Fields, Clark County.

Indian Fork Member (of Wells Formation)

Permian (Wolfcampian) : Idaho.

H. J. Bissell, 1960, Am. Assoc. Petroleum Geologists Bull., v. 44, no. 8, p. 1427 (chart). Name appears on correlation chart accompanying preliminary statement on eastern Great Basin Permo-Pennsylvanian strata. Overlies Sublett member (new) ; underlies unnamed cherty orthoquartzite member.

Present in Sublett Mountain area.

Indian Fork Sandstone (in Indian Bluff Group)

Pennsylvanian (Pottsville Series) : Eastern Tennessee.

C. W. Wilson, Jr., J. W. Jewell, and E. T. Luther, 1956, Pennsylvanian geology of the Cumberland Plateau: Tennessee Div. Geology [folio], p. 6, 19, pls. 2, 3, 4. Thickness 15 to 60 feet. Separated from overlying Pioneer sandstone by shale interval that is as much as 80 feet thick in places; separated from underlying Stockstill sandstone (new) by a shale interval that averages 40 to 60 feet in thickness.

Named from exposures along incline on north side of Indian Fork, Fork Mountain quadrangle, Anderson County.

Indian Fort Shale Member (of Brodhead Formation)

Lower Mississippian: Central Kentucky.

P. B. Stockdale, 1939, Geol. Soc. America Spec. Paper 22, p. 76, 170, 174, 188, pl. 15. Uppermost member of Brodhead formation (new) in area of Irvine facies (new). Typically silty to argillaceous shale, olive-gray with distinct maroon to purple patches. Thickness 30 to 45 feet. In type area, underlies Floyds Knob formation and overlies Combs Mountain siltstone member (new) of Brodhead formation. Extends beyond area of Irvine facies across the southwestern third of the area of the Morehead facies (new), as far as Rowan County. In area of Morehead facies, Indian Fort overlies Haldeman siltstone member (new). In this area the Indian Fort member together with Rothwell shale member (new) of Muldraugh formation (new) and intervening Floyds Knob horizon constitute "Morris Mountain shaly member" (Butts, 1922) which name should be discarded as a single stratigraphic unit.

Type section: Along secondary road up steep hill to old Indian Fort; base of section at juncture with State Highway 21, 1¼ miles east of road intersection at Big Hill, 3½ miles east-southeast of Berea, Madison County. Named for old Indian Fort located on cliff 3½ miles southeast of Berea.

Indian Gap Limestone (in Kanawha Formation)[1]

Pennsylvanian: Southern West Virginia.

Original reference: C. E. Krebs and D. D. Teets, Jr., 1916, West Virginia Geol. Survey Rept. Raleigh and western parts of Mercer and Summers Counties, p. 52, 108, 326, 340.

Occurs at Indian Gap, Raleigh County.

Indian Gulch[1] (Formation)

Mesozoic: East-central California.

Original reference: N. L. Taliaferro, 1933, Geol. Soc. America Bull., v. 44, no. 1, p. 149.

Occurs on Merced River and southward into Indian Gulch quadrangle.

Indian Hill Series[1]

Upper Cretaceous: Southeastern Massachusetts.

Original reference: N. S. Shaler, 1888, U.S. Geol. Survey 7th Ann. Rept., p. 340, pl. 20, map.

Probably named for Indian Hill on Marthas Vineyard.

Indian Hills Volcanics (in Alder Group)

Precambrian (Yavapai Series): Central Arizona.

C. A. Anderson and S. C. Creasey, 1958, U.S. Geol. Survey Prof. Paper 308, p. 20–21, pl. 1. Divided into two interbedded (lithologic and not stratigraphic) units: one andesitic and basaltic, the other rhyolitic. Andesitic and basaltic flows greenish black. Rocks porphyritic with holocrystalline, but commonly aphanitic, groundmass. Amygdules, composed of members of epidote group, and vesicles abundant. Rhyolitic flows inconspicuously porphyritic. Groundmass aphanitic; in places appears siliceous. Thickness not known because base of formation does not crop out. Outcrops in hills west of Coyote Spring ranch reveal maximum width of 6,500 feet. Conformably underlies Spud Mountain volcanics (new). Younger than Texas Gulch formation (new).

Named from exposures in low hills of this name along western front of Black Hills, Jerome area, Yavapai County. Only other major outcrops are 2 miles to north in low hills west of Coyote Spring Ranch.

Indian Hollow Sands[1]

Pleistocene: Northwestern Pennsylvania.

Original reference: E. H. Williams, Jr., 1920, Am. Philos. Proc., v. 59, p. 62, 73.

Named for Indian Hollow, Warren County.

Indian Ladder Formation

Indian Ladder Beds[1]

Upper Ordovician: Eastern New York.

Original reference: J. M. Clarke, April 15, 1911, New York State Mus. Bull. 149, p. 10–12.

Theodore Arnow, 1949, New York State Water Power and Control Comm. Bull. GW-20, p. 9 (table 1), 11 (fig. 3), 13, pl. 2. Formation described in Albany County where it consists of dark-gray to black argillaceous shales, which alternate with thin, yellow, rusty-looking calcareous sandstone beds; occasional heavy sandstone bed present. Thickness about 400 feet. Underlies Brayman shale; overlies Schenectady formation.

Named for exposures at Indian Ladder, near Meadowvale, Albany County.

Indian Meadows Formation

Eocene, lower: Northwestern Wyoming.

J. D. Love, 1939, Geol. Soc. America Spec. Paper 20, p. 10, 11 (fig. 2), 58–63, pl. 17. Proposed for lower Lower Eocene strata unconformably overlying rocks ranging from Precambrian to Upper Cretaceous, and unconformably underlying Wind River and other younger rocks. Chiefly variegated clays, sandstones, and coarse and fine conglomerates; a few algal ball limestones and small amounts of volcanic material. Thickness about 1,000 feet.

Type section: Eastern side North Fork River valley, in secs. 14, 15, and 16, T. 6 N., R. 6 W., in Wind River basin, 6 miles from front of Washakie Range. Name derived from Indian Meadows, a bottom-land area along North Fork River, about 1½ miles north of Circle Ranch, southwestern corner Kirwin quadrangle.

Indian Mills Sandstone (in Bluefield Formation)[1]

Mississippian: Southeastern West Virginia and southwestern Virginia.

Original reference: D. B. Reger, 1926, West Virginia Geol. Survey Mercer, Monroe, and Summers Counties, p. 300, 400.

Type locality: On north side of Indian Creek just west of Indian Mills, Summers County, W. Va.

Indian Mills Shale (in Bluefield Formation)[1]

Mississippian: Southeastern West Virginia.

Original reference: D. B. Reger, 1926, West Virginia Geol. Survey Rept. Mercer, Monroe, and Summers Counties, p. 300, 401.

Type locality: On north side of Indian Creek just west of Indian Mills, Summers County.

Indian Mountain Leucogranodiorite

Cretaceous: Southern California.

E. S. Larsen, Jr., 1948, Geol. Soc. America Mem. 29, p. 85–87, pl. 1. Nearly white in color, rather fine grained, and contains very little biotite. Upper part of mass shows faint streaking due to orientation of dark minerals, and this becomes more prominent as lower contact is approached. For some feet above base, the rock is well-banded micaceous gneiss with much more mica than usual. In contact with and intrudes Bonsall tonalite.

Named from exposures on Indian Mountain, northern part of San Luis Rey quadrangle.

Indianola Group

Upper Cretaceous: Central Utah.

S. L. Schoff, 1938, Ohio State Univ. Abs. Doctors Dissert. 25, p. 378. Series of conglomerates, sandstones, shales, and minor limestones. Thickness 9,350 to 14,680 feet. In Gunnison Plateau, overlies Arapien shale (new); underlies Price River formation. Name credited to E. M. Spieker.

E. M. Spieker, 1946, U.S. Geol. Survey Prof. Paper 205–D, p. 122, 126–130. In Thistle, Sixmile, and Salina Canyon areas, the unit, truncated by Price River and younger formations, is subdivided into four formations (ascending): Sanpete, Allen Valley shale, Funk Valley, and Sixmile Canyon (all new); in other areas undifferentiated. Overlies the Morrison(?) formation. Type area designated.

S. L. Schoff, 1951, Geol. Soc. America Bull., v. 62, no. 6, p. 622, 624–627. In Cedar Hills, undifferentiated Indianola is about 14,680 feet thick. Unconformably overlain by fluviatile and lacustrine deposits ranging from Montana to Eocene in age (Price River, North Horn, Flagstaff, Colton, and Green River formations).

Type area: Indianola district [Sanpete and Utah Counties], Wasatch Plateau.

Indian River Hornblende Syenite

Precambrian: Northeastern New York.

A. F. Buddington, 1939, Geol. Soc. America Mem. 7, p. 85, 285, 286. Mentioned in discussion of Adirondack igneous rocks. Hornblende syenite near village of Indian River is described under heading of Diana quartz syenite complex.

Village of Indian River is in Lowville quadrangle, Lewis County.

Indian River Slate[1]

Indian River Formation

Middle Ordovician: Eastern New York and southwestern Vermont.

Original reference: A. Keith, 1932, Washington Acad. Sci. Jour., v. 22, p. 360, 403.

George Theokritoff, 1959, New England Intercollegiate Geol. Conf. Guidebook 51st Ann. Mtg., p. 53, 56. Referred to as Indian River formation. Overlies Poultney formation; underlies unnamed Normanskill greywackes and black slates.

Named for Indian River, a few miles south of Granville, Washington County, N.Y.

Indian Spring Redbeds
Indian Spring Sandstone } (in Tonoloway Limestone)[1]

Upper Silurian: Northern Maryland.

Original reference: C. K. Swartz, 1923, Maryland Geol. Survey Silurian vol., p. 46–49.

H. P. Woodward, 1941, West Virginia Geol. Survey [Repts.], v. 14, p. 213. Indian Springs sandstone and associated Indian Springs red beds apparently represent extensions of the red Bloomsburg facies into the Tonoloway.

Named for occurrence at Indian Spring, Washington County.

Indian Springs Member (of Bird Spring Formation)[1]

Upper Mississippian: Southeastern Nevada.

Original reference: C. R. Longwell and C. O. Dunbar, 1936, Am. Assoc. Petroleum Geologists Bull., v. 20, no. 9, p. 1200–1207.

J. C. Hazzard, 1951, (abs.) Geol. Soc. America Bull., v. 62, no. 12, pt. 2, p. 1503. Incidental mention in discussion of revision of Devonian and Carboniferous sections, Nopah Range, Inyo County, Calif.

Described in vicinity of Indian Springs, 50 miles northwest of Las Vegas.

Indian Springs Shale[1]

Mississippian (Chesterian): Southwestern Indiana.

Original reference: C. A. Malott and J. D. Thompson, Jr., 1920, Science, new ser., v. 51, p. 521–522.

D. J. McGregor, T. G. Perry, and W. J. Wayne, 1957, Indiana Geol. Survey Field Conf. Guidebook 9, pl. 3. On chart showing evolution of nomenclature in Chester series of Indiana, unit termed Indian Springs shale is apparently included in Golconda formation.

Probably named for Indian Springs, Martin County.

†Indian Territory division[1]

Lower Cretaceous: Oklahoma.

Original reference: R. T. Hill, 1891, Geol. Soc. America Bull., v. 2, p. 504.

†Indio Formation[1]

Miocene, middle or upper: Southern California.

Original reference: J. P. Buwalda and W. L. Stanton, 1930, Science, new ser., v. 71, p. 101–106.

C. R. Allen, 1954, California Div. Mines Bull. 170, map sheet 20; 1957, Geol. Soc. America Bull., v. 68, no. 3, p. 328. Preoccupied name Indio replaced by Painted Hill formation (new). Bramkamp (1934, unpub. thesis) termed this unit [Painted Hill] Indio formation because its stratigraphic position is similar to that of Indio formation in Indio Hills (Buwalda and Stanton, 1930). Dibblee (1954) included in Palm Spring formation those beds of Indio Hills that are immediately post-Imperial in age. No assurance that post-Imperial rocks at Painted Hill and those in Indio Hills are actually parts of same formational unit.

Type section: Along northeast-southwest line through Indio Hills, about 2 miles northwest of Thousand Palm Canyon, Riverside County.

Indio Formation (in Wilcox Group)[1]

Eocene, lower: Southern Texas.

Original reference: A. C. Trowbridge, 1923, U.S. Geol. Survey Prof. Paper 131–D.

C. C. Mason, 1960, Texas Board Water Engineers Bull. 6003, p. 15–25. Composed predominantly of thin-bedded to laminated clayey sand and sandy shale, but includes some thick layers of sandstone, discontinous beds of lignite, and numerous calcareous, arenaceous, and ferruginous concretions. Thickness 0 to about 1,520 feet in Dimmit County. Lies unconformably on and overlaps Kincaid formation. Underlies Carrizo sand. Wilcox group. Type locality stated.

Type locality: On old Indio Ranch in Maverick and Dimmit Counties. Crops out in belt extending northward from Rio Grande through western Dimmit and western Maverick Counties.

Ingalls Formation

Oligocene(?) : Northeastern California.

Cordell Durrell, 1959, California Univ. Pubs. in Geol. Sci., v. 34, no. 3, p. 165 (fig. 1), 167–170. Pyroxene and hornblende andesite mudflow breccia; local thin volcanic conglomerate at base; black-weathering craggy outcrops. Thickness along Red Clover Creek about 550 feet; in west-central part of quadrangle, maximum thickness appears to be about 800 feet, but section may be partly duplicated by faulting. Separated from underlying Eocene Lovejoy formation and overlying middle Miocene(?) Delleker formation by unconformities, both intervals marked by extensive faulting and erosion. In Red Clover Creek area, the Ingalls is on Lovejoy at all points where base is exposed; in east-central part of quadrangle, rests in many places on granitic and metamorphic rocks; in west-central part, lies on basement of metamorphic rocks but also overlaps edge of channels of unit here referred to as auriferous gravel, and in several instances it rests on metamorphic rocks on one side of a fault and on auriferous gravels on the other. No area can be designated as type because of variability of composition and thickness from one part of quadrangle to another.

Named for Mount Ingalls in northern part of Blairsden quadrangle. Well exposed along Red Clover Creek.

Ingalls Peridotite

Pre-Tertiary: Northwestern Washington.

R. C. Ellis, 1959, Dissert. Abs., v. 20, no. 3, p. 990. Rocks of Mount Stuart block exposed along east margin of mapped area consist of Hawkins greenstone, Ingalls peridotite (largely sepentinized), and Mount Stuart granodiorite.

Report discusses geology of Dutch Miller Gap area.

Inglefield Sandstone[1]

Upper Pennsylvanian: Southwestern Indiana.

Original reference: M. L. Fuller and G. H. Ashley, 1902, U.S. Geol. Survey Geol. Atlas, Folio 84.

H. R. Wanless, 1939, Geol. Soc. America Spec. Paper 17, p. 87. Massive sandstone between Wabash above and Ditney formations; later erroneously correlated with Merom sandstone.

C. A. Malott, 1947, Indiana Acad. Sci. Proc., v. 57, p. 131. Part of Fuller's Inglefield formation (as mapped in Ditney and Patoka folios) is included in Dicksburg Hills sandstone.

R. C. Moore and others, 1944, Geol. Soc. America Bull., v. 55, no. 6, chart 6 (column 25). Shown on correlation chart as overlying Ditney formation and separated from overlying Parker limestone by Parker coal.

Named for Inglefield, Vanderburgh County.

†Ingles Conglomerate Member[1] (of Price Formation)

Silurian: Southwestern Virginia.

Original reference: M. R. Campbell, 1925, Virginia Geol. Survey Bull. 25.

Exposed on Ingles Mountain, back of Radford, Montgomery County.

Ingleside Chert Member (of Franciscan Formation)

Ingleside Chert (in Franciscan Group)[1]

Jurassic and Cretaceous: Northern California.

Original reference: A. C. Lawson, 1914, U.S. Geol. Survey Geol. Atlas, Folio 193.

U.S. Geological Survey currently classifies the Ingleside Chert as a member of the Franciscan Formation on the basis of a study now in progress.

Named for exposures in San Miguel Hills, east of Ingleside, San Francisco County.

Ingleside Formation[1]

Lower Permian: Central northern Colorado.

Original reference: R. M. Butters, 1913, Colorado Geol. Survey Bull. 5, p. 68, 75.

C. S. Lavington and W. O. Thompson, 1948, Colorado School Mines Quart., v. 43, no. 2, p. 38–40. Overlies and interstratifies with Fountain formation; underlies Lyons sandstone. Considered southward tongue of Casper formation of Wyoming.

T. S. Lovering and E. N. Goddard, 1950, U.S. Geol. Survey Prof. Paper 223, p. 34. Increases in thickness from featheredge near Boulder to about 250 feet near Wyoming-Colorado line. At type locality, near Fort Collins, formation consists of three beds of limestone separated by layers of crossbedded red sandstone. Rests with slight unconformity on Fountain formation; conformably underlies Satanka shale north of Ingleside, but to south unconformably underlies Permian Lyons sandstone.

E. K. Maughan and R. F. Wilson, 1960, *in* Guide to the geology of Colorado: Denver, Rocky Mountain Assoc. Geologists, p. 35–37, 41. Ingleside formation, part of Casper formation equivalent to Ingleside, and part of Fountain formation equivalent to Ingleside are of early Permian age.

Typically developed at Ingleside quarries and at Owl Canyon, 3 miles north of Ingleside, Larimer County.

Ingleside Formation

Recent: Southern Texas.

W. A. Price, 1939, (abs.) Am. Assoc. Petroleum Geolgists Bull., v. 23, no. 12, p. 1875. Lake Charles formation (new) and Ingleside formation replace Beaumont formation.

Present in Rio Grande delta. Type locality and derivation of name not given.

Inglis Formation (in Ocala Group)

†Inglis Limestone

Inglis Member (of Moodys Branch Formation)

Eocene, upper: Florida.

R. O. Vernon, 1951, Florida Geol. Survey Bull. 33, p. 115–140. Member is base of Jackson group in Florida and is a miliolid- and echinoid-rich cream-colored marine limestone. Complete thickness not exposed in any one place; as much as 54 feet in core holes; outcrops 2½ to as much as 30 feet. Conformably underlies Williston member (new); unconformably overlies Avon Park limestone.

H. S. Puri, 1953, (abs.) Jour. Sed. Petrology, v. 23, no. 2, p. 130; 1957, Florida Geol. Survey Bull. 38, p. 24–28. Rank raised to formation in Ocala group. Type locality stated.

C. W. Cooke, 1959, U.S. Geol. Survey Prof. Paper 321, p. 2 (table 1), 3. Referred to as limestone. Rocks now assigned to Inglis, though equivalent to the Moodys Branch were formerly included in Ocala limestone. Contains late Eocene echinoids.

Type locality: Around town of Inglis, Levy County, where limestone is exposed in several pits and quarries, and also along Withlacoochee River.

Ingramian Stage

Late Cretaceous: California.

P. P. Goudkoff, 1945, Am. Assoc. Petroleum Geologists Bull., v. 29, no. 7, p. 960 (table 1), 985–987, 1005. One of six stages, based on foraminiferal assemblages, in Upper Cretaceous column between top of Moreno and base of Panoche, as defined by Anderson and Pack (1915). Roughly correlative with upper part of type Panoche formation. Includes interval between Ciervian stage (new) above and Tracian stage (new) below.

Occurs in Great Valley in both surface and subsurface. Named from Ingram Creek [Fresno County].

Inman Formation (in Eden Group)

Upper Ordovician: Central Tennessee.

C. W. Wilson, Jr., 1949, Tennessee Div. Geology Bull. 56, p. 2 (fig. 1), 175–179. Greenish-gray calcareous shale with zones of red shale interbedded with beds of uniformly bedded greenish-gray to gray dove-colored fine-grained, dense limestone; at some localities limestone is clayey and laminated and in other places is uniformly medium grained. Beds of limestone range between 1 and 6 inches in thickness. Thickness 45 feet in Giles County, 48 feet in Franklin County, and 40 to 70 feet in Sequatchie Valley. Overlaps upon Catheys and overlapped by Leipers.

Named for exposures at Inman, Marion County. Restricted to synclinal belt in southwestern Lincoln County and east-central Giles County and in similar belt in Franklin and Moore Counties that is connected with the formation as exposed in Sequatchie Valley.

Inola Limestone Member (of Boggy Shale)[1]

Pennsylvanian (Des Moines Series): Northeastern Oklahoma.

Original reference: S. W. Lowman, 1932. Summaries and abstracts of technical papers presented before Tulsa Geol. Soc. 1932, unpaged.

R. D. Alexander, 1954, Oklahoma Geol. Survey Circ. 31, p. 12, 16 (fig. 2). Immediately above Bluejacket sandstone member is sequence of four cyclical units, each containing zone of marine fossils. Cap rock limestone of lowest of these cycles contains abundant fusulinids. Name Inola here restricted to lowest limestone, the only one that yields fusulinids. Fusulinids reported from Inola at type locality.

C. C. Branson, 1954, Oklahoma Geol. Survey Guide Book 2, p. 6. Referred to as Inola coal cycle.

Named for outlier on hill east of Inola, Rogers County.

Inskip Formation

Mississippian(?) : North-central Nevada.

S. W. Muller, H. G. Ferguson, and R. J. Roberts, 1951, Geology of the Mount Tobin quadrangle, Nevada: U.S. Geol. Survey Geol. Quad. Map [GQ–7]; 1951, Geology of the Winnemucca quadrangle, Nevada: U.S. Geol. Survey Geol. Quad. Map [GQ–11]. Lower half, mostly quartzite and slate with thin beds of limestone, some chert, a few greenstone flows, some graywacke, conglomerate, and quartzitic grit. Upper half, thin-bedded limestone interbedded with siliceous and calcareous slate and quartzite. Thickness more than 9,000 feet at type locality. Underlies Tallman fanglomerate (new) and Koipato formation with angular unconformities.

R. J. Roberts and others, 1958, Am. Assoc. Petroleum Geologists Bull., v. 42, no. 12, p. 2848. Throughout most of outcrop area Inskip and Leach formations are in fault contact, and their stratigraphic relations are not definitely known. The Leach appears to underlie the Inskip. Probably Late Mississippian.

Type locality: Inskip Canyon, west flank of East Range, Winneumcca quadrangle.

Institute Limestone[1]

Pennsylvanian: Eastern Kansas.

Original reference: E. Haworth, 1894, Kansas Univ. Quart., v. 2, p. 122, 124.

Exposed at Haskell Institute, Lawrence, Douglas County.

Interior Formation[1]

Interior Member (of Pierre Shale)

Upper Cretaceous: Southwestern South Dakota and northwestern Nebraska.

Original reference: F. Ward, 1922, South Dakota Geol. Nat. History Survey Bull. 11, p. 18–20, map.

A. L. Moxon, O. E. Olson, and W. V. Searight, 1939, South Dakota State Coll. Agriculture and Mech. Arts Tech. Bull. 2, p. 20, 23–25. Rank reduced to member status in Pierre shale. Name has precedence over Mowbridge member. Underlies Elk Butte member; overlies Virginia Creek member.

A. L. Moxon, O. E. Olson, and W. V. Searight, 1950, South Dakota State Coll. Agriculture and Mech. Arts Tech. Bull. 2 (revised), p. 20, 23. Replaced by Mowbridge now the accepted term.

Named for development in vicinity of town of Interior, Jackson County, S. Dak.

Intermediate Dolomite Member (of Boardman Formation)

Intermediate Limestone

Lower Ordovician: West-central Vermont.

G. W. Bain, 1931, Am. Jour. Sci., 5th ser., v. 22, no. 132, p. 508, 509. Intermediate limestone is slightly silicified dolomitic rock. Maximum thickness 190 feet.

Phillip Fowler, 1950, Vermont Geol. Survey Bull. 2, p. 25, 26. Rank reduced to Intermediate dolomite member, the middle member of Boardman formation in Castleton area, Rutland County. Formally described as thick-bedded rather porous light-gray dolomite generally containing some sandy beds and typical large quartz knots. Some patches of white marble enclosed in dolomite. Underlies Columbian marble member of Boardman formation; overlies Sutherland Falls marble member of Boardman formation.

Occurrence: Addison and Rutland Counties.

Intervale Clay Slate[1]

Silurian (?): East-central New Hampshire.

Original reference: M. Billings, 1928, Am. Acad. Arts and Sci. Proc., v. 63, p. 80, map.

Occurs two miles northeast of Intervale [village], Carroll County.

Intracanyon basalt formation

Recent: Central Oregon.

E. T. Hodge, 1940, Oregon State Coll. Studies in Geology, Mon. 1, [map with text]. Named and mapped as Intracanyon basalt formation. Described as basalt flows occupying and partly filling Deschutes, Crooked, and Metolius River canyons. Lies against old talus slopes, or Madras sediments.

Occurs in Madras quadrangle, Jefferson County.

Inwood Limestone[1]

Inwood Marble (in New York City Group)

Precambrian: Southeastern New York and western Connecticut.

Original reference: F. J. H. Merrill, 1890, Am. Jour. Sci., 3d, v. 39, p. 389–390.

J. J. Prucha, 1956, Am. Jour. Sci., v. 254, no. 11, p. 673. Inwood marble included in New York City group (new). Overlies Fordham gneiss; underlies Manhattan formation. White to gray, moderately silicated, medium-grained rock ranging in composition from calcite to nearly pure dolomite. Indistinguishable lithologically from marble layers occurring within Fordham and Manhattan formations. Correlations indicate lower Paleozoic age for New York City group.

J. W. Clarke, 1958, Connecticut Geol. Nat. History Survey Quad. Rept. 7, p. 18–21, geol. map. Geographically extended into Danbury quadrangle, Connecticut. On State Geological Map of 1906, it is called Stockbridge limestone. In subsequent work dealing with the quadrangle, Moore (1935, Connecticut Geol. Nat. History Survey Bull. 56) used term Stockbridge series; Balk (1936, Geol. Soc. America Bull., v. 47, no. 5) used term Wappinger marble. Inwood lies stratigraphically above Fordham gneiss and below Manhattan formation. It is excellent stratigraphic marker and helps to distinguish Manhattan and Hartland formations. New York City group.

Named for exposures in vicinity of Inwood on Manhattan Island.

Inwood Sandstone[1]

Silurian (?): Southeastern Pennsylvania.

Original reference: C. K. Swartz and F. M. Swartz, 1931, Geol. Soc. America Bull., v. 42, p. 635.

Bradford Willard, 1952, Pennsylvania Acad. Sci. Proc., v. 26, p. 75. Mentioned in report on lower Oriskany contact in eastern Pennsylvania. Thickness 49 feet. Occurs between Bloomsburg red beds and Onondaga limestone. Age unknown. Probably Silurian.

Occurs in section east of Swatara Creek at Swatara Gap near Inwood Station on Philadelphia and Reading Railway.

Inyan Kara Group[1]

Lower Cretaceous: Northeastern Wyoming and western South Dakota.

Original reference: W. W. Rubey, 1930, U.S. Geol. Survey Prof. Paper 165–A.

K. M. Waagé, 1959, U. S. Geol. Survey Bull. 1081–B, p. 13–90. Darton's subdivision of beds, originally called Dakota in Black Hills, has been difficult to apply outside of limited area in southeastern Black Hills in which names were first applied. In 1930, principal subdivisions, Lakota, Fuson, and Fall River (Dakota of Darton) formations, were placed in Inyan Kara group because they could not be distinguished consistently as separate units. Early miscorrelation of the Fall River (Dakota) with Dakota sandstone of southeastern Colorado has led to confusion in application of Darton's terminology outside of Black Hills. Stratigraphic studies of group reveal basic twofold lithogenetic subdivision which has been recognized in equivalent beds elsewhere in western interior region. Deposits of lower part of this division are dominantly sandy sediments of varied continental facies and are allied lithogenetically with underlying Morrison formation. Deposits of upper part are dominantly sandy sediments of marginal marine facies allied lithogenetically and gradational with overlying marine Skull Creek shale. Contact of the two parts is transgressive disconformity [see Dakota group for explanation] of regional extent marking initial incursion of Cretaceous sea. Subdivision and nomenclature of group is adjusted to conform to this lithogenetic division by redefinition of Fall River formation so that it corresponds with upper part and extending term Lakota, which here comprises Minnewaste and Fuson members, to include entire lower part. The transgressive disconformity becomes contact of Lakota and Fall River formations. Because of strictly local nature of much of the group, neither its name nor names Fall River and Lakota should be used outside of Black Hills region.

Named for exposures along Inyan Kara Creek, northeastern part of Moorcroft quadrangle, Crook County, Wyo.

Inyo Granite[1]

Upper Jurassic: Eastern California.

Original reference: J. H. Maxson, 1934, Pan-Am. Geologist, v. 61, no. 4, p. 311.

On east side of Inyo Range.

Inyo Marble[1]

Lower Cambrian: Eastern California.

Original reference: H. G. Hanks, 1886, California State Mining Bur. 6th Ann. Rept. State Min., pt. 1, p. 25.

Caps White Mountain, Inyo Range.

Inyo Series[1]

Lower and Middle Triassic: Eastern California.

Original reference: J. P. Smith, 1910, Jour. Geology, v. 18, table opposite p. 217.

Inyo Range.

Inyoan series[1]

Lower Triassic: Southeastern California and southwestern Nevada.

Original reference: C. R. Keyes, 1923, Pan-Am. Geologist, v. 40, p. 52, 59, 79.

Named for Inyo County, Calif.

†Iola Beds[1]

Pennsylvanian: Eastern Kansas.

Original reference: L. C. Wooster, 1905, The Carboniferous rock system of eastern Kansas.

Iola Limestone (in Kansas City Group)[1]

Iola Limestone (in Ochelata Group)

Iola Limestone Member (of Kansas City Formation)[1]

Pennsylvanian (Missouri Series): Eastern Kansas, southwestern Iowa, northwestern Missouri, southeastern Nebraska, and northeastern Oklahoma.

Original reference: E. Haworth and M. Z. Kirk, 1894, Kansas Univ. Quart. v. 2, p. 109.

R. C. Moore and others, 1937, Kansas Geol. Soc. Guidebook 11th Ann. Field Conf., p. 40 (table 1), 43. Included in Ochelata group in Oklahoma. Overlies Chanute shale; underlies Lane-Vilas shale. Comprises (ascending) Paola limestone, Muncie Creek shale, and Avant limestone members. Avant has priority over Raytown.

M. G. Oakes, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 4, p. 718 (fig. 2), 720 (table 1), 726. In Oklahoma, overlies Chanute formation; underlies Wann formation (revived, restricted, redefined).

J. R. Clair, 1943, Missouri Geol. Survey and Water Resources, 2d ser., v. 27, pl. 1. In Missouri, Iola limestone comprises (ascending) Frisbie limestone. Quindaro shale, and Argentine limestone members. Overlies Liberty Memorial shale member (new) of Chanute shale; underlies Island Creek shale member of Lane shale, Kansas City group.

F. C. Greene and W. V. Searight, 1949, Missouri Geol. Survey and Water Resources Rept. Inv. 11, p. 13. Iola formation redefined for Missouri. Iola of Kansas was incorrectly correlated with higher limestone, the Argentine, in Missouri by Haworth and Bennett (1908, Kansas Univ. Geol. Survey, v. 9), and the correlation was accepted by Hinds and Greene (1915, Missouri Bur. Geology and Mines, v. 13). Error was discovered by Newell in 1932, but change was not made in Missouri until 1947, when Kansas and Missouri geologists traced the Paola, Muncie Creek, and Raytown succession into type section of Iola. Hence, Iola formation in Missouri, like that of Kansas, consists of Paola limestone, Muncie Creek shale, and Raytown limestone members. Overlies Chanute shale (redefined for Missouri); underlies Lane shale (redefined for Missouri). Kansas City group.

G. E. Condra, 1949, Nebraska Geol. Survey Bull. 16, p. 35–36. Thickness of formation 9 feet, Cass County, Nebr.; about 7 feet, Winterset, Iowa; 10

to 12 feet, Kansas City, Mo.; 7 to 8 feet, northeastern Kansas; 10 to 30 feet, Iola, Kans. Includes Paola limestone, Muncie Creek shale, and Raytown limestone members.

T. L. Welp, L. A. Thomas, and H. R. Dixon, 1957, Iowa Acad. Sci. Proc., v. 64, p. 418 (fig. 1), 420. Thickness of formation about 10 feet in Madison and Adair Counties, Iowa. Includes only Raytown limestone member. Underlies Lane formation; overlies Chanute shale. Kansas City group.

H. G. Hershey and others, 1960, Iowa Highway Research Board Bull. 15, p. 26, fig. 5. Includes Raytown limestone member, 9 feet; Muncie Creek shale member about 2½ feet; Paola limestone, about 1 foot. Overlies Chanute shale; underlies Lane shale. Kansas City group.

Typically developed at Iola, Allen County, Kans.

†Iola Shale[1]

Pennsylvanian: Eastern Kansas.

Original reference: E. Haworth, 1894, Kansas Univ. Quart., v. 2, p. 124.

Probably named for Iola, Allen County.

Ion Dolomite Member[1] (of Decorah Formation)

Ion Submember (of Decorah Shale Member of Galena Formation)

Middle Ordovician: Northeastern Iowa, northwestern Illinois, southeastern Minnesota, and southwestern Wisconsin.

Original reference: G. M. Kay, 1928, Science, new ser., v. 67, p. 16.

C. R. Stauffer and G. A. Thiel, 1941, Minnesota Geol. Survey Bull. 29, p. 9 (geol. column), 81, 83–85. Considered submember of Decorah shale member of Galena formation in Minnesota. Occurs at top of Decorah; overlies Guttenberg submember. Consists of calcareous shale with layers or lenses of argillaceous limestone. Thickness 15 to 20 feet in St. Paul area.

M. P. Weiss, 1955, Jour. Paleontology, v. 29, no. 5, p. 763. Members of Decorah formation (Spechts Ferry, Guttenberg, and Ion) not recognizable rock units in Minnesota.

A. F. Agnew and others, 1956, U.S. Geol. Survey Prof. Paper 274–K, p. 285, 293–295. Member of Decorah formation. Type section, herein redescribed, consists of limestone, gray, or greenish gray, gray mottled, thin bedded, fossiliferous—1.3 feet; limestone, thin bedded, argillaceous, interbedded greenish shaly partings, ledge containing *Glyptorthis*—3.2 feet; shale, greenish, calcareous, and thin grayish-green shaly limestone beds, ledges contain *Glyptorthis* and *Dinorthis*—15.5 feet; shale, green, *Prasopora*—0.5 foot; limestone, grayish, coarsely crystalline, fossiliferous, numerous, *Prasopora*—1 foot; shale, olive-brown—0.3 foot. Total thickness 22 feet. Overlies Guttenberg limestone member; underlies cherty zone of Galena dolomite. In eastern part of zinc-lead mining district, Ion is predominantly dolomitic. Hence, consists of two facies: a western, typified by type section, and an eastern, of light- to medium-grayish-blue crystalline to granular vuggy medium- to massive-bedded less fossiliferous dolomites, with subordinate amounts of olive-gray argillaceous patches and dolomitic shale beds.

Type locality: In ravine along road in NW¼ sec. 35, T. 96 N., R. 4 W., about 1 mile southwest of hamlet of Ion, Allamakee County, Iowa.

Ione Formation[1]

Eocene: Northern California.

Original reference: W. Lindgren, 1894, U.S. Geol. Survey Geol. Atlas, Folio 5.

Ralph Stewart, 1949, U.S. Geol. Survey Oil and Gas Inv. Prelim. Chart 34. Includes "Dry Creek" sandstone member. A similar silty sand in a similar stratigraphic position has been described in Sierra foothills, 25 miles north of Marysville, by Allen (1929) who named it Dry Creek formation. However, name Dry Creek was preoccupied by Dry Creek shale in Montana. Although a valid name should be assigned to the unit, "Dry Creek" is used here in a quotational sense.

Named for exposures at Ione, Amador County.

Ionia Sandstone Member (of Saginaw Formation)

Ionia Sandstone[1]

Ionia Sandstone (in Grand River Group or Formation)

Pennsylvanian: Southern Michigan.

Original reference: A. Winchell, 1871, Michigan Geol. Survey Rept. Prog., p. 26–33.

W. A. Kelly, 1936, Michigan Dept. Conserv., Geol. Div. Pub. 40, Geol. Ser. 34, p. 207. Name applied to crossbedded, coarse-grained, varicolored sandstones outcropping in Grand River valley near Ionia. Overlies shales and micaceous sandstones of Saginaw group. Included in newly proposed Grand River group. Stratigraphic relations to Eaton sandstone (new) not determined.

G. V. Cohee, Carol Macha and Margery Holk, 1951, U.S. Geol. Survey Oil and Gas Inv. Chart OC–41, sheet 5. Recommended that Ionia sandstone be considered a member in Saginaw formation.

Michigan Geol. Soc., 1954, *in* Geologic cross section of Paleozoic rocks central Mississippi to northern Michigan: Tulsa, Okla., Am. Assoc. Petroleum Geologists, p. 28, 29. Herein considered member of Grand River formation. It is probable that future study will show that the Eaton is a brown-weathering facies of the Ionia as exact stratigraphic position of Eaton and Ionia members in the Grand River is not known. No paleontological evidence available to establish age of Ionia.

Probably named for exposures in abandoned quarries near Grand River between Lyons and Ionia, Ionia County.

Iowa Marble[1]

Mississippian: Central northern Iowa.

Original reference: C. A. White, 1870, Iowa Geol. Survey, v. 2, p. 312–313.

In Le Grand quarries, Marshall County.

Iowa Series[1]

Mississippian: Mississippi Valley region.

Original reference: S. Weller, 1920, Jour. Geology, v. 28, no. 4, p. 282; no. 5, p. 408–416.

J. M. Weller and A. H. Sutton, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 5, p. 766 (fig. 1), 771, 777–822. Series comprises (ascending) Kinderhook, Osage, and Meramec groups. Underlies Chester series. Report follows classification of Illinois Geological Survey. However, authors believe that Mississippian should have three-fold division, that

Kinderhook should be raised to rank of series, and that Valmeyer series should be recognized.

L. E. Workman and Tracey [Tracy] Gillette, 1956, Illinois Geol. Survey Rept. Inv. 189, p. 12. In previous Illinois Geological Survey reports, Kinderhook strata have been considered a group in Iowa series. In this report, Kinderhook is raised to series rank. Name Iowa is dropped, following usage in Mississippian correlation chart of Weller and others (1948). Valmeyer series is accepted to include Osage and Meramec groups.

Probably named for Iowa.

Iowa Falls Dolomite[1]

Iowa Falls Dolomite Member (of Hampton Formation)

Mississippian: Central northern Iowa.

Original reference: F. M. Van Tuyl, 1925, Iowa Geol. Survey, v. 30, p. 52, 92, 97.

J. M. Weller and others, 1948, Geol. Soc. America Bull., v. 59, no. 2, chart 5. Shown on correlation chart as uppermost member of formation. Overlies Eagle City beds; underlies Gilmore City limestone.

L. A. Thomas, 1960, Tri-State Geol. Soc. Guidebook 24th Ann. Field Conf., p. [3, 17–19]. Stratigraphic reconstruction of Lower Mississippian rocks across Iowa Falls area, when adjusted to orthodox system of classification, presents anomalous situation that is irreconcilable with stratigraphic relationships observed elsewhere in State. Believed that this stems from miscorrelations resulting in exaggerated thickness of Eagle City limestone and misunderstanding of relationships of Gilmore City limestone to Iowa Falls dolomite. Van Tuyl (1925) considered Eagle City limestone to be about 80 feet thick, to consist of two limestones separated by thick dolomite, and to be unconformable beneath Iowa Falls dolomite. Present evidence suggests that formation is essentially limestone, about 20 feet thick, and conformable with Iowa Falls and Maynes Creek dolomites. Van Tuyl considered Gilmore City limestone to be younger than Iowa Falls dolomite. Present study suggests that Iowa Falls is in part a dolomitized lateral equivalent of Gilmore City limestone.

Named for exposures in gorge of Iowa River at Iowa Falls, Hardin County.

Iowa Gulch Porphyry (in Gray Porphyry Group)

Upper Cretaceous(?) or Tertiary, lower: Central Colorado.

C. H. Behre, Jr., E. N. Goddard, and A. E. Sandberg, 1939, Preliminary geologic map of west slope of Mosquito Range in vicinity of Leadville, Colorado (1:12,000): U.S. Geol. Survey. Named on map legend. In older part of Gray porphyry group.

C. H. Behre, Jr., 1939, Colorado Sci. Soc. Proc., v. 14, no. 2, p. 64–65. Includes two facies—a typical porphyry and a breccia. The porphyry, which is more common, is light gray to brownish gray, nonclastic, distinguished by conspicuous well-crystalized phenocrysts of white feldspar and brown biotite in a dark-gray stony groundmass, frequently characterized by flow structure. The breccia, highly localized, shows matrix of finely fragmental material containing sharp-edged rock fragments of same composition as porphyry and very rarely small blocks of the sedimentary rocks cut by the breccia. Cut by Johnson Gulch porphyry. Type occurrence and derivation of name given.

C. H. Behre, Jr., 1953, U.S. Geol. Survey Prof. Paper 235, p. 46, 54–56, pl. 1. Megascopically most varied of rocks in Gray porphyry group. Differs from Johnson and Lincoln types in lack of conspicuous quartz phenocrysts and from Sacramento in its larger proportion of ground mass; resembles Evans Gulch and Mount Zion in its relatively fine texture and small average size of its phenocrysts, but is somewhat darker, more stony, and as a whole its texture more distinctly porphyritic; blue-gray facies in contrast to lighter gray or flesh colors of Evans Gulch. In igneous sequence, intrusion of Evans Gulch, Sacramento, and Lincoln porphyries was followed by intrusion of Iowa Gulch porphyry; relative ages of Evans Gulch, Sacramento, and Lincoln not determinable. Igneous rocks that are younger than Precambrian in area of this report [west slope of Mosquito Range] are either wholly or mainly Tertiary and only possibly in part late Cretaceous or early Pleistocene in age.

Well exposed in Iowa Gulch, west slope of Mosquito Range, where type occurrence is thick sill that lies under Manitou limestone, about 1 mile west of Hellena mine, Lake County.

Iowan Stade

Iowa(n) Drift,[1] Loess, Till

Iowan Glacial Substage

Iowan stage of glaciation[1]

Pleistocene (Wisconsin): Mississippi Valley.

Original reference: T. C. Chamberlain, 1895, Jour. Geology, v. 3, p. 270–277.

M. M. Leighton and H. B. Willman, 1950, Jour. Geology, v. 58, no. 6, p. 602 (fig. 2). 603–604. Chart shows Iowan substage between Farmdale (pro-Wisconsin) substage and Tazewell substage. Materials of Iowan are loess and till. In Illinois, west and south of Shelbyville, terminal moraine (outermost Tazewell), the Iowan loess constitutes lower part of Peorian loess. No clear separation of Iowan and Tazewell loesses, except at border of Wisconsin drift, where Iowan drift lies under and Tazewell loess lies upon Shelbyville drift.

J. C. Frye and A. B. Leonard, 1952, Kansas Geol. Survey Bull. 99, p. 24, 36, 37, 44, 52, 123, 128. Five substages of Wisconsinan recognized in Kansas: Iowan, Tazewellian, Bradyan (new), Caryan, and Mankatoan; also mentions Iowa and Iowan loess, Iowa till, Iowan stage and subage.

R. V. Ruhe, Meyer Rubin, and W. H. Scholtes, 1957, Am. Jour. Sci., v. 255, no. 10, p. 671–689. New radiocarbon dates in Iowa permit a grouping of age values and raise new problems in stratigraphic correlation of late Pleistocene deposits in Iowa and adjacent regions. An older group of ages greater then 29,000 years dates Iowan substage and pre-Iowan deposits. An old group of ages of 22,900 to 25,100 years dates the Farmdale substage. An intermediate group of ages ranges 14,000 to 17,000 years. A possible interpretation of the dates places Iowan substage in older position than the Farmdale rather than younger as heretofore believed. Iowan till yields wood with dates beyond present range of radiocarbon dating.

J. C. Frye and H. B. Willman, 1960, Illinois Geol. Survey Circ. 285, p. 1, 3, 7. Presentation of revised time-stratigraphic classification of Wisconsinan stage of Lake Michigan lobe. Stage consists of (ascending) Altonian, Farmdalian, Woodfordian, Twocreekan, and Valderan substages. Radiocarbon dates indicate that till of type Iowan of Iowa is older than type Farmdale of Illinois rather than younger. This reverses relative position of these two units. Dates from Iowan till are greater than 35,000 years and do not define age of the till or indicate its placement with the Illinois glacial succession. The Woodfordian includes Iowan substage of Illinois usage (but not of the type), type Tazewell and Cory substages.

M. M. Leighton, 1960. Jour. Geology, v. 68, no. 5, p. 529–552. Presentation of classification of Wisconsin glacial stage of north-central United States. Iowan glacial substage is separated from older Farmdale glacial substage by Farm Creek intraglacial substage and from younger Tazewell glacial substage by Gardena intraglacial substage. Author [Leighton] does not agree with classification presented by Frye and Willman (1960) and cites reasons.

Name amended to Iowan Stade to comply with Stratigraphic Code adopted 1961.

Named for exposures in eastern Iowa.

Iowa Point Shale Member (of Topeka Limestone)

Iowa Point Shale (in Calhoun Shale)[1]

Pennsylvanian (Virgil Series): Northeastern Kansas, southwestern Iowa, northwestern Missouri, and southeastern Nebraska.

Original reference: G. E. Condra, 1927, Nebraska Geol. Survey Bull. 1, 2d ser., p. 40, 43, 51, 102.

G. E. Condra and E. C. Reed, 1937, Nebraska Geol. Survey Bull. 11, 2d ser., p. 7, 12, 15, 20, 46, 51. Reallocated to member status in Topeka limestone. Underlies Cruzen [Curzon] limestone member; overlies Wolf River limestone member (new). Occurrences in Iowa noted.

R. C. Moore, 1948, Am. Assoc. Petroleum Geologists Bull., v. 32, no. 11, p. 2035 (fig. 5); 1949, Kansas Geol. Survey Bull. 83, p. 126 (fig. 22), 162–163; F. C. Greene and W. V. Searight, 1949, Missouri Geol. Survey and Water Resources Rept. Inv. 11, p. 18. Iowa Point shale member of Topeka formation: underlies Curzon limestone member; overlies Hartford limestone member. This is classification agreed upon by State Geological Surveys of Iowa, Kansas, Missouri, Nebraska, and Oklahoma.

G. E. Condra, 1949, Nebraska Geol. Survey Bull. 16, p. 21. Condra and Reed (1937) were uncertain regarding relation of the Hartford of southern Kansas to lower member of Topeka in northeastern Kansas, southeastern Nebraska, northwestern Missouri, and southwestern Iowa, so they proposed name Wolf River for basal member of Topeka in this area. Nebraska Survey will drop name Wolf River if it proves to be correlative with the Hartford, which was loosely defined by Kirk (1896) and may have priority, if it does not include beds of Du Bois, Iowa Point, and Wolf River age.

H. G. Hershey and others, 1960, Iowa Highway Research Board Bull. 15, p. 16, fig. 5. Commonly olive to dark brown in upper part grading to greenish gray below. Varies locally from calcareous shale to a complex of thin limestone beds. Thickness ranges from about ½ foot to 3½ feet. Member of Topeka limestone; underlies Curzon limestone member; overlies Hartford limestone member.

Type locality: In Missouri River bluff just east of Iowa Point, Doniphan County, Kans.

Ipava Shale and Sandstone (in Carbondale Formation)[1]

Pennsylvanian: Central western Illinois.

Original reference: T. E. Savage, 1927, Am. Jour. Sci., 5th, v. 14, p. 307–316.

Probably named for Ipava, in Fulton County.

Ira Slate[1]

Lower Ordovician: Southwestern Vermont.

Original reference: Arthur Keith, 1932, Washington Acad. Sci. Jour., v. 22, p. 360, 398.

Phillip Fowler, 1950, Vermont Geol. Survey Bull. 2, p. 34. Name abandoned. Has similar lithology to and is in same stratigraphic position as Hortonville slate in which beds are now included.

E-an Zen, 1959, New England Intercollegiate Geol. Conf., 51st Ann. Mtg., p. 3, Age of type Hortonville subject to question. Herein suggested that Keith's name Ira formation be revived for belt that runs from Florence south towards Dorset Mountain, a belt that cannot be traced into type Hortonville. Name Ira is appropriate as the writer [Zen] has found Middle Ordovician fossils in limestone lenses in the phyllite near Ira village.

Exposed in town of Ira which is south of West Rutland in Castleton quadrangle.

Irasburg Conglomerate[1]

Ordovician(?): Northeastern Vermont, and Quebec, Canada.

Original reference: C. H. Richardson, 1906, Vermont State Geologist 5th Rept., p. 82.

L. W. Currier and R. H. Jahns, 1941, Geol. Soc. America Bull., v. 52, no. 9, p. 1488, 1508, 1509. Considered an intraformational bed in the Waits River formation which is designated Middle Ordovician or later(?).

C. G. Doll, 1951, Vermont Geol. Survey Bull. 3, p. 15, 32–33. Basal conglomerate of Barton River formation of Silurian age. Type locality stated more specifically.

Named for Irasburg, Orleans County, Vt., where it is best represented in bed of Lords Creek and on adjacent slope to south.

Irasburg Granite[1]

Devonian: Northeastern Vermont.

Original reference: E. J. Foyles and C. H. Richardson, 1929, Vermont State Geologist 16th Rept., table opposite p. 288.

Probably named for Irasburg Township or Irasburg village, in Orleans County.

Ireland Sandstone[1] **Member** (of Lawrence Shale)

Pennsylvanian (Virgil Series): Central Kansas.

Original reference: R. C. Moore, 1932, Kansas Geol. Soc. 6th Ann. Field Conf. Guidebook, p. 93, 96, 113.

H. C. Wagner and L. D. Harris, 1953, U.S. Geol. Survey Oil and Gas Inv. Chart OC–48. In Fredonia quadrangle, generally a 5- to 20-foot grayish-orange to moderate-brown channel-filling sandstone, locally crossbedded and ripple-marked; sparsely fossiliferous. Shales in lower part of Lawrence thin and thicken laterally, and in places where the shales are missing the lower sandstones of Lawrence merge into single unit, making the Ireland as much as 60 feet thick. Filling of channels cut into underlying rocks abnormally increases thickness of Ireland also: locally, channels are cut as much as 15 feet into underlying Robbins shale member of Stranger formation. Basal member of formation; separated from overlying Amazonia member by an unnamed interval of shale and sandstone lenses.

Type locality: On Ireland Creek and farm of W. E. Ireland, 5 miles southwest of Yates Center, Woodson County.

Irene Conglomerate[1]

Precambrian (Belt Series): Southeastern British Columbia, Canada, and northwestern Idaho.

Original reference: R. A. Daly, 1912, Canada Geol. Survey Dept. Mines Mem. 38, maps 6, 7.

Named for outcrops on summit and slopes of Irene Mountains, British Columbia.

Irene Volcanic Formation[1]

Precambrian (?): Southeastern British Columbia, Canada and northwestern Idaho.

Original reference: R. A. Daly, 1912, Canada Geol. Survey Dept. Mines Mem. 38, maps 6, 7.

Named for outcrops along west slope of Irene Mountains, British Columbia.

Ireson Felsite

Upper Silurian or Lower Devonian: Southeastern Maine.

G. H. Chadwick, 1939, Am. Jour. Sci., v. 237, no. 5, p. 361. Incidental mention.

G. H. Chadwick, 1942, (abs.) Geol. Soc. America Bull., v. 53, no. 12, pt. 2, p. 1796, 1797. Occurs in form of laccolith and intrusive dikes. Older than Prettymarsh diorite (new); younger than Frenchmans Bay series. Upper Silurian or Lower Devonian.

G. H. Chadwick, 1944, New York Acad. Sci. Trans., ser. 2, v. 6, no. 6, p. 173, 177. Dikes described as pink weathering. Areal distribution given.

Occurs at Ireson's Hill and its cliffs at The Ovens on north shore of Mount Desert Island, Hancock County. Other exposures also on this island.

Iron Canyon Agglomerate Member (of Tuscan Formation)

[Pliocene]: Northern California.

R. C. Treasher, 1947, (abs.) Geol. Soc. America Bull., v. 58, no. 12, pt. 2, p. 1257. Tuscan formation subdivided into five members. Iron Canyon agglomerate fourth in sequence (ascending). Underlies Sacramento tuff and sand member; overlies Seven-Mile tuff and sand member.

Occurs at Iron Canyon dam site near Red Bluff, Tehama County.

Iron Creek Glaciation

Pleistocene: West-central Alaska.

D. M. Hopkins, 1953, *in* T. L. Péwé and others, U.S. Geol. Survey Circ. 289. p. 10, 13 (table 1). Four Quaternary glaciations recognized on Seward Peninsula. Iron Creek, the earliest, preceded Nome River glaciation (new). Represented by till and outwash encountered at Iron Creek. Faceted spurs adjoining bedrock benches several hundred feet above stream grade in Nome River valley and in nearby valleys assigned to Iron Creek glaciation.

D. M. Hopkins, F. S. MacNeil, and E. B. Leopold, 1960, Internat. Geol. Cong., 21st, Copenhagen, pt. 4, p. 46–57. Discussion of coastal plain at Nome. Three marine stratigraphic units (Submarine Beach, Third Beach-Intermediate Beach, and Second Beach) record at least three distinct intervals during which sea level stood as high or higher than at present and during which sea temperatures were warmer than at present. A fourth interval of high sea level may be represented by "Fourth Beach" at inner edge of coastal plain. Glacial drift of Iron Creek (Nebraskan or Kansan) glaciation and of Nome River (Illinoian) glaciation separates the three units. Outwash, alluvium, colluvium, windblown silt, and peat that accumulated during Wisconsin and Recent time cover the glacial drift and youngest of marine sediments.

In southwestern part of Seward Peninsula.

Irondale Limestone (in Conemaugh Formation)[1]

Pennsylvanian: Northern West Virginia, western Maryland, and southern Pennsylvania.

Original reference: I. C. White, 1891, U.S. Geol. Survey Bull. 65, p. 95.

Occurs at Irondale, Preston County, W. Va., and adjoining regions.

Irondequoit Limestone (in Clinton Group)

Irondequoit Limestone Member (of Clinton Formation)[1]

Middle Silurian: Central and western New York, and Ontario, Canada.

Original reference: J. M. Clarke, 1906, New York State Mus. 2d Rept. Dir. Sci. Div., 1905, p. 12.

C. K. Swartz and others, 1942, Geol. Soc. America Bull., v. 53, no. 4, chart 3. Correlation chart shows Irondequoit limestone in Clinton group, above Williamson shale and below Rochester shale. Niagaran series.

D. W. Fisher, 1953, Buffalo Soc. Nat. Sci. Bull., v. 21, no. 2, p. 27 (fig. 1), 32. In Niagara Gorge, unconformably overlies lower Reynales limestone; in Genesee Gorge overlies Williamson shale.

Named for town of Irondequoit, just north of Rochester, Monroe County, N.Y.

Iron Gate facies (of Clinton Formation)

Silurian (Niagaran): Southwestern Virginia.

Charles Butts, 1940, Virginia Geol. Survey Bull. 52, pt. 1, p. 238, 239, 242–243, 439b (pl. 55). Clinton formation in Virginia is composed almost entirely of shale and sandstone and varies geographically in character and proportions of its constituents. About midway of Appalachian Valley (in Virginia), where crossed by James and New Rivers, lower half of formation, which is composed of shale and sandstone, including highly ferruginous sandstone beds, has been termed Cacapon division; the upper half is composed mainly of white sandstone (closely resembling the Clinch), interbedded with shale, both constituting the Keefer member; it is proposed to designate this lithologic expression of formation the Iron Gate facies. Merges laterally into Cumberland facies (new). Well illustrated by section in the Narrows of New River, Giles County, where 157 feet of Cacapon division and 156 feet of Keefer sandstone are exposed.

Type section: Iron Gate arch in gorge of James River through Rich Patch Mountain, about 1½ miles southeast of Clifton Forge, Alleghany County.

Iron Hill Member (of Windrow Formation)

Cretaceous: Northeastern Iowa, southeastern Minnesota, and southwestern Wisconsin.

G. W. Andrews, 1958, Jour. Geology, v. 66, no. 6, p. 599, 605–607. The porous concretionary iron oxide deposit included in Windrow formation by Thwaites and Twenhofel (1921) is here designated Iron Hill member and is defined to include iron oxide deposits relatively free of coarse clastic material. Thickness about 15 feet. Unconformably underlies East Bluff member (new); unconformably overlies Cedar Valley limestone.

Named for exposure in roadcut on State Highway 9 near Iron Hill, about 1 mile north of Waukon, Allamakee County, Iowa.

Iron King Volcanics (in Alder Group)

Precambrian (Yavapai Series): Central Arizona.

C. A. Anderson and S. C. Creasey, 1958, U.S. Geol. Survey Prof. Paper 308, p. 26–28, pl. 1. Andesitic tuffaceous sedimentary rock and basaltic and perhaps andesitic flows. All but upper 500 to 1,000 feet is basalt; upper unit is andesitic tuffaceous sedimentary rock and is free of lava flows. Tuffaceous beds occur in transition zone with underlying Spud Mountain volcanics (new) and as interbeds in the flow. Basaltic flows range from grayish green to greenish black. Pillow structures in flows. Belt of Iron King volcanics ranges in width from 9,500 feet near Humboldt to 11,500 feet at south edge of map area. Because of duplication by the major syncline, formation is only about 5,500 feet thick.

Named from exposures in Iron King Gulch, Jerome area, Yavapai County.

Iron Mine Member (of Muldoon Formation)

Upper Mississippian (Chesterian): Central and eastern Idaho.

M. R. Thomasson, 1959, Dissert. Abs., v. 20, no. 3, p. 999. Composed of clastics. Thickness, 3,600 feet. Underlies Wildhorse member (new); overlies Garfield member (new).

Deposited in Muldoon trough, aligned N. 30° W.

Iron Mountain Conglomerate[1]

Upper Cambrian: Southeastern Missouri.

Original reference: A. Winslow, 1894, Missouri Geol. Survey, v. 6, p. 331, 354.

Named for Iron Mountain, St. Francois County.

Iron Mountain intrusive[1]

Cretaceous (?): Western Texas.

Original reference: C. Schuchert, 1927, Am. Jour. Sci., 5th, v. 14, p. 400.

Forms an intrusive stock north of Marathon, Brewster County, known as Iron Mountain.

Iron Mountain Porphyry[1]

Precambrian: Southeastern Missouri.

Original references: C. R. Keyes, 1894, Missouri Geol. Survey, v. 4, p. 30; 1895, Missouri Geol. Survey Sheet Rept. 4, v. 9.

Named for Iron Mountain, St. Francois County.

†Iron Mountain Series[1]

Precambrian (Llano Series): Central Texas.

Original reference: T. B. Comstock and E. T. Dumble, 1890, Texas Geol. Survey 1st Ann. Rept., p. lvii, 274, pl. 3.

Named for Iron Mountain, northwest of Valley Spring, Llano County.

Iron Ridge ore bed[1]

Silurian: Southeastern Wisconsin.

Original reference: E. O. Ulrich, 1911, Geol. Soc. America Bull., v. 22, p. 561.

Iron River Iron-Formation Member (of Michigamme Slate)[1]

Precambrian (upper Huronian): Northern peninsula of Michigan and northeastern Wisconsin.

Original reference: C. K. Leith, R. J. Lund, and A. Leith, 1935, U.S. Geol. Survey Prof. Paper 184.

In Iron River, Mich., Crystal Falls, Mich., and Florence, Wis., districts.

Ironside Beds[1]

Pliocene: Northeastern Oregon.

Original reference: J. C. Merriam, 1916, California Univ. Pub. Dept. Geology Bull., v. 10, no. 9, p. 129.

H. E. Wood 2d, 1941, Geol. Soc. America Bull., v. 52, no. 1, p. 22. Clarendonian.

At Ironside, Malheur County.

Ironside Dolomite Member (of Sultan Limestone)[1]

Middle and Upper Devonian: Southeastern Nevada and Southeastern California.

Original reference: D. F. Hewett, 1931, U.S. Geol. Survey Prof. Paper 162, p. 10, 14.

D. F. Hewett, 1956, U.S. Geol. Survey Prof. Paper 275, p. 40. Sultan limestone mapper in San Bernadino County, Calif. Each of the three members of Sultan limestone recognized in Goodsprings quadrangle appear to be present throughout region in which formation is recognized. Thickness 60 to 200 feet. Underlies Valentine limestone member.

U.S. Geological Survey currently considers the Sultan Limestone and its members to be Middle and Upper Devonian in age.

Well exposed near Ironside mine, 1 mile north of Boss mine, on west side of Spring Mountain Range, Goodsprings region, Nevada.

Iron Springs Formation

Upper Cretaceous (?): Southwestern Utah.

J. H. Mackin, 1947, Utah Geol. Soc. Guidebook 2, p. 7–8, 9, fig. 4. Gradational sequence of conglomerates, limestones, sandstones, and siltstones (lettered A–F); boundaries within sequence arbitrary; individual members vary in thickness and are probably not everywhere contemporaneous. Relations indicate regional warping or gentle folding of Iron Springs, with tight folding. Rarely preserved in full thickness (4,000 to 5,000 feet); ranges generally between 1,000 and 3,000 feet. Unconformably underlies Claron formation with angular discordance commonly less than 30° but locally as much as 90°. Separated from underlying Homestake formation by sandstone-shale unit probably equivalent in part to Jurassic Entrada.

J. H. Mackin, 1954, U.S. Geol. Survey Mineral Inv. Field Studies Map MF–14. In Granite Mountain area. Iron County, term Pinto sandstone is abandoned and the part of that formation between the Entrada and the Claron is designated Iron Springs formation. Here, formation is composed of lenticular beds of sandstone, shale, conglomerate, and fresh-water limestone; locally three stratigraphic units can be distinguished in lower part (A, B, and C). Total thickness of A, B, and C, about 400 feet; maximum thickness formation 3,000 feet.

Named for occurrence in vicinity of Iron Springs, Iron County.

Ironstone Quartz Diorite[1]

Devonian(?): Central and southern Massachusetts and northeastern Connecticut.

Original reference: B. K. Emerson, 1917, U.S. Geol. Survey Bull. 597, p. 168–170, map.

Named for exposures in railroad cut at Ironstone, in town of Blackstone, Worcester County, Mass.

Ironton Granite

Precambrian: Southeastern Missouri.

H. B. Graves, 1938, Acad. Sci. St. Louis Trans., v. 29, no. 5, p. 119. Fine-grained red granite.

Crops out in two areas west of Ironton, Iron County. Granite near Hogan, Fredericktown, and Knoblick may belong to same generation as that at Ironton.

Ironton Sandstone Member (of Franconia Sandstone)[1]

Upper Cambrian: Southwestern Wisconsin and southeastern Minnesota.

Original reference: F. T. Thwaites, 1923, Jour. Geology, v. 31, p. 550.

C R. Stauffer, G. M. Schwartz, and G. A. Thiel, 1938, (abs.) Geol. Soc. America Bull., v. 49, no. 12, pt. 2, p. 1902; 1939, v. 50, no. 8, p. 1238 (table 2), p. 1239; C. R. Stauffer and G. A. Thiel, 1941, Minnesota Geol. Survey Bull. 29, p. 30, 37–40 measured sections. In Minnesota, underlies Taylors Falls member (new) which name is used in preference to term Goodenough member as used by Twenhofel, Raasch, and Thwaites (1935).

R. R. Berg, 1953, Jour. Paleontology, v. 27, no. 4, p. 553, 554, 555; 1954, Geol. Soc. America Bull., v. 65, no. 9, p. 858 (fig. 1), 861–862, 863. Name abandoned. Franconia member names proposed by Twenhofel, Raasch, and Thwaites (1935) are geographic names applied to faunal zones. New member names are proposed to designate rock types, as distribution of faunal zones in formation is largely independent of natural rock units. Ironton member carries *Camaraspis* (*Elvinia*) fauna. This fauna is present in Woodhill and Birkmose members.

Type locality: Ironton, Sauk County, Wis.

Ironton slate[1]

Precambrian: Southeastern Missouri.

Original reference: C. R. Keyes, 1915, Iowa Acad. Sci. Proc., v. 22, p. 252.

Probably named for Ironton, Iron County.

Irontown Member (of Page Ranch Formation)

Oligocene, upper, or Miocene, lower: Southwestern Utah.

J. H. Mackin, 1960, Am. Jour. Sci., v. 258, no. 2, p. 90 (table 1), 97. Crudely bedded fanglomerate, made up chiefly of subangular blocks of Harmony Hills tuff (new) and other Quichapa ignimbrites. Underlies Kane Point tuff member (new); overlies Rencher formation. Zircon age of Kane tuff is 19 million years; this suggests that Rencher-Page Ranch period of extrusive-intrusive igneous activity is late Oligocene or early Miocene. Discussion of ignimbrites of area.

Exposed in east-facing scarp 2 miles northwest of Page Ranch and 1 mile southwest of Old Irontown historic site, Page Ranch quadrangle, Iron Springs district.

Ironwood Iron-Formation[1]

Precambrian (Animikie Series): Northwestern Michigan and northwestern Wisconsin.

Original reference: C. R. Van Hise, 1901, U.S. Geol. Survey 21st Ann. Rept., pt. 3, p. 338.

W. O. Hotchkiss, 1919, Eng. Mining Jour., v. 108, p. 501–505. Subdivided to include following members (ascending): Plymouth ferruginous chert, Yale, Norrie ferruginous chert, Pence ferruginous slate, and Anvil ferruginous chert.

N. K. Huber, 1959, Econ. Geology, v. 54, no. 1, p. 82–116. Detailed discussion of origin of formation. Included in Animikie series. Underlies Tyler formation; overlies Palms quartzite. Thicknesses (taken from bore holes) 421 and 513½ feet.

City of Ironwood, Mich., is partly located on formation.

Iroquois Flow or Amygdaloid (in Portage Lake Lava Series)

Precambrian (Keweenawan): Northern Michigan.

W. S. White, H. R. Cornwall, and R. W. Swanson, 1953, U.S. Geol. Survey Geol. Quad. Map GQ–27. More persistent lava flow in Portage Lake lava series, above Calumet and Hecla conglomerate and below Houghton conglomerate.

E. S. Davidson and others, 1955, U.S. Geol. Survey Geol. Quad. Map GQ–54. Amygdaloid is at top of flow in Mohawk quadrangle.

Amygdaloid is principal mineralized unit being mined in Iroquois mine, Mohawk quadrangle.

Iroquois Stage[1]

Pleistocene: Great Lakes region.

Original reference: W. Upham, 1895, Am. Geologist, v. 16, p. 106.

Irvine facies (of Brodhead Formation)

Lower Mississippian: Central Kentucky.

P. B. Stockdale, 1939, Geol. Soc. America Spec. Paper 22, p. 76, 166–177. Predominantly massive siltstones with lesser amounts of silty and argillaceous shales; no significant amount of limestone present. Thickness 150 to 195 feet. To the west-southwest, facies merges into the Liberty facies (new); to the north-northeast, merges into Morehead facies (new). Comprises Indian Fort shale, Combs Mountain siltstone, and Conway cut siltstone members (all new) of Brodhead formation (new). At type locality, underlies Floyds Knob formation and overlies New Providence formation, Boone Gap facies (new).

Type locality: Along State Highway 52 at hill west of Fitchburg Furnace Branch, Estill County, extending along highway 1½ miles northwest from bridge. Named for city of Irvine, located on lowland of Kentucky River.

Irvine Formation[1]

Pliocene or Pleistocene: Central Kentucky.

Original reference: M. R. Campbell, 1898, U.S. Geol. Survey Geol. Atlas, Folio 46, p. 3.

W. R. Jillson, 1947, Pliocene deposits of lower Kentucky River valley: Frankfort, Ky., Roberts Printing Co., p. 6–12. Occurrence in Franklin County discussed.

Named for Irvine, Estill County.

Irvine Shale (in Santiago Formation)

Eocene: Southern California.

George Lunetta, 1953, California Div. Mines Inf. Service, v. 6, no. 10, p. 4–6. Marine mudstone. Massive beds of shale from 40 to 60 feet thick alternate with thin beds of clayey sandstone and clayey limestone. Medium-grained sandstone occurs in lenticular beds up to 3 feet thick. Beds of limestone are generally 1 to 6 feet thick.

Occurs in Gypsum Canyon on Irvine Ranch, 2½ miles south of State Highway 18, in extreme northern end of Santa Ana Mountains, Orange County.

Irvineton parvafacies[1]

Upper Devonian: Northwestern Pennsylvania.

Original reference: K. E. Caster, 1934, Bulls. Am. Paleontology, v. 21, no. 71, p. 28.

Named from village of Irvineton, on Allegheny River, 4 miles west of Warren, Warren County.

Irving Greenstone[1]

Precambrian (Gunnison River Series): Southwestern Colorado.

Original reference: E. Howe, 1904, Jour. Geology, v. 12, p. 501–509.

Well exposed in southeastern part of Needle Mountains quadrangle and forms Irving Peak.

Irvington Gravels, Beds, or deposits

Pleistocene, lower: Northern California.

G. D. Louderback, 1951, California Div. Mines Bull. 154, p. 81. Southeast of Irvington, on east side of bay, a deposit of older alluvium has been cut and its eastern part elevated along a fault. Subsequent erosion has exposed gravels which have been excavated for commercial use. These Irvington beds have yielded a mammalian fauna considered to be lower Pleistocene in age.

D. E. Savage, 1951, California Univ. Dept. Geol. Sci. Bull., v. 28, no. 10, p. 219–224, 289. Terms Irvington gravels and Irvington deposits are used in this report [Late Cenozoic vertebrates, San Francisco Bay area], but terms are not formally defined. Irvington fauna was described from these gravels, and Irvingtonian stage was proposed for time of deposition of these rocks.

C. A. Hall, Jr., 1958, California Univ. Pubs. Geol. Sci., v. 34, no. 1, p. 31–33, fig. 2, geol. map. No formal naming of the formation (Irvington gravels) or type locality has been given in any publication. Savage (1951) used term Irvington gravels repeatedly throughout his report on Cenozoic vertebrates of San Francisco Bay region, and he is here considered to have named the unit. These gravels have been referred to as Santa Clara gravels by previous workers. Irvington gravels composed of crossbedded stream and, possibly in part, lake deposits. Dips 20° to 25° to the north or northeast. Unconformably overlies Briones sandstone. General appearance of formation is much like that of Livermore gravels, but mountain ridge separates Irvington and Livermore gravels; hence, the two units are mapped separately. Savage regarded Irvington fauna as "earlier Pleistocene" or post-Blancan, pre-Rancholabrean. Irvingtonian stage proposed by Savage (1951) for time of deposition of these rocks is lower Pleistocene in age.

Exposed at foot of Mission Peak (referred to by Savage as "Irvington-Mission San Jose bench"), Alameda County. Outcrop area is bounded on north by alluvium from Mission Creek and west by Hayward fault.

Irvingtonian Age

Pleistocene, early: North America.

D. E. Savage, 1951, California Univ. Pubs., Dept. Geol. Sci. Bull., v. 28, no. 10, p. 289. Provincial time term typified by Irvington (vertebrate) fauna. Irvingtonian is post-Blancan to pre-Rancholabrean.

Irwinton Sand Member (of Barnwell Formation)

Eocene, upper: East-central Georgia.

P. E. LaMoreaux, 1946, Georgia Geol. Survey Bull. 50, pt. 1, p. 3 (fig. 1), 10–11, 13, 17–18; 1946, Georgia Geol. Survey Bull. 52, p. 52, 59. At type locality and in Washington, Wilkinson, and Twiggs Counties, consists of 30 to 50 feet of light-yellow, gray, and white fine- to medium-grained micaceous quartz sand interbedded with thin gray to yellow layers, and an occasional bed of coarse white sand with carbonaceous zones. Thins updip to about 15 to 20 feet. Becomes coarse grained, and has an increasing number of clay beds so that in southern Jones, Baldwin, Hancock, and northern Washington Counties it contains about equally thick, 1- to 6-inch alternating beds of fine, medium or coarse sand and yellow and gray clay layers. May be in part equivalent to Sandersville limestone member (Cooke, 1943). Conformably overlies Twiggs clay member; underlies, with possible unconformity, a coarse red sand in upper part of formation. Believed to merge laterally with Twiggs clay into Ocala limestone in western half of Georgia.

Type locality: In gullies on Hatfield property 150 yards west of a cemetery which is 0.3 mile south of courthouse at Irwinton along Georgia Highway 29, Wilkinson County.

Isabel Sandstone[1] (in Carbondale Group)

Isabel Sandstone Member (of Spoon Formation)

Pennsylvanian: Western Illinois.

Original reference: H. R. Wanless, 1931, Illinois Geol. Survey Bull. 60, p. 192.

H. R. Wanless, 1957, Illinois Geol. Survey Bull. 82, p. 50 (fig. 22), 83–84, 191, 197, 198, 199. Fairly well indurated; upper part commonly thin bedded and lower part more massive. Six inches to about 10 feet thick, reaching maximum thickness near type outcrop. Included in Abingdon cyclothem.

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 33, 46 (table 1), 62, pl. 1. Rank reduced to member status in Spoon formation (new). Occurs above Greenbush coal member and below Abingdon coal member. Presentation of new rock-stratigraphic classification of Pennsylvanian strata of Illinois.

Type locality: High bank on southeast side of ravine, NW¼NE¼ sec. 16, T. 4 N., R. 3 E., Havana quadrangle, Fulton County. Named for Isabel Township.

Isabel-Firesteel facies or coal member (of Hell Creek Formation)

See **Hell Creek Formation.**

Isabella Granodiorite[1]

Upper Cretaceous: Southern California.

Original reference: W. J. Miller, 1931, California Univ. Pub. Dept. Geol. Sci. Bull., v. 20, no. 9, p. 343–352.

W. J. Miller and R. W. Webb, 1940, California Jour. Mines and Geology, v. 36, no. 4, p. 357–358, 378 (fig. 31), pl. 2. Shown on map and columnar section as Jurassic(?).

W. J. Miller, 1946, Geol. Soc. America Bull., v. 57, no. 5, p. 512, table 4. Late Mesozoic.

E. M. MacKevett, Jr., 1960, U.S. Geol. Survey Bull. 1087–F, p. 181-189, pls. Lead-alpha age determinations range from 85 to 96 million years. Average age is 90 million years, nearly equivalent to beginning of Late Cretaceous epoch. Younger than Kernville series.

Typical occurrence in vicinity of Isabella, Kernville quadrangle, Kern County.

Isabella Stage[1]

Quaternary: Puerto Rico.

Original reference: B. Hubbard, 1923, New York Acad. Sci. Scientific survey of Porto Rico and Virgin Islands, v. 2, pt. 1, p. 95.

†Ischua Sandstone[1]

Upper Devonian: Western New York.

Original reference: E. N. Horsford, 1840, New York Geol. Survey 4th Ann. Rept., p. 466, 469–470.

Occurs in Ischua stone quarries, Machias, Cattaraugus County.

†Ishawooa intrusives[1]

Miocene: Yellowstone National Park, Wyoming.

Original reference: A. Hague and others, 1904, U.S. Geol. Survey Mon. 32, Atlas; Canyon, Lake Crandall, and Ishawooa sheets.

Named for exposures on west side of Ishawooa Mesa, Yellowstone National Park.

Ishpeming Basic Volcanics

†Ishpeming Formation[1]

Precambrian (Huronian): Northwestern Michigan.

Original reference: C. R. Van Hise and W. S. Bayley, 1895, U.S. Geol. Survey 15th Ann. Rept., p. 590.

W. A. Seaman, 1944, Michigan Dept. Conserv., Geol. Survey Div. Prog. Rept. 10, p. 12 (table 1), 15. Term originally used to include conglomerate, quartzite, and slates above the Negaunee, but is here restricted to the volcanics accompanying the local upheaval that stopped deposition of Negaunee iron formation. Succeeded by Goodrich conglomerate, quartzite, and slate.

Named for occurrences in vicinity of Ishpeming, Marquette County.

Isla Mona Limestone

Miocene, lower or middle: Puerto Rico.

C. A. Kaye, 1959, U.S. Geol. Survey Prof. Paper 317–C, p. 146–147, pl. 12. Thick-bedded, dense, and finely crystalline limestone and dolomite; white on fresh surface but in cliffs stained yellow. Unconformable below Lirio limestone (new). On basis of corals, age appears to be Miocene, probably early or middle.

Forms main mass of Isla Mona and Monito.

†Island Series[1]

Upper Cretaceous: Southeastern Massachusetts and southeastern New York.

Original reference: L. F. Ward, 1895, U.S. Geol. Survey 15th Ann. Rept., p. 335–336.

Extends from Staten Island to Marthas Vineyard.

Island Creek Shale[1] Member (of Wyandotte Formation)

Upper Pennsylvanian (Missouri Series): Eastern Kansas, southwestern Iowa, and southeastern Nebraska.

Original reference: R. C. Moore, 1931, Kansas Geol. Soc. Guidebook 5th Ann. Field Conf., correlation chart.

R. C. Moore, 1948, Am. Assoc. Petroleum Geologists Bull., v. 32, no. 11, p. 2031 (fig. 4), 2033. Island Creek shale member of Wyandotte formation; underlies Farley limestone member; overlies Argentine limestone member. This is classification agreed upon by State Geological Surveys of Iowa, Kansas, Missouri, Nebraska, and Oklahoma. Previously, Missouri had classed Island Creek as basal member of Lane shale.

G. E. Condra, 1949, Nebraska Geol. Survey Bull. 16, p. 35. Thickness 2 to 3 feet or more in Iowa and Nebraska, about 20 feet in northwestern Missouri, maximum 40 feet in Kansas. Additional data on type locality.

H. G. Hershey and others, 1960, Iowa Highway Research Board Bull. 15, p. 25. As exposed in quarry in Madison County, Island Creek is a gray, platy, fossiliferous shale with limestone nodules near top. Thickness 4½ feet. Underlies Farley limestone member; overlies Argentine limestone member.

Type locality: In quarry, NW cor. sec. 11, T. 10 S., R. 23 E., near Wolcott, Wyandotte County, Kans. Named for Island Creek.

Island Hill Formation[1]

Lower Devonian: Northeastern Mississippi.

Original reference: W. C. Morse, 1928, Jour. Geology, v. 36, p. 31–43.

Fossiliferous limestone about 3 feet thick, above New Scotland limestone and below Whetstone Branch shale.

Exposed in Tishomingo County. Named for isolated hill on Yellow Creek about 3 miles above its mouth.

Island Mesa Beds[1]

Upper Devonian: Northern central Arizona.

Original reference: A. A. Stoyanow, 1936, Geol. Soc. America Bull., v. 47, no. 4, p. 500.

G. A. Cooper and others, 1942, Geol. Soc. America Bull., v. 53, no. 12, pt. 1, chart 4. Shown on correlation chart above Jerome formation.

Exposed 12 miles northeast of Jerome, on Verde River, and southwest of Island Mesa.

Island Mine Conglomerate[1] (in Eagle River Group)

Precambrian (Keweenawan): Northern Michigan.

Original reference: A. C. Lane, 1898, Michigan Geol. Survey, v. 6, pt. 1, p. 99, 204, 206, 217, pl. 1.

Named for occurrence in Island mine, Isle Royale.

Isle La Motte Limestone or Formation

Isle La Motte Marble[1]

Middle Ordovician: Northwestern Vermont and northeastern New York.

Original reference: Ebenezer Emmons, 1842, Geology New York, pt. 2, div. 4, geology of 2d dist., p. 386.

G. M. Kay, 1937, Geol. Soc. America Bull., v. 48, no. 2, p. 260–261, pl. 2. Limestone assigned to Trenton group of Mohawkian series. Described at type locality as black gray-weathering medium-textured heavy-ledged limestone. Probably includes underlying blue-black limestone. Total thickness 12½ feet. Underlies Larrabee member of Glens Falls formation; overlies Lowville limestone or Amsterdam limestone. Type section designated.

Marshall Kay, 1945, (abs.) Geol. Soc. America Bull., v. 56, no. 12, pt. 2, p. 1172. Overlies Youngman formation (new) in Highgate Springs sequence, northwestern Vermont.

R. B. Erwin, 1957, Vermont Geol. Survey Bull. 9, p. 27, 61, 66, 68–69, 85–89, pl. 1. Further described on Isle La Motte and in several fault blocks on South Hero Island in Lake Champlain. Maximum thickness in latter area 40 feet.

Marshall Kay, 1958, Am. Jour. Sci., v. 256, no. 2, p. 85–87. Considered lower Trentonian by Kay (1937). This designation now considered to be in error. Isle La Motte is now classified as Blackriveran and correlated with Chaumont limestone of Black River group of northwestern New York.

Type section: In Hill quarry on east side of Isle La Motte in Lake Champlain, Grand Isle County, Vt.

Isle La Motte Sandstone[1]

Lower Ordovician: Northwestern Vermont.

Original reference: H. M. Seely, 1906, Vermont State Geologist 5th Rept., p. 174–187.

Named for Isle La Motte, northern part of Lake Champlain.

Isle Royale Amygdaloid[1]

Precambrian (Keweenawan): Northern Michigan.

Original reference: R. D. Irving, 1883, U.S. Geol. Survey Mon. 5, p. 195.

T. M. Broderick, C. D. Hohl, and H. N. Eidemiller, 1946, Econ. Geology, v. 41, no. 7, p. 678 (fig. 1). Name appears on geologic section of Michigan copper district.

Named for occurrence in Isle Royale mine, Houghton County.

Isle Royale Flow[1]

Precambrian (Keweenawan): Northern Michigan.

Original reference: B. S. Butler and W. S. Burbank, 1929, U.S. Geol. Survey Prof. Paper 144 (chart compiled by M. G. Wilmarth).

Copper district of Keweenaw Point.

†Isle Royale trap[1]

Precambrian (Keweenawan): Northern Michigan.

Original reference: B. S. Butler and W. S. Burbank, 1929, U.S. Geol. Survey Prof. Paper 144 (chart compiled by M. G. Wilmarth).

Copper district of Keweenaw Point.

Islesboro Formation[1]

Cambrian(?): Central southern Maine.

Original reference: G. O. Smith, E. S. Bastin, and C. W. Brown, 1907, U.S. Geol. Survey Geol. Atlas, Folio 149, p. 2–3.

H. W. Allen, 1951, Maine State Geologist Rept. 1949–1950, p. 79. Sequence of metamorphosed sedimentary rocks in area of Rockland quadrangle, Knox County, is (ascending) Islesboro formation containing Coombs limestone member at top; Battie quartzite; Penobscot formation; and Rockland formation consisting of Weskeag quartzite member at base, a siliceous limestone member above the quartzite, and Rockport limestone member at top.

Named for development on Islesboro, Waldo County.

Isom Formation

Eocene(?) or Oligocene, lower(?): Southwestern Utah.

J. H. Mackin, 1960, Am. Jour. Sci., v. 258, no. 2, p. 90 (table 1), 92 (fig. 2), 98–99. Chiefly ignimbrites and lava flows with intercalations of sedimentary rocks. At type locality, consists of an ignimbrite of Leach Canyon type, a few tens of feet thick, which has not been definitely identified elsewhere and needs no formal name. Lower unit is Baldhills member (new); upper is Hole-in-the-Wall member (new). Thickens greatly and is widespread in High Plateaus. Underlies Quichapa formation; at type locality, overlies Needles Range formation (new); in some areas, overlies Claron formation or on volcanic rocks of local origin. Needles-Isom sequence is probably Eocene or early Oligocene in age. Discussion of ignimbrites of area.

E. F. Cook, 1960, Utah Geol. and Mineralog. Survey Bull. 70, p. 18 (fig. 1), 36–37, geol. map. Present in Bull Valley district, Washington County, where it has maximum thickness of 170 feet and consists of andesite(?) flows overlain by two thin, highly welded, latitic, vitric ignimbrites with sparse phenocrysts. Overlies Claron formation; underlies Quichapa formation. Wedges out southward. Tertiary.

Type locality: Southern slope of east-west ridge just north of Isom Creek in northwestern part of Iron Springs district (Three Peaks quadrangle, sec. 5, T. 35 S., R. 12 W.).

Ithaca facies sub-group[1]

Upper Devonian: Central southern New York.

Original reference; K. E. Caster, 1933, Geol. Soc. America Bull., v. 44, pt. 1, p. 202. Ithaca region.

Ithaca Member (of Genesee Formation)

Ithaca Shale

Ithaca Shale Member (of Portage Formation)[1]

Upper Devonian: Central New York.

Original reference: James Hall, 1839, New York Geol. Survey 3d Rept., p. 318–325.

G. A. Cooper and others, 1942, Geol. Soc. America Bull., v. 53, no. 12, pt. 1, p. 1743, chart 4. Ithaca shale consists of six members of uncertain relationships: Renwick shale, Six Mile shale, Cascadilla shale, Williams Bridge shale, Marathon sandstone, and Triphammer shale.

Wallace de Witt, Jr., and G. W. Colton, 1959, Am. Assoc. Petroleum Geologists Bull., v. 43, no. 12, p. 2814, 2815, 2821–2822. Reallocated to member status in Genesee formation. Near Cayuga Lake is a heterogeneous sequence of fine-grained sandstone, siltstone, silty shale, and silty mudrock. This sequence, which is about 400 feet thick near Ithaca, constitutes Ithaca group of Hall (1839) and most of Ithaca shale member of Portage formation (Williams and others, 1909, U.S. Geol. Survey Geol. Atlas, Folio 169). Name Ithaca member is here restricted to rocks above Renwick shale member and below West River shale member. Term shale is dropped from member name because the Ithaca is composed largely of siltstone and other nonfissile rocks. Thickness 413 feet at reference section, herein designated. Top of member is placed at top of thick-bedded sequence of siltstone, above which the rocks consist largely of silty gray shale containing much thinner beds of siltstone, a few thin beds of black shale, and scattered silty calcareous nodules. In Coy Glen and in some lentil of coquinite about 1 foot thick is present at top of member. Mapped westward from outcrops near Ithaca to exposures at the north end of West Branch of Keuka Lake. Intertongues with lower part of West River shale member in area between Keuka Lake and valley of West River. In vicinity of Keuka and Seneca Lakes, the Ithaca member of this paper was named Starkey tongue of Sherburne formation by Grossman.

Reference section: Coy Glen, 2 miles southwest of center of Ithaca, Tompkins County. Named for occurrence at Ithaca.

Ithaca Peak Granite

Ithaca Peak Porphyry

Mesozoic(?): Northwestern Arizona.

B. E. Thomas, 1949, Econ. Geology, v. 44, no. 8, p. 667, fig. 2; 1953, Geol. Soc. America Bull., v. 64, no. 4, p. 403–405, pl. 1. Ithaca Peak porphyry comprises two intrusions of granite porphyry within the Cerbat complex (new). Intrusion in Chloride district is curved steeply dipping sill from 2,000 to 5,000 feet thick, whereas intrusion in Mineral Park district is stock that has roughly circular exposed area 3½ to 4 miles in diameter. Several thick tongues extend out from southeast side of stock, largest reaching 1½ miles through Union Basin to Golconda mine. Tertiary(?).

M. G. Dings, 1951, U.S. Geol. Survey Bull. 978–E, p. 130–132, pl. 18. Cited as Ithaca Peak granite and restricted to Mineral Park district. Granite near Chloride tentatively assigned to Precambrian and renamed Chloride granite (new). Main mass of granite stock weathers buff to reddish brown. Fresh rock typically light-gray fine- to medium-grained porphyritic granite. Outlying bodies of granite particularly abundant from Mineral Park south into Stockton and Cerbat camps, some of which grade into granite porphyry, although most are of porphyritic granite. Geographic distribution given.

Named after imposing crag in Mineral Park district. Both Ithaca Peak and Turquoise Mountain composed of the granite. All in Wallapai mining district, Mohave County.

Itkillik Glaciation

Pleistocene: Central northern Alaska.

R. L. Detterman *in* T. L. Péwé and others, 1953, U.S. Geol. Survey Circ. 289, p. 11–12, 13 (table 1). Four Quaternary glacial advances recognized in Sagavanirktok-Anaktuvuk district. Itkillik preceded Echooka glaciation (new); succeeded Sagavanirktok glaciation (new). Till covers approximately 1,000 square miles and forms thin mantle 30 to 50 feet thick over much of area. Drift forms fan-shaped deposits at mouths of major valleys. A few well-developed moraines as much as 200 feet thick. Terminal and lateral moraines as well as knob and kettle topography easily recognized. Numerous kettle lakes. Piedmont lobe formed at time of Itkillik glaciation.

Named after Itkillik River in central part of Sagavanirktok-Anaktuvuk region.

Iuka Formation[1]

Lower Mississippian: Northeastern Mississippi.

Original reference: W. C. Morse, 1928, Jour. Geology, v. 36, p. 31–43.

Named for Iuka, Tishomingo County.

Ivan Limestone Member (of Graham Formation)

Ivan Formation or Limestone (in Thrifty Group)

Ivan Limestone (in Graham Group)

Ivan Limestone Member (of Thrifty Formation)[1]

Upper Pennsylvanian: Central northern Texas.

Original reference: F. B. Plummer and R. C. Moore, 1922, Jour. Geology, v. 30, p. 24, 31.

M. G. Cheney, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 1, p. 66 (fig. 1). Shown on correlation chart as Ivan formation in Thrifty group. Underlies Speck Mountain formation (Blach Ranch formation); overlies Avis sandstone.

M. G. Cheney and H. D. Eargle, 1951, Geologic map of Brown County, Texas (1:62,500): Texas Univ. Bur. Econ. Geology. Shown on columnar section as Ivan limestone in Thrifty group.

M. G. Cheney and H. D. Eargle, 1951, West Texas Geol. Soc. Guidebook Spring Field Trip, June 1–2, p. 1 (fig. 1). Listed on chart as Ivan (Rocky Mount), "*Bellerophon*" member of Thrifty formation. Occurs above Avis sandstone and below Speck Mountain (Blach Ranch member).

John Kay, 1956, North Texas Geol. Soc. Field Guidebook, May 25–26, fig. 4. Shown on generalized columnar section as Ivan limestone in Graham group. Underlies Blach Ranch limestone; overlies Avis sandstone.

D. H. Eargle, 1958, San Angelo Geol. Soc. Guidebook, Apr. 17–19, p. 50. Shown on composite section of Brown and Coleman Counties as Ivan limestone member of Graham formation. Consists of gray algal limestone that locally contains abundant horn corals and fusulinids. Thickness about 15 feet. Overlies Wayland shale; stratigraphically below Speck Mountain limestone member of Thrifty formation.

D. H. Eargle, 1960, U.S. Geol. Survey Prof. Paper 315–D, p. 71, pl. 27. Name Ivan limestone member of Graham formation extended into Brown and Coleman Counties and applied to unit that was described as *Bellerophon* bed by earlier authors (Nickell, 1938, Texas Univ. Bur. Econ. Geology Pub. 3801). Locally the Ivan changes in lithologic character from limestone to calcareous sandstone and (or) shale within short distances. Overlies Wayland shale member; separated from overlying Speck Mountain limestone member of Thrifty formation by shale unit that was called Speck Mountain clay bed by Drake (1893). Thickness as much as 18 feet.

Named for exposures in vicinity of Ivan, Stephens County.

Ivanhoe Glacial Substage

Pleistocene (Cary) : West-central Colorado.

R. L. Nelson, 1954, Jour. Geology, v. 62, no. 4, p. 331–333, fig. 2, table 4. Time of Wisconsin glaciation in Frying Pan Valley during which outwash deposits and Ivanhoe moraines were deposited. Older than Hell Gate glacial substage (new) ; younger than Biglow glacial substage (new).

Name derived from area just east of Ivanhoe. In Frying Pan River drainage just west of Continental Divide in Sawatch Range.

Ivanhoe Limestone Member (of Rome Formation)

Ivanhoe Limestone Member (of Shady Dolomite)[1]

Lower Cambrian : Southwestern Virginia.

Original reference: Charles Butts, 1933, Virginia Geol. Survey Bull. 42, p. 3, map legend.

G. W. Stose and A. I. Jonas, 1938, Virginia Geol. Survey Bull. 51–A, p. 8, 9. Reallocated to member status in Rome formation.

Charles Butts, 1940, Virginia Geol. Survey Bull. 52, pt. 1, p. 41, 44–46, 52. In Wythe and Pulaski Counties, Ivanhoe is uppermost member of Shady dolomite; overlies Austinville dolomite member (new) ; underlies Rome formation. Thickness 542 to 547 feet.

Named for exposures in vicinity of Ivanhoe, Wythe County.

Iversen Basalt

"Between late Cretaceous and Oligocene" : Northern California.

C. E. Weaver, 1944, Washington [State] Univ. Pubs. in Geology, v. 6, no. 1, p. 4, 17–18, pl. 2. Dark-gray to black dense fine-grained basalt with alternating flows of vesicular and amygdaloidal rock and intercalated lenslike masses of tuffaceous sandstone; pillow structure. Thickness 800 feet. [This part of description is identical with initial description given of unit termed Skooner Gulch basalt by Weaver, 1943. In 1944, Weaver redescribed the Skooner Gulch as a sandstone formation.] Lavas stand at high angles with prevailing northwestward dip. Rests unconformably upon sandstones and shales of Gualala group and lies with erosional unconformity below Oligocene(?) or lower Miocene sediments. Stratigraphic table shows basalt underlying redescribed Skooner Gulch formation.

Exposed in sea cliffs, highway cuts, and in outcrops on hill slopes within an area approximately 100 feet wide by 3 miles long and extending from near Iversen Point northward to and beyond mouth of Skooner Gulch, Mendocino County.

Ives Breccia Member (of Houy Formation)

Ives Breccia

Ives Conglomerate Member (of Chappel Formation)

Middle(?) and Upper Devonian : Texas.

F. B. Plummer, 1939, *in* West Texas Geol. Soc. [Guidebook] Nov. 11–12, p. 15. Basal conglomerate of Chappel formation. Made up of rounded chert cobbles derived from the Ellenburger; fairly firmly cemented into layers 8 inches to 1 foot thick.

P. E. Cloud, Jr., and V. E. Barnes, 1948, Texas Univ. Bur. Econ. Geology Pub. 4621, p. 27, 42, 44 (fig. 2), 46–49. Unit raised to formational rank and designated Ives breccia because of commonly angular character of chert pebbles and granules it contains. At locality cited by Plummer (1950), the Ives overlaps beds of Honeycut formation. Considered older than Chappel limestone. Correlated with beds considered to be basal Mississippian by some and uppermost Devonian by others.

F. B. Plummer, 1950, Texas Univ. Bur. Econ. Geology Pub. 4329, p. 26, 27. Underlies Espey Creek limestone member and overlies King Creek marl member (both new). Mississippian. Exposures noted.

P. E. Cloud, Jr., V. E. Barnes, and W. H. Hass, 1958, Geol. Soc. America Bull., v. 68, no. 7, p. 810, pl. 1. Rank reduced to member status in Houy formation (new). Occurs near base of formation and below Doublehorn shale member (new). Includes lag deposits of detrital chert of varied age and source. Zesch formation of Barnes and others (1947) is a partial synonym for Ives breccia. Middle(?) and Upper Devonian. Type site designated.

Type locality: Along Ives Branch on Gibbons Ranch 2½ miles southwest of Hall, San Saba County. This is Plummer's (1950) locality 205–T–125 which he designated as best exposure of Ives conglomerate.

Ivy Point Member[1] (of Ludlowville Shale)

Middle Devonian: Central New York.

Original reference: Burnett Smith, 1935, New York State Mus. Bull. 300, p. 11, 47.

G. A. Cooper and others, 1942, Geol. Soc. America Bull., v. 53, no. 12, pt. 1, chart 4. Underlies Spafford member; overlies Otisco member.

Type section: In first ravine north of Ivy (or Willow) Point on east side of Skaneateles Lake, three-fourths mile north and slightly west of Spafford Landing, Skaneateles quadrangle.

Iwana Green Schist[1]

Post-Carboniferous(?): Eastern Alabama.

Original reference: W. M. Brewer, 1896, Alabama Geol. Survey Bull. 5, p. 84, 89, 92.

Named for exposures about Iwana, Coosa County.

†Izard Limestone[1]

Lower and Middle Ordovician: Northern Arkansas.

Original reference: R. A. F. Penrose, Jr., 1891, Arkansas Geol. Survey Ann. Rept. 1890, v. 1, p. 102, 112–113, 121–124, 587–593.

Type locality: Penters Bluff, southeastern Izard County.

Izee Group

Middle Jurassic: East-central Oregon.

R. L. Lupher, 1941, Geol. Soc. America Bull., v. 52, no. 2, p. 227 (table 1), 229, 255. Consists of two noncalcareous formations, Hyde below and Snowshoe above (both new). Thickness 3,880 feet. Overlies Colpitts group (new); extends northeastward into Silvies River region, beveling both Colpitts and Mowich groups and lying discordantly upon Triassic strata; unconformably underlies Trowbridge shale (new).

Widely exposed along Ochoco anticline from western end of Jurassic rock area northeastward across South Fork Valley and into west side of Bear Valley. Named for Izee Grange and Schoolhouse near South Fork River between Poison Creek and Rosebud Creek, Crook County.

Jacaguas Group

Eocene, middle: Puerto Rico.

E. A. Pessagno, Jr., 1960, Geology of the Ponce-Coamo area, Puerto Rico: Puerto Rico Econ. Devel. Adm. and Princeton Univ. Dept. Geology, p. 70–103, geol. map. Includes two formations, Naranjo to east of the Río Guayo and Augustinillo to west of the Río Guayo. Thickness about 17,000 feet. Bounded on south by Cerrillos-Descalabrado fault that obscures its exact thickness.

E. A. Pessagno, Jr., 1960, Caribbean Geol. Conf., 2d, Mayagüez, Puerto Rico, 1959, Trans., p. 83. Name replaces Guayabal group, used to include Naranjo and Augustinillo formations.

Named after the Río Jacaguas near Juana Díaz.

Jacalitos Formation[1]

Jacalitos Stage

Pliocene, lower: Southern California.

Original reference: R. Arnold and R. Anderson, 1908, U.S. Geol. Survey Bull. 357.

S. S. Siegfus, 1939, Am. Assoc. Petroleum Geologists Bull., v. 23, no. 1, p. 27 (fig. 2), 32–36. Overlies Reef Ridge shale. Confusion in defining upper contact of Reef Ridge has resulted to some extent from difference of opinion regarding lower limit of the Jacalitos. Various interpretations discussed.

W. P. Woodring, 1940, U.S. Geol. Survey Prof. Paper 195, p. 27 (table), 114–117. Underlies Etchegoin formation (restricted), although Jacalitos (as shown in table on page 27) is included in the Etchegoin by some geologists.

I. F. Wilson, 1943, California Jour. Mines and Geology, v. 39, no. 2, p. 240. Term Etchegoin group is used in this report to include Jacalitos, Etchegoin, and possibly San Joaquin formations which cannot be distinguished in field in this report [San Benito quadrangle].

B. L. Clark, 1943, California Div. Mines Bull. 118, p. 190 [preprint 1941]. Marine lower Pliocene of San Joaquin Valley area may be referred to as Jacalitos stage. This is lower part of Etchegoin formation as redefined by Nomland (1917). He recognized two faunal zones in deposits referred originally by Arnold and Anderson to the Jacalitos.

C. W. Jennings, 1953, California Jour. Mines and Geology, v. 49, no. 3, p. 279. Formation, in Kings County, consists of about 3,500 feet of marine sandstone and conglomerate. Overlies Reef Ridge shale; underlies Etchegoin formation. Crops out as wide band in Kreyenhagen Hills and in Avenal syncline on west side of Reef Ridge.

J. W. Durham, R. H. Jahns, and D. E. Savage, 1954, California Div. Mines Bull. 170, chap. 3, p. 60 (fig. 2). Chart shows Jacalitos megafaunal "stage" equivalent to the Repettian and upper part of Delmontian microfaunal stages.

Named for exposures both north and south of Jacalitos Creek, and in Jacalitos Hills, Fresno County.

Jack Creek Formation (in Pacheco Group)

Upper Cretaceous: West-central California.

N. L. Taliaferro, 1941, (abs.) Am. Assoc. Petroleum Geologists Bull., v. 25, no. 11, p. 2095. Unconformably underlies sediments of Asuncion group.

N. L. Taliaferro, 1944, Am. Assoc. Petroleum Geologists Bull., v. 28, no. 4, p. 474–484. Light- to dark-gray sandy clay shales and silts with thin interbeds of fine-grained silty commonly crossbedded and ripple-marked sandstone; contains lenses and thin layers of ferruginous limestone and lenses of sandstone up to 25 feet thick in places. Thickness 1,600 to 2,900 feet. Has been tilted, folded and faulted. Underlies Asuncion group. Angular discordance between the two varies from a few degrees to 70°; unconformably overlies the Franciscan. In fault contact with Lower Cretaceous Marmolejo formation (new). Type section designated.

Type section: On Jack Creek extending for 1½ miles southeast of Dover Canyon Road, in southeast part of Adelaida quadrangle, Santa Lucia Range.

Jackfork Sandstone[1]

Jackfork Group

Mississippian: Southeastern and central southern Oklahoma and southwestern Arkansas.

Original reference: J. A. Taff, 1902, U.S. Geol. Survey Geol. Atlas, Folio 79.

David White, 1937, U.S. Geol. Survey Prof. Paper 186–C, p. 43–67. Age considered to be Pennsylvanian on basis of paleobotanic evidence. Previously regarded as uppermost Mississippian.

B. H. Harlton, 1938, Am. Assoc. Petroleum Geologists Bull., v. 22, no. 7, p. 854 (fig. 1), 856–857, 878–889. Rank raised to group. Divided into (ascending) Wildhorse Mountain, Prairie Mountain, Markham Mill, and Wesley formations (all new). Thickness as much as 8,700 feet. Overlies Chickasaw Creek formation (new) in Stanley group; underlies Union Valley sandstone. In Pushmataha (new) and Morrow series, both of which are included in the Bendian, shown as post-Chester and pre-DesMoines.

R. C. Moore and others, 1944, Geol. Soc. America Bull., v. 55, no. 6, chart 6 (column 35). Sandstone shown on correlation chart below Johns Valley shale and above Stanley shale. Morrow series.

C. L. Cooper, 1945, Jour. Geology, v. 53, no. 6, p. 390–397. Stanley and Jackfork formations have been correlated with Pennsylvanian, but their exact age is still a problem. Flora from these formations is unlike any known flora in North America and is younger than that from Wedington sandstone member of Fayetteville shale (Chester) and older than that in Baldwin coal in Bloyd shale of Morrow group (middle Pottsville).

J. M. Weller and others, 1948, Geol. Soc. America Bull., v. 59, no. 2, p. 106, chart 5 (column 57). Sandstone shown on correlation chart as Chesterian. Age still debatable.

H. D. Miser and others, 1954, Geologic map of Oklahoma (1:500,000): U.S. Geol. Survey. Mapped as Pennsylvanian.

L. M. Cline, 1956, Tulsa Geol. Soc. Digest, v. 24, p. 101, 102 (chart). Studies in central Ouachita Mountains revealed two complete stratigraphic sequences of Jackfork group: one southeast of Albion in eastern Pushmataha County, in Kiamichi Range, and one southeast of Big Cedar in Le Flore County. Exposures reveal Jackfork to be 5,600 and 5,700 feet thick respectively. This is much less than previous estimates. Also study reveals that upper part of type Wildhorse Mountain formation duplicates an equivalent interval in lower part of type Prairie Mountain formation. By definition Harlton's (1938) type Prairie Mountain includes type locality of Prairie Hollow maroon shale member; however, Prairie Hollow also occurs in midst of Wildhouse Mountain type section; stratigraphic overlap amounts to about 3,600 feet; hence, thickness of Jackfork group in Tuskahoma syncline should be considerably less than previously estimated. Harlton's (1938) Union Valley sandstone not equivalent to Union Valley of type locality and here considered part of Jackfork group. Age of group Chesterian or Morrowan.

B. H. Harlton, 1959, *in* The geology of the Ouachita Mountains—a symposium: Dallas, Tex., Dallas Geol. Soc. and Ardmore Geol. Soc., p. 131 (fig. 1), 135–136. Group includes (ascending) Wildhorse Mountain, Prairie Mountain, Markham Mill, Wesley, and Game Refuge (new) formations. Game Refuge replaces name Union Valley sandstone extended into area (Harlton, 1938). Overlies Chickasaw Creek formation of Stanley group; underlies unit referred to as Johns Valley shale of published reports. Pushmataha series (Carboniferous).

L. M. Cline, 1960, Oklahoma Geol. Survey Bull. 85, p. 42–58, pl. 1. Group includes (ascending) Wildhorse Mountain, Prairie Mountain, Markham Mill, Wesley, and Game Refuge formations. Thickness 5,600 to 5,800 feet. Overlies Stanley group; stratigraphically below Johns Valley shale. Meramecian and Chesterian.

H. D. Miser and T. A. Hendricks, 1960, Am. Assoc. Petroleum Geologists Bull., v. 44, no. 11, p. 1829–1834. Mississippian. Brief summary of development of different age interpretations that have been given for Jackfork sandstone, Stanley shale, and Johns Valley shale.

O. B. Shelburne, Jr., 1960, Oklahoma Geol. Survey Bull. 88, p. 17 (fig. 2), 26–33, pl. 1. Group described in Boktukola syncline where it is 5,400 to 6,500 feet thick. Overlies Stanley group; underlies Johns Valley shale. Mississippian, Chesterian; however, on figure 2, Meramec-Chester boundary is queried.

Named for Jackfork Mountain, Pittsburg and Pushmataha Counties, Okla.

Jackman Granite

Middle Devonian: West-central Maine.

H. W. Fairbairn and P. M. Hurley, 1957, Am. Geolphys. Union Trans., v. 38, no. 1, p. 105 (table 8), 106 (table 9). Incidental mention. Intrusive into Lower Devonian sediments.

Occurs at Jackman, Somerset County.

Jackpile Ore-Bearing Bed (in Brushy Basin Member of Morrison Formation)

Upper Jurassic: Northwestern New Mexico.

V. L. Freeman and L. S. Hilpert, 1956, U.S. Geol. Survey Bull. 1030–J, p. 317, 318. Very pale orange and locally white sandstone that is dominantly fine to medium grained with minor coarse grains at base. Characterized by scour-and-fill crossbedding, but some parallel bedding, often marked by claystone partings, is present also. Ranges from knife edge, where cutout by pre-Dakota(?) erosion, to about 175 feet at Jackpile mine. Constitutes uppermost 65 feet of member at Laguna section.

Traced from Laguna section, sec. 28 T. 10 N., R. 5 W., in nearly continuous exposures, into ore-bearing sandstone at Jackpile mine of Anaconda Copper Mining Co., Valencia County.

†Jacksboro Formation (in Cisco Group)[1]

Pennsylvanian: Central northern Texas.

Original reference: F. B. Plummer, 1919, Am. Assoc. Petroleum Geologists Bull., v. 3, p. 133–145.

Occurs in sandstone hills southwest of Jacksboro, Jack County, and also in Young County.

Jacksboro Limestone Member (of Graham Formation)[1]

Upper Pennsylvanian: Central northern Texas.

Original reference: F. B. Plummer, 1919, Am. Assoc. Petroleum Geologists Bull., v. 3, p. 133–145.

Named for exposures in vicinity of Jacksboro, Jack County.

Jacksina Formation[1]

Pre-Permian: Southeastern Alaska.

Original reference: W. C. Mendenhall, 1905, U.S. Geol. Survey Prof. Paper 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."

†Jackson Formation[1]

Pennsylvanian: Michigan.

Original reference: A. C. Lane, as reported by M. E. Wadsworth, 1893. Michigan Geol. Survey Rept. 1891 and 1892, p. 66.

Named for exposures at Jackson, Jackson County.

Jackson Formation[1] **or Group**

Eocene, upper: Gulf Coastal Plain from Georgia to southern Texas.

Original references: T. A. Conrad, 1856, Philadelphia Acad. Nat. Sci. Proc., v. 7, p. 257–258; E. W. Hilgard, 1860, Rept. Geology and Agriculture Mississippi, p. 128–135

M. A. Hanna and Donald Gravell *in* James McGuirt, 1934, Shreveport Geol. Soc. [Guidebook] 11th Ann. Field Trip, chart facing p. 30. Correlation chart shows Jackson comprises (ascending) Moodys Branch, Yazoo, and Danville Landing (new) groups. Danville Landing group contains Danville Landing beds. [Use of term group not explained.]

B. C. Renick, 1936, Texas Univ. Bull. 3619, p. 13–55. Group comprises (ascending) Caddell (Moodys marl), Wellborn (with Bedias and Carlos sandstones), Manning (with Dilworth and Yuma sandstones), and Whitsett formations. Overlies Yegua formation of Claiborne group; underlies Catahoula formation.

H. N. Fisk, 1938, Louisiana Dept. Conserv., Geol. Bull. 10, p. 89–111. In central Louisiana, outcrop of Jackson group extends southwestward in narrow belt from Ouachita River in southern Caldwell Parish to Red River south of Montgomery. Covers most of northwestern La Salle Parish and northern third of Grant Parish. Includes (ascending) Moodys Branch marl, Yazoo clay, and Danville Landing beds. Underlies Vicksburg group; overlies Cockfield formation of Claiborne group, transition zone. Upper Eocene.

C. W. Cooke, 1939, Jour. Paleontology, v. 13, no. 3, p. 337–340. Jackson raised to group rank in Mississippi where Moodys marl is basal formation. Name Moodys replaces name Gosport. Hence, Claiborne group restricted to formations heretofore classified as lower Claiborne.

L. D. Toulmin, Jr., 1940, Alabama Geol. Survey Bull. 46, p. 40–46. Gosport sand has been transferred from Claiborne group to Jackson group (Cooke, 1939). Cooke (1939) and Gardner (1939, U.S. Geol. Survey Prof. Paper 189–F) advocate dropping name Gosport and applying name Moodys marl to deposits in Alabama heretofore known as Gosport. In present report, name Gosport sand is retained for those beds in Alabama traditionally known by that name. Formations of Jackson group west of Tombigbee River are Moodys marl and Yazoo clay. Ocala limestone in eastern Alabama, southwestern Georgia, and Florida is probably equivalent to Moodys marl and Yazoo clay. Disconformably overlies Claiborne formation; conformably underlies Red Bluff clay of Vicksburg group.

G. E. Murray, 1947, Am. Assoc. Petroleum Geologists Bull., v. 31, no. 10, p. 1837–1839. In central Gulf Coastal Plain, sediments of Jackson age crop out in northwest-southeast-trending belt across central Mississippi and southern Alabama and in southwest-trending belt across central Louisiana. Isolated outcrops exposed in Embayment areas as far north as Kentucky. In type area, Jackson [group] consists of thin basal transgressive beach sand (Moodys formation) and an upper blue-gray fossiliferous clay (Yazoo). Yazoo is increasingly calcareous eastward and, in eastern Mississippi and western Alabama, is divisible into four members (ascending): North Creek clay (new), Cocoa sand, Pachuta marl (new), and Shubuta clay (new). In central Louisiana, Danville Landing formation is present above Yazoo clay. Farther east in Alabama entire Jackson changes to lime facies (Ocala limestone). Above Claiborne group; below Vicksburg group.

R. O. Vernon, 1951, Florida Geol. Survey Bull. 33, p. 11–172. Applin and Applin (1944) recognized in Jackson group and in Ocala limestone an upper and lower member and separated from base of Ocala limestone by about 80 feet of section that is composed of two lithologically and faunally distinct beds, about 30 and 50 feet thick. This interval is correlated with Moodys Branch formation, and names Williston and Inglis are here proposed for the two members. As used in this report [Citrus and Levy Counties], the upper Eocene, Jackson group of peninsular Florida, is composed of two formations, Ocala limestone (restricted) and Moodys Branch formation, Jackson-Claiborne contact is placed at top Avon Park limestone. Jackson group separated from older beds by disconformity.

J. F. L. Connell, 1958, Southwestern Louisiana Jour., v. 2, no. 4, p. 321–347. Discussion of Jackson group in Georgia. Outcrop area extends along inner edge of Coastal Plain from Seminole County to Savannah River Includes Ocala limestone and Barnwell formation. Cooper marl not believed to be present in Georgia.

D. H. Eargle, 1959, Am. Assoc. Petroleum Geologists Bull., v. 43, no. 11, p. 2623–2635. Jackson group in south-central Texas consists of (ascending) Caddell, Wellborn, McElroy, and Whitsett formations. Group is used in this report only as rock unit term.

H. V. Andersen, 1960, Louisiana Dept. Conserv., Geol. Bull. 34, p. 94–102, maps. In Sabine Parish, group comprises (ascending) Moodys Branch formation, Yazoo formation, Danville Landing beds, and Mosley Hill formation (redefined). Overlies Cockfield formation of Claiborne group; underlies Sandel formation (new). Oligocene.

Named for exposures at Jackson, Miss., along Peak River and Moodys Branch.

Jackson Limestone (in Greene Formation)[1]

Permian: Southwestern Pennsylvania.

Original reference: J. J. Stevenson, 1907, Geol. Soc. America Bull., v. 18, p. 97, 110, 112.

Exposed in Center and Jackson Townships, Greene County.

Jacksonboro Limestone[1]

Miocene, lower: Eastern Georgia.

Original reference: W. H. Dall, 1892, U.S. Geol. Survey Bull. 84, p. 83–84.

Occurs near confluence of Brier Creek and Beaver Dam Creek, which together form a tributary of Savannah River, 3 miles below Jacksonboro, Screven County.

Jacksonburg Limestone[1]

Middle Ordovician: Northern New Jersey and eastern Pennsylvania.

Original reference: H. B. Kümmel, 1908, U.S. Geol. Survey Geol. Atlas, Folio 161.

R. L. Miller, 1937, Geol. Soc. America Bull., v. 48, no. 11, p. 1687–1718. At type locality, the Jacksonburg consists of 135 feet of limestone, the lower 58 feet of which contain *Leperditia fabulites* Conrad and *Doleroides* sp. cf. *D. gibbosus* Billings. These beds are probably of Rockland age. Remaining 77 feet is of Hull and Sherman Fall age. Unconformably overlies Kittatinny limestone; underlies Martinsburg shales, some disconformity. In Pennsylvania, faunas of Hull and Sherman Fall age are present. In main belt of Jacksonburg, *Leperditia* zone has not been recognized, and near Stockertown the basal beds seem to be Hull. Formation divided into two parts on basis of lithology, the lower being the "cement limestone" facies and the upper being the "cement rock" facies. "Cement rock" east of Schuylkill River, which has been called Leesport, is assigned to Jacksonburg. Underlies Martinsburg shales; overlies Beekmantown.

Carlyle Gray, 1951, Pennsylvania Geol. Survey Prog. Rept. 136, p. 15–19. Name Jacksonburg applied in this paper to all impure limestones in part formerly called Leesport lying between Annville or Beekmantown formation and Martinsburg formation in Berks County. Thickness varies. Formation is absent in at least one area due to an erosional unconformity and elsewhere due to thrust-faulting. Intense folding and faulting and lack of large exposures make it difficult to estimate thickness. West of Womelsdorf, basal conglomeratic part of formation is estimated to be about 250 feet thick where fully developed and rest of formation may be as much as 750 feet thick. Whole formation disappears abruptly east of Womelsdorf, being hidden by thrust fault. Present in anticlinal embayment of Martinsburg shale northeast of Womelsdorf where basal conglomerate is absent and rest of formation is estimated to be not more than 700 feet thick. East of Schuylkill River and in bluffs 3 miles south of West Leesport, formation is more than 270 feet thick.

J. P. Hobson, Jr., 1957, Am. Assoc. Petroleum Geologists Bull., v. 41, no. 12, p. 2716 (fig. 3), In Berks County, Pa., overlies Ontelaunee formation (new) of Beekmantown group.

Bradford Willard, 1958, Pennsylvania Acad. Sci. Proc., v. 32, p. 177–183. In Lehigh and Delaware River valleys, overlies Coplay formation, name reinstated to replace term Beekmantown as applied to Lower and lower

Middle Ordovician beds between Upper Cambrian Allentown and Middle Ordovician Jacksonburg formations.

C. E. Prouty, 1959, Pennsylvania Geol. Survey, 4th ser., Bull. G-31, p. 28-29. Interval between Beekmantown group and Martinsburg formation, embodying essentially the Leesport in east-central Pennsylvania and in restricted sense the Jacksonburg of eastern Pennsylvania and western New Jersey, is divided into (ascending) Annville, Myerstown, and Hershey limestones. Myerstown corresponds to "cement limestone" of Jacksonburg and the Hershey to the "cement rock." Comparison of the Myerstown and Hershey to Jacksonburg of New Jersey indicates several megascopic as well as faunal differences; also, base of Jacksonburg is older than base of Myerstown. Subdivision of approximate Jacksonburg equivalents in Pennsylvania into formational units does not necessarily call for reclassification of Jacksonburg formation in New Jersey as classification in Pennsylvania does not involve typical Jacksonburg. However there is a separate problem as to status of type Jacksonburg. If Weller (1903, New Jersey Geol. Survey Rept. Paleontology, v. 3) is correct in assuming a Black River age for the lower and a Trenton age for the upper Jacksonburg, there is good cause for erecting separate formation names for upper and lower units and abandonment or redefinition of term Jacksonburg. If Miller (1937) is correct in assuming Trenton age for entire Jacksonburg (a view favored by present author), then there would be some cause to assign new names to the highly different lower and upper Jackonsburg, in which case the latter term might be elevated to group status, or alternatively, the subdivisions might be assigned formal member names with Jacksonburg maintaining its present formational status. Since a disconformity probably exists between lower and upper Jacksonburg, the choice of one name (Jacksonburg) to include units separated by a potential break might be an unfortunate one. As name Jacksonburg is deeply bedded in literature, it might best be preserved.

Named for occurrence at Jacksonburg, Warren County, N.J.

Jackson Butte Andesite

Neocene: Central California.

F. L. Ransome, 1899, U.S. Geol. Survey Geol. Atlas, Folio 63, p. 6. Massive andesite 400 to 500 feet thick. Light colored with slight reddish tint; small porphyritic crystals of dark hornblende.

Forms Jackson Butte, Amador County, Mother Lode district.

Jacksonian Stage

Eocene: Gulf and Atlantic Coastal Plain.

G. E. Murray and L. J. Wilbert, Jr., 1950, Am. Assoc. Petroleum Geologists Bull., v. 34, no. 10, p. 1990-1997. Jacksonian stage introduced as time and time-rock unit replacing Jackson formation and Jackson group as major division of Eocene sediments of Gulf and Atlantic Coastal Plain. Jacksonian stage is a time-rock unit which embraces all sediments deposited during time occupied by advance and retreat of late Eocene sea in Gulf and Atlantic coastal region. In this view, the earliest sediment which can be associated definitely with advance of this sea, or can be found to have been deposited during time sea was advancing, becomes Jacksonian; latest stratum which can be tied to retreat of this sea is included likewise. Identification of Jacksonian deposits is principally paleontological problem. Inherent in concept of Jacksonian stage is the thought that other major "lithologic" divisions of Gulf Coast Tertiary should be reconstituted in same manner. Hilgard (1860, Rept. of the geology and agriculture of State of Mississippi) used "Jackson stage;" Heilprin (1884, Philadelphia Acad. Nat. Sci. Jour., v. 9) and Dall (1898, U.S. Geol. Survey 18th Ann. Rept., pt. 2) used "Jacksonian;" most workers since then implied what we now know as "time-rock terminology" in their use of Jackson.

L. J. Wilbert, Jr., 1953, Arkansas Geol. Survey Bull. 19, p. 1–125. Discussion of Jacksonian stage in southeastern Arkansas. The outcrop areas is minimum distance of 60 miles from nearest Jacksonian exposure in coastwise belt. Jacksonian deposits include both marine and nonmarine strata. Name White Bluff formation given to marine unit and Redfield given to nonmarine unit. White Bluff formation overlies beds of Claiborne group. Paleontology of stage discussed.

Alan Cheetham, 1957, Gulf Coast Assoc. Geol. Soc. Trans., v. 7, p. 89–97. Fauna of Shubuta clay, "Red Bluff", marl, Forest Hill formation, and Bumpnose limestone has been considered intermediate between "typical Jacksonian" and "typical Vicksburgian" faunas. Cheilostome bryozans in these sediments are much more similar to those of Vicksburgian than to those of Jacksonian. Name *Spondylus dumosus* zone is proposed to designate sediments containing this fauna. Boundary between *Spondylus dumosus* zone and underlying Jacksonian is contact between what are commonly regarded as Oligocene and Eocene series in eastern Gulf Coast region. Correlation chart shows Moodys marl. Williston limestone, Inglis limestone, North Creek clay, Crystal River limestone, Cocoa sand, and Pachuta marl as Jacksonian.

C. W. Stuckey, Jr., 1960, Gulf Coast Assoc. Geol. Soc. Trans., v. 10, p. 285–298. Literature is reviewed relating to Jacksonian stage. Term Jacksonian stage is used as proposed by Murray and Wilbert (1950). All formation and member names from Rio Grande River in Texas, through Louisiana and Mississippi to western Alabama are incorporated in report.

Type section of Jackson group or Jackson formation (exposures in and around town of Jackson, Hinds County, Miss.) is designated as typical of Jacksonian stage. Outcrops in Jasper, Clarke, and Wayne Counties, Miss., and in Choctaw and Clarke Counties, Ala., are cited as alternative standard sections.

Jackson Park Shale Member (of Kanwaka Shale)[1]

Pennsylvanian (Virgil Series): Eastern Kansas and southeastern Nebraska.

Original reference: R. C. Moore, 1932, Kansas Geol. Soc. 6th Ann. Field Conf. Guidebook, p. 94, 96.

R. C. Moore and others, 1951, Kansas Geol. Survey Bull. 89, p. 67. Basal member of Kanwaka shale; underlies Clay Creek limestone member; overlies Kereford limestone member of Oread limestone. Thickness 16 to 52 feet.

Type locality: Jackson Park, southeastern part of Atchison, Atchison County, Kans.

Jacksonville Drift

Jacksonville Substage

Pleistocene (Illinoian): Illinois.

M. M. Leighton and H. B. Willman, 1949, *in* Itinerery of State Geologists Field Conference of late Cenozoic Geology of Mississippi Valley, p. 7

(table 1); 1950, Jour. Geology, v. 58, no. 6, p. 602 (fig. 2). Illinoian stage is divided into (ascending) Loveland, Payson, Jacksonville, and Buffalo Hart substages.

H. R. Wanless, 1957, Illinois Geol. Survey Bull. 82, p. 125 (fig. 50), geol. section 46, 48, 55, 58, 59, 64, 66. At maximum advance, Jacksonville glacier formed a large lobe that extended down broad lower Illinois Valley. Jacksonville drift contains much outwash sand and gravel. Greatest thickness of gravel is 46 feet, about one-third mile northwest of Frederick, in NE¼SE¼ sec. 7, T. 1 N., R. 1 E. Derivation of name given.

Named for Jacksonville in Scott County, which is on Jacksonville moraine.

†Jacksonville Formation[1]

Miocene, upper: Northeastern Florida.

Original reference: W. H. Dall, 1892, U.S. Geol. Survey Bull. 84, p. 124–125, 157, 158, 327.

Named for exposures in excavation made for city waterworks at Jacksonville, Duval County.

Jack Valley Formation

Silurian: Western Utah.

R. W. Rush, 1956, Utah Geol. and Mineralog. Survey Bull. 53, p. 9, 12 (fig. 3), 21–25, 40–41 (fig. 9), 53 (fig. 11), 60. Prososed for argillaceous black nodular dolomite ranging up to 250 feet thick, bearing strophomenid brachiopods. Overlies Roberts Mountain [s] dolomite; unconformably underlies Decathon dolomite (new). Part of Jack Valley is exposed in fault blocks in Ibex Hills and at head of Kings Canyon; base of unit not exposed at any of these localities where Jack Valley lies in fault contact with other units. Upper part of Jack Valley is series of interbedded medium- and dark-gray dolomite beds that differ somewhat from typical nodular dolomite below. Probably unsolved facies or stratigraphic tongue problem exists in Jack Valley unit.

Well exposed on west side of Jack Valley, in Confusion Mountains, sec. 25, T. 21 S., R. 15 W., Millard County.

Jacob Sand[1]

Pleistocene: Southeastern New York and islands of southern New England.

Original reference: M. L. Fuller, 1905, Geol. Soc. America Bull., v. 16, p. 367–390.

Lawrence Weiss, 1954, U.S. Geol. Survey Prof. Paper 254–G, p. 146. Jacob sand is supposedly transition zone between interglacial Gardiners clay below and glacial Manhasset formation above. At type locality, buff fine-grained clayey sand, consisting chiefly of quartz grains, muscovite, and some dark minerals.

Named for exposures [type locality] near Jacobs Hill on north shore of Long Island, 8 miles northeast of Riverhead.

Jacobs Chapel Shale

Lower Mississippian: Indiana.

Guy Campbell, 1946, Geol. Soc. America Bull. 57, no. 9, p. 855–856. Soft greenish to dark-green glauconitic sparsely fossiliferous shale. Thickness about 9 inches. Lies between top of New Albany shale and Rockford limestone. Included in the Kinderhook and in Rockford by some workers.

Type section: One mile west of Jacobs Chapel Church, in lot 85 Clark Grant, Clark County.

Jacobsville Sandstone[1]

Jacobsville Formation

Precambrian or Cambrian; Northern Michigan.

Original reference: A. C. Lane and A. E. Seaman, 1907, Jour. Geology, v. 15, p. 680, 692.

F. T. Thwaites, 1943, Michigan Acad. Sci., Arts and Letters Papers, v. 28, p. 496–497, 501. Age of Jacobsville sandstone not yet established; quite likely Upper Keweenawan. Probably nonmarine deposits.

W. S. White, H. R. Cornwall, and R. W. Swanson, 1953, U.S. Geol. Survey Geol. Quad. Map GQ–27. Sandstone as exposed in southeast corner of Ahmeek quadrangle consists primarily of buff or salmon-colored fine- to coarse-grained sandstone with subordinate amounts of reddish-brown pebble conglomerate. Beds cropping out in quadrangle probably represent about 500 feet of formation. Drill hole records indicate thickness of at least 1,800 feet. Precambrian or Cambrian.

W. K. Hamblin, 1958, Michigan Dept. Conserv. Geol. Survey Div. Pub. 51, p. 6 (fig. 1), 15–69. Formation discussed in detail. Four lithic units recognized in formation; conglomerate facies, lenticular sandstone facies, massive sandstone facies; and red siltstone facies. Thickness varies because of relief of Precambrian surface on which formation was deposited. Underlies Munising formation; in some areas, covered by glacial drift. Along most of Lake Superior coast from Munising to Beaver Lake, the Jacobsville is below water level. Age has been matter of conjecture for many years. Discussion of factors favoring Keweenawan age and evidence opposing Keweenawan age. Unconformity between Jacobsville and Munising formations exposed at Grand Island proves that the Jacobsville is older than Upper Cambrian. It is impossible to estimate magnitude of this unconformity and to state whether the Jacobsville is Lower and Middle Cambrian or Upper Keweenawan. Evidence opposing Keweenawan age for Jacobsville appears to be quite substantial. Writer [Hamblin] concludes that the Jacobsville represents continental deposition in an enclosed basin during time marine sediments of Lower and Middle Cambrian age were being deposited in other parts of country. Formation was named by Lane and Seaman (1907). Term was applied to red sandstone east of Copper Range. It includes "lower red member" of Houghton's "Lake Superior sandstone" and most of "Eastern sandstones" of Irving (1883, U.S. Geol. Survey Mon. 5).

Named for exposures at Jacobsville, Houghton County.

Jacque Mountain Limestone Member (of Minturn Formation)

Jacque Mountain Limestone Member (of Battle Mountain Formation)

Jacque Mountain Limestone Member (of Maroon Formation)[1]

Pennsylvanian: Western central Colorado.

Original reference: S. F. Emmons, 1898, U.S. Geol. Survey Tenmile Spec. Folio 48.

K. G. Brill, Jr., 1942, Am. Assoc. Petroleum Geologists Bull., v. 26, no. 8, p. 1376 (fig. 1), 1378 (fig. 2), 1379–1380, 1389. Reallocated to member status in Battle Mountain formation (new). Overlies Robinson limestone member; lies near top of formation, about 120 feet below State Bridge formation (new). Thickness about 30 feet; locally splits into two limestone beds 100 feet apart.

Ogden Tweto, 1949, Colorado Sci. Soc. Proc., v. 15, no. 4, p. 152 (table 1), 204–205, 207–208. Reallocated to member status in Minturn formation. Overlies White Quail limestone member; top of member marks top of Minturn as here defined. Typically 15 to 25 feet of dark-bluish to light-gray fine-grained limestone, some parts of which are characteristically oolitic. Contains cephalopods and gastropods that might be either Pennsylvanian or Permian, but evidence slightly favors Pennsylvanian age.

First described from slopes of Jacque Mountain, Tenmile district.

Jacumba Volcanics[1]

Tertiary, upper, and Quaternary: Southern California.

Original reference: W. J. Miller, California Jour. Mines and Geology, v. 31, no. 2, p. 138–140, map.

G. B. Oakeshott, 1951, Am. Assoc. Petroleum Geologists Bull., v. 35, no. 2, p. 258. Listed on generalized stratigraphic section as basalt and pyroclastics several hundred feet thick. Older than Saugus formation and younger than Pico formation.

Exposed in several areas north and east of Jacumba, San Diego County.

Jaeger Diorite Complex

Age not stated: Central southern Arizona.

Leonid Bryner, 1958, Dissert. Abs., v. 19, no. 6, p. 1341. With metamorphic inclusions. Comprises oldest group of rocks in mapped area. Intruded by Ko Vaya quartz monzonite (new). Older than clastic sediments of continental, fluviatile origin, which are inferred to be Lower Cretaceous.

In South Comobabi Mountains and Ko Vaya Hills, Papago Indian Reservation, Pima County.

Jagger Bend Limestone Member (of Belle Plains Formation)[1]

Jagger Bend Limestone (in Belle Plains Group)

Permian: Central Texas.

Original reference: N. F. Drake, 1893, Texas Geol. Survey 4th Ann. Rept., pt. 1, p. 421, 426.

M. G. Cheney, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 1, p. 66 (fig. 1). Rank raised to formation in Belle Plains group.

R. C. Moore, 1949, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 80, sheet 2. Mostly dark-blue-gray medium-grained hard even layers that contain abundant minute vermicular foraminiferal debris; lowermost limestone bed is rather conspicuous yellow-brown limestone 2 to 3 feet thick; other beds mostly weather gray; thin shales between the limestones are dark blue to brownish and clayey. Thickness about 85 feet. Underlies Valera shale member; overlies Voss shale member.

P. T. Stafford, 1960, U.S. Geol. Survey Bull. 1081–G, p. 274, pls. 11, 12. Member geographically extended into Brazos River valley. Thickness 60 to 120 feet. Overlies Voss shale member; underlies Valera shale member, boundary not distinct.

Named from westward loop of Colorado River located short distance southwest of Leaday, Coleman County.

Jake Creek Sandstone Member (of Carbondale Formation)

Jake Creek Sandstone (in Carbondale Group)

Pennsylvanian: West-central Illinois.

H. R. Wanless, 1957, Illinois Geol. Survey Bull. 82, p. 89, 204. Thin-bedded fine-grained micaceous sandstone in Liverpool cyclothem. Sandstone only locally present but has maximum thickness of about 18 feet. Occurs above Francis Creek shale and below Oak Grove beds.

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 35. Rank reduced to member status in Carbondale formation (redefined). Occurs above Francis Creek shale member and below Lowell coal member. Presentation of new rock-stratigraphic classification of Pennsylvanian strata in Illinois.

Type locality: On Jake Creek, NE¼ sec. 13, T. 4 N., R. 1 E., Vermont quadrangle, Fulton County.

Jakes Creek Formation

Pennsylvanian: Eastern Nevada and western Utah.

Grant Steele, 1960, Dissert. Abs., v. 20, no. 12, p. 4635. Incidental mention in stratigraphic interpretation of Pennsylvanian-Permian systems of eastern Great Basin. In list of formations [sequence not stated], Jakes Creek follows Strathearn and precedes Carbon Ridge.

Type locality and derivation of name not stated.

Jalama Formation

Upper Cretaceous: Southern California.

T. W. Dibblee, Jr., 1950, California Div. Mines Bull. 150, p. 23–24, 38 (fig. 2), pls. 1, 2. Consists of about 4,000 feet of clay shales and sandstones overlying Espada formation (new) and disconformably underlying Eocene Anita shale. At type locality, 2,850 feet exposed; here relationship to overlying Anita shale is accordant. In Santa Rosa hills, overlain by Anita shale and Sierra Blanca limestone with angular unconformity of about 15°.

Type locality: Divide between Santa Anita and Bulito Canyons, in the Santa Ynez Mountains, Santa Barbara County.

Jameco Gravel[1] or **Formation**[1]

Pleistocene: Southeastern New York and islands of southern New England.

Original reference: A. C. Veatch, 1903, Jour. Geology, v. 11, p. 766–776.

Lawrence Weiss, 1954, U.S. Geol. Survey Prof. Paper 254–G, p. 145–146. Thickness of gravel about 100 feet in western Long Island. Recognized in well samples by its characteristically high content of diabase fragments and its position beneath Gardiners clay. Not recognized with certainty in eastern part of island. Considered younger than Mannetto gravel on basis of degree of weathering.

Named for Jameco pumping station of Brooklyn water works, a few miles south of Jameco, N.Y., where borings first revealed the beds. Recognized on Block Island, Marthas Vineyard, and Cape Cod.

James Limestone (in Trinity Group)

James Limestone Bed (in Pine Island Member of Glen Rose Formation)

James Limestone Member (of Pearsall Formation)

Lower Cretaceous (Comanche Series): Subsurface in Louisiana, Arkansas, and Texas.

W. B. Weeks, 1938, Am. Assoc. Petroleum Geologists Bull., v. 22, no. 8, p. 961 (fig. 4), 970. Bed in upper part of Pine Island member of Glen Rose. Oolitic coquinoid to sandy gray lime and fine sand. Apparently correlative with Dierks limestone of outcrop.

R. W. Imlay, 1944, U.S. Geol. Survey Oil and Gas Inv. Prelim. Chart 3. Referred to as James limestone (in Trinity group). Underlies Rodessa formation; overlies Pine Island shale.

J. M. Forgotson, Jr., 1957, Am. Assoc. Petroleum Geologists Bull., v. 41, no. 10, p. 2342–2346. Member of Pearsall formation; overlies Pine Island member. For purposes of this study, defined as stratigraphic interval and its correlative rock equivalents in W. C. Feazel's Tonway Smith well No. 1, sec. 18, T. 21 N., R. 2 E., Union Parish, La., between depths of 4,255 and 4,370 feet. Separated from overlying Rodessa by variable interval referred to as Bexar shale member of its equivalent. Cow Creek member is both rock-stratigraphic and time-stratigraphic equivalent of James member.

Named for Arkansas Fuel Oil Co. James well No. 1 in sec. 14, T. 20 N., R. 1 E., Union Parish, La., from 3,827 to 3,917 feet.

†Jamesburg Formation[1]

Pleistocene: New Jersey.

Original reference: R. D. Salisbury, 1894, New Jersey Geol. Survey Ann. Rept. 1893, p. 60–72.

Well exposed in upper part of railway excavation near Jamesburg, Middlesex County.

Jameson Shale Member (of Markley Sandstone)

Eocene: Northwestern California.

C. E. Weaver, 1941, Geol. Soc. America Mem. 35, p. 17 (table 3), 62–64. Consists of light-creamy-white to tan thinly laminated siliceous and sandy shales, often paper shales. Thickness 200 to 1,200 feet. Base of shale about 1,400 feet above base of Markley; both top and base of Jameson are gradational into sandstone.

Named from Jameson Canyon in Carquinez quadrangle, north of San Francisco Bay. Occupies a single area between Elkhorn Peak and Napa Junction, Napa County.

†James River Series[1]

Lower Cretaceous: Eastern Virginia.

Original reference: L. F. Ward, 1895, U.S. Geol. Survey 15th Ann. Rept., p. 318.

Well exposed on James River from Richmond to Dutch Gap Canal, on Appomattox from below Petersburg to near its mouth, and on west bank of Potomac between Mount Vernon and Aqui Creek.

James River Shale[1]

Devonian(?): Southwestern Missouri.

Original reference: E. M. Shepard, 1905, Bradley Geol. Field Sta. Drury Coll. Bull., v. 1, pt. 2, p. 56, 67.

Occurs along and near James River.

Jamestown Coal Member (of Carbondale Formation)

Pennsylvanian: Southern Illinois.

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 34, 48 (table 1), pl. 1. Assigned member status in Carbondale formation (redefined). Occurs above Brereton limestone member and below Conant limestone member (new). Coal named by Bell and others (1931, Illinois Geol. Survey Ill. Pet. 19). Presentation of new rock-stratigraphic classification of Pennsylvanian strata in Illinois.

Type locality: NW¼NE¼ sec. 34, T. 5 S., R. 4 W., Perry County.

Jamestown Conglomerate[1]

Upper Devonian: Western New York.

Original reference: G. D. Harris, 1891, Am. Geologist, v. 7, p. 164–174.

Occurs at Jamestown, Chautauqua County.

Jamestown cyclothem (in Carbondale Formation)

Jamestown cyclothem (in Carbondale Group)

Pennsylvanian: Southeastern Illinois.

J. M. Weller, 1942, Illinois Acad. Sci. Trans., v. 35, no. 2, p. 145 (table 1). In list of cyclothems in McLeansboro, occurs below Bankston Fork cyclothem and above Brereton cyclothem.

H. R. Wanless and Raymond Siever, 1956, Illinois Geol. Survey Circ. 217, p. 10, pl. 1. Shown on correlation chart at top of Carbondale group. Includes Pokeberry limestone in western Illinois and Jamestown limestone in southern Illinois. Type locality given.

H. R. Wanless, 1957, Illinois Geol. Survey Bull. 82, p. 113. Believed to be equivalent of Pokeberry cyclothem.

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 52 (table 2), pl. 1. In Carbondale formation (redefined). Above Brereton cyclothem; in some areas, below Sparland cyclothem and in others below Bankston. Presentation of new rock-stratigraphic classification of Pennsylvanian strata in Illinois; cyclical classification independent of rock-stratigraphic classification.

Type locality: NW¼NE¼ sec. 34, T. 5 S., R. 4 W., Perry County.

Jamestown Limestone (in Carbondale Group)

Jamestown Limestone (in McLeansboro Group)

Jamestown Limestone Member (of McLeansboro Formation)[1]

Pennsylvanian: Southwestern Illinois.

Original reference: A. H. Bell, C. Ball, and L. McCabe, 1931, Illinois Geol. Survey Press Bull. 19.

J. M. Weller, L. G. Henbest, and C. O. Dunbar *in* C. O. Dunbar and L. G. Henbest, 1943, Illinois Geol. Survey Bull. 67, p. 17 (fig. 3). Shown on columnar section as limestone in McLeansboro group; stratigraphically below Anvil Rock sandstone and above Herrin limestone.

H. R. Wanless and Raymond Siever, 1956, Illinois Geol. Survey Inf. Circ. 217, p. 10. Shown on correlation chart as limestone in Jamestown cyclothem at top of Carbondale group. Type locality given.

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 35, 54 (table 3). Replaced by Conant Limestone Member (new) of Carbondale Formation (redefined). Name Jamestown will be used for the coal beneath the limestone. Presentation of new rock-stratigraphic classification of Pennsylvanian strata in Illinois; cyclical classification independent rock-stratigraphic classification.

Type locality: NW¼NE¼ sec. 34, T. 5 S., R. 4 W., in vicinity of Jamestown, Perry County.

Jamesville Limestone Member (of Manlius Limestone)

Jamesville Limestone[1] (in Manlius Group)

Lower Devonian: Central New York.

Original reference: Burnett Smith, 1929, New York State Mus. Bull. 281, p. 26, 27, 30–31.

G. H. Davis 3d, 1953, New York State Mus. Circ. 35, p. 8, 9, 10. Termed a member.

L. V. Rickard, 1955, New York State Geol. Assoc. Guidebook 27th Ann. Mtg., p. 2 (columnar section), 4–5, 7. In central New York, underlies Deansboro member (new) of Coeymans limestone. Jamesville and Clark Reservation are grouped together under heading of transitional beds between Manlius group and Helderberg group above.

U.S. Geological Survey currently classifies the Jamesville as a member of the Manlius and designates its age as Lower Devonian on the basis of a study now in progress.

Type section: At "Green Lake" State Park (Clark Reservation), west of Jamesville, town of De Witt, Onondaga County.

Jane Lew Sandstone (in Conemaugh Formation)[1]

Jane Lew Sandstone (in Pittsburgh Redbeds)

Pennsylvanian: Southwestern Pennsylvania and northern West Virginia.

Original reference: D. B. Reger, 1916, West Virginia Geol. Survey Rept. Lewis and Gilmer Counties, p. 153.

W. O. Hickok 4th and F. T. Moyer, 1940, Pennsylvania Geol. Survey, 4th ser., Bull. C–26, p. 95. Jane Lew is a thin hard sandstone, 8 to 10 feet thick; occurs at several places in Pittsburgh redbeds.

Named for exposures on Hackers Creek, just east of Jane Lew, Lewis County, W. Va.

Janesville Shale (in Admire Group)

Permian: Southeastern Kansas.

R. C. Moore and M. R. Mudge, 1956, Am. Assoc. Petroleum Geologists Bull., v. 40, no. 9, p. 2273, 2274 (fig. 1). Defined to include strata between Foraker limestone above and Falls City limestone below. Average thickness 75 feet. Includes (ascending) West Branch shale, Five Point limestone, and Hamlin shale members.

Type section: In cut on east-west road in SW¼SE¼ sec. 23, T. 23 S., R. 10 E., Greenwood County. Name derived from Janesville Township.

Jangle Limestone Member (of Cadiz Formation)

Jangle Limestone

Middle Cambrian: Southern Nevada.

M. S. Johnson and D. E. Hibbard, 1957, U.S. Geol. Survey Bull. 1021–K, p. 339–340, pls. 32, 33. Name Jangle limestone substituted for Peasley limestone of Wheeler (1940) in Pioche and Groom districts because of differences in thickness, lithologic characteristics, and possibly in formational boundaries. Subdivided into three units each of which consists of limestone. Lower unit, 80 feet thick, consists of dark-smoky-gray to steel-gray prominent ledge-forming limestone containing buff irregular silty partings. Lower 40 feet of this unit includes some well-bedded finely crystalline limestone beds a few inches thick; remaining 40 feet dominantly resistant calcitic poorly to fairly well-bedded limestone. Middle unit, 115 feet thick, consists of dark-gray limestone containing buff to reddish-brown silty material which is distinctive for its slope-forming character. Upper unit, 80 feet thick, consists of dark-gray to smoky-gray ledge-forming limestone containing a few buff silty partings and round, concentric algal masses. Thickness 275 feet where completely exposed on Jangle Ridge. Conformably overlies Chisholm shale; conformably underlies Yucca Flat formation (new). Lower boundary is at lithologic break between shale and overlying limestone. Upper contact is at break between dark-gray limestone of Jangle and lowest, light-gray limestone bed of Yucca Flat.

U.S. Geological Survey classifies the Jangle Limestone as a member of the Cadiz Formation on the basis of a study now in progress.

Named for outcrops on Jangle Ridge, Atomic Energy Commission Nevada Proving grounds area, Nye County.

Janssen Clay Member (of Dakota Formation)

Upper Cretaceous: Central and north-central Kansas.

Norman Plummer, 1942, (abs.) Compass, v. 22, no. 4, p. 327. Dakota as defined here is subdivided into two members, Terra Cotta (lower) and Janssen (upper).

Norman Plummer and J. F. Romary, 1942, Kansas Geol. Survey Bull. 41, pt. 9, p. 336–340. Consists largely of gray to dark-gray clay and silt, some beds of fissile shale, and commonly a bed of lignite or highly lignitic clay; gray clay in lower half contains zones of siderite or limonite pellets, but no hematite. Thickness 30 to 80 feet, near minimum thickness in type area. Overlies Terra Cotta member, contact is drawn at top of marked concentration of concretionary "iron"; in places "quartzitic" silt or fine sand underlies concretionary "iron" bed; underlies Graneros shale.

Type area: Near center line sec. 3, T. 16 S., R. 9 W., near Janssen Station, Ellsworth County.

Jarbidge Rhyolite

Miocene, upper (?) : Northeastern Nevada.

R. R. Coats, 1957, U.S. Geol. Survey Trace Elements Inv. Rept. TEI–690, Book 2, p. 305–306. Quartz-rich rhyolitic rocks. Thickness at least 2,000 feet; unit sliced into number of fault blocks and reliable stratigraphic markers not recognized within it; hence, total thickness difficult to determine. Overlies Deadhorse tuff (new). In northeastern quarter of quadrangle, disconformably underlies Gods Pocket dacite (new) ; locally 30 to 50 feet of pale-gray vitric tuff separates the units.

U.S. Geological Survey currently considers the Jarbidge Rhyolite to be upper Miocene (?) in age.

Named for occurrence in Jarbidge quadrangle.

Jardine Basalt

[Pre-Paleozoic] : Southwestern Montana.

A. D. Howard, 1937, Geol. Soc. America Spec. Paper 6, p. 16–17, pl. 4. "Basalt" exposed at summit of minor peak which is composed of Precambrian schist. Exposure is weathered brown. Rock is metamorphosed. Degree of metamorphism comparable to that exhibited by the schist, so that locally the rock is true schist, and elsewhere, where intimately penetrated by silica, is fine-textured gneiss. Rock probably represents an ancient basic intrusion in old metamorphic rocks, because Paleozoic formations show no such metamorphism.

Caps mountain on east side of Bear Gulch ("Bear Creek" of Yellowstone folio), just east of town of Jardine. Lies at altitude of about 8,400 feet.

Jarita Basalt Member (of Los Pinos Formation)

Miocene(?) or Pliocene(?) : Central northern New Mexico.

Fred Barker, 1958, New Mexico Bur. Mines Mineral Resources Bull. 45, p. 3, 38 (table 5), 46–48, pl. 1. Flows of olivine basalt; widely separated, disconnected single and multiple flows. Divided into unnamed northern, central, and southern types based primarily on petrographic characteristics. Maximum thickness 50 feet. Disconformably underlies Cordito member (new) ; overlies Esquibel member (new). Name credited to Butler (unpub. dissert.).

Named from an elongate exposure along western rim of La Jarita Mesa northeast of Vallecitos; Las Tablas quadrangle.

Jarvis Church Conglomerate Member (of Konawa Formation)

Permian: East-central Oklahoma.

W. F. Tanner, 1956, Oklahoma Geol. Survey Bull. 74, p. 110–111, pl. 1. Name applied to multicolored cherts that occur about 250 feet above base of formation. Member is a single bed about 10 feet thick. Crossbedding and torrent bedding are common; uppermost horizon is clay pebble conglomerate which grades upward into thin crossbedded sandstone, thin limy sandstone, or marllike shale.

Typically developed near Jarvis Church, in sec. 23, T. 10 N., R. 5 E., Seminole County.

Jasper conglomerate[1]

Precambrian: Southwestern Minnesota and northwestern Iowa.

Original references: C. R. Keyes, 1914, Iowa Acad. Sci. Proc., v. 21, p. 187; 1914, Science, new ser., v. 40, p. 144.

Probably named for Jasper, Pipestone County, Minn.

Jasper Member (of Everton Formation)

Jasper Limestone[1]

Middle Ordovician: Northern Arkansas.

Original reference: A. H. Purdue and H. D. Miser, 1916, U.S. Geol. Survey Geol. Atlas, Folio 202.

E. E. Glick and S. E. Frezon, 1953, U.S. Geol. Survey Circ. 249, p. 3 (fig. 2), 4, 5, 6. Rank reduced to member of Everton. Separated from underlying Newton sandstone member by sequence of dolomite, sandy dolomite, and dolomitic sandstone beds about 90 feet thick; underlies St. Peter sandstone. Middle Ordovician.

Named for Jasper, Newton County.

Jasper Creek Shale (in Graford Formation)[1]

Pennsylvanian: Central northern Texas.

Original reference: G. Scott and J. M. Armstrong, 1932, Texas Univ. Bull. 3224, p. 33.

Occurs in valley of Jasper Creek, Wise County, and on slopes of escarpment to west.

Jasper Knob zone (in Negaunee Formation)[1]

Precambrian (middle Huronian) : Northern Michigan.

Original reference: J. L. Adler, 1935, Jour. Geology, v. 43, no. 2, p. 113–132.

Type locality: Southeastern part of Ishpeming, northern slope of Jasper Knob, Marquette County.

Jasper Lake Greenstone Conglomerate or Agglomerate (in Knife Lake Series)

Precambrian: Northeastern Minnesota.

J. W. Gruner, 1941, Geol. Soc. America Bull., v. 52, no. 10, p. 1583 (table 1), 1593–1594, pl. 1. Name applied to greenstone conglomerate or agglomerate that extends from Conglomerate Lake to end of map area 7 miles to east. Consists principally of two kinds of fragments: hornblende andesite with phenocrysts (metacrysts) of hornblende, and dense andesitic ones without any visible crystals. Unweathered rock is grayish or bluish green. Thickness 10,000 to 15,000 feet; this may be result of repetition of beds due to shallow asymmetric folding (pl. 1, cross section S–T). In this report, Knife Lake series is divided into 20 members. Table of approximate chronological sequence (ascending) shows Jasper Lake greenstone conglomerates as unit 4 occurring above Disappointment Mountain and Moose Lake greenstone conglomerates and below unnamed quartz porphyry conglomerates.

Extends from Conglomerate Lake in sec. 24, T. 65 N., R. 6 W., Lake County, Knife Lake area.

Java Formation

Upper Devonian: Western and central New York.

Wallace de Witt, Jr., 1960, Am. Assoc. Petroleum Geologists Bull., v. 44, no. 12, p. 1933–1939. Proposed for cyclically deposited Upper Devonian rocks in western and central New York that have been described previously (Pepper and de Witt, 1950) as Wiscoy sandstone and equivalent Hanover shale. Thicknesses: 94 feet at Silver Creek; 113 feet at Java village; 165 feet at Wiscoy; 185 feet in western Steuben County; more than 200 feet in central and eastern Steuben County. Comprises Pipe Creek shale, Hanover shale, and Wiscoy sandstone members. In western part of State, offshore shale and mudrock facies, Pipe Creek and Hanover members are dominant; in central part of State, near-shore siltstone and sandstone facies, Wiscoy sandstone, is dominant. Overlies West Falls formation; underlies Perrysburg formation.

Type section: Exposures along Beaver Meadow Creek above Angel Falls. Recognizable from Silver Creek, Chautauqua County eastward for more than 120 miles across parts of Cattaraugus, Erie, Wyoming, Allegany, Ontario, and Steuben Counties. Named from Java Township, Wyoming County.

Jawbone Conglomerate Member (of Kiawa Mountain Formation)

Precambrian: Central northern New Mexico.

Fred Barker, 1958, New Mexico Bur. Mines Mineral Resources Bull. 45, p. 1, 10, 25, pl. 1. Mostly quartz-pebble conglomerate with varying amounts of interlayered gray quartzite. The pebbles are light-gray, red, and black quartz, range from 4 to 25 mm in size, and are moderately well sorted, very well rounded, and mostly ovoid in shape. Granules and coarse grains of sand about as abundant as the pebbles. Matrix of conglomerate mostly blue-gray vitreous fine-grained kyanitic quartzite with hematitic layers. Crossbedding widespread. Some conglomerate is dark gray and slightly micaceous. Thickness on Jawbone Mountain at least 500 feet and perhaps as much as 2,000 feet; about 500 feet in canyon 1 mile southwest of Hopewell, and from there southeastward member appears to finger out into [lower] quartzite member. Underlies [lower] quartzite member and overlies Moppin series (new) from about 1½ miles west-northwest of Burned Mountain northwestward for several miles to west boundary of quadrangle.

Underlies Jawbone Mountain in extreme northwest corner of Las Tablas quadrangle. Also mapped in small area about 1½ miles northwest of Burned Mountain.

Jayville Granite (in Diana Syenite Complex)

Precambrian: Northeastern New York.

A. F. Buddington, 1939, Geol. Soc. America Mem. 7, p. 84, 85, 285, 286. Thought to be facies of Diana complex. Contains band of amphibolite and local masses of skarn thought to represent metamorphosed Grenville calcareous beds.

Present in Oswegatchie quadrangle. Jayville is in St. Lawrence County.

Jealousy Formation

Oligocene, upper: St. Croix, Virgin Islands (subsurface and surface).

D. J. Cederstrom, 1941, Am. Jour. Sci., v. 239, no. 8, p. 557. Name applied to gray clays and associated conglomerates that underlie Kingshill marl. Not known to crop out.

D. J. Cederstrom, 1950, U.S. Geol. Survey Water-Supply Paper 1067, p. 19–20, 68 (table 3), pl. 1. In central part of plain, test hole near Bethlehem shows that Kingshill marl is underlain by dark clayey formation known to be at least 1,938 feet thick; maximum thickness not known as base not reached. Section shows (ascending) 305 feet of dark clay with streaks of limestone, 5 feet of calcareous conglomerate, and 987 feet of greenish-gray clay. Name Jealousy formation is given to these sediments; above described section is type section. Near Jealousy estate, formation is 368 feet thick, and test drilling (well 39) shows 61 feet of hard calcareous conglomerate immediately above basement of Mount Eagle volcanics. Calcareous conglomerate that underlies Kingshill marl in stream beds near Jealousy is believed to be basal conglomerate of Jealousy formation.

Type section: Well 41, at Fredensborg.

Jeddito Formation

Pleistocene: Northeastern Arizona.

J. T. Hack, 1941, Geog. Review, v. 31, no. 2, p. 262–263; 1942, Harvard Univ. Peabody Mus. Am. Archaeology and Ethnology Papers, v. 35, no. 1, p. 48–51. Composed dominantly of russet-colored sand. Derived primarily by erosion of deposits on the mesas, sorted and transported by streams, ephemeral or perennial. Portion in lower part of valley is sandy, flood-plain deposit. In upper part of valley it is probably in places a channel deposit and in places a flood-plain deposit. Contains abundant layers of hard caliche in many places. Capped by 2 feet of fairly pure and hard limestone at one locality; more common are thin layers of sand, cemented by calcium carbonate. Recognized in most places by russet color and concretionary layers of caliche. Thickness at one measured section 9 feet. Underlies Tsegi formation (new). Contains proboscidian remains. Late Quaternary age.

C. B. Hunt, 1953, U.S. Geol. Survey Bull. 996–A, p. 4. In western Navajo country, proposed boundary between Pleistocene and Recent would be at top of Jeditto formation.

Best exposed in central part of Jeddito Valley [spelled Jadito on U.S. Geol. Survey Topog. Map or Arizona (1:500,000) for 1957] in stretch between Jeddito Trading Post and Awatovi, in western Navajo country.

Jeff Conglomerate (in Vieja Group)

Jeff Conglomerate Member (of Huelster Formation)

Tertiary: Southwestern Texas.

G. K. Eifler, Jr., 1951, Geol. Soc. America Bull., v. 62, no. 4, p. 343, pl. 1. Name applied to a sandstone and conglomerate unit constituting lowest beds of Huelster formation (new). Average thickness 25 feet. Conformably underlies volcanic tuff; lies with slight angular unconformity upon Taylor marl and Austin chalk.

R. K. DeFord, 1958, Texas Jour. Sci., v. 10, no. 1, p. 14. Usage of name extended into Rim Rock country and applied to basal conglomerate of Vieja group. In southern part of area, Gill breccia (new) intervenes between the basal conglomerate and Colmena tuff (new); northward the breccia pinches out and the conglomerate thickens, presumably as the lower part of Colmena tuff grades into conglomerate so that on north a major part of the interval between Buckshot ignimbrite (new) and base of Vieja group is occupied by conglomerate.

Type locality: In tributary ravine on left bank of Horse Thief Canyon about 3½ miles upstream from its junction with Limpia Creek near the Jeff Ranch, Barrilla Mountains, Reeves County.

Jeff Davis Granite

Precambrian(?): Northwestern Georgia.

J. W. Clarke, 1952, Georgia Geol. Survey Bull. 59, p. ix, 6 (table), 23–28, pl. 3. Garnetiferous biotite granite intrusive into metasediments overlying quartzite member of Manchester formation.

Named for exposures near Jeff Davis School, 5 miles northwest of Thomaston. Upson County. Batholith underlies large part of central and eastern parts of Thomaston quadrangle.

Jefferson Limestone,[1] Dolomite,[1] Formation, or **Group**

Upper Devonian: Montana, south-central and northern Idaho, northern Utah, and western Wyoming.

Original reference: A. C. Peale, 1893, U.S. Geol. Survey Bull. 110.

C. F. Deiss, 1933, Montana Bur. Mines and Geology Mem. 6, p. 41–45. Jefferson limestone, in northwestern Montana, subdivided into (ascending) White Ridge limestone, Glenn Creek shale, Coopers Lake limestone, Lone Butte limestone, and Spotted Bear limestone members. Middle Devonian.

G. B. Richardson, 1941, U.S. Geol. Survey Bull. 923, p. 19, pls. 1, 6. In Randolph quadrangle, Utah-Wyoming, Jefferson dolomite consists of about 1,200 feet of massive fine-grained dark-colored dolomite, which weathers to characteristic brown. Overlies Laketown dolomite and underlies Three Forks limestone; both contacts conformable. Middle Devonian.

G. A. Cooper and others, 1942, Geol. Soc. America Bull., v. 53, no. 12, pt. 1, p. 1768–1769, chart 4. Upper Devonian.

G. W. Berry, 1943, Geol. Soc. America Bull., v. 54, no. 1, p. 9 (fig. 3), 10–14. In Three Forks area, formation consists of dark-colored limestone in lower part and dark-colored dolomite in upper part. Unconformably overlies Dry Creek shale; underlies Three Forks formation. Middle and Upper Devonian.

L. L. Sloss and W. M. Laird, 1947, Am. Assoc. Petroleum Geologists Bull., v. 31, no. 8, p. 1407–1410, 1411–1412, 1415–1418. Formation, in central Montana, composed of an upper dolomite member, including some anhydrite or evaporite-solution breccia, and lower dense limestone member. In Three Forks area, breccia zone and overlying nonresistant shale of Three Forks formation are imperfectly exposed or entirely covered. To facilitate mapping, it would be more logical to revise Peale's (1893) classification and assign the breccias and associated shales to the Three Forks; but where the breccias are well exposed, as in type section, their genetic and lithologic relationships with main body of dolomite below are clear. Thickness 715 feet at Logan. Term Potlatch is applicable throughout Sweetgrass area subsurface and its use is recommended over Three Forks and Jefferson for that area.

C. P. Ross, 1947, Geol. Soc. America Bull., v. 58, no. 12, pt. 1, p. 1107–1108. In Borah Peak quadrangle, Idaho, Jefferson dolomite is about 1,000 feet thick, overlies Laketown dolomite and underlies Grand View dolomite.

J. S. Williams, 1948, Geol. Soc. America Bull., v. 59, no. 11, p. 1130 (table), 1139–1141. Formation, in Logan quadrangle, Utah, subdivided into (ascending) Hyrum dolomite and Beirdneau sandstone members (both new). Thickness as much as 2,120 feet. Overlies Water Canyon formation (new); underlies Madison formation.

F. D. Holland, Jr., 1952, Am. Assoc. Petroleum Geologists Bull., v. 36, no. 9, p. 1719. In northeastern Utah, underlies Leatham formation (new).

C. A. Sandberg and C. R. Hammond, 1958, Am. Assoc. Petroleum Geologists Bull., v. 42, no. 10, p. 2314–2322. Sloss and Laird (1947) in effect redefined the Jefferson to include at top a breccia and shale unit that Peale (1893) described as reddish- and brownish-yellow calcareous shale and mapped at base of overlying Three Forks formation. The two units that resulted from Sloss and Laird's revision are cartographically impractical because both the breccia zone and the overlying shales of the Three Forks are rarely visible. In present report, term Jefferson formation is used as defined by Peale and not as redefined by Sloss and Laird. Jefferson is raised to group status in subsurface of Williston basin and central Montana east of 111° meridian. Includes all beds overlying Souris River and underlying the Three Forks. Divided into Duperow formation and overlying Birdbear formation (new). Upper Devonian.

Named for exposures in hills on both sides of Missouri River just below junction of Three Forks of the Missouri, and on both sides of the Jefferson a few miles above its mouth, in Three Forks quadrangle, Montana.

Jefferson City Dolomite[1]

Jefferson City Formation (in Knox Dolomite)

Jefferson City Group

Lower Ordovician: Missouri and northern Arkansas.

Original reference: A. Winslow, 1894, Missouri Geol. Survey, v. 6, p. 331, 373, 375.

C. R. L. Oder, 1934, Jour. Geology, v. 42, p. 474 (table 1), 484–486. Geographically extended into eastern Tennessee where classified as formation in Knox dolomite. Occupies interval between top of Nittany and base of Cotter-Powell beds. Consists of 55 to 400 feet of thin- to heavy-bedded, dove- and dark- to brownish-gray fine-grained limestone and extremely light- to dark-green fine-grained to dense dolomite. Thin greenish-blue siliceous shales present on some bedding planes; coarse edgewise limestone conglomerates present locally.

J. S. Cullison, 1944, Missouri Univ. School Mines and Metallurgy Bull., Tech. Ser. v. 15, no. 2, p. 15, 17–32. Term Jefferson City has had many usages in the literature since originally defined by Winslow. Term should be dropped from the literature because of this. It is retained in this report as group term for following reasons: (1) a boundary between Rich Fountain and Theodosia formations (both new) is present within those beds originally defined as Jefferson City by Winslow; (2) predominant usage of them by most writers since Winslow has been in sense of group, even though it has not been defined as such; (3) term too well established in Missouri stratigraphic literature to be disposed of especially when beds involved are essentially same as those of previous usage. Underlies Cotter formation; unconformably overlies Roubidoux formation.

O. R. Grawe, 1945, Missouri Geol. Survey and Water Resources, 2d ser., v. 30, p. 52 (fig. 2), 59–62. Term Jefferson City formation used in this report [pyrite deposits of Missouri] in its older, unrestricted sense to include all dolomite beds above top of Roubidoux formation.

T. R. Beveridge, 1951, Missouri Geol. Survey and Water Resources, 2d ser., v. 32, p. 23–27, pl. 9. In this report [Weaubleau Creek area], no attempt is made to differentiate the Cotter from the Jefferson City, and name Jefferson City formation is used in unrestricted sense. Base not exposed in area; records from two wells which penetrated formation from top to bottom give thicknesses of 200 to 205 feet. Underlies Chouteau formation and in some areas the Sylamore. Ordovician, Canadian series.

Josiah Bridge, 1956, U.S. Geol. Survey Prof. Paper 277, p. 23. Kingsport limestone replaces Jefferson City formation as used by Oder (1934). Jefferson City, Cotter, and Powell are names of formations exposed in Missouri and Arkansas, and there is no possibility that they can be traced into Appalachian Valley.

Named for exposures at Jefferson City, Cole County, Mo.

†Jefferson City Group[1]

Lower Ordovician (Beekmantown) : Missouri.

Original reference: C. L. Dake. 1921, Missouri Univ. School Mines and Metallurgy, v. 6, no. 1.

Jeffersonian Series or Stage

Ordovician (Canadian) : North America.

R. H. Flower, 1957, New Mexico Bur. Mines Mineral Resources Mem. 2, p. 18. Divisions within Canadian system favor natural division into four major units: Gasconadian, Demingian, Jeffersonian, and Cassinian. Jeffersonian (Early Upper Canadian) beds are restricted geographically. Includes Jefferson City (Rich Fountain and Theodosia), Cotter, and Powell.

Marshall Kay, 1960, Internat. Geol. Cong., 21st, Copenhagen, pt. 7, p. 28–32. Canadian series includes Gasconadian, Demingian, Jeffersonian, and Cassinian stages.

Jeffersonian Stage[1] or Glacial Epoch

Pleistocene: Central northern Oregon.

Original reference: E. T. Hodge, 1930, Monthly Weather Rev., v. 58, p. 405–411.

E. T. Hodge, 1938, Geol. Soc. America Bull., v. 49, no. 6, p. 841 (table 1). Fourth of five glacial epochs in area. Occurs in interval between Willamettian epoch and Hood epoch.

Jeffersonville Limestone[1]

Middle Devonian: Indiana and north-central Kentucky.

Original reference: E. M. Kindle, 1899, Bull. Am. Paleontology, v. 3, no. 12, p. 8, 23, 110.

D. G. Sutton and A. H. Sutton, 1937, Jour. Geology, v. 45, no. 3, p. 331. Term Jeffersonville is synonym of Geneva, and by custom of priority latter name should be applied to all Indiana rocks of Onondaga age.

Guy Campbell, 1942, Geol. Soc. America Bull., v. 53, no. 7, p. 1060. South of Sellersburg, Jeffersonville is overlain by Silver Creek formation; northward Speeds formation lies between Jeffersonville and Silver Creek.

G. A. Cooper and others, 1942, Geol. Soc. America Bull., v. 53, no. 12, pt. 1, chart 4. Lower or Middle Devonian.

E. M. Luttrell and Ann Livesay, 1952, Kentucky Geol. Survey, ser. 9, Bull. 11, p. 8. In western Kentucky, near Kentucky Lake, overlies Camden (Clear Creek) chert.

J. B. Patton and T. A. Dawson *in* H. H. Murray, 1955, Indiana Geol. Survey Field Conf. Guidebook 8, p. 38–39, pl. 1. In type section, Jeffersonville is divided into three zones: lower is brown to gray, dense to crystalline, dolomitic, contains prolific coral fauna and is generally known as "coraline zone"; middle is lighter gray or brown, dense to crystalline, and includes *Spirifer gregarius* beds; upper is tan or light-gray crystalline thick-bedded extremely fossiliferous limestone and includes *Spirifer acuminatus* zone. Thickness 26 to 46 feet. At type locality and northward through most of Clark County, overlies Louisville limestone; from northern Clark County northward, overlies Geneva dolomite; throughout southern Indiana, overlain by rocks of Hamilton age.

Named for Jeffersonville, Clark County, Ind., where formation is well exposed in the falls of the Ohio.

Jellico Formation[1]

Pennsylvanian: Northern Tennessee.

Original reference: L. C. Glenn, 1925, Tennessee Geol. Survey Bull. 33–B, p. 14, 18–21.

C. W. Wilson, Jr., J. W. Jewell, and W. T. Luther, 1956, Pennsylvanian geology of the Cumberland Plateau: Tennessee Div. Geology [Folio], p. 1. As result of recent fieldwork names Briceville, Jellico, Scott, and Anderson are discontinued, and complete new classification is presented.

Named for occurrence of Jellico coal within formation.

Jelm Formation[1]

Upper Triassic: Central Wyoming and northern Colorado.

Original reference: S. H. Knight, 1917, Geol. Soc. America Bull., v. 28, no. 1, p. 168.

G. E. Condra, E. C. Reed, and O. J. Scherer, 1940, Nebraska Geol. Survey Bull. 13, p. 2 (fig. 2), 6. Stratigraphic section in vicinity of Owl Creek Canyon section, northern Colorado, shows Jelm formation, about 60 feet thick, unconformably above Spearfish (redefined) and unconformably below Sundance beds.

J. D. Love, 1948, Wyoming Geol. Assoc. Geologists Guidebook 3d Ann. Field Conf., p. 100. Name Popo Agie is used in central Wyoming in preference to Jelm. Correlation of the two units has neither been definitely established nor disproved.

G. N. Pipiringos, 1953, Wyoming Geol. Assoc. Guidebook 8th Ann. Field Conf., p. 36 (chart), 37–38 correlation chart. Restricted to exclude upper 50 feet which are included in Nugget formation. As used here, name Jelm is applied only to lower part, about 200 feet thick in type area, of original Jelm formation. Consists of two well-defined members. Overlies Alcova formation.

R. G. Hubbell, 1956, Am. Assoc. Petroleum Geologists Bull., v. 40, no. 11, p. 2743–2748. In Freezeout Hills area, stratigraphically expanded above to include unit here named Troublesome Creek sandstone member. Underlies Sundance formation; overlies Alcova member of Chugwater.

G. N. Pipiringos, 1957, Wyoming Geol. Survey Bull. 47, p. 13, 15–17, pl. 5, strat. sections. Upper part of original Jelm formation is lithologically continuous with basal Sundance sandstone of Lee (1927, U.S. Geol. Survey Prof. Paper 149), the Entrada (Front Range, Colo.) of Baker, Dane, and Reeside (1936), and Heaton (1939, Am. Assoc. Petroleum Geologists Bull., v. 23, no. 8), and Nugget(?) sandstone of Neely (1937, Am. Assoc. Petroleum Geologists Bull., v. 21, no. 6). Fact that upper part of original Jelm formation (Nugget) is lithologically closely related to Sundance formation while rest of Jelm contains redbeds identical to those of underlying Chugwater, and a well-developed persistent conglomerate near its top, indicates that original Jelm straddles Triassic-Jurassic boundary. Proposed that name Jelm be applied only to part which rests disconformably on Chugwater and whose top grades into overlying Nugget sandstone within a few feet above Jelm conglomerate. Type section of Jelm (restricted) is at Red Mountain where it is 190 feet thick.

R. F. Walters, 1957, Rocky Mountain Assoc. Geologists Guidebook to geology of North and Middle Park Basins, Colorado, p. 85–86. In Independence Mountain area, North Park, Colo., formation is an 85-foot sequence consisting of basal clay gall conglomerate overlain by alternating red, pink, and white beds of fine- to coarse-grained calcareous sandstone and conglomerate interbedded with red shale. Unconformably overlies Chugwater; unconformably underlies Nugget(?).

Named for exposures near eastern base of Jelm Mountain, near southern line of Albany County, Wyo. Type section Jelm (restricted) is at Red Mountain 25 miles southwest of Laramie; section is in SW¼NW¼ sec. 16, T. 12 N., R. 76 W.

Jemez Marl[1]

Jemez Shales

Tertiary: Central northern New Mexico.

Original references: A. B. Reagan, 1903, Am. Geol., v. 31, p. 86; C. R. Keyes, 1932, Pan-Am. Geologist, v. 58, no. 4, p. 289.

Charles Keyes, 1936, Pan-Am. Geologist, v. 66, no. 1, p. 74. Puerco shale, as restricted by Mathews (1921, Am. Jour. Sci., 5th ser., v. 2, p. 220) could be properly renamed Jemez shales.

Derivation of name not given.

Jemison Chert[1]

Jemison Chert (in Talladega Series)

Lower Devonian: Eastern Alabama.

Original reference: Charles Butts, 1926, Alabama Geol. Survey Special Rept. 14, p. 57, 145–147, map.

T. N. McVay and L. D. Toulmin, 1945, Alabama Geol. Survey Bull. 55, p. 21. Jemison chert, Yellow Leaf quartz schist, Dempsey marble, and Erin shale occur in upper part of Talladega series.

Named for exposures at and near Jemison, Chilton County.

Jenkins Clay (in Cimarron Group)[1]

Jenkins Clay Member (of Cave Creek Formation)

Permian (Cimarron Series): Central-southern Kansas and western Oklahoma.

Original reference: F. W. Cragin, 1896, Colorado Coll. Studies, v. 6, p. 27–28.

G. H. Norton, 1939, Am. Assoc. Petroleum Geologists Bull., v. 23, no. 12, p. 1793, 1794, 1795. Unit formerly termed Jenkins clay is included in Nescatunga gypsum bed (new) in Blaine formation.

Named for former post office of Jenkins, Comanche County, Kans.

Jenkins Branch Chert Bed (in Cotter Dolomite)

Lower Ordovician: Northern Arkansas.

J. S. Cullison, 1944, Missouri Univ. School Mines and Metallurgy Bull., Tech. Ser., v. 15, no. 2, p. 35, pl. 2. Fossiliferous reddish- to brown chert bed that occurs stratigraphically above the Crooked Creek chert bed (new) about the middle of the Cotter; texture is open and porous and probably not more than 40 percent of the mass is chert. Readily recognizable only on partly weathered surfaces.

Well exposed in roadcut south of Jenkins Branch in NE cor. SW¼NE¼ sec. 7, T. 19 N., R. 15 W., Yellville quadrangle, Marion County.

Jenness Pond Member (of Littleton Formation)

Lower Devonian: Northern New Hampshire.

M. T. Heald, 1955, The geology of the Gilmanton quadrangle, New Hampshire: New Hampshire State Plan. Devel. Comm., p. 9, 10 (table 1), geol. map. Thin-bedded pseudoandalusite schist, pyritiferous schist, and mica schist. Underlies Durgin Brook member (new); overlies Pittsfield member (new).

Typical exposures in vicinity of Jenness Pond, Gilmanton quadrangle.

Jennings Formation[1]

Upper Devonian: Northern Virginia, western Maryland, and eastern West Virginia.

Original reference: N. H. Darton, 1892, Am. Geologist, v. 10, p. 13, 17, 18.

C. S. Prosser and C. K. Swartz, 1913, Maryland Geol. Survey, Middle and Upper Devonian Volume, p. 411–422. In Maryland, subdivided into (ascending) Genesee black shale, Woodmont shale (new), Parkhead sandstone, and Chemung sandstone members. Overlies Romney shale; upper limit not well defined, red sediments of Catskill type alternate with lighter colored fossiliferous sediments of Jennings type in upper part of Jennings.

Ernst Cloos, 1951, Maryland Dept. Geology, Mines and Water Resources Washington County [Rept. 14], p. 89–92, 99. Described in Washington County, Md. Thickness 4,000 to 4,800 feet.

Named from exposures at Jennings Gap on Jennings Branch, Augusta County, Va.

Jennings Mountain Complex

Precambrian: Northeastern New York.

A. F. Buddington, 1948, Geol. Soc. America Mem. 28, p. 25, Incidental mention in discussion of granitic rocks of the northwest Adirondacks.

Occurs in vicinity of Jennings Mountain.

Jerome Formation[1]

Upper Devonian: Central Arizona.

Original reference: A. A. Stoyanow, 1930, Pan-Am. Geologist, v. 53, no. 4, p. 316–317.

R. H. Denison, 1951, Fieldiana: Geology, v. 11, no. 5, p. 254. In upper Devonian (Chautauquan stage).

Section at Jerome, Yavapai County, described in detail.

Jeromian series

Paleozoic [Upper Devonian]: Arizona.

C. R. Keyes, 1942, Pan-Am. Geologist, v. 77, no. 3, p. 228. Jerome formation (of Stoyanow) regarded as series. Includes (ascending) Vecol limestone (new), 250 feet thick; Sycamore sandstone, 75 feet; and East Verde limestone (new), 350 feet. Older than Island Mesa limestone; younger than Tombstonian series(new).

[In Jerome region.]

Jerry Lava Flow

Recent: Southwestern Oregon.

E. T. Hodge, 1925, Oregon Univ. Pub., v. 2, no. 10, p. 37, 47, 53, 89, 101, 114, 115. Discussion of Mount Multnomah ancient ancestor of the Three Sisters. Lava flow that issued from Cinder Cone. Rests on morainic material.

Derivation of name not given. Cinder Cone is north of North Sister Mountain and south of Yapoah Crater.

Jerseyan Drift[1]

Jerseyan Glaciation[1]

Jerseyan Till

Pleistocene: New Jersey.

Original reference: T. C. Chamberlin and R. D. Salisbury, 1906, Geology, v. 3, p. 383–387.

Paul MacClintock, 1940, Geol. Soc. America Bull., v. 51, no. 1, p. 103–115. Discussion of weathering of Jerseyan till. Two pre-Wisconsin drift sheets are present in New Jersey. No evidence has come to light to modify Salisbury's and later Leverett's correlation with the Illinois and Kansan. Jerseyan, as used by Chamberlain and Salisbury, becomes group name equivalent to "pre-Wisconsin".

Named for development in New Jersey.

†Jessamine Limestone[1] (in Lexington Group)

Jessamine Limestone (in Lexington Limestone)

Middle Ordovician: Central northern Kentucky.

Original reference: A. M. Miller, 1919, Kentucky Dept. Geology and Forestry, ser. 5, Bull. 2, p. 25.

A. C. McFarlan and W. H. White, 1948, Am. Assoc. Petroleum Geologists Bull., v. 32, no. 8, p. 1634–1635. Limestone in lower Lexington limestone; underlies Benson limestone; overlies Logana formation. Thickness 75 to 80 feet.

D. K. Hamilton, 1948, Econ. Geology, v. 43, no. 1, p. 41, 42; 1950, Kentucky Geol. Survey, ser. 9, Bull. 5, p. 13–14. Limestone in Lexington group. Overlies Logana formation; underlies Benson limestone.

Named for Jessamine Creek, Jessamine County.

Jessamine Series[1]

Middle Ordovician: Central northern Kentucky.

Original reference: A. F. Foerste, 1906, Kentucky Geol. Survey Bull. 7, p. 10.

Type locality not stated, but probably Jessamine, Jessamine Creek, or Jessamine County.

Jesse Sandstone Member (of Catron Formation)[1]

Middle Pennsylvanian: Southeastern Kentucky and northeastern Tennessee.

Original reference: G. H. Ashley and L. C. Glenn, 1906, U.S. Geol. Survey Prof. Paper 49, p. 31, 33, 41.

Named for Jesse Creek, Bell County, Ky.

Jessup Formation

Pleistocene: Indiana.

H. H. Gray, R. D. Jenkins, and R. M. Weidman, 1960, Indiana Geol. Survey Bull. 20, p. 19 (fig. 3). Named on diagram showing formations of Pleistocene age in Indiana. Name appears below Trafalgar formation (new). Name credited to W. J. Wayne (in preparation).

Type locality and derivation of name not given.

Jester Dolomite Member (of Blaine Formation)[1]

Permian: Southwestern Oklahoma.

Original references: G. G. Suffel, 1929, Stanford Univ. Abs. Dissert., v. 4, p. 90; 1930, Oklahoma Geol. Survey Bull. 49, p. 29, 55–57, 63.

Exposed where road from Jester, Greer County, crosses heavy gypsums at SE cor. sec. 25, T. 7 N., R. 24 W.

Jetmore Chalk Member (of Greenhorn Limestone)[1]

Upper Cretaceous: Central western Kansas.

Original reference: W. W. Rubey and N. W. Bass, 1925, Kansas Geol. Survey Bull. 10, p. 16, 46, 51.

R. C. Moore and others, 1951, Kansas Geol. Survey Bull. 89, p. 24, 25. Chalky shale and chalky limestone, interbedded, "Shell-rock limestone" bed at top, gray, weathers to light gray. Thickness 20 feet (Ellis and Russell Counties) to 25 feet. Overlies Hartland shale member; underlies Pfeifer shale member; in Hamilton County, Pfeifer shale and underlying Jetmore chalk are thicker than farther east; they cannot be distinguished and have been together designated the Bridge Creek limestone member.

Named for prominent exposures south and east of Jetmore, along south side of Buckner Creek, Hodgeman County.

Jewell Phyllite (in Casco Bay Group)[1]

Pennsylvanian(?): Southwestern Maine.

Original reference: F. J. Katz, 1917, Washington Acad. Sci. Jour., v. 7, p. 198.

L. W. Fisher, 1941, Geol. Soc. America Bull., v. 52, no. 1, p. 141, 142–143. Mentioned in discussion of Pejepscot correlatives. Pejepscot formation (new) extends northward from Portland toward Lewiston and Brunswick and must include formations included in Berwick, Kittery, and Casco Bay group of Katz. Hornblende-epidote-chlorite schist crops out at Bunganac Landing conformably above Pejepscot gneiss. This schist, which is lithologically same as Spring Point greenstone of Katz, appears to be southwestern continuation of hornblende-rich gneiss which overlies marble at locality C (fig. 9). Phyllites, slates, and limestone of Casco Bay group overlie Spring Point greenstone in Portland area. Jewell phyllite is characterized by its silky sheen and its metacrysts of ottrelite, garnet, and staurolite. In these features it is same as Winthrop phyllite which carries transition from Sabattus sillimanite schist into Waterville slates in Winthrop area. Katz placed Jewell phyllite above Spurwink limestone and below Mackworth slate.

Named for development on Jewell Island in Casco Bay, Cumberland County.

Jewett Silt Member[1] (of Temblor Formation)

Miocene: Southern California (subsurface and surface).

Original reference: A. Diepenbrock, 1933, California Oil Fields, Div. Oil and Gas, v. 19, no. 2, p. 16, 22, pl. 2.

A. M. Keen, 1943, San Diego Soc. Nat. History Trans., v. 10, no. 2, p. 26 (fig. 1), 28 (fig. 2), 29. Mapped as Jewett silt in Kern River area near Round Mountain. Considered member of Temblor. Underlies Olcese sand; overlies Walker formation. Also referred to as Freeman and Jewett silts, often indistinguishable and grading downward locally in Pyramid Hill sand or "grit zone".

Named in subsurface from Shell Oil Co. Well No. "Jewett" 1, sec. 29, T. 28 S., R. 29 E., Kern County.

Jicara Formation

Paleocene, upper, to Eocene, middle: Puerto Rico.

T. R. Slodowski, 1958, Dissert. Abs., v. 18, p. 200. A complex, more than 9,000 meters thick, of volcanic flows with interbedded marine limestones, mudstones, tuffs, and sedimentary rocks derived from volcanic rocks, is divided into eight formations [sequence not indicated]: Sabana Grande, El Rayo, Ensenada, Río Yauco, Río Loco, Río Blanco, San Germán, and Jicara (new), San Germán and Jicara formations are separated from underlying Ensenada and Río Yauco formations, at least locally, by unconformities. Complex ranges in age from Senorian to late Paleocene, possibly Eocene.

E. A. Pessagno, Jr., 1960, Geology of the Ponce-Coamo area, Puerto Rico: Puerto Rico Econ. Devel. Adm. and Princeton Univ. Dept. Geology, p. 19 (correlation chart). Paleocene, upper, to Eocene, middle.

P. H. Mattson, 1960, Geol. Soc. America Bull., v. 71, no. 3, p. 345–346. Slodowski (1956, unpub. thesis) described formation as composed of thin- to thick-bedded fine-grained siliceous and calcareous tuffs; massive limestone and massive volcanic conglomerate locally present at base; minimum thickness 1,000 meters. Formation in Mayagüez area [this report] unconformably overlies Mayagüez group. San Germán and Jicara formations form structural unit south of Sabana Grande, the only area where they occur together.

Type locality: Region around Estacion La Plata and intersection of Routes 117 and 327, about 2 kilometers east of Mayagüez area, southeast of San Germán.

Jim Creek Shale Member (of Root Shale)

Jim Creek Limestone (in Wabaunsee Group)[1]

Pennsylvanian (Virgil Series): Eastern Kansas, southwestern Iowa, northwestern Missouri, southeastern Nebraska, and northeastern Oklahoma.

Original reference: R. C. Moore, 1932, Kansas Geol. Soc. 6th Ann. Field Conf. Guidebook, p. 94, 96.

F. C. Greene and W. V. Searight, 1949, Missouri Geol. Survey and Water Resources Rept. Inv. 11, p. 21. Jim Creek limestone is highest Pennsylvanian limestone identified in Missouri.

R. C. Moore and M. R. Mudge, 1956, Am. Assoc. Petroleum Geologists Bull., v. 40, no. 9, p. 2274 (fig. 1), 2275. Rank reduced to member status in Root shale (new). Underlies French Creek shale member; overlies Friedrich shale member.

H. G. Hershey and others, 1960, Iowa Highway Research Board Bull. 15, p. 11, fig. 5. Geographically extended into southwestern Iowa where it is classified as formation in Wabaunsee group. Consists of dark-blue to black argillaceous limestone that weathers red or brown; upper part commonly thin bedded and lower part massive. Thickness about 1 foot. Fossils include *Chonetes* and *Myalina*. Overlies Friedrich shale; underlies French Creek shale.

Type locality: On Jim Creek, sec. 29, T. 7 S., R 11 E., Pottawatomie County, Kans.

Jim Ned Shale Member (of Belle Plains Formation)

Jim Ned Shale (in Belle Plains Group)

Permian: Central Texas.

M. G. Cheney, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 1, p. 66 (fig. 1), 96. Proposed to replace Coleman bed of Drake (1893); name Coleman preoccupied. Lower half of formation consists of channel sandstone deposits and sandstone lentils (becoming more prominent northward), sandy shales, thin lignitic coals and black shales with plant remains, and thin limestone beds; upper part green and reddish shales with thin dolomitic members. Thickness 100 to 125 feet. Underlies Elm Creek limestone and extends downward to disconformity at top of Fisk formation (new).

R. C. Moore *in* M. G. Cheney, 1948, Abilene Geol. Soc. [Guidebook] Spring Field Trip, June 11–12, sheets 3, 4; R. C. Moore, 1949, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 80, sheet 2. Reduced to member status in

Belle Plains formation. Underlies Elm Creek limestone member; overlies Overall limestone member of Admiral formation.

Type locality: In south part of the Newschaffer Survey No. 750 just west of highway bridge over Jim Ned Creek on Coleman-Baird Highway about 10 miles north of Coleman, Coleman County.

Joachim Dolomite[1]

Middle Ordovician: Eastern Missouri, northern Arkansas, and southwestern Illinois.

Original reference: A. Winslow, 1894, Missouri Geol. Survey, v. 6, p. 331, 352.

H. S. McQueen, 1937, Missouri Geol. Survey and Water Resources 59th Bienn. Rept., app. 1, p. 11–12, pl. 3. Chiefly dolomite, magnesian limestone, and thin beds of shale and sandstone. Approximately 60 feet above base of formation is bed of fine-grained sandstone 4 to 10 feet thick. Overlies Dutchtown formation (new).

J. G. Grohskopf, 1948, Am. Assoc. Petroleum Geologists Bull., v. 32, no. 3, p. 360, 362–364. Underlies Rock Levee formation (new). The Rock Levee includes some beds previously assigned to Joachim. Previous workers have stated that no chert occurs in the Joachim. However, in residues from well cuttings, a few fragments of light-gray to almost white chert was noted in many wells. This chert became a marker in subsurface work and has been traced for several hundred miles in eastern Missouri. It has been noted at two surface localities. Careful surface mapping will no doubt reveal its presence at many localities. It is here proposed that name Joachim be restricted to rocks overlying either the Dutchtown or St. Peter and including the chert zone at top. As thus defined, the Joachim is 175 feet thick at Cape Girardeau and gradually thins northwest until it is overlapped by the "Decorah" in vicinity of Kimmswick.

Named for exposures along Joachim Creek, Jefferson County, Mo.

Joana Limestone[1]

Joana Limestone Member (of White Pine Shale)

Lower Mississippian: Eastern Nevada and western Utah.

Original reference: A. C. Spencer, 1917, U.S. Geol. Survey Prof. Paper 96, p. 24, 26, map.

G. S. Campbell, 1951, Utah Geol. Soc. Guidebook 6, p. 21 (fig. 4), 23. Joanna [Joana] limestone geographically extended into House and Confusion Ranges, Utah, where it is 100 to 300 feet thick, underlies Chainman shale and overlies Pilot shale.

W. H. Easton and others, 1953, Am. Assoc. Petroleum Geologists Bull., v. 37, no. 1, p. 147 (fig. 2). Shown as member of White Pine shale on correlation chart of recommended revision of stratigraphic units in Great Basin.

T. B. Nolan, C. W. Merriam, and J. S. Williams, 1956, U.S. Geol. Survey Prof. Paper 276, p. 4 (fig. 1), 54–56. Described in stratigraphic section in vicinity of Eureka where it is as much as 125 feet thick; overlies Pilot shale and underlies Chainman shale. Early Mississippian.

R. L. Langenheim, Jr., and Herbert Tischler, 1960, California Univ. Pub. Geol. Sci., v. 38, no. 2, p. 108 (fig. 5), 110. Discussion of Quartz Spring area, Inyo County, Calif. Formations Tin Mountain limestone, Perdido formation, and Rest Spring shale, as defined by McAllister (1952), are utilized in this discussion and description of rocks in area. On other hand, Joana limestone, Peers Spring formation, and Chainman shale, with somewhat different limits, are the formations to which these same rocks would be assigned in regional discussion of Mississippian stratigraphy in Great Basin.

Named for Joana mine, on south side of Robinson Canyon, 2 miles above Ely, White Pine County, Nev.

Joaquin Ridge Sandstone Member (of Panoche Formation)

Upper Cretaceous: Central California.

P. P. Goudkoff, 1945, Am. Assoc. Petroleum Geologists Bull., v. 29, no. 7, p. 962 (fig. 2), 989. Mentioned in discussion of Weldonian stage (new). Shown on chart as underlying Ragged Valley shale and overlying Alcade shale (new). Name credited to J. Q. Anderson.

A. S. Huey, 1948, California Div. Mines Bull. 140, p. 31. Referred to as member of Panoche in discussion of Moreno Grande formation (new) and Moreno formation.

Occurs in San Joaquin Valley in Coalinga-Ortigalito area.

Joe Lott Tuff

Pliocene(?): Southwest-central Utah.

Eugene Callaghan, 1939, Am. Geophys. Union Trans. 20th Ann. Mtg., pt. 3, p. 439 (fig. 2), 440 (fig. 3), 449–450. Several discrete areas of white to light-yellow or brownish tuff are grouped as Joe Lott tuff. Thickness of outcrops highly variable; in Clear Creek basin aggregate thickness more than 1,000 feet; here tuff is in massive beds, in places between 50 and 100 feet thick; these beds show no lamination, but thin pinkish interbeds are commonly laminated. Upper part of tuff, exposed in northwestern part of region, interbedded with abundantly porphyritic latite and quartz-latite flows of Dry Hollow latite (new). Commonly overlies Dry Hollow latite; locally overlies Mount Belknap rhyolite (new) and Bullion Canyon volcanics (new). Tertiary.

U.S. Geological Survey currently considers the Joe Lott tuff to be Pliocene (?). This designation made on the basis of a restudy of units in area.

Named for exposures on Joe Lott Creek in northern part of Marysvale region. Largest exposures are in Clear Creek basin west of Sevier and in Beaver River basin southwest of Delano Peak.

Joes Canyon Formation

Ordovician: Central Nevada.

Marshall Kay, 1960, Internat. Geol. Cong., 21st, Copenhagen, pt. 12, p. 97 (fig. 3). Discussion of Paleozoic continental margin in central Nevada. Clipper Canyon sequence comprises (ascending) Charcoal Canyon, Petes Summit, Sams Spring, and Joes Canyon formations (all new). Clipper Canyon sequence isolated by surrounding Tertiary volcanic rocks.

Clipper Canyon, Toquima Range, Nye and Lander Counties.

†Joes Rock Granite[1]

Devonian(?): Southeastern Massachusetts.

Original reference: C. H. Warren and S. Powers, 1914, Geol. Soc. America Bull., v. 25, p. 456, map.

Mapped at Joes Rock, west of Sheldonville, Norfolk County.

Joes Valley Member (of North Horn Formation)

Paleocene: Central Utah.

C. L. Gazin, 1941, U.S. Natl. Mus. Proc., v. 91, no. 3121, p. 6. Proposed for Paleocene part of North Horn formation. Defined as beginning with the highly colored clay and sandy clay, locally black carbonaceous shales, resting abruptly but without apparent disconformity on massive sandstones capping dinosaur-bearing North Horn beds. Upper part includes greater quantity of buff sandstone, with thicker zones of more uniformly colored sandy clay, ending abruptly beneath Flagstaff limestone. Estimated thickness several hundred feet.

Well exposed on mountain slopes adjacent to Joes Valley, Emery County. Also exposed in Dragon Canyon and on North Horn Mountain.

Johannesburg Gneiss[1]

Precambrian: Southern California.

Original reference: C. D. Hulin, 1925, California State Mining Bur. Bull. 95, p. 21–23, 28, map.

W. J. Miller, 1946, Geol. Soc. America Bull., v. 57, no. 5, p. 509, table 4. Older Precambrian; older than Rand schist.

Named for exposures 2 miles north of Johannesburg, Kern County.

John Day Formation[1]

Oligocene, upper, and Miocene, lower: Central northern Oregon.

Original reference: O. C. Marsh, 1875, Am. Jour. Sci., 3d, v. 9, p. 52.

Morton Green, 1950, (abs.) Geol. Soc. America Bull., v. 61, no. 12, pt. 2, p. 1538–1539. Since 1902, formation has been considered divisible into three parts: lower reddish trachytic tuffs, middle blue-green, and upper buff andesitic tuffs. Early studies indicated that a rhyolitic flow separates middle and upper beds. Plant remains from lower beds have been determined as upper Oligocene in character, and mammal remains in middle and upper divisions as lower Miocene. Recent studies indicate that the rhyolite is welded tuff, ignimbrite, and this grades into andesitic tuff of upper division. Since characteristics for middle and upper beds are the same, separated only by local extrusive variant, it seems evident that any division is artificial.

Howel Williams, 1957, A geologic map of the Bend quardangle, Oregon, and a reconnaissance geologic map of the central portion of the High Cascade Mountains (1:125,000): Oregon Dept. Geology and Mineral Industries. Oldest rocks in Bend quadrangle. Consists principally of flows and domes of rhyolite, welded rhyolite tuffs, bedded rhyolite tuffs, and varicolored fluviatile and lacustrine tuffaceous sediments; flows of andesite and basalt subordinate. Maximum thickness not over 5,000 feet and may be less. Underlies Columbia River basalt. Upper Oligocene and lower Miocene.

R. V. Fisher and R. E. Wilcox, 1960, U.S. Geol. Survey Prof. Paper 400–B, p. B302–B304. Formation exposed mainly in southern part of Monument quadrangle. Aggregate thickness about 950 feet. Tentatively divided into three unnamed members, which do not strictly conform to those proposed by Merriam (1901, Geol. Soc. America Bull., v. 12, p. 496–497) for section at Picture Gorge. Lower member consists of deep-red friable mudstones and siltstones, 67 feet thick. Middle member, 530 feet thick, divided into two parts: lower dominantly reddish and upper colored in light shades of red, yellow, gray, and green, welded tuff present locally. Upper member, 346 feet thick, characterized by light-gray or buff colors and weathers to silty powdery soil. Late Oligocene and early Miocene.

Typical localities are along John Day River. Well exposed in Picture Gorge.

Johnnie Formation[1]

Precambrian: Eastern California and southeastern Nevada.

Original reference: T. B. Nolan, 1928, Am. Jour. Sci., 5th, v. 17, p. 461–472.

L. F. Noble, 1941, Geol. Soc. America Bull., v. 52, no. 7, p. 952–953. Geographically extended into southern Death Valley region, where it overlies Noonday dolomite and underlies Stirling quartzite. Hazzard (1937, California Jour. Mines and Geology, v. 33, no. 4) described Johnnie(?) formation in Resting Springs and Nopah region, California. Name Johnnie used here without query with the understanding that not all of type Johnnie is represented in Death Valley.

C. R. Longwell, 1952, Washington Acad. Sci. Jour., v. 42, no. 7, p. 212. Suggestion made that Johnnie formation, Noonday dolomite, Deep Springs formation, and Reed dolomite of Inyo region be carried under "age unknown" because there is no firm basis for drawing lower boundary of Cambrian in Death Valley region.

B. K. Johnson, 1957, California Univ. Pubs. Geol. Sci., v. 30, no. 5, p. 372–375, figs. 1, 3. Described in Manly Peak quadrangle, California, where it it 2,000 to 2,500 feet thick; underlies Stirling quartzite and overlies Noonday dolomite. Nonfossiliferous. In this report, beds below *Olenellus* zone are referred to the Precambrian. In Nopah-Resting Springs Ranges, top of Johnnie formation is 4,500 feet below lowest occurrence of *Olenellus*; hence, formation is well within late Precambrian as defined in this report.

First described in Johnnie Wash, north of Johnnie mine, Spring Mountains region, Nevada.

Johnny Bull Sandstone (in Bisbee Group)

Lower Cretaceous: Southwestern New Mexico.

Elliot Gillerman, 1958, New Mexico Bur. Mines Mineral Resources Bull. 57, p. 52–53, table 1, pl. 1. Interbedded light-colored fine-grained well-sorted well-cemented orthoquartzite, dark-grayish-brown fine-grained well-cemented subgraywacke, and brown shale. Sandstone and interbedded shale comprise major part of formation. Shale beds typically thin bedded. No complete section observed. Thickness at type locality 1,047 feet. Conformably overlies Still Ridge formation (new).

Type section: Central part is about a mile due west of Johnny Bull mine, from which unit is named. Section measured along south side of prominent hill just north of road to Silver Hill mine, in SE¼ sec. 4, T. 25 S., R. 21 W., Peloncillo Mountains, Hidalgo County.

Johnny Lyon Granodiorite

Precambrian: Southeastern Arizona.

P. E. Damon, 1959, Arizona Geol. Soc. Guidebook 2, p. 19 (table 3), 20. Briefly mentioned in paper on geochemical dating of igneous and metamorphic rocks. Alpha-lead dates for zircon separates given as 615 and 815 million years.

In Johnny Lyon Hills, about 50 miles east of Tucson.

Johnsburg Limestone[1]

Precambrian: Northeastern New York.

Original reference: H. L. Alling, 1918, New York State Mus. Bull. 199.

Type locality: Johnsburg, Warren County.

Johnson Granite Porphyry[1] (in Tuolumne Intrusive Series)

Cretaceous: Eastern California.

Original reference: F. C. Calkins, 1930, U.S. Geol. Survey Prof. Paper 160, p. 127–128, map.

J. F. Evernden, G. H. Curtis, and J. Lipson, 1957, Am. Assoc. Petroleum Geologists Bull., v. 41, no. 9, p. 2121, 2122, 2123 (fig. 1). Discussed in paper dealing with potassium-argon dating of igneous rocks. Age given as 82.4 millions of years. Younger than Cathedral Peak granite and Hoffman quartz monzonite (new).

Named for fact it forms Johnson Peak in Yosemite National Park.

Johnson Gravels[1]

Miocene: Northern California.

Original reference: J. S. Diller, 1892, Geol. Soc. America Bull., v. 3, p. 371–394.

Extend south of 40th parallel, through Cascade mine to vicinity of Haskell Peak, Taylorsville region.

Johnson Shale[1] (in Council Grove Group)

Permian: Southeastern Nebraska, northeastern Kansas, and northern Oklahoma.

Original reference: G. E. Condra, 1927, Nebraska Geol. Survey Bull. 1, 2d ser., p. 84, 86, 88.

R. C. Moore, J. C. Frye, and J. M. Jewett, 1944, Kansas Geol. Survey Bull. 52, pt. 4, p. 168; R. C. Moore and others, 1951, Kansas Geol. Survey Bull. 89, p. 48. Gray shale that locally, in northern Kansas, contains thin beds of argillaceous limestone; dark carbonaceous material occurs in upper part of shale in north; lower and middle parts are commonly somewhat sandy. Thickness ranges from about 16 feet in northern part of Kansas to about 25 feet in southern part. Underlies Long Creek limestone member of Foraker limestone. Wolfcamp series.

P. B. Greig, 1959, Oklahoma Geol. Survey Bull. 83, p. 85–86. In Kansas and Nebraska, rocks of interval above Long Creek limestone and below Glenrock limestone member of Red Eagle limestone are known as Johnson shale. In Pawnee County, Red Eagle limestone has not been subdivided, and it is not certain that Glenrock member is present. Name Johnson shale has been retained and applied to beds between Eagle Rock and Long Creek limestone member of Foraker limestone. Unit extends southward into Lincoln County. Thickness 35 to 60 feet in Pawnee County.

Named for exposures 1½ miles north of Johnson County, Nebr.

Johnsonburg Sandstone[1]

Mississippian: Northwestern Pennsylvania.

Original reference: K. E. Caster, 1934, Bulls. Am. Paleontology, v. 21, no. 71, p. 139–140.

Occurs in southern suburb of Johnsonburg, Elk County.

†Johnson Creek Conglomerate[1]

Precambrian (Keweenawan) : Northern Michigan.

Original reference: A. C. Lane, 1911, Michigan Geol. and Biol. Survey Pub. 6, geol. ser. 4, p. 527, 546, 554, 555.

Probably named for exposures on Johnson Creek, Houghton County.

Johnson Gap Formation

Triassic(?) : Southeastern Colorado and northeastern New Mexico.

R. B. Johnson and E. H. Baltz, 1960, Am. Assoc. Petroleum Geologists Bull., v. 44, no. 12, p. 1896 (fig. 1), 1897–1899. Sequence of thin to thick beds of gray silty siliceous limestone conglomerate that contains pebbles and cobbles of gray finely crystalline limestone. Conglomerate interbedded with gray and light-red silty and siliceous limestone; red, siliceous, thin-bedded siltstone; greenish gray and brown plastic shale; and gray and red, fine-grained quartzose sandstone. Thickness at type locality about 90 feet. Thickens southward from wedge-edge about 2 miles north of Johnson Creek to about 100 feet at State line, and about 110 feet at Gold Creek, about 8 miles south of Johnson Creek and 3 miles into New Mexico. Rests with apparent unconformity on Sangre de Cristo formation. Upper beds truncated by erosion surface at base of overlying Entrada sandstone.

Type locality: Johnson Creek, secs. 19 and 20, T. 34 S., R. 69 W., Sangre de Cristo Mountains, Colo. Named for exposures in gap of Johnson Creek, locally known as Johnson Gap, 3 miles west of Tores, Las Animas County, Colo.

Johnson Gulch Porphyry[1] (in Gray Porphyry Group)

Early Tertiary: Northern central Colorado.

Original reference: S. F. Emmons, J. D. Irving, and G. F. Loughlin, 1927, U.S. Geol. Survey Prof. Paper 148.

C. H. Behre, Jr., 1953, U.S. Geol. Survey Prof. Paper 235, p. 53–54, 57, pl. 1. Younger than Iowa Gulch porphyry. Intrusion of Johnson Gulch porphyry was latest event in igneous sequence in area [west slope of Mosquito Range]. Igneous rocks younger than Precambrian in area of this report are either wholly or mainly Tertiary and only possibly in part late Cretaceous or early Pleistocene.

U.S. Geological Survey currently designates the age of the Johnson Gulch Porphyry as early Tertiary on basis of a study now in progress.

Named for development in Johnson Gulch, Leadville district, Lake County.

Johnson Mill Graphite Schist

[Precambrian] : Western Virginia.

W. A. Nelson, 1949, (abs.) Virginia Acad. Sci. Proc. 1948–49, p. 140. Overlies Lynchburg gneiss; underlies Charlottesville formation (new).

Report discusses structure and stratigraphy of the Blue Ridge in Albemarle and adjacent counties. Main Blue Ridge mountain is an overturned anticline, with axial plane dipping 28° to southeast, and thrust fault bordering it on its western edge.

Johnson Peak Formation

Upper Cretaceous: Southern California.

O. T. Marsh, 1956, Dissert. Abs., v. 16, no. 1, p. 101; 1960, California Div. Mines Spec. Rept. 62, p. 7 (fig. 3), 16–18, pls. 1, 2. Approximately 65 percent of formation at Johnson Peak consists of pale- to dark-green silty shale which weathers light brown; locally shale contains fine carbonaceous particles; limestone nodules and thin limestone beds common throughout shale; some thin layers of yellowish-green siltstone present; thinly bedded arkosic sandstones make up the remaining 35 percent. About 200 to 300 feet below top of formation is a prominent lens of massive thinly bedded concretionary graywacke which attains maximum thickness of about 380 feet northeast of Orchard Peak; this lens is named Enebro sandstone member (Spanish for "juniper") in reference to numerous junipers that thrive on its sandy soil. [Enebro not considered formal name.] Thickness at type section 2,250 feet; about 800 feet near western limit of outcrop; about 950 feet at eastern limit, near Devil's Den. Except where faulted, conformably overlies Risco formation (new); conformably underlies Aguila sandstone (new). Presence of single *Baculites* sp. indicates Late Cretaceous age.

Type locality: Section through Johnson Peak, Three Peaks anticline, Tent Hills quadrangle, Kern County. Crops out mainly east and northwest of Orchard Peak and in Three Peaks anticline.

Johnson Run Sandstone

†Johnson Run Sandstone (in Pottsville Formation)[1]

Pennsylvanian (Pottsville Series): Central northern Pennsylvania.

Original reference: C. A. Ashburner, 1879, Geol. map of McKean County: Pennsylvania 2d Geol. Survey.

Henry Leighton, 1941, Pennsylvania Geol. Survey, 4th ser., Bull. M–23, p. 57, 103. Johnson Run sandstone (Pottsville series) is separated from underlying Kinzua Creek sandstone by Alton coal group. Forms top of Pottsville in many areas.

First described in McKean County. Also noted in Cameron and Clinton Counties.

Johnson Spring Formation

Johnson Spring Formation (in Eureka Group)

Middle Ordovician: East-central California.

H. R. Pestana, 1960, Jour. Paleontology, v. 34, no. 5, p. 862–873. Interbedded limestone, dolomite, and quartzite. Thickness 163 to 384 feet; 208 feet at type section. Conformably overlies Barrel Spring formation; conformably underlies Ely Springs dolomite. This is unit referred to as undifferentiated upper part of Eureka group by Langenheim and others (1956, Am. Assoc. Petroleum Geologists Bull., v. 40, no. 9).

Type section: Lead Canyon Trail section, Independence quadrangle, Inyo Mountains. Outcrops of formation parallel outcrops of other Paleozoic formations along eastern side of Mazourka Canyon.

Johns Pond Formation

Silurian(?): Central western Maine.

R. J. Willard, 1959, Dissert. Abs., v. 19, no. 11, p. 2918. Passes from low-grade greenstones in north through hornblende-epidote-(albite or oligoclase) amphibolites to middle-high-grade almandite-hypersthene-biotite-andesine granulites in the south. Thickness about 1,600 feet. Underlies Perry Mountain formation; overlies Lost Brook formation (new).

In Kennebago Lake quadrangle.

Johnstone Peak Tuff Breccia (in Glendora Volcanics)

Miocene, middle or older: Southern California.

J. S. Shelton, 1955, Geol. Soc. America Bull., v. 66, no. 1, p. 65–67, pls. 1, 4. Name applied to accumulations of tuff that occur at various horizons in volcanics in foothills area. Contains numerous scattered subangular fragments and blocks ranging in diameter from fraction of inch to over 10 feet. Proportion of blocks to tuff matrix ranges from about 10 to over 50 percent. In most outcrops, deposit is chaotic with no sign of bedding; locally contains lenses and thin streaks of bedded tuff matrix. Breccias lie between and upon the three lava members of volcanic series and range in thickness from about 100 to 700 feet.

Typically exposed south of Johnstone Peak, in San Gabriel Mountains, Los Angeles County.

Johnston Hill Glaciation

Pleistocene: Southwestern Alaska.

E. H. Muller, 1953, *in* T. L. Péwé and others, U.S. Geol. Survey Circ. 289, p. 2, 13 (table 1). Four major glaciations tentatively recognized in northern part of Alaska Peninsula. Johnston Hill was second early ice advance, or major recessional phase of preceding (unnamed) glaciation. Includes bouldery outwash in shore bluffs west of Johnston Hill and till in bluffs at mouth of Naknek River. Characteristic topographic expressions of glaciation largely destroyed by succeeding glaciations. Succeeded by Mak Hill glaciation (new). Name credited to Abrahamson (unpub. dissert.).

Named for prominent till ridge 12 miles southwest of Naknek, northern Alaska Peninsula.

Johnstown Limestone Member (of Allegheny Formation)[1]

Johnstown Limestone (in Allegheny Group)

Upper Pennsylvanian: Western Pennsylvania.

Original reference: H. M. Chance, 1880, Pennsylvania 2d Geol. Survey Rept. V_2.

W. O. Hickok 4th and F. T. Moyer, 1940, Pennsylvania Geol. Survey, 4th ser., Bull. C–26, p. 60 (table), 74, fig. 21. Included in Kittanning subdivision of Allegheny group. Thickness as much as 10 feet. Separated from overlying Freeport sandstone by Upper Kittanning coal; overlies Upper Westernport sandstone.

Named for occurrence at Johnstown, Cambria County.

Johns Valley Shale[1]

Mississippian and Pennsylvanian: Southeastern Oklahoma and central and western Arkansas.

Original reference: E. O. Ulrich, 1927, Oklahoma Geol. Survey Bull. 45, p. 6, 21–23, 30, 36–37.

B. H. Harlton, 1938, Am. Assoc. Petroleum Geologists Bull., v. 22, no. 7, p. 896. Name abandoned. Replaced by Round Prairie formation (new).

R. C. Rea, 1947, Tulsa Geol. Soc. Guidebook Field Conf., May 8, 9, 10, p. 47–49. Johns Valley shale of Pennsylvanian age (some say Bendian) lies conformably between Jackfork sandstone below and Atoka formation above in normal sequence at all localities where it was observed in western Ouachita Mountains. Measured sections indicate minimum of

300 feet and maximum thickness of 900 feet. Characterized by presence of erratic and exotic boulders ranging from Cambrian to Mississippian in age.

H. D. Miser and others, 1954, Geologic map of Oklahoma (1:500,000): U.S. Geol. Survey. Mapped as Pennsylvanian.

L. M. Cline, 1956, Tulsa Geol. Soc. Digest, v. 24, p. 103–106. Upper part of Johns Valley shale is partial equivalent of Mississippian Caney formation of Arbuckle province. Type locality of the Johns Valley is in bowl-shaped Johns Valley in trough of Tuskahoma syncline. Also type locality of Caney shale is along Caney Creek (originally Cane Creek) which is also in Johns Valley topographic basin. Many Mississippian fossils illustrated by Girty (1909, U.S. Geol. Survey Bull. 377) were collected in Johns Valley. With recognition of exotic boulders of Arbuckle and (or) Ozark facies that are embedded in the shale, Ulrich (1927) proposed name Johns Valley for the boulder-bearing shale. He acknowledged the Mississippian age of rocks containing Caney fauna, but held that they were erratics which had been transported to Johns Valley in early Pennsylvanian time. The pre-Mississippian boulders and blocks in Johns Valley are foreign to Ouachita province, but it is now believed that the so-called "Caney boulders" are sideritic concretions indigenous to Caney, that the Caney "blocks" are substantially where the shale was deposited, and that the type Caney is in reality the lower part of the type Johns Valley as defined by Ulrich.

L. M. Cline and O. B. Shelburne, 1959, *in* The geology of the Ouachita Mountains—a symposium: Dallas Geol. Soc. and Ardmore Geol. Soc., p. 193–204. Formation discussed in detail. Harlton's (1938) name Round Prairie not accepted by later workers. Overlies Game Refuge sandstone; underlies Atoka formation. Thickness 425 to 900 feet. Mississippian-Pennsylvanian.

H. D. Miser and T. A. Hendricks, 1960, Am. Assoc. Petroleum Geologists Bull., v. 44, no. 11, p. 1829–1832. Discussion of age of Johns Valley shale, Jackfork sandstone, and Stanley shale. Geologic evidence establishes presence of both Pennsylvanian and Mississippian beds in Johns Valley shale.

Typically exposed in center of Tuskahoma syncline, particularly in north half of T. 1 S., R. 16 E. Named for settlement (on Cane Creek, in northwest part of Pushmataha County, about 6 miles north of Eubanks) which is now called Johns Valley, but which, at time Taff named Caney shale, was locally known as Caney and which Taff in 1925 stated was type locality of Caney shale.

Johns Wash Limestone

Upper Cambrian: East-central Nevada.

Harald Drewes and A. R. Palmer, 1957, Am. Assoc. Petroleum Geologists Bull., v. 41, no. 1, p. 106 (fig. 2), 108 (fig. 3), 115, 117; Harald Drewes, 1958, Geol. Soc. America Bull., v. 69, no. 2, p. 224 (fig. 2), 226, pl. 1. Name applied to 250-foot unit of coarsely crystalline and clastic, light- to dark-gray limestones that commonly makes cliff above Lincoln Peak formation (new). Underlies Corset Spring shale (new).

Type section: Head of Johns Wash, Mount Washington-Lincoln Peak area, Snake Range.

Joins Formation[1] (in Simpson Group)

Middle Ordovician: Central southern Oklahoma.

Original references: E. O. Ulrich, 1928, Manuscript chart exhibited at New York meeting of Geol. Soc. America; C. E. Decker, 1930, Am. Assoc. Petroleum Geologists Bull., v. 14, no. 12, p. 1495.

R. W. Harris, 1957, Oklahoma Geol. Survey Bull. 75, p. 55–61. Consists of thin limestones and shales with several intraformational conglomerates near base; limestones are light to dark gray and vary from fine grained and resistant to coarsely crystalline and crumbling; shales are characteristically green and less abundant and thinner bedded than those of overlying Simpson formations. Thickness at type locality approximately 300 feet; thins to 160 feet in southeastern end of Arbuckle Mountains; ranges from 200 feet at northwestern end to zero at northeastern end. Overlapped by Oil Creek formation; unconformably overlies Arbuckle dolomitic limestone. Ostracoda indicate more indirectly than directly Chazyan age; none of the Ostracoda in the Joins has been recorded from Chazyan strata outside Oklahoma; similarity of Joins and Oil Creek (Chazyan) Ostracoda is indirect evidence of Chazyan age.

Type locality: Exposures along Spring Creek on Johns Ranch, in Carter County, T. 2 S., R. 1 W., northwest of Woodford, near western end of Arbuckle Mountains.

Joins Ranch Formation[1]

Lower Ordovician (Chazy): Central southern Oklahoma.

Original reference: E. O. Ulrich *in* C. E. Decker, Dec. 1930, Am. Assoc. Petroleum Geologists Bull., v. 14, no. 12, p. 1495.

Arbuckle and Wichita Mountains.

Joliet Conglomerate[1]

Pleistocene: Northeastern Illinois.

Original reference: J. W. Goldthwait, 1909, Illinois Geol. Survey Bull. 11, p. 42.

Named for Joliet, Will County.

Joilet Limestone[1]

Joliet Dolomite

Joliet stage

Middle Silurian: Northeastern and western Illinois.

Original reference: G. A. Shufeldt, Jr., 1865, Am. Jour. Sci., 2d, v. 40, p. 389.

C. K. Swartz and others, 1942, Geol. Soc. America Bull., v. 53, no. 4, chart 3. Correlation chart shows Joliet dolomite (restricted) as underlying Cordova dolomite (new) and overlying Rockdale dolomite (new).

J. N. Payne, 1942, Illinois Geol. Survey Bull. 66, p. 191 (table 8). Shown on table of general classification of geologic time as Joliet stage in Niagaran epoch.

Well exposed in quarry of National Stone Co., Joliet, Will County.

Jolliff Conglomerate Member (of Golf Course Formation)

Jolliff Limestone Member (of Dornick Hills Formation)[1]

Pennsylvanian (Morrow Series): South-central Oklahoma.

Original reference: J. A. Waters, 1927, Jour. Paleontology, v. 1, p. 129.

B. H. Harlton, 1938, Am. Assoc. Petroleum Geologists Bull., v. 22, no. 7, p. 854 (fig. 1). Correlation chart shows Jolliff below Otterville and above Limestone Gap shale (new).

B. H. Harlton, 1956, *in* Ardmore Geol. Soc., Petroleum geology of southern Oklahoma—a symposium v. 1: Tulsa, Okla., Am. Assoc. Petroleum Geologists, p. 137 (fig. 2), 138. Member of Golf Course formation (new). Overlies Primrose sandstone member; underlies Otterville limestone member. South of Ardmore the Jolliff conglomerate is lowest unit of Morrowan age.

C. W. Tomlinson and William McBee, Jr., 1959, *in* Ardmore Geol. Soc., Petroleum geology of southern Oklahoma—a symposium, v. 2: Tulsa, Okla., Am. Assoc. Petroleum Geologists, p. 20. Jolliff limestones and conglomerates occur south of Ardmore where they were described by Tomlinson (1929, Oklahoma Geol. Survey Bull. 46) as basal member of Dornick Hills formation, now regarded as group. Along much of its 15-mile outcrop, consists of two coarse conglomerates, each 10 to 30 feet thick. Conglomerates locally disappear or grade into thin tan limestones. Where these occur, they are the first extensive limestones above the Sycamore (Mississippian). They are also lowest conglomerates in sedimentary section here, above Cambrian arkosic conglomerates at base of Reagan sandstone—except for intraformational flat-pebble conglomerates in the Joins and upper Arbuckle beds (Ordovician) and the very local 4-inch bed in Lake Ardmore formation. Tan to black shales fill the varying interval (50 to 200 feet) between major competent strata of Jolliff unit. South of Ardmore, about 800 feet of black shale with sideritic layers intervene between Jolliff conglomerates and Otterville limestone—next higher resistant member of Dornick Hills group.

Named for outcrops in Jolliff Prairie, on allotment of Norman Criner Jolliff, in sec. 24, T. 5 S., R. 1 E., Carter County, east of axis of Overbrook anticline.

Jolly Limestone (in McLeansboro Formation)[1]

Pennsylvanian: Western Kentucky.

Original reference: F. M. Hutchinson, 1912, Kentucky Geol. Survey Bull. 19, p. 30–125.

Probably named for Jolly, Webster County.

Jolly Limestone Member (of Savanna Sandstone)[1]

Pennsylvanian: Central southern Oklahoma.

Original reference: G. D. Morgan, 1924, [Oklahoma] Bur. Geology Bull. 2, p. 74–75.

C. C. Branson, 1957, Oklahoma Geology Notes, v. 17, no. 11, p. 108. Rejected by Oklahoma Geological Survey. Name preoccupied.

Well exposed in road in front of J. S. Jolly's house, 300 yards east of NW cor. sec. 8, T. 1 N., R. 7 E., Pontotoc County.

Jollytown Limestone Member (of Washington Formation)[1]

Jollytown Limestone (in Washington Group)

Permian: Southwestern Pennsylvania, western Maryland, and northern West Virginia.

Original reference: I. C. White, 1891, U.S. Geol. Survey Bull. 65, p. 22, 23, 24, 29, 34.

W. O. Hickok 4th and F. T. Moyer, 1940, Pennsylvania Geol. Survey, 4th ser., Bull. C–26, p. 151. Included in Washington group, although not exposed in Fayette County.

Named for exposures in vicinity of Jollytown, Greene County, Pa.

Jollytown Sandstone (in Washington Formation)[1]

Jollytown Sandstone Member (of Greene Formation)

Permian: Southwestern Pennsylvania, eastern Ohio, and western West Virginia.

Original reference: E. V. d'Invilliers, 1895, Pennsylvania 2d Geol. Survey Summ. Final Rept., v. 3, pt. 2, p. 2573.

Wilber Stout, 1943, Ohio Geol. Survey, 4th ser., Bull. 44, p. 154, chart facing p. 108. In Ohio, termed sandstone member of Greene formation, Dunkard series.

R. L. Nace and P. P. Bieber, 1958, West Virginia Geol. Survey Bull. 14, p. 17 (table 2). In Harrison County, W. Va., Jollytown sandstone is shown as underlying unnamed shale below Dunkard coal and overlying Jollytown coal and (or) slate and shale. Included in Greene formation, Dunkard group.

Thomas Arkle, Jr., 1959, Geol. Soc. America Guidebook Pittsburgh Mtg., p. 118 (table 1). Shown on table of classification of Greene series. Above Jollytown coal and below Dunkard coal.

First described near mouth of Hoover Run on Dunkard Creek, Washington County, Pa.

Jonesboro Limestone[1]

Mississippian: Southwestern Illinois.

Original reference: H. Engelmann, 1868, Illinois Geol. Survey, v. 3, p. 43.

Well exposed one-half mile west of Jonesboro, Union County.

Jonesboro Limestone[1] (in Knox Group)

Lower Ordovician: Northeastern Tennessee and southwestern Virginia.

Original reference: E. O. Ulrich, 1911, Geol. Soc. America Bull., v. 22, p. 564, 637, 671–674, pl. 27.

John Rodgers, 1953, Tennessee Div. Geology Bull. 58, pt. 2, p. 62, 63–64, pl. 11. In proposing term Jonesboro limestone, Ulrich included within it virtually whole southeastern phase of Knox group, as exposed in Jockey Creek section, and at same time included in his Copper Ridge virtually whole northwestern phase as exposed in Thorn Hill section, because he believed rocks in Knox group in Thorn Hill section were almost entirely older than those in Jockey Creek section. Later studies have shown that the rocks in the two sections cover almost the same span. The Jonesboro is restricted, in Jockey Creek section and elsewhere, to the Ordovician part of Knox group (southeastern phase). On present map, this phase of Knox group is divided into Jonesboro limestone above and Conococheague limestone below. The Jonesboro consists largely of dark-blue-weathering limestone some of which is "ribboned" with thin layers of silty dolomite; fairly thick sandstone beds occur in lower 400 feet or so. Thickness about 2,000 feet.

P. B. King and H. W. Ferguson, 1960, U.S. Geol. Survey Prof. Paper 311, p. 28 (tables), 56–57, 126, pl. 1. Thickness 1,700 feet in Denton Valley, north-central Shady Valley quadrangle. Overlies Conochocheague limestone. Top formation in Knox group in this area. Underlies Lenoir limestone. Lower Ordovician.

First described in vicinity of Jonesboro, Washington County, Tenn.

Jonesburg Sandstone Member (of Vamoosa Formation)

Jonesburg Sandstone Member (of Nelagony Formation)[1]

Pennsylvanian (Virgil Series): Southern Kansas and central northern Oklahoma.

Original reference: M. I. Goldman, 1920, U.S. Geol. Survey Bull. 686–W, p. 329–330.

W. F. Tanner, 1956, Oklahoma Geol. Survey Circ. 40, p. 48–50, pl. 1. Reallocated to Vamoosa formation in Oklahoma. Thickness 38 to 54 feet. Upper part consists of buff fine-grained sandstone, middle part of alternating flaggy siltstones and shales, and lower part of contorted buff sandstone and greenish-gray siltstone. Lower part lies at about same stratigraphic position of Bowhan sandstone member; top lies about 100 feet below Middle Oread limestone. The 100-foot interval from the Jonesburg to the Middle Oread is primarily shale, with many lenses of sandstone and a few lenses of limestone; south of southern limit of the Jonesburg, this lenticular zone extends from Labadie limestone member to the Middle Oread, a thickness of about 170 feet; that is, the Jonesburg sandstone is a named member in lower part of an otherwise unsystematized sequence of lenses.

Named for exposure on top of ridge west of Jonesburg, Chautauqua County, Kans.

Jones Point Shale Member (of Topeka Limestone)

Jones Point Shale (in Calhoun Shale)[1]

Pennsylvanian (Virgil Series): Southeastern Nebraska, southwestern Iowa, eastern Kansas, and northwestern Missouri.

Original reference: G. E. Condra, 1927, Nebraska Geol. Survey Bull. 1, 2d ser., p. 40, 43, 51.

G. E. Condra and E. C. Reed, 1937, Nebraska Geol. Survey Bull. 11, 2d ser., p. 15, 46, 49–50. Reallocated to member status in Topeka limestone; underlies Sheldon limestone member; overlies Curzen [Curzon] limestone member. Occurrences in Missouri noted.

R. C. Moore, 1948, Am. Assoc. Petroleum Geologists Bull., v. 32, no. 11, p. 2035. Member of Topeka formation. Overlies Iowa Point shale member; underlies Sheldon limestone member. This is classification agreed upon by State Geological Surveys of Iowa, Kansas, Missouri, Nebraska, and Oklahoma, May 1947.

H. G. Hershey and others, 1960, Iowa Highway Research Board Bull. 15, p. 16, fig. 5. Light- to dark-gray argillaceous to calcareous fossiliferous shale with some beds of thin fossiliferous limestone. Thins to northeast; thickness 7 feet near Thurman, Fremont County; 2.3 feet west of Macedonia, Pottawatamie County; 0.7 foot near Howe, Adair County. Member of Topeka limestone; underlies Sheldon limestone member; overlies Curzon limestone member.

Named for Jones Point, spur in Missouri River bluffs east of Union, Cass County, Nebr.

Jones Ranch Beds

Pleistocene: Southwestern Kansas.

H. T. U. Smith, 1940, Kansas Geol. Survey Bull. 34, p. 110–111, pl. 15B. Name applied provisionally to deposits from which Jones Ranch fauna was described by Hibbard (1940, Kansas Acad. Sci. Trans., v. 43). Consist of poorly consolidated sand, silt, and clay. Thickness 34 to 60 feet. Vertebrate faunas indicate Pleistocene age, probably early.

J. C. Frye and C. W. Hibbard, 1941, Kansas Geol. Survey Bull. 38, p. 411, 416. Included in Meade formation (redefined).

T. G. McLaughlin, 1946, Kansas Geol. Survey Bull. 61, p. 123. Considered part of Kingsdown silt.

J. C. Frye and A. B. Leonard, 1952, Kansas Geol. Survey Bull. 99, p. 110. Listed among units classed at least in part as Sanborn formation.

Occur along headwaters of Sand Creek, in southern part of T. 32 S. and northern part of T. 33 S., R. 27 W., southeast of Meade, Meade County.

Jonestown Beds or Formation (in Martinsburg Formation or Group)

Ordovician: East-central and central Pennsylvania.

Bradford Willard, 1939, Pennsylvania Acad. Sci. Proc., v. 13, p. 129, 131. Name proposed for beds or formation in upper part of Martinsburg "formation." Described as basically dark shale weathering to buff chips; also includes many red shale bands and lenticular bodies of platy or brecciated, rarely massive, limestone. This alternation of dark shale, red shale, and limestone is not sharply defined below but passes over into nonred limestone-poor older Martinsburg shales. Maximum thickness 500 feet. Underlies Shochary sandstone.

Bradford Willard, 1943, Geol. Soc. America Bull., v. 54, no. 8, p. 1068, 1074, 1075, 1090, 1116 (fig. 8), 1118. Beds further described as including cross-bedded sandy layers, oolite, and an abundance of limestone breccia or edgewise conglomerate associated with the limestones and red beds. Continental quivalent of marine Martinsburg with which it intergrades. In eastern outcrops of Martinsburg group, unit lies stratigraphically near base of sandstones ("Fairview" and Shochary) and extends down into underlying shale (Dauphin).

Named for exposure along Swatara Creek north of Jonestown, Lebanon County.

Jonestown Volcanics

Ordovician: Central Pennsylvania.

Owen Bricker, 1960, Pennsylvania Geologists Guidebook 25th Ann. Field Conf., p. 92–99. Consists of volcanics interbedded with series of shales, sandstones, and limestone. Section shows (ascending) dark-gray shale, green arkosic sandstone, thin beds of red shale; red basalt breccia, massive basalt and some porphyritic basalt, about 600 feet; dark-gray shale containing beds of red and purple shale, green arkosic sandstone, and thin limestone, about 125 feet; hard white sandstone with angular fragments of green clay, about 150 feet; dark-gray shale with thin beds of red, purple, and green shale; about 50 feet; dark-greenish-gray basalt breccia, massive basalt, and amygdaloidal basalt, about 500 feet; fine- to medium-grained blue-gray limestone, about 150 feet; dark-gray to black fissile shale. Stratigraphic position of volcanics is within main belt of Martinsburg formation.

Volcanics are south of Jonestown, Lebanon County. Form topographic high known locally as Bunker Hill.

Jordan Limestone Member (of Bingham Quartzite)[1]

Pennsylvanian: Central northern Utah.

Original reference: A. Keith, 1905, U.S. Geol. Survey Prof. Paper 38, p. 38, map, sections.

Named for occurrence in Old Jordan mine, Bingham district.

Jordan Sandstone[1]

Jordan Sandstone Member (of Trempealeau Formation)

Upper Cambrian: Southern Minnesota, northern Illinois, Iowa, and Wisconsin.

Original reference: A. Winchell, 1872, Rept. of geol. survey of Belle Plaine, Scott County, Minn., 16 p.

G. O. Raasch, 1939, Geol. Soc. America Spec. Paper 19, p. 97–105. Trempealeau formation subdivided into (ascending) St. Lawrence, Lodi, and Jordan members.

C. R. Stauffer and G. A. Thiel, 1941, Minnesota Geol. Survey Bull. 29, p. 46–49, measured sections. Described in southeastern Minnesota where it includes Norwalk member below and Van Oser member above. Overlies Lodi member of St. Lawrence formation; underlies Oneota dolomite; in some areas, separated from Oneota by Kasota sandstone and Blue Earth siltstone. St. Croixian series.

J. N. Payne *in* H. B. Willman and J. N. Payne, 1942, Illinois Geol. Survey Bull. 66, p. 191 (table 8), 192. Jordan stage of Cambrian period mentioned in discussion of geologic history of pre-Pennsylvanian in Illinois.

B. F. Howell and others, 1944, Geol. Soc. America Bull., v. 55, no. 4, chart 1 (column 61). Shown on correlation chart as member of Trempealeau formation.

G. O. Raasch, 1951, Illinois Acad. Sci. Trans., v. 44, p. 150. Uppermost member of Trempealeau formation. Overlies Lodi member; underlies Sunset Point formation (new) which name replaces term Madison formation as previously used in Wisconsin.

G. O. Raasch, 1952, Illinois Acad. Sci. Trans., v. 45, p. 94. Includes Van Oser submember.

C. A. Nelson, 1956, Geol. Soc. America Bull., v. 67, no. 2, p. 165–184. Discussion of Upper Croixan stratigraphy of Upper Mississippi Valley. Terminology adopted represents return to early lithologic classifications in which St. Lawrence and Jordan formations are recognized as dolomitic strata and massive sandstone, respectively. Urged that term Trempealeau, previously employed as formation name to include all these strata and also as stage name, be restricted to Trempealeauan stage.

R. R. Berg, C. A. Nelson, and W. C. Bell, 1956, Geol. Soc. America Guidebook Minneapolis Mtg. Field Trip 2, p. 13–20. Formation consists of massive- to well-bedded fine- to coarse-grained sandstone lying above Lodi member of the St. Lawrence. Contact with St. Lawrence generally sharp and drawn above highest siltstone and at base of continuous sandstone. Thickness 20 to 150 feet; average about 100 feet. Trowbridge and Atwater (1934) suggested member terminology, Norwalk and overlying Van Oser. This subdivision officially adopted for Minnesota classification by Stauffer and others (1939, Geol. Soc. America Bull., v. 50, no. 8). These units are of limited applicability and have been used in few published measured sections of Jordan. They serve to emphasize general upward gradation of the Jordan from fine- to coarse-grained sandstone. Relation of Jordan sandstone to Madison (Irving, 1875) or Sunset Point (Raasch, 1951) sandstone of eastern Wisconsin not clear. Twenhofel, Raasch, and Thwaites (1935, Geol. Soc. America Bull., v. 46, no. 11) appear to be only workers who have applied term Madison away from type section at Madison, Wis., and their usage is ambiguous; unit not recognized in Minnesota. Difficulty that various workers have experienced in clearly differentiating Jordan from Madison in a single section suggests that they represent lateral facies of one another. The Madison (Sunset Point) may bear same relation to the Jordan as does the Kasota sandstone. These strata lie between true Jordan and true Oneota dolomite deposits. Disconformity commonly suggested at top of Jordan is based on catastrophic concept that Jordan sandstone cannot contain post-Cambrian fossils (as does the Kasota) and has yet to be clearly demonstrated on physical evidence. Croixan series.

Named for exposures in Sand Creek at Jordan, Scott County, Minn.

Jordan Narrows unit (in Salt Lake Group)

Oligocene, middle, to Miocene, middle: North-central Utah.

L. W. Slentz, 1955, Utah Geol. Soc. Guidebook 10, p. 23, 24 (fig. 6), 25–26. Salt Lake group, in Lower Jordan Valley, is divided into (ascending) Traverse volcanics, Jordan Narrows unit, Camp Williams unit, Harkers fanglomerate, and Travertine unit. Jordan Narrows unit is chiefly white marlstone with oolitic argillaceous and cherty limestone, sandstone, clays, and rhyolitic tuffs, all fresh-water lacustrine deposits. Total thickness unknown but exceeds 300 and perhaps 2,000 feet. Interfingering relationships with Traverse volcanics.

Type locality: Jordan Narrows and Beef Hollow. Areal extent of unit not definitely known but may underlie entire Jordan Valley. Lower Jordan Valley is defined as that part of Jordan Valley northward from Traverse Mountains to Great Salt Lake.

Jornada Basalt

Quaternary: Central southern New Mexico.

F. E. Kottlowski and others, 1956, New Mexico Bur. Mines Mineral Resources Mem. 1, p. 72. Vesicular basalt. Thickness from 50 to 100 feet. Partly covered by thin sheet of Recent windblown sand and clay.

Occupies rectangular-shaped area, about 20 miles from east to west and 11 miles from north to south on northwest side of Jornada del Muerto, Socorro County.

Jornada Gravels

Age not given: Southwestern New Mexico.

F. E. Kottlowski, 1958, Roswell Geol. Soc. Guidebook, 11th Field Conf., p. 109. Gravels are of angular pebbles typical of alluvial fan gravels and dissimilar to rounded gravels now found along the Rio Grande.

Exposed along Highway U.S. 70, 65 miles southwest of Alamogordo.

Jornada Limestone (in Montoya Group)

Upper Ordovician: Southwestern New Mexico.

V. C. Kelley, 1951, Am. Assoc. Petroleum Geologists Bull., v. 35, no. 10, p. 2201 (table), fig. 2. Thickness ranges from fraction of a foot to 400 feet. Underlies Fusselman limestone; overlies Cable Canyon sandstone.

Exposed in Caballo Mountains.

Jornadan series[1]

Quaternary: New Mexico.

Original reference: C. R. Keyes, 1915, Conspectus of geologic formations of New Mexico: Des Moines, Robert Henderson, State Printer, p. 8.

Jose Butte Basalt or Flow (in Clayton Basalt)

Late Cenozoic: Northeastern New Mexico.

Brewster Baldwin and W. R. Muehlberger, 1959, New Mexico Bur. Mines Mineral Resources Bull. 63, p. 122, pl. 1–b. Ten basalt flows in what is termed Folsom sequence of Clayton basalt are named and mapped. Stratigraphic position of six of these basalts has been determined. Jose Butte is youngest in known sequence. Overlies Robinson Mountain basalt. Thickness unknown although topographic breaks along margin indicate at least 20 feet. Rock is medium-gray holocrystalline porphyritic olivine basalt.

Jose Butte lies along Colfax-Union County line, and basalt from it covers several square miles northwest of Capulin Mountain.

Jose Shale Member (of Yegua Formation)

Eocene (Claiborne): Western Texas, and Tamaulipas, Mexico.

J. M. Patterson, 1942, Am. Assoc. Petroleum Geologists Bull., v. 26, no. 2, p. 259 (fig. 2), 265. Name applied to predominantly red and green bentonitic shales above Mier sandstone tongue and below Loma Blanca sandstone tongue of Yegua formation. Thickness 70 to 130 feet.

Named from Jose ranchhouse located 1¾ miles northeast of village of Falcon, Falcon quadrangle, Texas.

Jose Creek Member (of McRae Formation)

Upper Cretaceous: Southwestern New Mexico.

H. P. Bushnell, 1955, Compass, v. 33, no. 1, p. 11 (table), 12–14. Lower part of member at type locality consists of green shale and siltstone beds interbedded with coarse-grained tan to dark-brown or greenish andesitic sandstone beds. Upper part distinguished by coarse-grained andesitic sandstone beds that weather dark brown and by tan to cream-colored bedded chert. Conglomerate interspersed with sandstone beds at type locality. Contains sequence of coarse volcanic conglomerate beds in vicinity of Elephant Butte Dam. Thickness at type locality 394 feet. Conformably underlies Hall Lake member (new); unconformably overlies Mesaverde formation.

Type locality: Immediately east of Elephant Butte Reservoir, north of McRae Canyon, Sierra County. Outcrops of member observed only near Elephant Butte Reservoir in McRae Canyon, and at south end of Fra Cristobal Mountains.

Joserita Member (of Lowell Formation)

Lower Cretaceous: Southeastern Arizona.

A. A. Stoyanow, 1949, Geol. Soc. America Mem. 38, p. 11–12, 15, pl. 27. Consists of following units (ascending): soft sandstone and arenaceous shale, gray shaly limestone, soft shale and sandstone, Baga shale and limestone (new), yellow dolomite, Espinal grit (new), Corta sandstone (new), and Quimbo dolomite (new). Thickness 123 feet. Underlies Saavedra member (new); overlies Pacheta member (new).

In standard section of Lowell formation in Ninety One Hills. Type locality of formation also designated as Ninety One Hills area, immediately north of international border in vicinity of international monument No. 91, southeast of Bisbee Junction in Southern Pacific Railway, Cochise County.

Joshua Schist

Pre-Triassic: Western Massachusetts.

M. E. Willard, 1951, Bedrock geology of the Mount Toby quadrangle, Massachusetts: U.S. Geol. Survey Geol. Quad. Map [GQ–8]. Name proposed for well-foliated, coarse-grained muscovite-quartz-biotite schist and gneiss. Large iron-stained flakes of muscovite cause gilded appearance. Partly pegmatized; cut by granite dikes and sills. Overlies Erving hornblende schist. Mapped previously as part of Amherst schist; new name introduced since unit can not be traced to other areas of the Amherst and latter at its type locality underlies the Erving. Gneissic beds were formerly mapped as Williamsburg granodiorite. Pre-Triassic.

Named for Joshua Hill, east of Mount Toby, Mount Toby quadrangle.

Joshua Schist (in Evington Group)

Lower Paleozoic(?): South-central Virginia.

W. R. Brown, 1951, (abs.) Geol. Soc. America Bull., v. 62, no. 12, pt. 2, p. 1547. Incidental mention.

W. R. Brown, 1953, Kentucky Geol. Survey, ser. 9, Spec. Pub. 1, p. 91 (fig. 1). Blue-gray phyllite and fine-grained schists. Biotite porphyroblasts common. Calcareous in part. Thickness from a fraction of a foot to 500 feet. Overlies Candler formation (new); underlies Arch marble (new), all in Evington group (new). Type locality designated. Paleozoic(?).

G. H. Espenshade, 1954, U.S. Geol. Survey Bull. 1008, p. 16. Included in Archer Creek formation (new).

W. R. Brown, 1958, Virginia Div. Mineral Resources Bull. 74, p. 8 (fig. 2). Age shown on columnar section as Lower Paleozoic(?).

Type locality: Along parts of Joshua Creek 6½ miles east of Lynchburg, Campbell County. Lynchburg quadrangle.

Joshua Submember (of Otisco Member of Ludlowville Formation)

Middle Devonian: Central New York.

W. A. Oliver, Jr., 1951, Am. Jour. Sci., v. 249, no. 10, p. 709–713, 716–717, fig. 6 (facing p. 724). Name proposed for upper coral bed in Otisco member. Consists of mass of closely packed rugose coral skeletons; interstices filled with same shaly sediments as that constituting body of Otisco. Maximum thickness 50 feet. Thins laterally and marked at edges by thin fingers extending into shale of the Otisco. Base lies in sharp contact with shale without sandstone platform. Interval between base and Centerfield limestone member of Ludlowville 90 to 100 feet. Lower coral bed is Staghorn Point submember (Smith, 1935).

Named for exposures at Lord's Hill near Joshua, Onondaga County. Areal extent northeast-southwest is 9 miles.

Joyita Sandstone Member (of Yeso Formation)

Permian: Central New Mexico.

C. E. Needham and R. L. Bates, 1943, Geol. Soc. America Bull., v. 54, no. 11, p. 1660. Name applied to soft crossbedded sandstone that forms uppermost unit of formation. In Joyita Hills, 160 feet thick and consists of pink, orange, and yellow thin-bedded sandstone that weathers to rounded ledges; orange color and manner of weathering distinguish member.

Thickness 185 feet at Yeso type section; 120 feet at Chupadera Mesa; 105 feet at Bend. Overlies limestones of middle evaporites or Canas gypsum member (new); underlies Glorieta sandstone.

Named from section in canyon of west-flowing tributary of Rio Grande in La Joyita Hills 18 miles north of Socorro and about 4½ miles south of village of La Joya, Socorro County.

Juab Limestone (in Pogonip Group)

Lower Ordovician (Chazyan): Western Utah.

L. F. Hintze, 1951, Utah Geol. and Mineralog. Survey Bull. 39, p. 17–18, 57, 58. Proposed for the fine sandy calcisiltite limestone that overlies Wahwah limestone (new) and underlies Kanosh shale (new). Thickness at type locality 139 feet.

R. E. Cohenour, 1959, Utah Geol. and Mineralog. Survey Bull. 63, p. 12 (table 1), 73–74, pl. 1. Described in Sheeprock Mountains where it is 161 to 204 feet thick; conformably overlies Wahwah (Wah Wah) limestone and conformably underlies Kanosh shale. Included in Pogonip group.

Type locality: NE¼ sec. 31, T. 22 S., R. 14 W., Millard County. Name derived from Juab County.

Jualin Diorite[1]

Lower Cretaceous (?): Southeastern Alaska.

Original reference: A. Knopf, 1911, U.S. Geol. Survey Bull. 446, p. 24–25, map.

Exposed at Jualin and in Jualin mine, Berners Bay region.

Juan Ascencio Chert Beds[1]

Cretaceous (?): Puerto Rico.

Original reference: D. R. Semmes, 1919, New York Acad. Sci., Scientific survey of Porto Rico and Virgin Islands, v. 1, p. 65.

Juan Ascencio Member (of Fajardo Shale)[1]

Upper Cretaceous: Eastern Puerto Rico.

Original reference: H. A. Meyerhoff, 1931, New York Acad. Sci. Scientific survey of Porto Rico and Virgin Islands, v. 2, pt. 3, p. 288.

R. C. Mitchell, 1954, Puerto Rico Univ. Agr. Expt. Sta. Tech. Paper 13, p. 36 (table 2). Thickness of Fajardo shale with Juan Ascencio member 1,100 feet. Upper Cretaceous.

Occurs in Fajardo district.

Juana Díaz Formation

Juana Díaz Marls[1] or Shales[1]

Oligocene, middle: Puerto Rico.

Original reference: C. P. Berkey, 1915, New York Acad. Sci. Annals, v. 26, p. 10, 17.

A. D. Zapp, H. R. Bergquist, and C. R. Thomas, 1948, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 85. Formation includes about 655 meters of middle Oligocene conglomerate, sandy limestone, and shales. Roughly divided into three members: upper shale 140 meters; middle sandy limestone and limy shale 375 meters; and lower sandy conglomerate 140 meters. Basal Tertiary in south Coastal Plain; underlies Ponce formation.

R. C. Mitchell, 1954, Puerto Rico Univ. Agr. Expt. Sta. Tech. Paper 13, p. 36 (table 2), 57. Northeast of town of Juana Díaz, formation rests unconformably upon rocks believed to be the Cañas Arriba formation (new).

E. A. Pessagno, Jr., 1960, Geology of the Ponce-Coamo area, Puerto Rico: Puerto Rico Econ. Devel. Adm. and Princeton Univ. Dept. Geology, p. 103–107. In area north of Juana Díaz, formation rests unconformably on rocks of lower middle Eocene Jacaguas group (new). Underlies Oligocene-Miocene Ponce formation.

Named for exposures east of village of Juana Díaz and along the Río Jacaguas to west.

Juana Lopez Member (of Mancos Shale)

Juana Lopez Sandstone Member (of Carlile Shale)

Upper Cretaceous: Northern New Mexico and western Colorado.

C. H. Rankin, 1944, New Mexico Bur. Mines Mineral Resources Bull. 20, p. 7, 12, 19–20, fig. 3. Very calcareous thin-bedded sandstone near top of Carlile; weathers brown; grades into shale at base. Thickness 10 feet. Contains abundant Frontier fauna. For mapping purposes in northern New Mexico, top of Juana Lopez could well be used as top of Carlile.

C. E. Stearns, 1953, Geol. Soc. America Bull., v. 64, no. 4, p. 463, 466, pl. 1. In Galisteo-Tonque area, New Mexico, Carlile-Niobrara contact not marked by mappable lithologic horizon, but Juana Lopez member is close approximation. This member, about 6 feet of interbedded arenaceous shale and very thin-bedded arenaceous fetid limestone, forms low persistent hog-back 300 to 475 feet above Greenhorn limestone and marks break between "lower Mancos shale" and "middle Mancos shale." Juana Lopez is overlain by about 500 feet of argillaceous shale ("middle Mancos shale").

C. E. Stearns, 1953, Am. Assoc. Petroleum Geologists Bull., v. 37, no. 5, p. 967–968. Persistent horizon marker, but since lithology varies it seems advisable to retain name but avoid lithologic designation.

U.S. Geological Survey currently classifies the Juana Lopez as a member of Mancos Shale on the basis of a study now in progress.

Type section: In sec. 32, T. 15 N., R. 7 E., on Mesita Juana Lopez Grant, 6 miles northwest of Cerrillos, Santa Fe County, N. Mex. Widespread in New Mexico and Colorado.

Jubilee phase (of Amargosa chaos)

Post-Miocene(?): Southern California.

L. F. Noble, 1940, (abs.) Geol. Soc. America Bull., v. 51, no. 12, pt. 2, p. 1936. Listed as a phase of the Amargosa chaos, an assemblage of blocks on overthrust plate of Amargosa thrust.

L. F. Noble, 1941, Geol. Soc. America Bull., v. 52, no. 7, p. 965, 972–977. Mosaic of fault blocks composed mostly of sedimentary and volcanic rocks and breccias of granitic, sedimentary, and metamorphic rocks ranging in age from Precambrian to Tertiary. Maximum thickness not over 1,000 feet. Jubilee phase lies at one place on Virgin Spring phase and at another place forms the sole of the thrust. Calico and Jubilee phases not in contact in the area, and their relative position is not known. Unconformably overlain by Pliocene(?) Funeral fanglomerate.

Occurs in Virgin Spring area near Death Valley. Name derived from Jubilee Wash, where mosaic is exposed on both sides of Shoshone-Death Valley Highway at Chaos Ridge.

Judd Shale Member (of Frontier Formation)

Upper Cretaceous: Northeastern Utah.

L. A. Hale, 1960, Wyoming Geol. Assoc. Guidebook 15th Ann. Field Conf., p. 136 (chart 1), 139 (fig. 1), 140, 141–142, 143 (fig. 2), 145 (fig. 3). Where well exposed, consists of gray marine shale 690 to 760 feet thick. Apparently thins to west because it is not recognized in section along Echo Reservoir north of Coalville. Represents a tongue of Hilliard shale of southwestern Wyoming. Lies between Grass Creek member (new) below and Upton sandstone member (new) above. Name credited to D. W. Trexler (unpub. thesis).

Exposed in Judd Canyon, 6 miles east of Coalville, Summit County.

Judd Creek Latite

Tertiary: Western Utah.

G. H. Thomas, 1958, Brigham Young Univ. Research Studies, Geology Ser., v. 5, no. 4, p. 13–14, pl. 1. Fine-grained aphanite with porphyritic texture; locally reddish color.

Named from exposures near Judd Creek, Tooele County. Covers about 3 square miles in and around sections 16 and 17, T. 10 S., R. 7 W.

Judith River Formation (in Montana Group)[1]

Upper Cretaceous: Central, northern, southeastern, and southern Montana and northwestern Wyoming.

Original references: F. B. Meek and F. V. Hayden, 1856, Philadelphia Acad. Sci. Proc., v. 8, p. 267; 1858, v. 9, p. 123; 1862, v. 13, p. 418; 1862, Am. Philos. Soc. Trans., new ser., v. 12.

J. D. Love, J. L. Weitz, and R. K. Hose, 1955, Geologic map of Wyoming (1:500,000): U.S. Geol. Survey. As mapped, Montana group includes Telegraph Creek and Eagle sandstones, Claggett shale, and Judith River formation along north margin of Yellowstone National Park.

W. J. McMannis, 1955, Geol. Soc. America Bull., v. 66, no. 11, pl. 7. Plate 7 shows Livingston formation intertongues with Claggett, Judith River, Bearpaw, Lennep, Hell Creek, Tullock, and Lebo formations.

M. M. Knechtel and S. H. Patterson, 1956, U.S. Geol. Survey Bull. 1023, p. 12 (fig. 3), 34–36, pls. 1, 2. Formation, as mapped near Montana-Wyoming boundary, comprises two members: Parkman sandstone and an upper unnamed member. Thickness about 255 feet as exposed east of Hardin, Mont. Overlies Claggett shale member of Cody shale; underlies Bearpaw shale.

Named for occurrence near mouth of Judith River, Mont.

Judkins Formation

Quaternary: Western Texas.

R. M. Huffington and C. C. Albritton, Jr., 1941, Am. Jour. Sci., v. 239, no. 5, p. 327–329. An aeolian deposit consisting of reddish-brown massive sandstone with interstitial clay and fine silt. At type locality, maximum thickness 6 feet; base not exposed. Underlies Monahans formation (new); surface of contact sharply defined and irregular in profile; in different places, rests on rock of Triassic, Cretaceous, and older Quaternary age.

Type locality: South side of Highway 80, 6½ miles northeast of Monahans, near Sand Hills, Ward County. Probably named from nearby village of Judkins [also spelled Judkin].

Judson Member (of St. Lawrence Formation)

Upper Cambrian (St. Croixian): Minnesota.

C. R. Stauffer, G. M. Schwartz, and G. M. Thiel, 1938, (abs.) Geol. Soc. America Bull., v. 49, no. 12, pt. 2, p. 1902. Named as lower member of formation. Underlies Lodi member; overlies Franconia formation. [Probably replaced by Nicollet Creek member.]

Type locality of St. Lawrence formation is in Scott County.

Jueyes Lens (in Ildefonso Formation)

Upper Cretaceous: Puerto Rico.

E. A. Pessagno, Jr., 1960, Geology of the Ponce-Coamo area, Puerto Rico: Puerto Rico Econ. Devel. Adm. and Princeton Univ. Dept. Geology, p. 34. Massive limestone lens in upper part of formation.

Named from village of Río Jueyes near which it is located.

Julian Group[1]

Triassic or older: Southern California.

Original reference: F. J. H. Merrill, 1914, Geology and Mining Resources San Diego and Imperial Counties; California State Mining Bur., p. 11–12.

Named for village of Julian, San Diego County.

†Julian limestone[1]

Middle Ordovician: Iowa.

Original reference: C. R. Keyes, 1922, Pan-Am. Geologist, v. 37, p. 252–255.

Named for Julian Township.

Julian Schist[1]

Triassic(?) or older: Southern California.

Original reference: F. J. H. Merrill, 1914, Geology and mineral resources of San Diego and Imperial Counties: California State Mining Bur., p. 11–12.

D. L. Everhart, 1951, California Div. Mines Bull. 159, p. 58–60, pls. 2, 3, 4, 5. Consists essentially of quartz-mica schist and quartzite; the former far more abundant. Older than other intrusive rocks in area. Shown on map as Triassic(?). Previous workers have assigned various ages to the schist, and in one instance age is given as Jura-Triassic.

Richard Merriam, 1958, California Div. Mines Bull. 177, p. 9–11, pl. 1. Described and mapped in Santa Ysabel quadrangle. Older than Stonewall quartz diorite.

Named for village of Julian, Santa Ysabel quadrangle, San Diego County, which occurs in midst of mass.

†Julian series[1]

Middle Ordovician: Iowa.

Original reference: C. R. Keyes, 1927, Pan-Am. Geologist, v. 47, p. 146–148.

Dubuque region.

Juliand Member[1] (of Enfield Formation)

Juliand zone

Upper Devonian: Southeastern New York.

Original reference: G. H. Chadwick, 1933, Pan-Am. Geologist, v. 60, p. 99, 285.

G. A. Cooper and others, 1942, Geol. Soc. America Bull., v. 53, no. 12, pt. 1, chart 4. Shown on correlation chart as Juliand zone, below Van Etten zone and above Kattel shale.

Named from exposures in Juliand Hill just east of village of Greene, Greene County.

Jumbo Dolomite Member (of Talladega Slate)[1]

Jumbo Dolomite (in Talladega Series)

Paleozoic(?): Eastern Alabama.

Original reference: Charles Butts, 1926, Alabama Geol. Survey Spec. Rept. 14, p. 53, map.

T. N. McVay and L. D. Toulmin, 1945, Alabama Geol. Survey Bull. 55, p. 20. Included in lower part of Talladega series.

Named for exposures and quarries at and near Jumbo, Chilton County.

Jumbo Volcanics[1]

Late Paleozoic or Mesozoic: Northeastern Washington.

Original reference: C. E. Weaver, 1920, Washington Geol. Survey Bull. 20, p. 95, map.

Occurs at headwaters of Fifteen Mile Creek, at east end of Jumbo Mountain, Stevens County.

Jumonville Sandstone

Upper Devonian (Conewango): Southwestern Pennsylvania.

W. M. Laird, 1941, Pennsylvania Topog. and Geol. Survey Prog. Rept. 126, p. 11, 12. Name will probably be used, following more definitive study of area, for unit here termed Sandstone D in Riceville stage and described as interbedded gray-brown sandstones and shales with some lenses of white quartz-pebble and clay-gall conglomerate. More sandy than underlying shale. Thickness 135–152 feet. Disconformably underlies Mississippian beds; conformably overlies Shale C (Watering Trough shale).

Type locality: Along the National Pike at Watering Trough Inn below crest of Chestnut Ridge, Fayette County. Longer section exposed in Youghiogheny Gorge through Chestnut Ridge in vicinity of mouth of Indian Creek.

Juncal Formation

Eocene, middle: Southern California.

B. M. Page, J. G. Marks, and G. W. Walker, 1951, Am. Assoc. Petroleum Geologists Bull., v. 35, no. 8, p. 1730 (fig. 2), 1733 (fig. 3), 1734 (fig. 4), 1747, 1749–1756. In type area, north of Santa Ynez fault, separable into three members: lower shale with lenticular sandstone, middle sandstone, and upper shale and sandstone. Changes in facies are pronounced, and threefold division not always recognizable in other areas. South of the fault, formation is sandstone and shale as in type section, but composition and thickness of the three members are quite different and none of members mapped in type section can be identified with certainty. Thickness at type locality 3,360 feet; south of fault where formation includes Camino Cielo sandstone member (new), thickness is 5,520 feet. In and near type locality, Juncal lies with angular unconformity on Upper Cretaceous strata (Pendola shale) and is conformably overlain by upper Eocene Matilija sandstone; south of fault, Juncal disconformably(?) overlies Upper Cretaceous Debris Dam sandstone (new) and the Romero conglomerate lentils (new). In vicinity of Mono Debris Dam, conformably overlies Sierra Blanca limestone; 1½ miles southwest of Pendola Guard Station, where strata are exposed in core of an anticline, Debris Dam sandstone is missing, and Juncal unconformably overlies undifferentiated Cretaceous shale.

W. R. Merrill, 1952, *in* Am. Assoc. Petroleum Geologists, Soc. Econ. Paleontologists Mineralogists, Soc. Explor. Geophysicists Joint Ann. Mtg. Guidebook, p. 17. Includes Wheeler sandstone member in area from Ojai to Ozena.

Type locality: In crestal region of Agua Caliente anticline, Santa Barbara County. Section extends from point in small canyon 10,200 feet N. 55° E. of Pendola Guard Station to point 9,500 feet N. 21° E. of Juncal CCC Camp. Extends northward beyond limits of mapped area where it is involved in structural complexities; south of type section, it is truncated by Santa Ynez fault, reappears south of Santa Ynez River valley, and is traceable entire lateral extent of map area on crest and flanks of Santa Ynez Mountains. Nelson (1925, Bull. California Univ. Geol. Sci., v. 15, no. 10) mapped unit as "undifferentiated Eocene" in upper India and Mono Creeks area; there it conformably overlies Sierra Blanca limestone.

Juncos Gabbro[1]

Age(?) Puerto Rico.

Original references: C. R. Fettke, 1924, New York Acad. Sci., Scientific survey of Porto Rico and Virgin Islands, v. 2, pt. 2, p. 153; 1924, Am. Inst. Mining and Metall. Trans., v. 70, p. 1026–1042.

Junction limestone[1]

Upper Jurassic: Utah.

Original reference: C. R. Keyes, 1924, Pan-Am. Geologist, v. 41, p. 36, 301.

Derivation of name not stated.

Junction City facies (of New Providence Formation)

Lower Mississippian: Central Kentucky.

P. B. Stockdale, 1939, Geol. Soc. America Spec. Paper 22, p. 76, 115–117. Soft argillaceous shale, blue gray, olive gray, to drab. "Clayey character is outstanding". Foerste (1905) named the unit Linietta clay. Thickness 70 to 125 feet; thinnest along axis of Cincinnati Arch in Casey County. Merges with Keith Knob facies (new) westward and with Dicks River facies (new) eastward. Underlies New Albany black shale.

Named for Junction City, located at edge of Lexington Plain, at foot of Plateau escarpment in southeastern Boyle County. Good outcrops occur along the fairly even line of escarpment westward across southern Boyle County along irregular belt southward into Lincoln County.

Junction City Quartzite[1]

Precambrian (middle Huronian): Central northern Wisconsin.

Original reference: S. Weidman, 1907, Wisconsin Geol. Nat. History Survey Bull. 16, p. 91.

Exposed in vicinity of Junction City, Portage County.

Junction Creek Sandstone (in San Rafael Group)

Junction Creek Sandstone Member (of Morrison Formation)

Junction Creek Sandstone Member (of Wanakah Formation)

Upper Jurassic: Southwestern Colorado.

M. I. Goldman and A. C. Spencer, 1941, Am. Assoc. Petroleum Geologists Bull., v. 25, no. 9, p. 1748 (fig. 2), 1750–1751, 1753 (table 1). Proposed for uppermost member of Morrison formation. Estimated thickness 300 feet. Overlies Wanakah marl member. [See La Plata sandstone.]

E. G. Eckel, 1949, U.S. Geol. Survey Prof. Paper 219, p. 27 (table), 29–30, pl. 2. Rank raised to formation. Predominantly massive white to light-buff friable crossbedded sandstone; thin partings of greenish-gray or light-red shale partings numerous. Thickness 200 to 500 feet. Overlies Wanakah formation (redefined); underlies Morrison formation.

L. C. Craig and C. N. Holmes, 1951, New Mexico Geol. Soc. Guidebook 2d Field Conf., p. 94. Reallocated to member status in Wanakah formation. Similar to and appears to occupy same stratigraphic position as Bluff sandstone. Relation of Junction Creek to Morrison formation not definitely established; upper part may have been deposited synchronously with lower bed of Morrison in southwestern Colorado.

L. W. Kilgore, 1955, Four Corners Geol. Soc. Guidebook [1st] Field Conf., p. 120, fig. 2. Suggested that Eckel's interpretation of Junction Creek as separate formation be followed and its age relationship placed with San Rafael group. Generalized cross section of Animas River valley shows Junction Creek sandstone overlying Summerville formation and underlying Salt Wash sandstone of Morrison group.

E. B. Ekren and F. N. Houser, 1959, U.S. Geol. Survey Mineral Inv. Field Studies Map MF–221. Mapped in Moqui SE quadrangle, Colorado, where it is 250 to 300 feet thick and consists of three gradational units. Upper unit, 20 to 50 feet thick, is argillaceous fine-grained reddish sandstone with obscure flat stratification. Middle unit, about 150 feet thick, of fine- to coarse-grained poorly sorted sandstone, cross-stratified at high angle; weathers to a "slick rim." Lower unit, 30 to 50 feet thick, has same general lithology as middle unit but with low-angle cross-stratification and numerous horizontal truncations. Overlies Summerville formation, contact gradational; underlies Salt Wash sandstone member of Morrison formation. San Rafael group. Upper Jurassic.

Named from exposures opposite Animas City Mountain between Junction Creek and Animas River, La Plata County.

June Bell Rhyolite[1]

Tertiary: Central northern Nevada.

Original reference: E. H. Rott, Jr., 1931, Nevada Univ. Bull., v. 25, no. 5.

Occurs in small area on June Bell claim in Gold Circle or Midas mining district, western part of Elko County.

June Lake Basalt

Pleistocene: Eastern California.

W. C. Putnam, 1940, (abs.) Geol. Soc. America Bull., v. 51, no. 12, pt. 2, p. 1939. Basalt flow from small cinder cone in floor of June Lake glacial trough.

Occurs in region about June Lake in east-central Sierra Nevada.

Juniata coal measures[1]

Devonian: Pennsylvania.

Original reference: F. Platt, 1877, Pennsylvania 2d Geol. Survey H_2, p. xxiii–xxx.

Juniata Formation[1]

Upper Ordovician: Central southern and eastern Pennsylvania, western Maryland eastern Tennessee, western Virginia, and eastern West Virginia.

Original reference: N. H. Darton, 1896, U.S. Geol. Survey Geol. Atlas, Folios 28 and 32.

Bradford Willard and A. B. Cleaves, 1939, Geol. Soc. America Bull., v. 50, no. 7, p. 1165–1198. Discussion of Ordovician-Silurian relations in Pennsylvania. Term Oswego has been misapplied in Pennsylvania. For beds commonly referred to by that name, Bald Eagle is revived and treated as basal Juniata. Overlies Martinsburg formation; underlies Tuscarora formation. There is a disconformity between Bald Eagle and Tuscarora east of Susquehanna River and either a disconformity or unconformity below Bald Eagle or Tuscarora or Shawangunk from Susquehanna River to southeastern New York. Either hiatus might be used as Ordovician-Silurian line of separation. If lower is accepted, Juniata is Silurian; if upper is used, then Juniata is Ordovician.

Charles Butts, 1940, Virginia Geol. Survey Bull. 52, pt. 1, p. 203, 205, 207, 221–229. Occupies space between Oswego sandstone below and Tuscarora sandstone above in northern end of Appalachian Valley in Virginia; farther southwest, it is overlain by Clinch sandstone and rests everywhere upon *Orthorhynchula* zone of Martinsburg shale. In Lee County, the equivalent Sequatchie formation also succeeds *Orthorhynchula* zone. Maximum thickness about 725 feet, northwest of Monterey, Highland County.

F. M. Swartz, 1948, Pennsylvania Geologists Guidebook 14th Ann. Field Conf., supp., diagram (following p. 4), fig. 3. Underlies unit termed Run Gap sandstone.

H. P. Woodward, 1951, West Virginia Geol. Survey, v. 21, p. 387–408. Juniata formation, as herein defined, is uppermost member of Ordovician in West Virginia. Directly underlies Tuscarora sandstone. Overlies Oswego sandstone, or where Oswego is absent, Martinsburg formation. Thickness 150 to 800 feet. In previous West Virginia Geological Survey reports, the Juniata has been called "Red Medina" and regarded as a Silurian formation.

John Rodgers, 1953, Tennessee Div. Geology Bull. 58, pt. 2, p. 97–98, pls. Mapped in eastern Tennessee. Juniata and Sequatchie formations form sheet of red or maroon sediments similar in lithology to older sheet represented by Bays and Moccasin formations and long confused with it. The Juniata and Sequatchie, like Bays and Moccasin formations, are respectively the less and more calcareous parts of the sedimentary sheet; they intergrade laterally and boundary between them is arbitrary. For present map, it has been taken along line of Hunter Valley and Whiteoak Mountain faults, but belts northwest of these faults as far as Powell River anticline and Kingston fault are transitional and, though shown on map as Sequatchie, could equally well have been mapped as Juniata.

F. M. Swartz, 1957, Pennsylvania State Univ., Dept. Geology Contr. 3, 58 p. Formation, from Tyrone Gap to Susquehanna Gap, includes (ascending) East Waterford red sandstone member (new), Plummer Hollow red mudstone and sandstone member (new), and Run Gap red sandstone member. Overlies Bald Eagle sandstone (Spring Mount sandstone member, new, in western part of area) and Lost Run conglomerate in eastern part.

L. D. Harris and R. L. Miller, 1958, U.S. Geol. Survey Geol. Quad. Map GQ-111. Name Juniata abandoned in Clinch Mountain area of Duffield quadrangle, Virginia, and term Sequatchie extended into area.

H. H. Arndt and others, 1959, Geol. Soc. America Guidebook Pittsburgh Mtg., p. 6-7, pl. 1. Juniata is the Red Medina of Pennsylvania Second Geologic Survey and is presently correlated with Queenston of New York. Thickness varies from 85 feet at Susquehanna Gap to 2,000 feet near Lewistown. Overlies Bald Eagle formation; underlies Tuscarora formation, transitional.

Named for typical occurrence on Juniata River in Pennsylvania.

Juniata River Series[1]

Devonian: Pennsylvania.

Original reference: F. Platt, 1877, Pennsylvania 2d Geol. Survey Rept. H., p. 6, 8.

Juniper Andesites[1]

Cenozoic: Northern California.

Original reference: Howel Williams, 1932, California Univ. Pub., Dept. Geol. Sci. Bull., v. 21, no. 8, geol. map.

O. P. Jenkins, 1943, California Div. Mines Bull. 118, p. 678. Cenozoic. Overlie Willow Lake basalts.

Occur in Lassen National Park.

†Juniperan Stage

Eocene, early: California.

V. S. Mallory, 1953, (abs.) Jour. Paleontology, v. 27, no. 6, p. 903. Named as one of six stages, based on foraminiferal assemblages, in lower Tertiary of California. Includes interval between Ulatisian above, and Paleocene Bulitan [Bulitian] stage.

V. S. Mallory, 1959, Lower Tertiary biostratigraphy of the California Coast Ranges: Tulsa, Okla., Am. Assoc. Petroleum Geologists, p. 34. Replaced by Penutian stage (new).

Juniper Flat Granite

Triassic or Jurassic: Southeastern Arizona.

W. G. Hogue and E. D. Wilson, 1950, Arizona Bur. Mines Bull. 156, Geol. Ser. 18, p. 21, fig. 7. Intrudes Precambrian schist and is overlain by basal conglomerate of Cretaceous, but its relation to Paleozoic not clear.

James Gilluly, 1956, U.S. Geol. Survey Prof. Paper 281, p. 53-55, pl. 5. Light reddish brown in outcrop and pinkish gray on fresh fracture. Most of it is porphyritic within central Cochise County, although much of it along Tombstone Canyon is equigranular. Considerable range in grain size. Forms discordant intrusive masses that cut all formations up to and including Horquilla limestone. Rough tendency to form sills beneath

Bolsa quartzite; all other contacts appear to be clean cut and without regard to preexisting structures. Older than Glance formation. Triassic or Jurassic. Type locality designated.

Type locality: Juniper Flat on west side of Mule Mountains, where granite is well exposed. Also well exposed on northeast wall of Tombstone Canyon. In west-central Cochise County.

Juniper Hill Formation[1]

Juniper Hill Shale Member (of Lime Creek Formation)

Upper Devonian: Central northern Iowa.

Original reference: A. O. Thomas, 1925, Iowa Geol. Survey, v. 30, p. 116, footnote.

M. A. Stainbrook, 1944, Illinois Geol. Survey Bull. 68, pt. 1, p. 182, 187. Rank reduced to member status in Lime Creek formation. Basal member of formation; comprises about 45 feet of sparsely fossiliferous blue shale. Underlies Cerro Gordo member; overlies Nora member of Shellrock formation.

Named for exposures on Juniper Hill, about 1 mile northwest of Rockford Brick and Tile Plant, Floyd County.

Junipero Sandstone

Eocene: West-central California.

R. R. Thorup, 1941, (abs.) Geol. Soc. America Bull., v. 52, no. 12, pt. 2, p. 1958. Listed as underlying Lucia shale (new) and unconformably overlying basement complex. Thickness as much as 125 feet.

R. R. Thorup, 1943, California Div. Mines Bull. 118, pt. 3, p. 463–465. Described as white to light-gray, coarse to pebbly, feldspathic sandstone. Lies unconformably on basement complex (Sur "series" and Santa Lucia quartz-diorite) and has basal conglomerate which averages 8 feet in thickness. Conformably underlies Lucia shale. Formerly considered part of Vaqueros which is herein stratigraphically restricted in its type area.

Type locality: NE¼ sec. 34, T. 20 S., R. 6 E., Junipero Serra quadrangle, Monterey County.

Juniper Ridge Sandstone (in Panoche Formation or Group)

Upper Cretaceous: Central western California.

P. P. Goudkoff, 1945, Am. Assoc. Petroleum Geologists Bull., v. 29, no. 7, p. 962 (fig. 2). Panoche group (or formation) is subdivided into 10 units. Juniper Ridge sandstone is fourth in sequence (ascending). Occurs between units termed Lower Waltham shale and Upper Waltham shale. Assigned to Delevanian stage (new). Name credited to J. Q. Anderson.

Occurs in Coalinga-Ortigalito area, San Joaquin Valley.

Jupiter shales

Precambrian (Chuaran series): Northern Arizona.

Charles Keyes, 1938, Pan-Am. Geologist, v. 70, no. 2, p. 107 (chart), 112. Shales mainly dark colored, often black. Thickness 1,700 feet. Underlie Oso beds (new); overlie Gunther dolomite (new).

Best developed in valleys paralleling west rim of Marble Canyon. Particularly conspicuous and complete under the cliff ruins known as Jupiter's Temple, situated a few miles below mouth of Little Colorado River; Grand Canyon region.

Jurupa Series[1]

Paleozoic and Paleozoic(?) : Southern California.

Original reference: J. W. Daly, 1935, Am. Mineralogist, v. 20, no. 9, p. 638–647, map.

W. J. Miller, 1946, Geol. Soc. America Bull., v. 57, no. 5, p. 475–476, table 4. Paleozoic and probable Paleozoic. Series includes undifferentiated complex (metasedimentary), Chino crystalline limestone, quartzite and schist, and Sky Blue crystalline limestone.

Occurs in Jurupa Mountains, Riverside County.

Kaaterskill Formation[1] or Sandstone

Middle Devonian: Southeastern New York.

Original reference: Bradford Willard, 1933, Geol. Soc. America Bull., v. 44, no. 3, p. 498.

G. A. Cooper and others, 1942, Geol. Soc. America Bull., v. 53, no. 12, pt. 1, chart 4. Shown on correlation chart as Kaaterskill sandstone, Middle Devonian.

G. H. Chadwick, 1944, New York State Mus. Bull. 336, p. 121, 122–125, 127, geol. map. Referred to as Kaaterskill sandstones and mapped with overlying Kiskatom redbeds in Catskill and Kaaterskill quadrangles. Underlies Onteora red beds. Thickness 250 to 300 feet. Middle Devonian.

Ledges make the falls of the Kaaterskill [Greene County].

Kaaterskillian series

Devonian (Devonic) : Eastern North America.

[C. R.] Keyes, 1941, Pan-Am. Geologist, v. 75, no. 4, p. 157 (chart), 311. Name proposed for the eastern Devonic; Linnian series applied to western Devonic. The two series overlap at the Mississippi River in Missouri. In Missouri, includes (ascending) Bailey limestone, Clear Creek limestones, Grand Tower limestones, and Wittenberg shales.

Kaau Basalt or Tuff

See **Kaau Volcanics** (in Honolulu Volcanic Series).

Kaau Mud Flow

Pleistocene: Oahu Island, Hawaii.

H. T. Stearns, 1940, Hawaii Div. Hydrography Bull. 5, p. 51–52. Consists chiefly of small nodules of Kaau basalt, a few bombs and olivine segregations, and numerous fragments of Koolau basalt set in gray dirty matrix. No bedding present. Deposit reaches height of about 60 feet above adjacent Kaau basalt. Also referred to as Palolo Valley mud flow.

G. A. Macdonald and D. A. Davis *in* Jacques Avias and others, 1956, Lexique Strat. Internat., v. 6, Océanie, fasc. 2, p. 93. Probably correlative with Kaau volcanics in lower part of Honolulu volcanic series. Locally rests on tuff of Kaau volcanics.

Well exposed over small area in Palolo Valley, 1 mile above mouth of Waiomoa Stream, on south side of Koolau Range, about 9 miles west of Makapuu Head.

Kaau Volcanics[1] (in Honolulu Volcanic Series)

Pleistocene, upper: Oahu Island, Hawaii.

Original reference: H. T. Stearns, 1935, Hawaii Div. Hydrography Bull. 1.

G. A. Macdonald and D. A. Davis *in* Jacques Avias and others, 1956, Lexique Strat. Internat., v. 6, Océanie, fasc. 2, p. 93–94. Tuff and melilite-nepheline basalt lava erupted from Kaau Crater; tuff was formed in part by phreatic explosions; secondary deposits of tuff occur below crater along Pukele, Waiomo, and Palolo Valleys. At least two flows are present, separated by tuff. Upper flow averages about 20 feet thick. Rests in part on Koolau volcanic series and in part on older alluvium. Volcanics erupted during high stand of sea preceding minus 60-foot (Waipio) stand, and probably the plus 95-foot (Kaena) stand. Terms Kaau basalt and Kaau tuff have been used for parts of the volcanics. Pleistocene.

Named for Kaau Crater, which is believed to have been its source. Covers fraction of square mile in upper part of Palolo Valley and its tributaries, on south side of Koolau Range about 9 miles west of Makapuu Head.

Kachess Rhyolite[1]

Eocene: Central Washington.

Original reference: G. O. Smith and F. C. Calkins, 1906, U.S. Geol. Survey Geol. Atlas, Folio 139.

C. E. Weaver, 1937, Washington [State] Univ. Pubs. in Geology, v. 4, p. 45, 51. Kachess rhyolite consists of numerous flows intercalated within Naches formation. On eastern side of Lake Kachess the rhyolites unconformably overlies Swauk formation and unconformably underlies Teanaway basalts. Swauk, Naches, and Kachess are probably in part contemporaneous.

R. J. Foster, 1960, Geol. Soc. America Bull., v. 71, no. 2, p. 105. Silver Pass volcanic rocks (new) include type area for Smith and Calkins' Kachess rhyolite. Mapping for present study has shown that rhyolites of many different ages were included in Kachess rhyolite by Smith and Calkins. They were aware of these inconsistencies and described relationships of the Kachess as peculiar, noting that it was interbedded with the Swauk, Teanaway, and Naches formations and occurred between the Naches and Teanaway formations. These relationships would require extrusion of the Kachess to have begun in Swauk time, to have extended across the unconformity between the Swauk and Teanaway, and to have continued until post-Teanaway time. In mapped area, rocks called Kachess by Smith and Calkins can be separated into two groups, presumably of different ages, the Silver Pass volcanic rocks of post-Swauk and pre-Teanaway age and the rhyolite within Naches formation.

Well exposed on northeast side of Kachess Lake [Kittitas County], Snoqualmie quadrangle.

Kagel Fanglomerate[1]

Pleistocene or Recent: Southern California.

Original reference: M. L. Hill, 1930, California Univ. Pub., Dept. Geol. Sci. Bull., v. 19, no. 6, p. 141, 144.

B. F. Howell, 1954, California Div. Mines Bull. 170, map sheet 10. Referred to as Kagel alluvium. May be same age as Beehive Mesa alluvium (new). Pleistocene or Recent.

Named for exposures in Kagel Canyon, Los Angeles.

Kagman Andesite

See **Hagman Formation.**

Kaguyak Formation

Upper Cretaceous: Central southern Alaska.

A. S. Keller and H. N. Reiser, 1959, U.S. Geol. Survey Bull. 1058–G, p. 273–278, pls. 29, 32. Divided into three informal members: lower fossiliferous siltstone member, 2,000 feet thick at type locality; middle massive locally crossbedded concretionary sandstone and interbedded siltstone and silty shale member, 1,090 feet; and upper thin-bedded sandstone and siltstone member, 1,460 feet. Total measured thickness 4,550 feet. Overlies Naknek formation; upper contact of formation not seen.

Type section: Includes exposures at Kaguyak and the sequence exposed in the sea cliffs from mouth of Big River to Swikshak River, Mount Katmai area, Alaska Peninsula.

Kaguyak Formation

Upper Cretaceous: Southern Alaska.

T. C. Hiestand, 1957, Oil and Gas Jour., v. 55, no. 49, p. 194 (table 1). Listed on chart only. Marine. Thickness 10,000 feet.

Under heading—Alaska Peninsula, Kenai Peninsula, Sustina district, and Copper River district.

Kahuku Volcanic Series

Pleistocene: Hawaii Island, Hawaii.

H. T. Stearns and G. A. Macdonald, 1946, Hawaii Div. Hydrography Bull. 9, p. 64 (chart), 67 (table), 68–71. Comprises all basalt flows and interbedded ash beds that are unconformable on Ninole volcanic series and that were laid down before end of deposition of ash member (Pahala) at its top. Unit is the Pahala basalt renamed, name Pahala being here restricted to top ash member. At type locality, consists of about 600 feet of interbedded aa and pahoehoe flows overlain by 40 feet of yellow ash; one massive flow 100 feet above base is about 100 feet thick; other flows average about 15 feet in thickness. Underlies Kau volcanic series (new).

D. A. Davis and G. A. Macdonald *in* Jacques Avias and others, 1956. Lexique Strat. Internat., v. 6, Océanie, fasc. 2, p. 94. Pleistocene.

Type locality: Kahuku Pali, a fault scarp running north from South Point. Exposed intermittently in windows in Kau and Puna volcanic series around eastern and southern sides of Mauna Loa from Hilo Point and at Kealakekua Bay on west side of island.

Kaibab Limestone (in Aubrey Group)[1]

Kaibab Limestone (in Park City Group)

Kaibab Formation

Permian: Western Utah, northern Arizona, southeastern California, and southeastern Nevada.

Original reference: N. H. Darton, 1910, U.S. Geol. Survey Bull. 435, p. 21, 28, 32.

E. D. McKee, 1937, Carnegie Inst. Washington Year Book 36, p. 341–343. In typical exposure, Kaibab consists of two massive limestone members, above and below each of which are units composed of red beds, gypsum, and impure thin-bedded limestones; unconformity present at top of middle red-bed member. Proposed that name Kaibab be restricted to upper massive limestone together with associated members above and below and that these be termed Kaibab formation. Members below unconformity are here named Toroweap formation.

E. D. McKee, 1938, Carnegie Inst. Washington Pub. 492, p. 12, 35–61, strat. sections. Based on approximately 50 measured sections, classification has been developed embodying principal divisions of the Kaibab. Formation used in restricted sense is divided vertically into three members, designated as α, β, and γ, from top to bottom. These members are characterized as (α) time of receding sea, (β) time of most extended sea, and (γ) time of advancing sea. The α or uppermost has been referred to variously as the A member, the Super Aubrey, Bellerophon limestone, and Harrisburg gypsiferous member; middle division, commonly termed "cherty limestone" is B member of most earlier writers. The γ or lowermost is local in distribution and is recognized only on Mogollon Plateau; it is unrecorded in earlier literature. Facies of members discussed in detail. Underlies Moenkopi. Overlies Toroweap formation or in areas where Toroweap is absent, as on Mogollon Plateau south of Flagstaff, the Kaibab overlies Coconino sandstone.

N. D. Newell, 1948, Geol. Soc. America Bull., v. 59, no. 10, p. 1045 (fig. 2), 1057. Geographically extended into Confusion Range, Utah, where it is about 2,000 feet thick and consists of cherty drab to dark-gray relatively unfossiliferous limestone. Underlies Phosphoria formation; overlies Supai equivalents.

H. E. Gregory, 1948, Geol. Soc. America Bull., v. 59, no. 3, p. 226, 227; 1950, U.S. Geol. Survey Prof. Paper 220, p. 50–55. Unconformably underlies underlies Timpoweap member (new) of Moenkopi formation.

C. R. Longwell, 1949, Geol. Soc. America Bull., v. 60, 5, p. 930 (table 1), 931. In Muddy Mountains, Nev., consists of upper and lower limestone members separated by middle member, chiefly gypsum. An additional upper unit, Harrisburg member of Reeside and Bassler, present locally. Lower limestone unit and overlying gypseous beds may correspond to McKee's (1938) Toroweap formation of the Plateau. Thickness 600 to 800 feet. Overlies unnamed red beds; unconformably underlies Moenkopi formation.

C. B. Hunt, Paul Averitt, and R. L. Miller, 1953, U.S. Geol. Survey Prof. Paper 228, p. 38 (table), 46–47, pl. 1. Described in Henry Mountains region where it is restricted to steep flanks of San Rafael Swell and Circle Cliffs. Consists of white, buff, light-gray limestone and limy sandstone containing siliceous concretions. Thickness commonly 50 to 100 feet. Overlies Coconino sandstone; underlies Moenkopi formation.

D. F. Hewett, 1956, U.S. Geol. Survey Prof. Paper 275, p. 45–46, pl. 1. Mapped in San Bernardino County, Calif.

R. K. Hose and C. A. Repenning, 1959, Am. Assoc. Petroleum Geologists Bull., v. 43, no. 9, p. 2178–2180. In Confusion Range, basal formation of Park City group. Consists of 480 feet of somewhat cherty bioclastic limestone. Underlies Plympton formation (new); overlies Arcturus formation.

H. J. Bissell, 1960, Am. Assoc. Petroleum Geologists Bull., v. 44, no. 8, p. 1427 (fig. 3), 1433 (fig. 9), 1434–1435 (fig. 10). In Spring Mountains area, Nevada, overlies Spring Mountain formation (new).

Grant Steele, 1960, Intermountain Assoc. Petroleum Geologists Guidebook 11th Ann. Field Conf., p. 109–112. West of Gold Hill mining district, Nevada, a sequence of thin- to thick-bedded cherty limestones overlies Loray formation (upper beds of Nolan's Oquirrh formation). Nolan (1935) named this sequence Gerster formation. Nolan placed lower contact of Gerster at top of "Oquirrh formation" and upper contact at base of overlying Triassic limestones and shales. Present study shows that lower 170 feet of Nolan's Gerster is lithologically equivalent to Kaibab formation. Seems appropriate to restrict Gerster to those limestones above the light-gray cherty carbonates of the Kaibab.

Type locality: Kaibab Gulch, a deep canyon cut entirely across northern part of Kaibab Plateau, about 8 miles southwest of abandoned settlement of Paria, Utah, about 6 miles north of Arizona line. Caps Kaibab Plateau on north side of Grand Canyon. At type locality, overlies Hermit shale.

Kailua Volcanic Series[1]

Pliocene(?) : Oahu Island, Hawaii.

Original reference: H. T. Stearns, 1935, Hawaii Div. Hydrog. Bull. 1.

H. T. Stearns, 1940, Hawaii Div. Hydrog. Bull. 5, p. 48–50. Kailau amygdaloidal basalts, formerly regarded as part of an independent volcano older than Koolau volcano, are believed to represent caldera complex of Koolau volcano.

G. A. Macdonald and D. A. Davis *in* Jacques Avias and others, 1956, Lexique Strat. Internat., v. 6, Océanie, fasc. 2, p. 95. Composed of amygdaloidal flows of basalt and olivine basalt pahoehoe and aa accumulated in caldera of Koolau volcano, and the dike complex cutting them. Flows as much as 60 feet thick. Total exposed thickness about 1,650 feet; rocks extend below sea level. Probably separated from adjacent extra-caldera Koolau lavas by faults and buried fault scarps. Formerly considered older than Koolau lavas, they are now believed probably contemporaneous with, or even younger than, lavas of Koolau volcanic series in crest region of Koolau Range.

Named for occurrence near town of Kailau. Crop out over about 15 square miles in Kailau area on northeast side of Koolau Range, 6 to 12 miles northwest of Makapuu Head.

Kaimuki Basalt (in Honolulu Volcanic Series)

Kaimuki Volcanics[1]

Pleistocene, upper: Oahu Island, Hawaii.

Original reference: C. K. Wentworth, 1926, Bernice P. Bishop Mus. Bull. 30, p. 40, 42, 44.

G. A. Macdonald and D. A. Davis *in* Jacques Avias and others, 1956, Lexique Strat. Internat., v. 6, Océanie. fasc. 2, p. 95–96. Referred to as Kaimuki basalt. Consists of nepheline basanite lava flows with some cinder and spatter composing small lava shield. Lava varies from dense to very scoriaceous. Maximum thickness about 400 feet. Overlies Diamond Head tuff; underlies marine limestone of plus 25-foot (Waimanalo) stand of sea, and lithified calcareous sand dunes of minus 60-foot (Waipio) stand.

Type locality: Kaimuku Hill. Covers about 2 square miles on south side of Koolau Range about 10 miles west of Makapuu Head.

Kaiparowits Formation[1]

Upper Cretaceous: Central southern Utah.

Original reference: H. E. Gregory and R. C. Moore, 1931, U.S. Geol. Survey Prof. Paper 164.

H. E. Gregory, 1950, U.S. Geol. Survey Prof. Paper 220, p. 51 (table), 109–110, 128, 130–131. In Zion Park region, consists of bluish-drab fine- to moderately coarse-grained arkosic sandstone and sandy shale, with weak calcareous cement; forms slopes and badlands; plants, vertebrates, and fresh- and brackish-water shells. Thickness 600 to 750 feet. Unconformably underlies Wasatch formation; unconformably overlies Wahweap and Straight Cliffs sandstones. Forms part of Gray Cliffs and is continuously exposed across Kolob and Skutumpah terraces.

E. F. Cook, 1952, Utah Geol. Soc. Guidebook 7, p. 96. In Pine Valley Mountains, unconformably underlies Claron conglomerate. Thickness about 1,200 feet.

First described in Kaiparowits Plateau region. Occurs on Kaiparowits Peak.

Kalama Volcanics[1] (in Honolulu Volcanic Series)

Recent: Oahu Island, Hawaii.

Original reference: H. T. Stearns, 1935, Hawaii Div. Hydrography Bull. 1.

G. A. Macdonald and D. A. Davis *in* Jacques Avias and others, 1956, Lexique Strat. Internat., v. 6, Océanie, fasc. 2, p. 96. Lava flow of nepheline basanite with spatter and cinder at its source. Thickness unknown; at least 10 feet, base not exposed. Underlies Koko tuff. No reef of plus 25-foot (Waimanalo) stand of sea present on lava; hence, eruption is believed to be later than Waimanalo stand (last high stand of sea during Pleistocene).

Named for Kalama Crater, a symmetrical crater about 500 feet across and 50 feet deep, at source of flow. Covers about three-fourths square mile on south side of Koolau Range 1 to 2 miles southwest of Makapuu Head.

Kalama River Mud Flow

Recent: Western Washington.

Don Mullineaux, 1960, Oregon Country Geol. Soc. Newsletter, v. 26, no. 5, p. 40. Hot mud flow; contains charred logs as much as 3 feet in diameter. Radiocarbon dating on wood gave age of 2,000 years ± 250.

Came down west side of Mount St. Helens and flowed down Kalama River valley to Merrill Lake, distance about 8 miles.

Kalamazoo Volcanics

Tertiary: Eastern Nevada.

J. C. Young, 1960, Intermountain Assoc. Petroleum Geologists Guidebook 11th Ann. Field Conf., p. 160, 164–165. Flows, volcanic breccias, conglomerates, and lapilli, and subordinate ignimbrites. Thickness approximately 2,000 to 3,500 feet. Overlies Kinsey Canyon formation (new); unconformably underlies North Creek formation (new).

Named for exposures at Kalamazoo Pass-upper Kalamazoo Canyon, Schell Creek Range area, Ely quadrangle.

Kalaupapa Basalt

Pleistocene(?): Molokai Island, Hawaii.

H. T. Stearns, 1946, Hawaii Div. Hydrography Bull. 8, p. 69 (table), 73; H. T. Stearns and G. A. Macdonald, 1947, Hawaii Div. Hydrography Bull. 11, p. 25–26, 109, table facing p. 16; G. A. Macdonald, and D. A. Davis *in* Jacques Avias and others, 1956, Lexique Strat. Internat., v. 6, Océanie, fasc. 2, p. 96–97. Porphyritic olivine basalt pahoehoe. Maximum thickness 405 feet; base not exposed. Separated from East Molokai volcanic series (new) by erosional unconformity.

Type locality: Kalaupapa Peninsula. Covers about 6¼ square miles, comprising all Kalaupapa Peninsula.

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Kalihi Volcanics[1] (in Honolulu Volcanic Series)

Pleistocene, upper: Oahu Island, Hawaii.

Original reference: H. T. Stearns, 1935, Hawaii Div. Hydrography Bull. 1.

G. A. Macdonald and D. A. Davis *in* Jacques Avias and others, 1956, Lexique Strat. Internat., v. 6, Océanie, fasc. 2, p. 97. Lava flow of melilite-nepheline basalt and associated cinder cone remnant. Cone more than 100 feet thick. Lava about 50 feet thick. Rest with erosional unconformity on Koolau volcanic series. Extent noted.

Exposed in area of about 1.7 square miles along Kalihi Valley, from crest of Koolau Range southwestward to sea, about 14 miles west of Makapuu Head.

Kalkberg Limestone[1] (in Helderberg Group)

Kalkberg Limestone Member (of Coeymans Limestone)

Kalkberg Limestone Member (of New Scotland Formation)

Lower Devonian: Eastern and east-central New York and northern Pennsylvania.

Original reference: G. H. Chadwick, 1908, Science, new ser., v. 28, p. 346–348.

F. M. Swartz, 1939, *in* Bradford Willard, F. M. Swartz, and A. B. Cleaves, Pennsylvania Geol. Survey, 4th ser., Bull. G–19, p. 55–56, 60, 88. Rank reduced to member status in New Scotland formation. Geographically extended into Pennsylvania.

Rudolf Ruedemann, J. H. Cook, and D. H. Newland, 1942, New York State Mus. Bull. 331, p. 128. Referred to as Kalkberg member of Coeymans limestone.

G. H. Chadwick, 1944, New York State Mus. Bull. 336, p. 64, 67–71 [1946]. Member of New Scotland; underlies Catskill shaly limestone member.

Winifred Goldring, 1946, New York State Mus. Bull. 332, p. 159–161. Member of New Scotland; underlies Catskill shaly limestone member. Thickness 40 feet in type area; about 20 feet in Capital district (Helderberg area).

Theodore Arnow, 1949, New York State Water Power and Control Comm. Bull. GW–20, p. 8 (table 1), 15. Kalkberg is transition formation between underlying Coeymans limestone and overlying New Scotland limestone. Thickness about 25 feet in Albany County. Lower Devonian.

L. V. Rickard, 1955, New York State Geol. Assoc. Guidebook 27th Ann. Mtg., p. 7–8, 9. Kalkberg cherty limestone is considered to be a distinct mappable formation separated from the Coeymans below and the shaly New Scotland above. Extends as far west as Oriskany Falls where it is represented by uppermost 6 feet of limestone just beneath Oriskany sandstone in Oriskany Falls quarry where it is much younger than it is in eastern New York. Helderbergian series.

Well exposed on Catskill Creek, Greene County N.Y. Name Kalkberg (lime hill) is local Dutch designation for Helderbergian Ridge, and is pronounced Collak-barrakh.

Kalorama Member[1] (of Santa Barbara Formation)

Pleistocene: Southern California.

Original reference: E. D. Pressler, 1929, California Univ. Pub. Bull. Dept. Geol. Sci., v. 18, no. 13, p. 325–345.

T. L. Bailey, 1943, Geol. Soc. America Bull., v. 54, no. 10, p. 1557, 1560. Pleistocene.

Occurs in vicinity of Santa Barbara, Ventura County.

Kaltag Formation[1] (in Shaktolik Group)

Lower Cretaceous: Central western and central Alaska.

Original reference: G. C. Martin, 1926, U.S. Geol. Survey Bull. 776, p. 395–412, chart opp. p. 474.

R. W. Imlay and J. B. Reeside, Jr., 1954, Geol. Soc. America Bull., v. 65, no. 3, pl. 1 (facing p. 246). Lower Cretaceous.

T. G. Payne, 1955, U.S.. Geol. Survey Misc. Geol. Inv. Map I–84. Nonmarine formation included in Shaktolik group in Koyukuk geosyncline and Hogatza uplift areas.

Named from exposures on northwest bank of Yukon River between Kaltag and the Williams mine. In Nulato-Norton Bay district, Lower Yukon River region, and Koyukuk River region.

Kalua O Lapa Flow

Recent: Maui Island, Hawaii.

Grote Reber, 1959, Geol. Soc. America Bull., v. 70, no. 9, p. 1245, 1246. pl. 1 (fig. 1). Consists of a single flow. Radiocarbon dating gives age about 200 years. Overlies part of Kamahena flow (new).

On southwest side of Haleakala.

Kamahena Flow

Recent: Maui Island, Hawaii.

Grote Reber, 1959, Geol. Soc. America Bull., v. 70, no. 9, p. 1245, 1246, pl. 1 (fig. 1). Consists of a single flow. Lower part of flow buried by Kalua O Lapa flow (new). Radiocarbon dating gives age about 890 years.

On southwest side of Haleakala.

Kamanaiki Basalt[1] (in Honolulu Volcanic Series)

Pleistocene, upper: Oahu Island, Hawaii.

Original reference: H. T. Stearns, 1935, Hawaii Div. Hydrography Bull. 1.

G. A. Macdonald and D. A. Davis *in* Jacques Avias and others, 1956, Lexique Strat. Internat., v. 6, Océanie, fasc. 2, p. 97–98. Fresh dark-gray slightly vesicular basalt. Shows well developed columnar jointing. Unconformably overlies Koolau volcanic series and sediments laid down during stand of sea higher than present one; underlies limestone of the plus 25-foot (Waimanalo) stand of sea. Extent noted.

Named for occurrence in Kamanaiki Valley where it forms a 40-foot V-shaped fill in a waterfall at 750 feet altitude. Occurs as patches at other localities in valley and adjacent valleys.

Kamehame Basalt[1]

Pleistocene, upper (?) and Recent: Hawaii Island, Hawaii.

Original reference: H. T. Stearns, 1926, Geol. Soc. America Bull., v. 37, p. 151; 1930, U.S. Geol. Survey Water-Supply Paper 616, p. 69.

H. T. Stearns and G. A. Macdonald, 1946, Hawaii Div. Hydrography Bull. 9, p. 103. Rocks on western and southern slopes of Kilauea were mapped as Kamehame basalt; because this name included both lavas from Mauna Loa and Kilauea, it is herein replaced by new name, Puna volcanic series.

Named for Kamehame Hill, 3½ miles south of town of Pahala.

Kameset Agglomerate

See Gamsetu Agglomerate.

Kamiah Volcanics[1]

Tertiary : Northern Idaho.

Original reference: A. L. Anderson, 1930, Idaho Bur. Mines and Geology Pamph. 34.

C. P. Ross and J. D. Forrester, 1958, Idaho Bur. Mines and Geology Bull. 15, p. 13. Report is an expansion of map explanation of Geologic map of Idaho, 1947. North of westward flowing stretch of Salmon River, rocks that resemble Challis volcanics are rare. The only rocks there grouped with Challis volcanics are Kamiah volcanics of Anderson (1930). These rocks are andestic and latitic flows, erosion remnants of which constitute buttes in small area in Idaho County. They are surrounded and overlapped by Columbia River basalt.

Represented in outline and area by Kamiah Buttes, about 12 miles south of town of Kamiah, Lewis County.

Kamishak Formation

Kamishak Chert[1]

Upper Triassic : Central southern Alaska.

Original reference: G. C. Martin and F. J. Katz, 1912, U.S. Geol. Survey Bull. 485, p. 47, table facing p. 30, map.

L. B. Kellum, 1945, New York Acad. Sci. Trans., ser. 2, v. 7, no. 8. p. 203 (table 1), 204. Kamishak formation exposed at Cold Bay is dominantly limestones. Underlies Bidarka formation (new).

Typically exposed on west shore of Kamishak Bay, especially in vicinity of Bruin Bay ; Cook Inlet region.

Kanab limestone[1]

Carbonic : Northern Arizona.

Original reference: C. R. Keyes, 1936, Pan-Am. Geologist, v. 66, p. 216.

Named from Kanab plateau bordering the Kanab side-canyon opposite Cataract Canyon, in Grand Canyon region.

†Kanab Sandstone[1]

Upper Triassic and Jurassic (?) : Southwestern Utah.

Original reference: E. Huntington and J. W. Goldthwait, 1903, Jour. Geol. ogy, v. 11, p. 46–63.

Kane County.

Kanab Canyon Member (of Muav Formation)

Lower and (or) Middle Cambrian : Northwestern Arizona.

E. D. McKee, 1945, Carnegie Inst. Washington Pub. 563, p. 14 (fig. 1), 29, 102–105. Changes in lithology considerably from east to west. At type locality consists of single massive cliff of uniform lithology composed of mottled limestone; 25 miles to southeast at Bass trail it includes sandy shale in basal 10 feet, and 8 miles farther in the same direction, it is divisible, on basis of lithology, into two parts of about equal thickness. Thickness increases westward and northward as far as Granite Park, and ranges from 62 to 143 feet. Underlies Gateway Canyon member (new) ; overlies Peach Springs member (new).

Type locality: At mouth of Kanab Canyon, where it is lowest massive cliff-forming unit, not far above level of Colorado River, Lowest subdivision of Muav formation throughout eastern part of Grand Canyon.

Kanaka Formation[1]

Mississippian: Northern California.

Original reference: H. G. Ferguson, 1929, Am. Inst. Mining Metall. Engineers Pub. 211, p. 4.

J. M. Weller and others, 1948, Geol. Soc. America Bull., v. 58, no. 2, chart 5 (column 15). Shown on correlation chart above Tightner formation and below Relief quartzite.

Named for exposures in valley of Kanaka Creek, Sierra County.

Kanapou Volcanic Series

Pliocene(?): Kahoolawe Island, Hawaii.

H. T. Stearns, 1946, Hawaii Div. Hydrography Bull. 8, p. 63, 65 (fig. 1). Name applied to thin-bedded pahoehoe and aa basalt together with few thin beds of firefountain debris and cinder cones and associated intrusives that make up Kahoolawe volcanic dome. Two groups of lavas distinguished in series: pre-caldera lavas and the caldera-filling lavas some of upper members of which are slightly differentiated. Five post-erosional lavas and pyroclastics of Recent age lie unconformably on cliff at Kanapou Bay.

G. A. Macdonald and D. A. Davis *in* Jacques Avias and others, 1956, Lexique Strat. Internat., v. 6, Océanie, fasc. 2, p. 98–99. Pliocene(?).

Type section: Cliffs in Kanapou Bay.

Kanawha Black Flint (in Allegheny Formation or Group)

Kanawha Black Flint (in Kanawha Formation[1] or Group)

Pennsylvanian: Northern West Virginia.

Original reference: I. C. White, 1891, U.S. Geol. Survey Bull. 65, p. 98.

H. R. Wanless, 1939, Geol. Soc. America Spec. Paper 17, p. 88. Marine chert previously considered near top of Kanawha group but here placed in lower Allegheny.

R. C. Moore and others, 1944, Geol. Soc. America Bull., v. 55, no. 6, chart 6 (column 12). Shown on correlation chart below Roaring Creek sandstone and above Buffalo Creek limestone and coal.

Exposed along Great Kanawha River, on Elk River, and at other places in Kanawha County.

Kanawha Formation (in Pottsville Group)[1]

Kanawha Group

Kanawha Series

Middle Pennsylvanian: West Virginia, Kentucky, and Virginia.

Original reference: M. R. Campbell and W. C. Mendenhall, 1896, U.S. Geol. Survey 17th Ann. Rept., pt. 2.

P. H. Price and E. T. Heck, 1939, West Virginia Geol. Survey [Rept.] Greenbrier County, p. 214, 215, 220–222. Kanawha group comprising upper part of Pottsville series, is youngest group of stratified rocks in Greenbrier County: only basal part represented; maximum thickness 250 feet. Overlies New River group.

M. G. Cheney, 1945, Am. Assoc. Petroleum Geologists Bull., v. 29, no. 2, p. 140 (chart 2), 142, 146. Pennsylvanian system divided into six series in standard Appalachian section and in standard Midcontinent section. Kanawha series of Appalachian section is correlated with Lampasas series of Midcontinent section. Succeeds New River series and is followed by Allegheny series.

C. B. Read and S. H. Mamay, 1960, U.S. Geol. Survey Prof. Paper 400–B p. B381. Middle Pennsylvanian on basis of fossil plants.

U.S. Geological Survey currently classifies the Kanawha as a formation in the Pottsville Group in West Virginia.

Complete section exposed in hills north of Kanawha Falls, W. Va.

Kanawha volcanic zone (in Eagleford Formation)

Cretaceous: Northeastern Texas.

R. T. Hazzard, 1939, Shreveport Geol. Soc. Guidebook 14th Ann. Field Trip, p. 138–140, 143. Ferruginous sands, clayey tuffaceous sands, tuffaceous sands with fossil casts; characterized by development of fossiliferous sandy limestone lenses and fossiliferous, calcareous sandstone lenses. Thickness 15 to 20 feet. Separated from overlying Medill volcanic zone by an interval of 80 to 90 feet of bluish-gray bedded clay shales; separated from underlying Pine Bluff volcanic zone by shale interval that varies from 158 to 212 feet in thickness.

Named from exposures near Kanawha, Red River County.

Kanayut Conglomerate

Upper Devonian: Northern Alaska.

A. L. Bowsher and J. T. Dutro, Jr., 1957, U.S. Geol. Survey Prof. Paper 303–A, p. 3, 5, 7–13, figs. 2–4, pl. 2. Probable nonmarine conglomerate, sandstone, and shale. Comprises three members (ascending): lower, about 1,400 feet thick; middle, of massive chert-pebble conglomerate, 1,030 feet thick; and Stuver member at top, about 860 feet of orthoquartzite, gray, red, and green shale, and conglomerate. Composite section 3,300 feet thick. Disconformably underlies Kayak shale (new); overlies unnamed shale and sandstone.

Type locality: On ridge south of Mount Wachsmuth, Shainin Lake area, central Brooks Range. Typically exposed along east side of Alapah Creek upstream from Shainin Lake. Named from Kanayut River which originates at north end of Shainin Lake.

Kandik Formation[1]

Lower Cretaceous: Northeastern Alaska.

Original reference: J. B. Mertie, Jr., 1930, U.S. Geol. Survey Bull. 816, p. 136.

J. T. Dutro, Jr., and T. G. Payne, 1957 Geologic map of Alaska (1:2,500,000): U.S. Geol. Survey. Appears on map legend.

Typically exposed in valley of Kandik River from the Yukon northeast probably to boundary [international], in Eagle-Circle district.

Kane Limestone (in Allegheny Formation)[1]

Pennsylvanian: Central northern Pennsylvania.

Original reference: C. A. Ashburner, 1885, Pennsylvania 2d Geol. Survey Rept. R_2, p. 72, 73.

Quarried at Gen. Kane's quarry, west of road leading from Catholic Church to J. Pistner's, Elk County.

Kanektok Silts and Gravels[1]

Pleistocene: Central southern Alaska.

Original reference: J. E. Spurr, 1900, U.S. Geol. Survey 20th Ann. Rept., pt. 7, p. 177.

Extend along lower course of Kanektok River to Oklune Mountains and farther up Kanektok River.

Kaneohe Volcanics[1] (in Honolulu Volcanic Series)

Pleistocene: Oahu Island, Hawaii.

Original reference: H. T. Stearns, 1935, Hawaii Div. Hydrography Bull. 1.

G. A. Macdonald and D. A. Davis *in* Jacques Avias and others, 1956, Lexique Strat. Internat., v. 6, Océanie, fasc. 2 ,p. 99. Cinder cones and lava flow of nepheline basalt and melilite-nepheline basalt. Pleistocene.

Type locality: Main highway 2 miles south of Kaneohe village. Covers about 1½ square miles on northeast side of Koolau Range, 11½ miles northwest of Makapuu Head.

Kane Point Tuff Member (of Page Ranch Formation)

Oligocene, upper, or Miocene, lower: Southwestern Utah.

J. H. Mackin, 1960, Am. Jour. Sci., v. 258, no. 2, p. 90 (table 1), 97, 98. Consists of vitric ignimbrite of rhyolite composition. Overlies Irontown member (new). Zircon age 19 million years; this indicates that Rencher-Page Ranch period of extensive-intrusive igneous activity is late Oligocene or early Miocene. Discussion of ignimbrites of area.

Named for peak several miles southwest of east-facing scarp near Page Ranch, Page Ranch quadrangle, Iron Springs district.

Kangaroo Formation[1]

Pennsylvanian(?) and Permian: Central Colorado.

Original reference: R. D. Crawford, 1913, Colorado Geol. Survey Bull. 4, p. 70.

J. W. Gabelman, 1952, Am. Assoc. Petroleum Geologists Bull., v. 36, no. 8, p. 1588. Sangre de Cristo formation is probably correlative with Maroon formation of Mosquito Range and has some counterpart in the Kangaroo of the Sawatch Range.

Named for Kangaroo Gulch, Monarch district.

Kankakee Limestone[1] or **Formation**

Kankakee stage

Lower Silurian: Northeastern, central, and western Illinois and eastern Missouri.

Original reference: T. E. Savage, 1916, Geol. Soc. America Bull., v. 27, p. 305–324.

J. N. Payne, 1942, Illinois Geol. Survey Bull. 66, p. 191 (table 8), 194. Shown on table of general classification of geologic time as Kankakee stage of Alexandrian epoch. Younger than Edgewood stage. During Kankakee stage, seas became clear and little or no clastic material was deposited.

E. C. Brown and J. W. Whitlow, 1960, U.S. Geol. Survey Bull. 1123–A, p. 40–42, pl. 3. Described in Dubuque South quadrangle, Iowa-Illinois. Ranges in thickness from 50 feet where it overlies Edgewood dolomite in southeastern part of quadrangle to 45 feet northwest of Dubuque airport.

Comprises grayish-yellow dense fine-grained dolomite and as much as 50 percent bedded chert in upper 40 feet. Overlies Tete des Morts member (new) of Edgewood dolomite; underlies Hopkinton dolomite.

Well exposed along Kankakee River about 5 miles south of Richey, Macon County, Ill.

Kanosh Shale (in Pogonip Group)

Lower or Middle Ordovician: West-central Utah and eastern Nevada.

L. F. Hintze, 1951, Utah Geol. and Mineralog. Survey Bull. 39, p. 9 (fig. 2) 18–19, 29 (fig. 4), 57–58, 64–66. Predominantly yellowish-brown, olive-gray, or pink fissile shale with intercalated thin-bedded limestones; several thin-bedded orange-weathering siltstones and fine sandstones in upper part. Fossiliferous. Thickness about 500 feet in Ibex area, Utah; about 370 feet at Scipio. Overlies Juab limestone (new); underlies Lehman formation (new). Lower Ordovician.

R. E. Cohenour, 1959, Utah Geol. and Mineralog, Survey Bull. 63, p. 74–75. Described in Sheeprock Mountains area where it is present in East and West Lookout Hills as narrow band dipping beneath cliff-forming Swan Peak quartzite. Conformably overlies Juab formation. Thickness 205 feet; neither top nor base exposed. Kanosh shale is approximate age equivalent of lower part of Swan Peak formation of Ross (1949, Am. Jour. Sci., v. 247, no. 7) in northwestern Utah, of upper half of Antelope Valley limestone of Eureka, Nev., and of Orient shale member of Orient formation in West Tintic mining district on eastern edge of Sheeprock Range (Stringham, 1942, Geol. Soc. America Bull., v. 53, no. 2). Proposed that names Orient formation and its subdivision Orient shale and Orient quartzite be supplanted by Kanosh shale and Swan Peak quartzite.

J. A. Teichert, 1959, Utah Geol. and Mineralog. Survey Bull. 65, p. 12 (fig. 2), 25, 29–31, fig. 3. Described in southern Stansbury Range, Utah, where it is about 162 feet thick, overlies Garden City formation, and underlies Fish Haven dolomite. Middle Ordovician.

Type locality: Flank of Fossil Mountain, W¼ cor. sec. 19–30, T. 22 S., R. 14 W., Millard County, Utah. Named for village of Kanosh. Extends westward to Snake Range in Nevada.

Kanouse Sandstone[1]

Kanouse Sandstone and Conglomerate (in Onondaga Formation or Group)

Middle Devonian: Northern New Jersey and southeastern New York.

Original reference: H. B. Kummel, 1908, U.S. Geol. Survey Geol. Atlas, Folio 161.

Bradford Willard, 1937, Am. Jour. Sci., 5th ser., v. 33, no. 196, p. 271, 272. In proposed succession in Green Pond Mountain area, New Jersey, Kanouse sandstone and conglomerate is assigned to Onondaga formation. Occurs below Cornwall shale and above Decker limestone (basal Helderberg) Lower Devonian.

Bradford Willard, 1939, Pennsylvania Geol. Survey, 4th ser., Bull. G–19, p. 138. Referred to as Kanouse member of Onondaga group.

G. A. Cooper, 1942, Geol. Soc. America Bull. v. 53, no. 12, pt. 1, chart 4, Age of Kanouse sandstone given as Lower or Middle Devonian.

C. H. Kindle and S. H. Eidman, 1955, Jour. Paleontology, v. 29, no. 1, p. 183–185. At Highland Mills, N.Y., overlies Schoharie grit. Contains fauna that is distinct from the Schoharie-Esopus. Apparently represents a near-shore facies of Onondaga sea, deposited contemporaneously with Onondaga limestone of Catskill and Schoharie regions.

A. J. Boucot, 1959, Jour. Paleontology, v. 33, no. 5, p. 734–735. In Highland Mills area, New York, overlies Woodbury Creek member (new) of Esopus formation. Upper contact with overlying Cornwall shale, of Hamilton age, not exposed. Minimum thickness 50 feet. Contains fauna of Onondaga age. Lower Devonian.

Well exposed in Valley west of Kanouse Mountain, Passaic County, N.J.

Kansan Glaciation

Kansan Drift[1]

Kansan stage of deglaciation[1]

Pleistocene : Mississippi Valley.

Original references: T. C. Chamberlain, 1894, *in* James Geikie, The Great Ice Age, 3d ed.: London, Edward Stanford, p. 724–775; 1895, Jour. Geology, v. 3, p. 270–277; 1896, Jour. Geology, v. 4, p. 872–876.

J. C. Frye and A. B. Leonard, 1952, Kansas Geol. Survey Bull. 99, p. 38, 52 (fig. 2), 70–104. Kansan age (stage) is interval between Aftonian and Yarmouthian. It is assumed that Kansas is type region for this stage. Kansan stage contains Atchison formation, Kansas till, and Meade formation which includes Grand Island sand and gravel member at base and Sappa member with Pearlette volcanic ash bed. In Nebraska, stage contains Red Cloud formation, Atchison formation, Kansan till, Grand Island formation, and Sappa formation. In Iowa and Illinois, term Ottumwan is used to include the Kansan and Yarmouthian.

H. R. Wanless, 1957, Illinois Geol. Survey Bull. 82, p. 130–132. Kansan deposits include early Kansan calcareous laminated silt, pro-Kansan loess and peat soil, till, and sand and gravel. Kansan drift is present in each of quadrangles, Beardstown, Glasford, Havana, and Vermont, of this report, in exposures generally limited to bedrock valleys or places of moderately low altitude. In many exposures, silt or loess of early Kansan, Yarmouth, or Aftonian age is directly overlain by Illinoian till. Because Kansan till is missing in these exposures, it seems likely that Kansas glacier did not entirely cover this area.

Name amended to Kansan Glaciation to comply with Stratigraphic Code adopted 1961.

Named for development in Kansas.

Kansan Period[1]

Pennsylvanian: Kansas.

Original reference: L. C. Wooster, 1906, Kansas Acad. Sci. Trans., v. 20, pt. 1, p. 75–82.

Kansas Till

Pleistocene (Kansan) : Kansas.

J. C. Frye and A. B. Leonard, 1952, Kansas Geol. Survey Bull. 99, p. 24, 36, 37, 44, 52, 123, 128. Kansas till, used here as stratigraphic unit of formation rank, includes deposits made directly by Kansas glacier and some water-laid sediments interstratified with the till. Does not include pro-glacial silts, sands, and gravels deposited in front of advancing glacier (Atchison formation) or outwash deposits from retreating glacier (Meade formation). No type section specified since term has been accepted for more than 50 years, but reference sections designated. Thickness as much as 300 feet; 9 feet at Iowa Point section, Doniphan County, where it overlies Nebraska till and underlies Loveland silt member (Illinoian stage).

Reference sections: Exposures in cut banks about one-half mile southwest of type locality of Atchison formation, NE¼ sec. 10, T. 6 S., R. 20 E., Atchison County. Exposures north of Atchison along Missouri River bluffs. Iowa Point section, NE¼SE¼ sec. 6, T. 2 S., R. 20 E., Doniphan County.

Kansas City Group[1]

Kansas City Formation[1]

Pennsylvanian (Missouri Series): Northwestern Missouri, southwestern Iowa, eastern Kansas, and southeastern Nebraska.

Original reference: H. Hinds, 1912, Missouri Bur. Geol. and Mines, v. 11, p. 7.

H. S. McQueen and F. C. Greene, 1938, Missouri Geological Survey and Water Resources, 2d ser., v. 25, p. 27, pl. 5. Term Kansas City group, as used in this report [northwestern Missouri], includes all beds between base of Hertha limestone and top of "Iola" limestone. It appears that bed designated Iola at Kansas City by early geologists is a higher bed than that which was named Iola limestone at Iola, Kans. According to Kansas Geological Survey, the true Iola can be traced into the Raytown at Kansas City. Left thus without a name, the "Iola" in the vicinity of Kansas City has been given name Argentine for upper gray part and name Frisbie for basal yellowish beds by Kansas Geological Survey. Outcrops upon which changes in nomenclature have been based are in Kansas and the field work was done in that State. Overlies Pleasanton group; underlies Lansing group, basal formation of which is Lane shale according to Missouri Survey usage.

R. C. Moore, 1948, Am. Assoc. Petroleum Geologists Bull., v. 32, no. 11, p. 2028–2033; 1949, Kansas Geol. Survey Bull. 83, p. 68 (fig. 14), 74–111; F. C. Greene and W. V. Searight, 1949, Missouri Geol. Survey and Water Resources Rept. Inv. 11, p. vi, 10–14; H. G. Hershey and others, 1960, Iowa Highway Research Board Bull. 15, p. 24–28, fig. 5. At conference, May 1947, revised definition of Kansas City group was agreed to by State Geological Surveys of Iowa, Kansas, Missouri, and Nebraska; this term not applicable to Missourian deposits in Oklahoma. Lower boundary of group placed at base of Hertha formation, and upper boundary at base of Plattsburg formation of Lansing group. This modifies originally designated limits (Hinds, 1912) by addition of "Lane shale" of Missouri usage (Island Creek shale, Farley limestone, and Bonner Springs shale) at top of group and to same extent changes usage that has been followed by Missouri Geological Survey since 1912. Newly agreed upper boundary coincides with definition of this line that has been employed for past 15 years in Kansas (Moore, 1932) and Nebraska (Condra, 1935, Nebraska Geol. Survey Paper 8), but lower limit of group (top of Dennis formation) used by Kansas and Nebraska Geological Surveys in recent years differs from definition accepted by the conference, which follows original Missouri Survey usage and that followed in Iowa. Group is subdivided into (ascending) Bronson, Linn (new), and Zarah (new) subgroups. Redefined group thus comprises (ascending) Hertha limestone, Ladore shale, Swope limestone, Galesburg shale, Dennis limestone, Cherryvale shale, Drum limestone, Chanute shale, Iola limestone, Lane shale, Wyandotte limestone, and Bonner Springs shale.

G. E. Condra, 1949, Nebraska Geol. Survey Bull. 16, p. 34–42. Group in Nebraska includes (ascending) Hertha, Ladore, Swope, Galesburg, Dennis, Fontana, Sarpy (new), Drum, Chanute, Iola, Lane, Wyandotte, and Bonner Springs formations.

Named for exposures at Kansas City, Mo.

†Kansas City Limestone[1]

Pennsylvanian: Northwestern Missouri.

Original references: J. A. Gallaher, 1898, Missouri Geol. Survey Bienn. Rept., p. 51; 1900, Missouri Geol. Survey, v. 13, p. 206.

†Kansas City Oolite[1]

Pennsylvanian: Northwestern Missouri.

Original reference: G. C. Broadhead, 1886, St. Louis Acad. Sci. Trans., v. 4, p. 483.

Kanuti Group[1]

Paleozoic: Northern central Alaska.

Original reference: W. C. Mendenhall, 1902, U.S. Geol. Survey Prof. Paper 10, p. 37, pl. 5.

J. T. Dutro, Jr., and T. G. Payne, 1957, Geologic map of Alaska (1:2,500,000): U.S. Geol. Survey. Mapped with Mississippian volcanic rocks.

Kanuti River flows for 30 miles through canyon cut in these rocks.

Kanwaka Shale (in Shawnee Group)[1]

Kanwaka Shale Member (of Shawnee Formation)[1]

Kanwaka Shale Member (of Vamoosa Formation)

Pennsylvanian (Virgil Series): Eastern Kansas, southwestern Iowa, northwestern Missouri, and southeastern Nebraska.

Original reference: J. W. Beede, 1902, Kansas Univ. Sci. Bull., v. 1, p. 163.

R. C. Moore, 1949, Kansas Geol. Survey Bull. 83, p. 142 (fig. 29), 150–151; R. C. Moore and others, 1951, Kansas Geol. Survey Bull. 89, p. 62 (fig. 23), 67. Name applied to beds between top of Oread formation and base of Lecompton formation. Includes both marine and nonmarine deposits. Thickness 40 to 145 feet. Divisible into three members recognized from central Kansas northward (ascending): Jackson Park shale, Clay Creek limestone, and Stull shale. A few feet below the Lecompton is a persistent sandstone which thickens southward to form main part of Elgin sandstone in Oklahoma.

G. E. Condra, 1949, Nebraska Geol. Survey Bull. 16, p. 24. Thickness 7 to 9 feet in Weeping Water Valley, Cass County.

T. L. Welp, L. A. Thomas, and H. R. Dixon, 1957, Iowa Acad. Sci. Proc., v. 64, p. 419. Thickness about 10 feet in measured section near Winterset, Madison County.

P. B. Greig, 1959, Oklahoma Geol. Survey Bull. 83, p. 30–32. Referred to as shale member of Vamoosa formation. Beds limiting Kanwaka formation of Kansas not present in Pawnee County section. Most southerly outcrops of Oread limestone are in Osage County, and only top limestone member of Lecompton formation extends as far south as Pawnee County. Hence, true Kanwaka as defined in Kansas cannot be delimited. However, interval between Wynona sandstone and Lecompton limestone in Pawnee County contains unit lithologically similar to Kanwaka formation, and, because it occupies essentially same stratigraphic position, name

Kanwaka will be applied in this report. Elgin sandstone wedges into section as member within Kanwaka interval. Thickness about 265 feet. Overlies Wynona member; underlies Lecompton limestone member of Pawhuska.

H. G. Hershey and others, 1960, Iowa Highway Research Board Bull. 15, p. 20–21, fig. 5. At type locality, Kanwaka consists of two shale members separated by limestone member. In Iowa, where it is thin, the limestone member is not well defined and is undifferentiated. Between Griswold and Lewis, the Kanwaka is gray to buff fossiliferous shale commonly containing nodular limestone beds. Clay Creek limestone member not recognized, and Kereford limestone member of Oread does not appear to be present; therefore, this shale interval probably includes equivalents of Kereford and Heumader intervals of the Oread. Thickness here about 10 feet. Near Stennett, Kereford limestone has been recognized, and it is possible to distinguish between Kanwaka and upper Oread, although Kanwaka members are undifferentiated; thickness here 6½ to 7 feet. Thickness about 10 feet east of Greenfield. Underlies Lecompton limestone; overlies Oread limestone. Shawnee group.

Type locality: Exposures east of Stull, in Kanwaka Township, about 9 miles due west of Lawrence, Douglas County, Kans.

Kaohikaipu Volcanics[1] (in Honolulu Volcanic Series)

Pleistocene, upper, or Recent: Oahu Island, Hawaii.

Original reference: H. T. Stearns, 1935, Hawaii Div. Hydrography Bull. 1.

G. A. Macdonald and D. A. Davis *in* Jacques Avias and others, 1956, Lexique Strat. Internat., v. 6, Océanie, fasc, 2, p. 99. Red cinder, bombs, and spatter and associated black pahoehoe olivine basalt lava flow containing many phenocrysts of olivine. Volcanics are isolated, and relationships to other units of Honolulu series not known. Partly overlain by lithified calcareous sand dunes. Includes Kaohikaipu lava (Winchell, 1947, Geol. Soc. America Bull., v. 58, no. 1, p. 21).

Named for Kaohikaipu Island which consists largely of these volcanics.

Kapaula Basaltic Andesite (in Hana Volcanic Series)

Pleistocene(?): Maui Island, Hawaii.

G. A. Macdonald *in* H. T. Stearns and G. A. Macdonald, 1942, Hawaii Div. Hydrography Bull. 7, p. 230 (table), 244–246, pl. 1. Single flow of aa; interflow clinker present locally and in such there may be more than one flow but elsewhere above basal clinker entire thickness is composed of dense rock. Columnar jointing not prominent; platy jointing rare; phenocrysts seldom present. Resembles Makaino flow (new) and occupies approximately same stratigraphic position; the two may be branches of same flow or separate flows erupted simultaneously from different points on same fissure. Exposed thickness 40 to 50 feet; 140 feet in test hole 20. Overlies Waiaaka lava (new). Each member in series is underlain by local erosional unconformity.

G. A. Macdonald and D. A. Davis *in* Jacques Avias and others, 1956, Lexique Strat. Internat., v. 6, Océanie, fasc. 2, p. 100. Pleistocene(?).

Occurs as a narrow valley-filling flow which followed valley of ancient Kapaula Stream, Haleakala (East Maui) volcano. Exposed from coast to 2,000 feet south of Koolau ditch, where it disappears beneath later Paakea lava.

Kara Bentonitic Member (of Pierre Shale)

Upper Cretaceous: Northeastern Wyoming.

C. S. Robinson, W. J. Mapel, and W. A. Cobban, 1959, Am. Assoc. Petroleum Geologists Bull., v. 43, no. 1, p. 103 (fig. 2), 111–113. Sequence of gray shale and gray bentonite. Thickness about 100 feet. At type section, top of member is about 300 feet stratigraphically below base of Fox Hills sandstone, and base of member is estimated to be about 2,100 feet above base of Pierre shale and about 1,000 feet above Mitten black shale member of Pierre. In northwestern Crook County, Wyo., and in Carter County, Mont., rocks of same age as Kara bentonitic member apparently are represented either by upper part of black shale unit that overlies Monument Hill bentonitic member, or possibly by Fox Hills sandstone.

Type section: NW¼ sec. 2, T. 48 N., R. 67 W., 1½ miles south of Kara, Weston County.

Karla Kay Conglomerate Member (of Burro Canyon Formation)

Lower Cretaceous: Southwestern Colorado and southeastern Utah.

E. B. Ekren and F. N. Houser, 1959, Am. Assoc. Petroleum Geologists Bull., v. 43, no. 1, p. 195–199. Lowest conglomerate in Burro Canyon formation. Part of a system of shoestring channel-filling conglomerate and conglomeratic sandstone lenses. Lenses thin sharply toward sides of channel, but a thin gently cross-laminated fine-grained sandstone of the channel-fill commonly extends laterally, beyond channel edge, several tens to hundreds of feet. Rarely are channel fills more than 2,000 feet wide or more than 65 feet thick; commonly 500 to 800 feet wide.

Named from an exposure at the Karla Kay mine in McElmo Canyon, Montezuma County, Colo., where one of the channel-fills is well exposed.

†Kasaan Greenstone[1]

Lower Cretaceous (?) : Southeastern Alaska.

Original reference: A. H. Brooks, 1902, U.S. Geol. Survey Prof. Paper 1, p. 40–52, map.

C. W. Wright, 1915, U.S. Geol. Survey Prof. Paper 87, p. 68. Kasaan greenstone, as used by Brooks (1902) not used in this report.

E. N. Goddard, L. A. Warner, and M. S. Walton, Jr., 1944, Copper-bearing iron deposits of the Mount Andrew-Mamie area, Kasaan Peninsula, Prince of Wales Island, southeastern Alaska: U.S. Geol. Survey [Mineral deposits of Alaska-Short Prelim. Repts.]. p. 3–4, fig. 3. Made up of metamorphosed interlayered volcanic rocks, pyroclastics, limestones, and poorly sorted sediments in Mount Andrew-Mamie area. Volcanics predominate in lower part of section, and sediments predominate in upper part.

Occurs in peninsula lying between Clarence Strait and Kasaan Bay: Ketchikan region.

Kashong Member (of Moscow Shale)[1]

Middle Devonian: Central New York.

Original reference: G. A. Cooper, 1930, Am. Jour. Sci., 5th, v. 19, p. 218, 231.

R. G. Sutton, 1951, Rochester Acad. Sci. Proc., v. 9, nos. 5–6, p. 375–377, pl. 1. Name proposed by Cooper for shale sequence above Portland Point member and Windom shale member. Thickness about 38 feet in Batavia quadrangle [this report]. Overlies Menteth limestone member; underlies Windom shale member.

Type section: On Kashong Creek, Seneca Lake.

†Kaskaskia Limestone,[1] Formation,[1] or Group[1]

Mississippian: Western Illinois, western Kentucky, and eastern Missouri.

Original reference: J. Hall, 1857, Am. Assoc. Adv. Sci. Proc., v. 10, p. 55–56.

Named for Kaskaskia, Ill., near mouth of Kaskaskia River.

Kaskaskia sequence

Devonian (Chautauquan) to Mississippian (Osagean): Central and western United States.

L. L. Sloss, W. C. Krumbein, and E. C. Dapples *in* C. R. Longwell, chm., 1949, Geol. Soc. America Mem. 39, p. 112 (table 2), 115–121. "Operational unit" for use in interregional facies analysis. Named for Kaskaskia River in south-central Illinois. Limits of sequence in Illinois are Ste. Genevieve limestone-Wapsipinicon limestone; in Kansas, Ste. Genevieve limestone-"Chattanooga shale"; in Wyoming, Madison limestone-Darby formation.

Kasota Sandstone[1]

Lower Ordovician (Beekmantown): Southeastern Minnesota.

Original reference: L. H. Powell, 1935, St. Paul Inst. Sci. Mus., Sci. Bull. 1, p. 2–16.

C. R. Stauffer and G. A. Thiel, 1941, Minnesota Geol. Survey Bull. 29, p. 7 (geol. column), 50 (fig. 13), 54–55. Lies at base of Ordovician. Varies from a few inches to 6½ feet in thickness. White sandstone with medium to coarse well-rounded grains. Bedding slightly irregular; occasionally contact with underlying Jordan is uneven, indicating disconformity. Separated from overlying Oneota dolomite by thin Blue Earth siltstone.

Known only at Kasota and at St. Peter along Minnesota River, Le Sueur County.

Kassler Sandstone Member (of South Platte Formation)

Lower Cretaceous: North-central Colorado.

K. M. Waagé, 1955, U.S. Geol. Survey Prof. Paper 274–B, p. 31, figs. 10, 17, 19. Throughout most of nonmarine phase of South Platte formation (new) in southern part of northern foothills area, the first sandstone subunit at top of South Platte lies on dip slope of hogback, and crest of hogback is formed by second sandstone subunit. Latter is here named Kassler sandstone member. It is dominant ledge-forming sandstone of formation from Golden quadrangle, where it is about 30 feet thick, south to Kassler quadrangle, where it is between 75 and 100 feet thick. North of Golden quadrangle, too thin to be mapped. Can be traced as far as El Dorado Springs quadrangle, where it is about 10 feet thick. To the north appears to grade gradually into marine siltstone and shale member.

Type section: At end of hogback 0.5 mile north of South Platte River at Kassler. Named for exposure in Kassler quadrangle. It is part of composite type section of South Platte formation. In northern Front Range foothills.

Kasutesyo (Kasuteshio) Limestone

See Castiyo Limestone.

Katahdin Granite[1]

Post-Lower Devonian: Central Maine.

Original reference: C. H. Hitchcock, 1861, Maine Bd. Agric. 6th Ann. Rept., p. 259.

A. J. Boucot, 1954, Am. Jour. Sci., v. 252, no. 3, p. 144–148. Probably post-Lower Devonian. Discussion of stratigraphic relationships of Katahdin granite with Toppan's Ripogenous [Ripogenus] series, and Fisher's [in Willard, 1945] Chesuncook limestone and Ripogenus volcanics

Exposed in Mount Katahdin area in eastern Piscataquis and western Penobscot Counties.

Katalla Formation[1]

Oligocene and Miocene: Southeastern Alaska.

Original reference: G. C. Martin, 1905, U.S. Geol. Survey Bull. 250, p. 13.

D. J. Miller, D. L. Rossman, and C. A. Hickcox, 1945, Preliminary report on petroleum possibilities in the Katalla area, Alaska: U.S. Geol. Survey, p. 6–8; 1945, Geologic and topographic map and sections of the Katalla area, Alaska: U.S. Geol. Survey War-Minerals Inv. Prelim. Map. Consists of about 8,600 feet of marine shale, sandstone, and conglomerate in Katalla area. Compiled from continuous, apparently conformable, section measured from Split Creek southward along Redwood Creek-Burls Creek divide and Redwood Creek-Puffy Creek divide to point near southern end of latter divide. Divided into seven members (ascending): unnamed shale, Split Creek sandstone, Basin Creek member (new), Burls Creek shale, organic shale, Point Hey member, and Puffy member. Measured section in many respects representative of average thickness and lithology of formation as exposed in Katalla area. Oligocene(?).

W. Waloweek and W. L. Norem, 1957, Jour. Paleontology, v. 31, no. 3, p. 674–675. Oligocene and Miocene.

Typically exposed in region northeast of Katalla, along banks of whole of peninsula between Bering Lake and Controller Bay and cropping out in most of hills south and east of Bering River.

†Katemcy Series[1]

Upper Cambrian: Central Texas.

Original reference: T. B. Comstock and E. T. Dumble, 1890, Texas Geol. Survey 1st Ann. Rept., p. lxi, 289–293, pl. 3.

Named for Katemcy Creek, Mason County.

Kate Peak Formation

Kate Peak Andesite or Andesite Series

Miocene or Pliocene, lower: Western Nevada.

V. P. Gianella, 1936, Nevada Univ. Bull., v. 30, no. 9, p. 68–73, pl. 1. Pyroxene andesites, glassy lavas, tuffs, breccias, and agglomerates. Some flows with prominent biotite and hornblende phenocrysts. Estimated thickness about 1,200 feet. Plate shows age as early Pliocene; text states that fossil evidence places upper part of andesites in lower Pliocene and lower part of series possibly extruded in late Miocene time.

G. A. Thompson, 1956, U.S. Geol. Survey Bull. 1042–C, p. 54–55, pl. 3. Formation described in Virginia City quadrangle. Most abundant rock in formation is coarse agglomerate that contains blocks of andesite of contrasting color and texture; flows and flow breccias also present. Contains vitrophyre member in northeastern part of quadrangle. Maximum thickness more than 2,000 feet. Vitrophyre member at least 1,000 feet thick and probably nearly 2,000 feet in thickest part. Top of formation intertongues with overlying Truckee formation. Miocene or early Pliocene.

D. I. Axelrod, 1956, California Univ. Pubs. Geol. Sci., v. 33, p. 32, 64. Underlies Coal Valley formation (new).

D. I. Axelrod, 1958, California Univ. Pubs. Geol. Sci., v. 34, no. 2, p. 97, map 1. From type area in Silver City region, andesite can be traced almost continuously into Verdi basin where it is exposed chiefly in Carson Range south of Truckee River. Section largely one of interbedded agglomerates; mudflow breccias, and lavas. Thickness 1,500 to 2,500 feet. Underlies Coal Valley formation. Rests on all older rocks in area; near Fleish lies on granodiorite or on metamorphic rocks. Outside mapped area rests on Alta andesite; on basis of interfingering relationships with Mehrten formation of Sierra Nevada, Kate Peak andesites were erupted chiefly during span of time ranging from Mio-Pliocene transition to later part of early Pliocene with a few episodes extending into early middle Pliocene.

D. I. Axelrod and W. S. Ting, 1960, California Univ. Pubs. Geol. Sci., v. 39, no. 1, p. 3. In fault contact with upper Pliocene Wichman formation (new).

Named for Kate Peak in Flowery Range, east of Silver City. Covers an extensive area in Virginia City quadrangle.

Katherine Granite[1]

Precambrian: Northwestern Arizona.

Original reference: C. Lausen, 1931, Arizona Bur. Mines Bull. 131, p. 22–27, pl. 2.

Katherine district, Mohave County.

†Katmai Series[1]

Jurassic: Central southern Alaska.

Original reference: W. C. Mendenhall, 1900, U.S. Geol. Survey 20th Ann. Rept., pt. 7, p. 317 (table).

Katmai, Katmai Point and on Katmai River.

Katsberg Red Beds[1]

Upper Devonian: Eastern New York.

Original reference: G. H. Chadwick, 1933, Am. Jour. Sci., 5th, v. 26, p. 480, 482–483, 484.

G. H. Chadwick, 1944, New York State Mus. Bull. 336, p. 135–139, geol. map. Described in Catskill and Kaaterskill quadrangles. Thickness about 3,000 feet where complete. Although formation is here called redbeds (which it actually is farther west) it contains very little red in this area. This absence of abundant red color has puzzled many observers and has been one of reasons for their thinking that later rocks here supervened upon the Catskill. Include Stony Clove sandstone member at base and Wittenberg conglomerate member in upper part. Overlies Onteora redbeds; underlie Slide Mountain conglomerate.

Type section: On steep slopes of highest peak, Slide Mountain in Catskill Mountains. Katsberg is old Dutch name for mountains miscalled "Catskills" by the English.

Kattel Shale[1]

Upper Devonian: Southeastern New York.

Original reference: G. H. Chadwick, 1932, Eastern States Oil and Gas Weekly, v. 1, no. 17, p. 7.

G. A. Cooper and others, 1942, Geol. Soc. America Bull., v. 52, no. 12, pt. 1, chart 4. Shown on correlation chart above Cincinnatus shale and sandstone and below Juliand "zone" of Enfield shale.

Type locality: Kattel Hill, especially the long Lackawanna Railway cut around its east base, between Chenango Bridge and Chenango Forks, Broome County.

Kau Volcanic Series

Pleistocene, upper(?), and Recent: Hawaii Island, Hawaii.

H. T. Stearns and G. A. Macdonald, 1946, Hawaii Div. Hydrography Bull. 9, p. 38 (fig. 12), 62 (table), 64 (table), 65 (fig. 17), 67 (table), 76–78. Assemblage of Recent and latest Pleistocene rocks laid down by Mauna Loa volcano. Separated into lower or prehistoric member and upper or historic member. Lavas form thin veneer, commonly one flow thick, on lower slopes of Mauna Loa but thicken toward summit and in walls of Mokuaweoweo exceed 600 feet. Chiefly porphyritic or nonporphyritic aa and pahoehoe basalts; flows average about 15 feet in thickness. Rocks of Ninole and Kahuku volcanic series form kipukas in Kau lavas. One of latest prehistoric lavas is Keamuku lava flow. Overlapped by Puna lavas (new) between Kilauea caldera and Keaau. Overlies Kahuku volcanic series (new) and Pahola ash. Kau and Puna volcanics formerly included in Kamehame basalt.

G. A. Macdonald and D. A. Davis *in* Jacques Avias and others, 1956, Lexique Strat. Internat., v. 6, Océanie, fasc. 2, p. 100. Late Pleistocene(?) and Recent.

Type locality: In wall of Mokuaweoweo caldera. Named from Kau district where rocks are well exposed.

Kauai Lavas.

Pliocene(?): Kauai Island, Hawaii.

N. E. A. Hinds, 1930, Bernice P. Bishop Mus. Bull. 71, p. 56–57. Basaltic lava flows; make up main cone of Kauai volcano. Consist of lower and upper lavas separated by Waimea conglomerate (new). Thickness of lower lavas about 4,000 feet. Unconformable below lavas and pyroclastics of late Kolea volcanic episode.

D. A. Davis and G. A. Macdonald *in* Jacques Avias and others, 1956, Lexique Strat. Internat., v. 6, Océanie, fasc. 2, p. 100–101. Included in what is now known as Waimea Canyon volcanic series. Pliocene(?).

Distributed over most of island.

Kauffman Member (of Mercersburg Formation)

Middle Ordovician (Trentonian): South-central Pennsylvania.

L. C. Craig, 1949, Geol. Soc. America Bull., v. 60, no. 4, p. 715 (fig. 1), 734–738. Name proposed for upper member of formation. Described at type section as dark-gray fine- to medium-grained, thin crinkly to slabby gray-weathering limestone. Thick slabby or thin cobbly beds developed locally in eastern belts of outcrop; usually platy bedded in western belts. Four metabentonites present at type section; each is immediately succeeded by several feet of olive-drab to green shale or blocky siltstone. Maximum thickness 168 feet; thins northeastward. Conformably overlies Housum member (new); disconformably underlies Oranda formation.

Type section: In fields adjacent to Cumberland Valley Railroad, 2.1 miles southwest of Marion, Franklin County. Named for village of Kauffman, 1.6 miles southeast of type section.

Kaupo Basalt[1] (in Honolulu Volcanic Series)

Pleistocene, upper, or Recent: Oahu Island, Hawaii.

Original reference: H. T. Stearns, 1935, Hawaii Div. Hydrography Bull. 1.

G. A. Macdonald and D. A. Davies *in* Jacques Avias and others, 1956, Lexique Strat. Internat., v. 6, Océanie, fasc. 2, p. 101. Flow of olivine basalt pahoehoe that issued from talus at foot of windward cliff (Pali) of Koolau Range 200 feet above sea level and flowed to ocean. Surface only sparsely soil covered, and neither Manana tuff nor reef of the plus 25-foot (Waimanalo) stand of sea is present on it. Extent noted.

Named for abandoned Kaupo village situated on flow. Forms small peninsula, with area of about 0.1 square mile, 1 mile northwest of Makapuu Head.

Kaupo Mud Flow (in Hana Volcanic Series)

Pleistocene: Maui Island, Hawaii.

H. T. Stearns *in* H. T. Stearns and G. A. Macdonald, 1942, Hawaii Div. Hydrography Bull. 7, p. 65 (table), 67 (table), 107–108, pls. 1, 21B. Coarse breccia with blocks reaching 50 feet across. Forms hills that project through later Hana lavas (new) and cliffs 300 feet high along coast. Exposed thickness 355 feet in sea cliff at Puu Maneoneo; extends below sea level.

G. A. Macdonald and D. A. Davis *in* Jacques Avias and others, 1956, Lexique Strat. Internat., v. 6, Océanie, fasc. 2, p. 101. Included in Hana volcanic series. Pleistocene.

Named for exposures at mouth of Kaupo Valley, Haleakala (East Maui) volcano.

†Kaupulehu Flow

Recent: Hawaii Island, Hawaii.

G. A. Macdonald, 1949, U.S. Geol. Survey Prof. Paper 214–D, p. 75. Several flows were extruded from Hualalai Volcano probably during years 1800 and 1801. Kaupulehu flow originated at vent between 5,500 and 6,000 feet above sea level on northwest flank. Another flow, Huehue, originated at row of cones at 1.500 feet altitude shortly after Kaupulehu flow. Kaupulehu is largely aa and Huehue flow is largely pahoehoe.

Kaweah Series

Triassic(?) : Southern California.

Cordell Durrell, 1940, California Univ. Dept. Geol. Sci., v. 25, no. 1, p. 13, 116, fig. 29, geol. map. Metamorphic series made up of great variety of sedimentary and intrusive and extrusive rocks. Divided into four stratigraphic units (ascending) : Yokohl amphibolite, Lemon Cove schist, Homer quartzite, and Three Rivers schist. Age of series unknown, but Triassic age is suggested by comparison with Mineral King beds and rocks of Inyo Range.

Occurs in southern Sierra Nevada in north-central part of Tulare County.

†Kawishiwin Agglomerate,[1] Greenstones,[1] or Series[1]

Precambrian (Keewatin) : Northeastern Minnesota.

Original reference: N. H. Winchell, 1889, Minnesota Geol. Survey 17th Ann Rept. 1888, p. 41–42, 45–46, 68, 70.

Probably named for Kawishiwi River, Vermilion district.

Kawvian Series or Epoch

Upper Pennsylvanian: North America.

R. C. Moore and M. L. Thompson, 1949, Am. Assoc. Petroleum Geologists Bull., v. 33, no. 3, p. 284–285, 286, 288–289 (fig. 1), 297–300. Analysis of physical characters and paleontological features of Pennsylvanian rocks in North America leads to conclusion that stratigraphic cleavage at two positions within system has paramount significance. Three series recognized: Ardian-Lower Pennsylvanian, Oklan-Middle Pennsylvanian, and Kawvian-Upper Pennsylvanian. Approximately upper one-third of Pennsylvanian system belongs to Kawvian series which includes formations from oldest Missourian to base of Permian. Kawvian rocks divided into Missourian stage below and Virgilian stage above. Time equivalent is Kawvian epoch.

Typically displayed in valley of Kaw (Kansas) River in northeastern Kansas. Name derived from commonly used alternative designation of Kansas (or Kaw) River which joins the Missouri at Kansas City.

Kayak Shale

Lower Mississippian: Northern Alaska.

A. L. Bowsher and T. J. Dutro, Jr., 1957, U.S. Geol. Survey Prof. Paper 303–A, p. 4, 6, 14–15, figs. 2–4, pl. 2. At type locality composed of five unnamed members (ascending): sandstone, 130 feet thick; lower black shale, 595 feet; argillaceous limestone, 80 feet; upper black shale, 140 feet; and red limestone, 10–15 feet. Total thickness approximately 960 feet. Disconformably underlies Wachsmuth limestone (new); disconformably overlies Kanayut conglomerate (new).

Type locality: In saddle near foot of south slope of Mount Wachsmuth, Shainin Lake area, central Brooks Range. Name taken from Kayak Creek, which joins Alapah Creek south of Shainin Lake.

Kaycee Formation

Recent: Eastern Wyoming.

L. B. Leopold and J. P. Miller, 1954, U.S. Geol. Survey Water-Supply Paper 1261, p. 10–11. Described as uniform tan or light-brown silt consisting of moderately well sorted grains, predominantly quartz. Grains subrounded but not pitted. Lenses of sand or fine gravel locally present. In places there is a thin basal gravel. Unconformably overlies Ucross formation (new).

Type locality: Left bank in the reach of Powder River from Kaycee to Sussex.

Kayenta Formation (in Glen Canyon Group)[1]

Upper Triassic(?): Northeastern Arizona, southwestern Colorado, and southeastern and southern Utah.

Original reference: A. A. Baker, C. H. Dane, and E. T. McKnight, 1931, U.S. Geol. Survey Prelim. map showing structure of parts of Grand and San Juan Counties, Utah.

A. A. Baker, C. H. Dane, and J. B Reeside, Jr, 1936, U.S. Geol. Survey Prof. Paper 183, p. 5. pls. Name Kayenta here used for beds in northern Arizona and southeastern Utah that have been previously designated "Todilto" and "Todilto(?)" formation. Overlies Wingate sandstones; underlies Navajo sandstone. Middle formation of Glen Canyon group which is herein classified as Jurassic(?). Type locality stated.

H. E. Gregory, 1950, U.S. Geol. Survey Prof. Paper 220, p. 51 (table), 79–81, pl. 2, geol. sections. Described in Zion Park region where it is 75 to 100 feet thick in Johnson Canyon, 118 to 200 feet in Kanab Canyon, 130 to 165 feet in Sand Canyon, 0 to 180 feet in Zion Park, and 25 to 310 feet east of Paria. Underlies Navajo sandstone; overlies Wingate sandstone.

Paul Averitt and others, 1955, Am. Assoc. Petroleum Geologists Bull., v. 39, no. 12, p. 2520–2523. As redefined in southwestern Utah and along Echo Cliffs of northern Arizona, includes sequence of beds between top of Springdale sandstone member of Moenave formation and base of Navajo sandstone. Sequence 1,190 feet thick at Cedar City, Utah; 714 feet at Zion Canyon; 680 feet at Kanab; and 150 to 500 feet in Echo Cliffs area. At Cedar City, includes Cedar City tongue (new); in Kanab area includes Tenney Canyon tongue (new). Divided locally into two parts by Shurtz and Lamb Point tongues (both new) of Navajo sandstone, but elsewhere is single unit with fairly well-defined boundaries. Jurassic(?).

J. W. Harshbarger, C. A. Repenning, and J. H. Irwin, 1957, U.S. Geol. Survey Prof. Paper 291, p. 3 (table), 17–19, pl. 2. At type locality, is represented by sandstone facies typical of unit throughout most of Colorado Plateau; to southwest of type locality, increases in silt content. Thickness: 55 feet at Rock Point near its eastern limit; 144 feet at Kayenta; 466 feet at Gap where it includes many silty units that are tongues of silty facies; 678 feet along Ward Terrace. In eastern half of Navajo country, conformably overlies Wingate sandstone (Lukachukai member); in western half of country, conformably overlies Moenave formation. Intertongues with basal part of overlying Navajo sandstone. Contains *Tritylodontoids*; study of these fossils is incomplete, but they seem to be closest to Old World forms generally referred to Upper Triassic.

U.S. Geological Survey currently designates the age of the Kayenta Formation as Upper Triassic(?) on the basis of a study now in progress.

Type locality: In Comb Ridge, 1 mile northeast of Kayenta, Navajo County, Ariz.

Keanae Basalt (in Hana Volcanic Series)

Pleistocene(?): Maui Island, Hawaii.

H. T. Stearns *in* H. T. Stearns and G. A. Macdonald, 1942, Hawaii Div. Hydrography Bull. 7, p. 95 (table), 96. Dark-gray olivine basalt containing phenocrysts of olivine and augite. Last lava flow to reach lower part of Keanae Valley.

G. A. Macdonald and D. A. Davis *in* Jacques Avias and others, 1956, Lexique Strat. Internat., v. 6, Océanie, fasc. 2, p. 102. Pleistocene(?).

Named for exposures at Keanae village, Haleakala (East Maui) volcano. At an altitude of 1,300 feet, lava covers entire floor of Keanae Valley, but farther north it divided into two branches, one followed eastern wall of valley to altitude of 500 feet and the other followed gulch of present Piinaau Stream at foot of western wall. At the coast, western branch spread out to form lava delta on which village of Keanae is located.

Keanakakoi Formation

Recent: Hawaii Island, Hawaii.

C. K. Wentworth, 1938, Hawaiian Volcano Observatory 3d Spec. Rept., p. 92–102. Applied to whole series of surface ash layers which appear to have resulted from successive explosions of Kilauea during present physiographic epoch; as thus defined, includes not only 1790 ash but also that of 1924 as component members. Includes variety of materials; some parts largely lapilli and dust produced by phreatic explosions; other parts reticulite and pyroclastics thrown out by magmatic explosions. Maximum thickness over 30 feet, on tongue of caldera rim.

H. T. Stearns and G. A. Macdonald, 1946, Hawaii Div. Hydrography Bull. 9, p. 108. Treated as aa member of Puna volcanic series (new).

Type locality: Surface in vicinity of Keanakakoi Crater.

Kearny Formation

Pennsylvanian (Morrow): Southwestern Kansas (subsurface).

M. L. Thompson, 1944, Kansas Geol. Survey Bull. 52, pt. 7, p. 414–417. Name proposed for 127 feet of rocks encountered between base of producing sand at depth of 4,752 feet and top of highly oolitic limestone, believed to be of Mississippian age, at depth of 4,879 feet in type well. Type section composed of greenish-gray, bluish-gray, and dark-gray coarsely crystalline to dense glauconitic fossiliferous limestones interbedded with dark-gray and green fossiliferous shales. Subordinate amount of sandstone and sandy glauconitic fossiliferous limestone occurs in lower part. Four different although gradational lithologic zones can be recognized.

Type well: Stanolind Oil and Gas Co. No. 1 Patterson well, SE cor. sec. 23, T. 22 S., R. 38 W., Kearny County.

Kearsarge Amygdaloid[1] (in Portage Lake Lava Series)

Precambrian (Keweenawan): Northern Michigan

Original reference: L. L. Hubbard, 1895, Michigan Geol. Survey, v. 5, pt. 1, p. 117, footnote.

H. R. Cornwall, 1954, U.S. Geol. Survey Geol. Quad. Map GQ–51. Included in Portage Lake lava series.

At Kearsarge [mining] location, Houghton County.

Kearsarge Andalusite Group[1]

Paleozoic(?): Central southern New Hampshire.

Original reference: C. H. Hitchcock, 1877, Geology of New Hampshire, pt. 2, p. 585–588, 674, pl. 24.

Occurs on Mounts Kearsarge and Ragged, constituting a band 12 miles long and from 3 to 4 miles wide in towns of Warner, Sutton, Andover, and Salisbury, Merrimack County.

Kearsarge Conglomerate[1]

Precambrian (Keweenawan): Northern Michigan.

Original reference: A. R. Marvine, 1873, Michigan Geol. Survey, v. 1, pt 2, p. 114, chart.

H. R. Cornwall, 1951, Geol. Soc. America Bull., v. 62, no 2, p. 161. Incidental mention in report on Keweenawan lavas.

Named for occurrence in old Kearsarge mine, Houghton County.

Kearsarge Flow[1] (in Portage Lake Lava Series)

Precambrian (Keweenawan): Northern Michigan.

Original reference: B. S. Butler and W. S. Burbank, 1929, U.S. Geol. Survey Prof. Paper 144 (chart compiled by M. G. Wilmarth).

W. S. White, H. R. Cornwall, and R. W. Swanson, 1953, U.S. Geol. Survey Geol. Quad. Map GQ–27. Included in Portage Lake lava series.

At the Kearsarge [mining] location, Houghton County

Kearsarge West Amygdaloid[1]

Precambrian (Keweenawan) : Northern Michigan.

Original reference: B. S. Butler and W. S. Burbank, 1929, U.S. Geol. Survey Prof. Paper 144 (chart compiled by M. G. Wilmarth).

Named for fact that it lies west of Kearsarge amygdaloid.

Kearsarge West Flow[1]

Precambrian (Keweenawan) : Northern Michigan.

Original reference: B. S. Butler and W. S. Burbank, 1929, U.S. Geol. Survey Prof. Paper 144 (chart compiled by M. G. Wilmarth).

Copper district of Keweenaw Point.

Keasey Shale[1] or **Formation**

Keasey Stage

Eocene, upper, and Oligocene, lower: Northwestern Oregon and southwestern Washington, and British Columbia, Canada.

Original reference: H. G. Schenck, 1927, California Univ. Pub., Dept. Geol. Sci. Bull., v. 16, no. 12, p. 457, 459.

C. E. Weaver, 1937, Washington [State] Univ. Pubs. in Geology, v 4, p. 104, 105. Thickness of formation in Rock Creek area, near Keasey, about 1,200 feet. Lower part composed of dark-grayish-brown somewhat stratified medium-grained tuffaceous sandy shales containing several species of fossil mollusca; upper two-thirds composed of medium to dark-brownish-gray rather massive medium- to coarse-grained shaly sandstone within which fossils are scarce. Underlies Pittsburg Bluff formation; basal contact not observed. Lower Oligocene.

C. E. Weaver and others, 1944, Geol. Soc. America Bull., v. 55, no. 5, p. 592, chart 11. In southwestern Washington, a section consisting of Metchosin volcanics and Keasey, Lincoln, and Astoria formations has been folded and deeply eroded so as to expose over 3,000 feet of the Metchosin. Keasey rests unconformably on the volcanics; also present on Vancouver Island. Eocene and Oligocene.

W. C. Warren, Hans Norbisrath, and R. M. Grivetti, 1945, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 42. Shale described west of Willamette River. Thickness about 1,800 feet in vicinity of Sunset Tunnel on Wolf Creek Highway. Overlies Cowlitz formation; disconformably underlies Pittsburg Bluff formation. Upper Eocene or lower Oligocene.

W. C. Warren and Hans Norbisrath, 1946, Am. Assoc. Petroleum Geologists Bull., v. 30, no. 2, p. 220 (table 1), 225–228. Formation described in upper Nehalem River basin. Thickness 1,800 to 2,000 feet. Overlies Cowlitz formation; underlies Pittsburg Bluff formation.

J. W. Durham, 1950, Geol. Soc. America Bull., v. 61, no. 11, p. 1254–1255. A stage based on faunal assemblages.

M. L. Steere, 1955, Geol. Soc. Oregon Country News Letter, v. 21, no. 10, p. 85. In Sunset Tunnel area, Columbia County, Oreg., overlies Nehalem formation (new).

Typically exposed on railroad at Keasey Station, Columbia County, Oreg.

†Keddie Formation[1]

Pennsylvanian: Northern California.

Original reference: J. S. Diller, 1892, Prelim, proof-sheet ed. U.S. Geol. Survey Lassen Peak Folio.

Forms narrow belt on northeast slope of Keddie-Dyer Ridge, Plumas County.

†Keechelus Andesitic Series[1]

Keechelus Andesite or Formation

Eocene to Miocene: Central Washington.

Original reference: G. O. Smith and F. C. Calkins, 1906, U.S. Geol. Survey Geol. Atlas, Folio 139.

H. A. Coombs, 1936, Washington [State] Univ. Pubs. in Geology, v. 3, no. 2, p. 150–171. Series described in Mount Rainier National Park. Includes rock types referred to as Mineral Mountain andesite porphyry, Sheepskull Gap tuffs, Sourdough Mountain breccias, Chinook Pass diorite porphyry, Longmire acid breccias, Starbo altered tuffs, Cayuse Pass acid hornfels, and Mowich hypersthene basalt. Overlies rocks of Puget group with angular unconformity; intruded by Snoqualmie granodiorite. Exact upper age limit of Keechelus unknown. Only materials definitely overlying the younger capping flows in vicinity of park are [Mount] Rainier volcanics; elsewhere volcanic activity in Keechelus may have extended into Pliocene and judging from freshness of flows, may be equivalent to [Mount] Rainier lavas in age.

G. E. Goodspeed and H. A. Coombs, 1937, Am. Jour. Sci., v. 34, 5th ser., no. 199, p. 12–15. Miocene age of Keechelus is in doubt. "Type locality" given.

W. C. Warren, 1941, Jour. Geology, v. 49, no. 8, p. 795–802. In Mount Aix quadrangle, upper part of Keechelus andesitic series is mapped as separate unit—Fifes Peak andesite. Marginal flows of Yakima basalt overlap Fifes Peak andesite and are clearly younger than the andesite. Snoqualmie granodiorite probably intermediate in age between lower part of Keechelus and Fifes Peak andesite. Overlies undifferentiated rocks considered to be pre-Oligocene. Map bracket shows Keechelus Oligocene(?) to Miocene.

R. V. Fisher, 1954, (abs.) Geol. Soc. America Bull., v. 65, no. 12, pt. 2, p. 1340. Formation, covering hundreds of square miles in southern Washington Cascades, is thick sequence of andesitic volcanic breccias, tuffs, flows, and interbedded continental sediments. It is gently folded and intruded by small dioritic stocks and diabasic dikes. Age variously regarded as Miocene and (or) Oligocene. On basis of single oreodont, it is now thought to be mainly Oligocene. Immediately south of Mount Rainier, lower part of Keechelus is interbedded with upper part of the probable upper Eocene Puget group. Keechelus, therefore, appears to belong in part to upper Eocene.

D. R. Crandell and L. M. Hard, Jr., 1959, U.S. Geol. Survey Geol. Quad. Map GQ–125. Series described in Buckley quadrangle where it conformably overlies Puget group. Eocene to Miocene.

R. J. Foster, 1960, Geol. Soc. America Bull., v. 71, no. 2, p. 118–121, pl. 1. Referred to as Keechelus andesite. Term andesitic series considered inappropriate. Type area designated because none was stated by Smith and Calkins. Most workers have considered east shore of Lake Keechelus as the type. Relationship of Keechelus of various workers to new type area must be established by further mapping. Section along Lake Keechelus is metamorphosed; at newly designated type area, Keechelus consists of sequence of bedded andesites with minimum of 3,500 feet exposed. Here, overlies Naches formation and is intruded by Snoqualmie granodiorite.

At Denny Mountain, Keechelus is andesite breccia; appears to overlie Guye formation unconformably. In area of this report, base of Keechelus may be as old as Eocene; no younger rocks are in stratigraphic contact with Keechelus.

Type locality (Goodspeed and Coombs): Along eastern shore of Lake Keechelus, about 70 miles southeast of Seattle on Sunset Highway which connects Puget Sound region with eastern Washington. Type area (Foster): West face to Rampart Ridge at altitude of Rachel Lake which drains into south branch of Box Creek, Kittitas County.

Keechi Creek Formation (in Whitt Group)

Keechi Creek Shale and Sandstone (in Mineral Wells Formation)[1]

Pennsylvanian (Canyon): Central northern Texas.

Original references. F. B. Plummer and R. C. Moore, 1922, Jour. Geology, v. 30, p. 25, 31; Texas Univ. Bull. 2132, p. 78.

M. G. Cheney, 1940, Am Assoc. Petroleum Geologists Bull., v. 24, no. 1, p. 66 (fig. 1), 88. Rank raised to formation in Whitt group (new). Expanded below to base of Turkey Creek sandstone. Underlies Palo Pinto formation; overlies Salesville formation. Name Mineral Wells dropped in this report.

Leo Hendricks, 1957, Texas Univ. Bur. Econ. Geology Pub. 5724, p. 25, fig. 3, pl. 1. This report [Parker County] follows Cheney's (1940) definition of Keechi Creek. However, objection is raised to Cheney's procedure of reclassification. Group terminology not used in this report.

Typically exposed along Keechi Creek west of Mineral Wells, Palo Pinto County.

Keefer Sandstone Member (of Clinton Formation)[1]

Keefer Member (of Mifflin Formation)

Keefer Sandstone (in Clinton Group)

Middle Silurian: Western Maryland, central Pennsylvania to northeastern West Virginia.

Original reference: E. O. Ulrich, 1911, Geol. Soc. America Bull., v. 22, p. 522, 545, 591, pl. 28.

H. P. Woodward, 1941, West Virginia Geol. Survey, v. 18, p. 8, 92–106, measured sections. Keefer sandstone described in West Virginia. Thickness 5 to 30 feet. Overlies Rose Hill formation; underlies Rochester shale. Included in Clinton group. Middle Silurian, Niagaran series.

C. K. Swartz and others, 1942, Geol. Soc. America Bull., v. 53, no. 4, chart 3. Correlation chart shows that Clinton—central Pennsylvania to northeastern Tennessee—comprises (ascending) Rose Hill shale, Keefer sandstone, and Rochester shale. Niagaran series.

H. H. Arndt and others, 1959, Geol. Soc. America Guidebook Pittsburgh Mtg., p. 5, 6, 21, 23. Rank reduced to member status in Mifflin formation (new). Underlies Rochester member; overlies Rose Hill formation. Thickness commonly 40 to 50 feet; locally absent. At Mount Union section referred to as Keefer formation; thickness 47 feet. The Keefer is the "Ore sandstone" of Pennsylvania Second Geological Survey Reports.

Carlyle Gray and others, 1960, Geologic map of Pennsylvania (1:250,000): Pennsylvania Geol. Survey, 4th ser. Clinton group, as mapped, includes Rose Hill formation, Keefer sandstone, and Rochester shale.

Named for Keefer Mountain a few miles northeast of Hancock, Washington County, Md.

Keel Limestone Member (of Chimneyhill Limestone)

Lower Silurian: South-central Oklahoma.

R. A. Maxwell, 1936, Northwestern Univ. Summ. of Doctoral Dissert., v. 4, p. 132, 134. An oolitic limestone 6 to 8 feet thick. Underlies Cochrane member (new); unconformably overlies Hawkins member (new).

T. W. Amsden, 1957, Oklahoma Geol. Survey Circ. 44, p. 4 (fig. 2), 6 (fig. 3), 11–16, fig. 4. Unconformably overlies Ideal Quarry member (replaces Hawkins limestone member); unconformably underlies Cochrane member. Type locality designated.

Type locality: NW¼NE¼NE¼ sec. 36, T. 3 N., R. 5 E., Pontotoc County. Name taken from allottee who originally owned land.

Keeler Canyon Formation

Pennsylvanian to Lower Permian: Eastern California.

C. W. Merriam and W. E. Hall, 1957, U.S. Geol. Survey Bull. 1061–A, p. 4–7. Consists of thin-bedded medium- to dark-gray impure silty and arenaceous to pebbly limestones and limy siltstones, with intercalations of pinkish or maroon fissile shale. Silicified fusulinids are sometimes an important constituent of the pebbly limestones. All rocks show clastic texture, and bedding is inclined to be platy or flaggy with few layers as much as 3 feet thick. Formation highly folded; section overturned in Darwin Hills. Thickness averages 2,200 feet; in Darwin quadrangle, formation thickens to about 4,000 feet. Where section is greatly thinned, there is evidence that segments have been cutout by faulting. Conformably overlies Chainman shale in New York Butte quadrangle; in Darwin quadrangle, overlies an unnamed limestone which seemingly overlies the Chainman; unconformably underlies Owens Valley formation (new) with angular discordance of about 15° in some places.

W. E. Hall and E. M. MacKevett, 1958, California Div. Mines Spec. Rept. 51, p. 7 (table 1), 9–10, pl. 1. In Darwin quadrangle, consists of a lower member, about 2,300 feet thick, of thin-bedded limestone with intercalated limestone-pebble conglomerate and an upper member, about 1,700 feet thick of calcilutite and fine-grained calcarenite with lesser shale and limestone-pebble conglomerate. Underlies Owens Valley formation; overlies Rest Spring shale. Ranges in age from probable Atoka or Des Moines (Pennsylvanian) to probable late Wolfcamp (Permian).

Type locality: East of the Estelle Tunnel portal and 2 miles southwest of Cerro Gordo Peak, southern Inyo Mountains.

Keen Conglomerate

Pennsylvanian (Strawn): Central Texas.

Robert Pavlovic, 1958, Am. Assoc. Petroleum Geologists Bull., v. 42, no. 4, p. 891–892. Massive coarse green chert conglomerate with wavy closely banded black and white chert common. Thickness about 25 feet. Occurs approximately in middle(?) of the Strawn.

Named from Keen Creek in southeast corner of Zephyr quadrangle, Mills County. Traced about 6 miles along strike from Pompey Creek on Mullin topographic sheet to head of Rough Creek where it is hidden by the Cretaceous.

Keene Gneiss[1]

Precambrian : Northern New York.

Original reference: W. J. Miller, 1918, Geol. Soc. America Bull., v. 29, p. 400–462, geol. map.

M. H. Krieger, 1937, New York State Mus. Bull. 308, p. 15, 41–42, 43, 47, geol. map. Keene gneiss included in discussion of anorthosites in Thirteenth Lake quadrangle.

Named for exposures along State road just north of village of Keene, Lake Placid quadrangle, Essex County.

Keene Limestone[1]

Upper Cambrian and Middle Devonian : Western central Montana.

Original reference: W. H. Weed, 1901, U.S. Geol. Survey 22d Ann. Rept., pt. 2, p. 434, 438, 505, map.

Named for Keene mine, Elkhorn region.

Keeseville Sandstone[1]

Upper Cambrian (?) : Northern New York.

Original reference: E. Emmons, 1841, New York Geol. Survey 5th Rept., p. 130, 131.

D. W. Fisher, 1956, Internat. Geol. Cong., 20th, Mexico, Cambrian Symposium, pt. 2, p. 333. Although Emmons (1841) treated Keeseville sandstone as variety of Potsdam sandstone, name was later revived for upper predominantly white part of the Potsdam, and name Potsdam was restricted to lower, largely red, part (Chadwick, 1920, New York State Mus. Bull. 217–218). Because reddish and white sandstone interfinger, advisability of using two names is questioned. Not considered valid name.

A. W. Postel, A. E. Nelson, and D. R. Wiesnet, 1959, U.S. Geol. Survey Geol. Quad. Map GQ–123. Potsdam sandstone in Nicholville quadrangle is divided into two members. Nicholville conglomerate (new) below and upper unnamed orthoquartzite member. Unnamed upper member corresponds to Keeseville sandstone of Emmons.

Extends from Keeseville to Hopkinton, St. Lawrence County.

Keetley Volcanics

Tertiary, lower (?) : North-central Utah.

M. B. Kildale, 1958, Utah Mineralog. Soc. Field Trip, Aug. 17, 1958, p. 8. Series of volcanic rocks largely of andesitic flows, agglomerates, and tuffs. Unconformably overlie older folded sedimentary rocks. Probably early Tertiary in age. Altered by hydrothermal solutions southeast of Keetley.

In eastern and northeastern parts of Park City mining district. Well exposed in cuts along new highway between Silver Fork junction and Hailstone, and occur in vicinity of Keetley.

Keewatin Group, Volcanics

Precambrian : Northern Minnesota and Canada.

Original reference: A. C. Lawson. 1885, Report on the geology of the Lake of the Woods region with special reference to the Keewatin (Huronian?) belt of the Archaean rocks: Canada Geol. and Nat. History Survey, 1885, the same being part CC of Canada Geol. and Nat. History Survey Ann. Rept., new ser., v. 1, 1886, p. 10CC–13CC, 14CC–15CC.

F. F. Grout and others, 1951, Geol. Soc. America Bull., v. 62, no. 9, p. 1023–1029, 1074. Lawson (1885) named the Keewatin from exposures on

Lake of the Woods, most of which are in Canada. No doubt the series is equivalent to outcrops south of the boundary. Outcrops run east on Canadian side nearly to Port Arthur and almost connect with the Minnesota belt from Saganaga Lake to Cass County. West of that, drift cover is thick. Hays and others (1905, Jour. Geology, v. 13, no. 2) found original Keewatin a fairly well developed unit and approved name to cover greenstone, green schist, and the iron-formation of basement complex, apparently considering it below Knife Lake (Seine) group. Keewatin group in Minnesota divided into Ely greenstone and Soudan iron-bearing formation. Keewatin having been named from outcrops on Lake of the Woods has its type locality in Minnesota. Widespread use of term is based on evidence (not all equally good) that other rocks can be correlated with those near Lake of the Woods. Possible that greenstones resembling those at type locality may be of different ages. Pettijohn (1937, Geol. Soc. America Bull., v. 48, no. 2) reported greenstones of two ages north of type locality. He would restrict the Keewatin to the older of the two series. Cooke and others (1931, Canada Geol. Survey Mem. 166) suggest that there are larger, well-exposed, and less-metamorphosed greenstones in northern Ontario and Quebec, which have so long been agreed upon as Keewatin that it would be well to substitute that as type locality. Term Earlier Precambrian System as used in this report includes Keewatin Period.

Type locality: Keewatin district, Lake of the Woods area, northern Minnesota.

Keewatin Series[1]

Precambrian: Lake Superior region.

Original reference: A. C. Lawson, 1885, Report on the geology of the Lake of the Woods region with special reference to the Keewatin (Huronian?) belt of the Archaean rocks: Canada Geol. and Nat. History Survey, 1885, the same being part CC of Canada Geol. and Nat. History Survey Ann. Rept., new ser., v. 1, 1886, p. 10CC–13CC, 14CC–15CC.

F. F. Grout and others, 1951, Geol. Soc. America Bull., v. 62, no. 9, p. 1023. Early Precambrian System, as used in this report [Precambrian of Minnesota], includes Keewatin Period and the time of the following period of invasion, orogeny, and erosin. Rocks include (1) Keewatin flows and associated Soudan iron formation and minor sediments, and (2) pre-Knife Lake granite, usually designated Laurentian.

Name derived from Keewatin district.

†Keg Creek Sand[1]

Eocene, upper: Eastern Georgia.

Original reference: S. W. McCallie, 1919, Jour. Geology, v. 27, p. 176.

Named for exposures on Keg Creek, Washington County.

Keith Knob facies (of New Providence Formation)

Lower Mississippian: Central Kentucky.

P. B. Stockdale, 1939, Geol. Soc. America Spec. Paper 22, p. 76, 112–114. Predominantly a gray, blue-gray, olive-gray to drab argillaceous shale with local siltstone layers in lower part. Thickness 125 to 175 feet, in harmony with general southward thinning of formation. Merges with Silver Hills facies (new) to north and west and with Junction City facies (new) to east. Underlies Culver Springs shale member of Brodhead formation, Pilot Knob facies (all new); overlies New Albany shale.

Well exposed along U.S. Highway 62, one-half mile southwest of Boston, Nelson County. Named for Keith Knob, westernmost prominence in Nelson County.

Kekekabic Granite[1]

Precambrian: Northeastern Minnesota.

Original reference: N. H. Winchell, 1900, Minnesota Geol. Survey Final Rept., v. 5, pt. 1, p. 32.

J. T. Stark and V. G. Sleight, 1939, Geol. Soc. America Bull., v. 50, no. 7, p. 1032 (table 2), 1036. Intrudes Knife Lake series in Kekequabic area. Presumably contemporaneous with Vermilion granite (batholith).

Occurs along south side of Kekekabie [Kekequabic] Lake, Vermilion district, Lake County.

Kekekabic Tuffs, Agglomerates, Slates, and Andesite Porphyry (in Knife Lake Series)

Precambrian: Northern Minnesota.

J. W. Gruner, 1941, Geol. Soc. America Bull., v. 52, no. 10, p. 1583 (table 1), 1606–1608, 1624. Overlies Amoeba Lake graywackes, slates, and tuffs. Porphyry is interstratified with tuffs, agglomerates, and slates in vicinity of Kekekabic Lake; near Eddy Lake, lies on top of other sediments. Thickness 2,000 to 4,000 feet. Difficult to limit series upward because transition is gradual. In this report, Knife Lake series is divided into 20 members. Table of approximate chronologial sequence (ascending) shows Kekekabic tuffs as member 11.

Type locality not stated. Probably named for occurrence at Kekekabic Lake.

Kekekabic Lake Tuffs, Agglomerates, Slates, and Andesite Porphyry

See Kekekabic Tuffs, Agglomerates, Slates, and Andesite Porphyry.

Keller Group

Pennsylvanian (Virgil Series): Central and southern New Mexico.

M. L. Thompson, 1942, New Mexico Bur. Mines Mineral Resources Bull. 17, p. 27 (table 2), 69–71. Proposed for group of rocks between top of Hansonburg group (new) of Missouri series below and the base of the Fresnal group (new). Includes Moya (top) and Del Cuerto formations (both new). At type locality, group is about 132 feet thick and is composed largely of limestone; several thick beds of arkosic sandstone, conglomerate and shale occur in lower two-thirds of group. Lithology varies markedly among some localities.

Carel Otte, Jr., 1959, New Mexico Bur. Mines Mineral Resources Bull. 50, p. 19. Holder formation includes Fresnal and Keller groups in the classification of Thompson (1942).

Type locality: At north end of Oscura Mountains on northeast bluff of canyon that cuts across northern part of mountains. Located mainly in NE¼ sec. 31, T. 5 S., R. 6 E., but extends a short distance into west-central part of sec. 32, Socorro County. Name derived from Keller Spring on east slope of Oscura Mountains about 2 miles east of South Oscura Peak.

Kellogg Shale

Eocene, upper: Northern California.

B. L. Clark and A. S. Campbell, 1942, Geol. Soc. America Spec. Paper 39, p. 1, 4 (fig. 3), 5–9. Name applied to 130-foot shale unit lying stratigraphically below Markley formation, and in western part of area forms upper part of series of sands and shales which have been known locally as "Nortonville" shales. Shale is uniform; some layers are thin-bedded paper shales and others more massive; unweathered rock, buff to light-chocolate; weathered surface almost pure white. In type area, underlies San Pablo formation.

Type section: On bank of road between Kellogg Creek and Byron Hot Springs, northeast of Mount Diablo.

Kelly Formation

Pennsylvanian: North-central Utah.

H. J. Bissell, 1936, Iowa Acad. Sci. Proc., v. 43, p. 240, 241. Predominantly sandstone and limestone interbedded; minor amounts of conglomerate and shale. Thickness 1,885 feet. Underlies Hobble formation (new). Rocks have been referred to Oquirrh formation. Proposed in this report to elevate Oquirrh to rank of series in this region.

Type section: In Hobble Creek Canyon, central part T. 7 S., R. 3 E., east of Springville, Utah County.

Kelly Limestone

Kelly Formation[1]

Mississippian: Southwestern New Mexico.

Original reference: G. L. Herrick, 1904, Am. Geol., v. 13, p. 310–312. [See Graphic-Kelly limestone.]

S. B. Talmage and T. P. Wootton, 1937, New Mexico Bur. Mines Mineral Resources Bull. 12, p. 27. Since its definite correlation with the Lake Valley limestone has been established, it seems preferable to discontinue use of local term, Kelly limestone, in Magdalena Mountains.

V. T. Stringfield, A. H. Koschmann, and G. F. Loughlin, 1942, U.S. Geol. Survey Prof. Paper 200, p. 14–16, pl. 2. In Magdalena district, for most part it is light bluish-gray medium- to coarse-grained thick-bedded high-calcium limestone with persistent bed of dense argillaceous limestone in middle part known as "silver pipe" or "indicator." Thickness ranges from 90 to 135 feet; exceeds 110 feet in most places.

A. K. Armstrong, 1958, New Mexico Bur. Mines Mineral Resources Mem. 5, p. 3, 5, 11, figs. 6, 8, 9. Formation ranges in thickness from 0 to 75 feet in Magdalena, Lemitar, and Ladron Mountains. Disconformably overlies Caloso formation. Keokuk (Osage) age.

Named for Kelly, Magdalena district, Socorro County.

Kelly Hill facies[1] (of Carwood Formation)

Lower Mississippian: Southern Indiana.

Original reference: P. B. Stockdale, 1931, Indiana Dept. Conserv., Div. Geology Pub. 98, p. 77, 186–191.

J. M. Weller and others, 1948, Geol. Soc. America Bull., v. 59, no. 2, p. 127–128, pl. 2. Mississippian facies nomenclature discussed. Correlation chart lists Kelly Hill facies of Carwood formation.

Name taken from hill 2 miles southwest of Nashville which is crossed by State Highway 46, NE¼NW¼ sec. 35 and SW¼SE¼ sec. 26, T. 9 N., R. 2 E., Brown County.

Kelso Shale

Lower Cambrian : Southern California.

J. C. Hazzard, 1938, (abs.) Geol. Soc. America Proc. 1937, p. 241. Listed as underlying Chambless limestone and overlying Tough Nut quartzite (new). Thickness 55–57 feet.

J. C. Hazzard, 1954, California Div. Mines Bull. 170, chap. 4, p. 30, 32. Name preoccupied ; unit renamed Latham shale.

Area is in Providence Mountains, San Bernardino County.

Kelvin Formation

Kelvin Conglomerate[1]

Lower Cretaceous : Central northern Utah.

Original reference: A. A. L. Mathews, 1931, Oberlin Coll. Lab. Bull., new ser., no. 1.

W. L. Stokes, 1944, Geol. Soc. America Bull., v. 55, no. 8, p. 970. Considered to be equivalent to Cedar Mountain group (new).

D. A. Andrews and C. B. Hunt, 1948, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 70. Shown on map legend as Kelvin formation.

A. E. Granger and others, 1952, Utah Geol. Soc. Guidebook 8, p. 15, pl. 1. Formation discussed in geology of central Wasatch Mountains. Conglomerates form its most prominent outcrops, but formation consists in greater part of pale reddish-brown to purple siltstone with smaller amounts of sandstone. Thickness in Parleys Canyon about 1,500 feet. Conformably overlies Morrison (?) formation ; underlies Frontier formation.

L. A. Hale, 1960, Wyoming Geol. Assoc. Guidebook 15th Ann. Field Conf., p. 138. Frontier formation, in Coalville anticline, contains a middle red-bed sequence 3,150 feet thick considered by some writers as belonging to Kelvin formation. This sequence is here named Chalk Creek member of Frontier.

Named for exposures at Kelvins Grove, Emigration Canyon, about 8 miles east of Salt Lake City.

Kemp Clay (in Navarro Group)[1]

Upper Cretaceous (Gulf Series) : Northeastern Texas.

Original reference: R. T. Hill, 1901, U.S. Geol. Survey 21st Ann. Rept., pt. 7, p. 342–344.

L. W. Stephenson, 1941, Texas Univ. Bur. Econ. Geology Pub. 4101, p. 27–30. Youngest formation in group. Unconformably underlies Midway group; overlies Corsicana marl; in Bexar County, merges westward along strike into Escondido formation. Maximum thickness not determined; well records in Limestone County show thickness of about 370 feet, but that figure may be exceeded in places. Locally formation appears to be no more than 160 feet.

D. L. Frizzell, 1954, Texas Univ. Bur. Econ. Geology Rept. Inv. 22, p. 52–53. Foraminifera described.

Presumable type locality is faulted inlier near Kemp, Kaufman County.

Kemper Member (of Naheola Formation)

[Paleocene] : West-central Alabama and east-central Mississippi.

W. F. Roux, Jr., 1958, Dissert. Abs., v. 19, no. 5, p. 1056. Upper Midway Naheola formation composed of Matthews Landing, Oakhill, and Kemper members.

Type locality and derivation of name not given.

Kenai Formation[1]

Eocene(?) and Oligocene: Central southern Alaska.

Original reference: W. H. Dall and G. D. Harris, 1892, U.S. Geol. Survey Bull. 84, p. 234.

F. H. Moffit, 1954, U.S. Geol. Survey Bull. 989–D, p. 143. In recent years, formation has been restricted to rocks of the type locality on Kenai Peninsula.

F. F. Barnes and E. H. Cobb, 1959, U.S. Geol. Survey Bull. 1058–F, p. 224–229, pls. Only known bedrock in Homer district. Consists of moderately indurated sand, silt, and clay in generally thin and intergrading beds and lenses, interbedded with a few lenses of fine conglomerate and many beds of subbituminous and lignitic coal ranging from a few inches to 7 feet in thickness. Total thickness of formation not known, because neither top nor base has been recognized, but probably exceeds 4,700 feet; this figure is aggregate thickness of sections measured along northwest shore of Kachemak Bay.

Type locality: Homer district, Kenai Peninsula.

Kendall Sandstone Member (of Gypsum Spring Formation)

Jurassic: Western Wyoming.

R. E. Skinner, 1960, Wyoming Geol. Assoc. Guidebook 15th Ann. Field Conf., p. 129–130. Marine type clastics including sandstone, siltstone, and some thin limestones; buff, tan, and red. Thickness in outcrop about 20 to 25 feet. Basal member of formation. Unit has been termed "Nugget Pay" and included in Nugget formation.

Well exposed in southwest part of sec. 25, T. 38 N., R. 110 W., Sublette County. Name derived from nearby Kendall Ranger station and local name for valley in which station is located and sandstone exposed.

Kendall Tuff[1]

Tertiary: Southwestern Nevada.

Original reference: F. L. Ransome, 1909, U.S. Geol. Survey Prof. Paper 66, p. 28, 41.

Named for Kendall mine, Goldfield district.

Kendall Green Slate[1]

Precambrian: Eastern Massachusetts.

Original reference: W. E. Hobbs, 1899, Am. Geologist, v. 23, p. 109–115.

Occurs in Kendall Green area, Middlesex County.

Kendrick Shale (in Breathitt Formation)

Kendrick Shale (in Pottsville Group)[1]

Pennsylvanian: Southeastern Kentucky.

Original reference: W. R. Jillson, 1919, Kentucky Dept. Geology and Forestry, ser. 5, v. 1, p. 96–104.

H. R. Wanless, 1939, Geol. Soc. America Spec. Paper 17, p. 88. Marine shale in Breathitt formation; directly overlies Amburgy coal.

R. E. Hauser, 1953, Kentucky Geol. Survey Bull. 13, p. 11, 17. Thickness at type locality 50 feet.

Type locality: (Morse, 1931) On Cow Creek in Floyd County, approximately 15 miles east of Paintsville.

Kenilworth Member (of Blackhawk Formation)

Upper Cretaceous (Montana): Central eastern Utah.

R. G. Young, 1955, Geol. Soc. America Bull., v. 66, no. 2, p. 183, 184–185, figs. 2, 3, pl. 3. Consists of massive cliff-forming basal sandstone, an overlying series of coal-bearing rocks, and offshore bar sandstones behind which they were deposited. Basal sandstone grades into underlying tongue of Mancos shale, has sharply defined top, is white capped, and is medium grained, thick bedded, and buff colored with maximum thickness of 85 feet; crossbedding common in more massive beds. Coal-bearing rocks of about 160 feet of gray to black shale with lenses of white and buff sandstone and four minable coal beds which are (ascending): Kenilworth or Castlegate "D", Gilson, Fish Creek, and Rock Canyon. Separated from Sunnyside member (new) above and Aberdeen member (new) below by tongues of Mancos shale.

Named from exposures near Kenilworth, Carbon County. In Book Cliffs.

Kennebec Formation

Age not stated: West-central Maine.

A. R. Cariani, 1959, Dissert. Abs., v. 19, no. 10, p. 2577. Thinly bedded black sulfide-rich limestones, phyllites, and quartzites. Position and formational status of Kennebec still in doubt.

In Anson quadrangle.

†Kennedy Gravels,[1] Drift

Pleistocene (pre-Wisconsin): Northwestern Montana, and Alberta, Canada.

Original reference: B. Willis, 1902, Geol. Soc. America Bull., v. 13, p. 315, 328–330.

Leland Horberg, 1954, Geol. Soc. America Bull., v. 65, no. 11, p. 1102. Pre-Wisconsin Mountain drift of Glacier Park was described by Willis (1902) as Kennedy gravels and considered a fluvial deposit. Alden (1932, U.S. Geol. Survey Prof. Paper 174) determined its glacial origin and included it in his pre-Wisconsin Mountain drift. Inasmuch as references are clearly to same deposits, original name should be retained. Kennedy drift, which is at least 100 feet thick, includes both till and outwash and in places is cemented by calcium carbonate into tillite and conglomerate. Upper 20 feet in places is weathered and leached, so that residue of insoluble pebbles occur in yellow-brown, limonitic, clayey matrix.

G. M. Richmond, 1960, U.S. Geol. Survey Prof. Paper 400–B, p. B223. Discussion of correlation of alpine and continental glacial deposits of Glacier National Park and adjacent high plains, Montana. Three alpine glaciations occurred. Tills of these three ancient glaciers are all included in Kennedy drift of Horberg (1954). They have no continental counterparts in this region but are correlated with Nebraskan, Kansan, and Illinoian tills of central interior.

Type locality: Gravel mesa, 5,800 feet high, 5 miles east of Chief Mountain, north of Kennedy Creek and 900 feet above it, in northwestern part of Teton County, Mont.

Kenneth Limestone[1]

Upper Silurian or Lower Devonian: North-central Indiana.

Original reference: E. R. Cumings and R. R. Schrock, 1927, Indiana Acad. Sci. Proc., v. 36, p. 76–77.

C. K. Swartz and others, 1942, Geol. Soc. America Bull., v. 53, no. 4, chart 3. Shown on correlation chart in Cayugan series, but may be Devonian.

D. J. McGregor, 1958, Indiana Geol. Survey Bull. 15, p. 37–39. Gray to tan dense cherty and irregularly bedded limestone 30 to 40 feet thick. Overlies Kokomo limestone; underlies Pendleton sandstone. Lower Devonian.

Exposed in quarries at Kenneth Station and vicinity, Cass County.

Kennett Formation[1]

Middle Devonian: Northern California.

Original reference: J. P. Smith, 1894, Jour. Geology, v. 2, p. 591–593, 598.

A. R. Kinkel, Jr., W. E. Hall, and J. P. Albers, 1956, U.S. Geol. Survey Prof. Paper 285, p. 1, 32–38, pl. 1. Composed almost entirely of shale and limestone, but minor beds of shaley tuff and crystal tuff are interbedded with shale near base. Black shale forms lower part; it is commonly a black siliceous, thinly bedded rock which is locally crumpled and cut by a network of tiny quartz veins. Limestone forms upper part and is largely a coral reef. Maximum thickness probably not more than 400 feet; folding and repetition by faulting make it impossible to obtain exact thickness. Overlies Balaklala rhyolite; rhyolitic tuff of Kennett is interbedded with shale and grades downward through transition zone to rhyolitic tuff beds that are part of Balaklala rhyolite; conformably underlies Mississippian Bragdon within mapped area [West Shasta copper-zinc district]; outside area, Kennett has been uplifted by warping and erosional unconformity separates the two formations.

Exposed between Squaw and Backbone Creeks, about 4 miles west of Kennett, on Sacramento River. Exposed in northern part of West Shasta district as discontinuous erosion remnants on present topography of a much more continuous formation. Also exposed in southern part of Behemotosh Mountain quadrangle.

Kennett Limestone[1]

Precambrian: Southeastern Pennsylvania.

Original reference: T. D. Rand, 1900, Philadelphia Acad. Nat. Sci. Proc. 1900, pt. 1, p. 235–242.

Probably named for Kennett Square Station, Chester County.

Kenney Formation

Oligocene, upper, or Miocene, lower: Eastern central Idaho.

A. L. Anderson, 1957, Idaho Bur. Mines and Geology Pamph. 112, p. 13, 14, 16–17, pl. 1. Composed of beds of shale and to lesser extent of sandstone, conglomerate, and locally tuff and bentonite. Conglomerate beds are generally thin and not very persistent and are scattered here and there throughout formation. Much of the shale is light colored and generally somewhat sandy. Beds of sandstone are white or pale buff. Inferred thickness is several hundreds of feet. Passes beneath beds of Geertson and Carmen formations and unconformably overlies Challis volcanics in Baker quadrangle. Underlies Kirtley formation (new name to replace preoccupied Carmen). Thickness about 500 feet in North Fork quadrangle. Late Oligocene or early Miocene.

Named for Kenney Creek along which more or less typical exposures are to be found. Confined to Lemhi Valley, Lemhi County.

Kennicott Formation[1]

Lower Cretaceous: Central Alaska.

Original reference: O. Rohn, 1900, U.S. Geol. Survey 21st Ann. Rept., pt. 2, p. 424–440, pl. 52.

F. H. Moffit, 1938, U.S. Geol. Survey Bull. 894, p. 70–71. Rocks of type locality of Rohn's Kennicott formation in Fourth of July Pass now considered Lower Cretaceous. Those that overlie Upper Triassic rocks and, on paleontologic grounds, properly belong to Kennicott formation include conglomerate, brown sandstone, crumbly gray shale, and black shale.

J. T. Dutro, Jr., and T. G. Payne, 1957, Geologic map of Alaska (1:2,500,000): U.S. Geol. Survey. Appears on map legend.

Type locality: In Fourth of July Pass, Copper River region. Occurs on Bear and Fourth of July Creeks between Fohlin Creek and Kennicott Glacier.

Kenosha Shale Member (of Tecumseh Shale)[1]

Pennsylvanian (Virgil Series): Southeastern Nebraska, southwestern Iowa, and northeastern Kansas.

Original reference: G. E. Condra, 1930, Nebraska Geol. Survey Bull. 3, 2d ser., p. 47, 52.

G. E. Condra, 1949, Nebraska Geol. Survey Bull. 16, p. 23. Underlies Ost limestone member; overlies Avoca limestone member of Lecompton formation.

R. C. Moore, 1949, Kansas Geol. Survey Bull. 83, p. 156. Not distinct enough to be treated as subdivision of Tecumseh in Kansas.

H. G. Hershey and others, 1960, Iowa Highway Research Board Bull. 15, p. 19, fig. 5. Bluish argillaceous shale with *Crurithyris* near base. Thickness about 6½ feet near Thurman, Fremont County. Underlies Ost limestone member; overlies Avoca limestone member of Lecompton limestone.

Type locality: In Missouri River bluffs near mouth of Kenosha Valley, south of King Hill, Cass County, Nebr.

Kensington Granite-Gneiss

Age unknown: Eastern Maryland and District of Columbia.

Ernst Cloos *in* C. W. Cooke and Ernst Cloos, 1951, Geologic map of Prince Georges County and the District of Columbia (1:62,500): Maryland Dept. Geology, Mines and Water Resources. Highly foliated; coarse biotite granite. This youngest crystalline rock is a discordant granodiorite invading the schist in bodies which are too small to be shown on map. The granodiorite may be responsible for a great deal of the metamorphism of this area. Mapped in District of Columbia west of Rock Creek Park.

Ernst Cloos *in* C. W. Cooke and Ernst Cloos, 1953, Geologic map of Montgomery County and District of Columbia (1:62,500): Maryland Dept. Geology, Mines and Water Resources. Mapped in Montgomery County, northward from District of Columbia through Kensington to vicinity of Norwood.

Derivation of name not given, but probably named for occurrence at Kensington, Md.

Kent Bed[1]

Lower Cretaceous (Comanche Series): Southern Kansas.

Original reference: F. W. Cragin, 1895, Am. Geologist, v. 16, p. 383.

Derivation of name not stated.

Kent Till

Pleistocene (Wisconsin) : Northern Ohio and northwestern Pennsylvania.

V. C. Shepps and others, 1959, Pennsylvania Geol. Survey, 4th ser., Bull. G–32, p. 10 (fig. 3), 13 (fig. 4), 31–35, pl. 1. Bluish-gray moderately pebbly to pebbly calcareous loam to sandy loam till deposited during Kent advance in early Cary time. Kent advance followed Mogadore advance and preceded Lavery advance. Name credited to G. W. White (in press).

G. W. White, 1960, U.S. Geol. Survey Bull. 1121–A, p. 2 (table 1), 3 (fig. 1), 5–6. Thickness about 17 feet. Where base is exposed, lies unconformably upon bedrock or Mogadore till. Where Kent does not form surface material, it is commonly overlain unconformably by Hiram till; in places, Windham sand (new) lies between the tills. Locally overlain by Lavery till.

Named for exposures in vicinity of Kent, Portage County, Ohio.

Kentucky Shale[1]

Mississippian : Eastern Kentucky.

Original reference: N. S. Shaler, 1877, Kentucky Geol. Survey, new ser., v. 3, p. 183–186.

Kenwood Beds[1]

Kenwood Member (of Wapsipinicon Formation)

Middle Devonian : Eastern Iowa.

Original reference: W. H. Norton, 1894, Iowa Acad. Sci. Proc., v. 1, pt. 4, p. 23.

E. H. Scobey, 1940, Jour. Sed. Petrology, v 10, no. 1, p. 38 (fig. 1), p. 40. Composed chiefly of interbedded thinly laminated impure limestones and shales. Maximum thickness about 20 feet attained near Cedar Rapids. Underlies Spring Grove member; bluish shale at base rests with sharp lithologic break on Otis member. Kenwood here considered good member name as Independence shale with which it has been correlated is believed to be Lime Creek in age and therefore occupies much higher stratigraphic position. Middle Devonian (?). Type section designated.

Type section: Exposure along Indian Creek in Kenwood Park in northern Cedar Rapids, Linn County.

Kenwood Sandstone[1]

Kenwood Sandstone Member (of New Providence Formation)

Lower Mississippian: Western and northern Kentucky, southern Indiana, and southeastern Wisconsin.

Original reference: C. Butts, 1915, Kentucky Geol. Survey, 4th ser., v. 3, pt. 2, p. 148.

P. B. Stockdale, 1939, Geol. Soc. America Spec. Paper 22, p. 79, 108, 109–111. Rank reduced to member status in New Providence formation; occurs in Silver Hills facies of formation. Reasons for change are: areal extent is quite limited, it is a local facies feature of what both to north and to south is shale undifferentiated from that beneath; sandstone layers constitute minor part of interval; interbedded shale is of nature of shale below.

F. T. Thwaites, 1947, Michigan Acad. Sci., Arts, and Letters Papers, v. 33, p. 249 [1949]. Kenwood formation at Milwaukee, known only from fossils collected from dump of tunnel, believed to be Misssissippian.

Named for Kenwood Hill, near Louisville, Jefferson County, Ky.

Kenyon Member (of Mount Simon Formation)

Upper Cambrian: Northern Illinois (subsurface).

J. S. Templeton, Jr., 1950, Illinois Acad. Sci. Trans., v. 43, p. 153 (fig. 2), 154–155. Name proposed for thin conglomeratic sandstone overlying Crane member (new). Type section extends from depths of 2,975 to 3,105 feet. Thickness 34 to 130 feet. Where less than 80 feet thick is composed chiefly of coarse-grained sandstone containing quartz granules; where thicker, consists of conglomeratic sandstone interbedded with nonconglomeratic layers. Underlies Lowell member (new).

Type well: Wyman No. 1 (well 7), in NE¼NE¼SE¼ sec. 35, T. 41 N., R. 5 E., Dekalb County. Name derived from Kenyon School, 3¼ miles southeast of type well.

Keokuk Limestone

Keokuk Limestone (in Osage Group)[1]

Lower Mississippian (Osage Series): Iowa, Illinois, western Kentucky, and eastern Missouri.

Original reference: D. D. Owen, 1852, Rept. Geol. Survey Wisconsin, Iowa, and Minnesota, p. 91, 92., Philadelphia.

J. M. Weller, 1939, Kansas Geol. Soc. Guidebook 13th Ann. Field Conf., p. 131, 132–133. Keokuk limestone listed in Osage group, Valmeyer series. Burlington and Keokuk limestones not readily separable in southwestern Illinois and southeastern Missouri.

J. M. Weller and A. H. Sutton, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 5, p. 766 (fig. 1), 771, 795. Limestone in Osage group, Iowa series. Classification follows Illinois Geological Survey. Consists of 60 to 80 feet of interbedded limestone and chert with minor amounts of shaly material. Lower 30 feet is very cherty limestone known as Montrose member. In Ste. Genevieve County, Mo., is separated into two parts by unconformity, below which beds are lithologically indistinguishable from Burlington limestone.

J. M. Weller and others, 1948, Geol. Soc. America Bull., v. 59, no. 2, p. 150–156, chart 5. In standard Mississippian section, Keokuk limestone is uppermost formation of Osagean series. Occurs above Burlington limestone and below Warsaw limestone of Meramecian series.

G. G. Huffman and others, 1958, Oklahoma Geol. Survey Bull. 77, p. 14 (fig. 2), 44–46, pls. Described on southwestern flank of Ozark uplift where it consists of massive white to buff and gray-mottled fossiliferous chert; locally interbedded with irregular stringers of blue-gray dense fine-grained limestone. Crinoidal reefs or bioherms present locally. Thickness 0 to 250 feet; average thickness between 60 and 80 feet. Overlies Reeds Spring formation with unconformity. This hiatus represents most or all of Burlington time. Succeeded unconformably by various facies of Moorefield formation, the Hindsville, or locally by Fayetteville shale. Osagean.

Charles Collinson and D. H. Swann, 1958, Geol. Soc. America Guidebook St. Louis Mtg., Field Trip 3, p. 1, 4 (fig. 3). Generalized geologic column for field trip area [western Illinois] shows the Keokuk in Valmeyer series above the Burlington and below the Warsaw.

Named for exposures at Keokuk, Iowa. Well exposed along Soap Creek in quarry in Mississippi River bluff near mouth of creek.

Keonehunehune flow

Recent: Maui Island, Hawaii.

Grote Reber, 1959, Geol. Soc. America Bull., v. 70, no. 9, p. 1245, 1246, pl. 1 (fig. 3). Consists of single flow. Radiocarbon dating gives age of about 650 years.

On southwest side of Haleakala.

Keosauqua Sandstone[1]

Mississippian: Southeastern Iowa.

Original reference: C. H. Gordon, 1895, Jour. Geology, v. 3, p. 304–305.

Named for exposures in southern bank of Des Moines River about 2½ miles below Keosauqua, Van Buren County.

Keota Sandstone Member (of McAlester Formation)

Keota Sandstone Member (of Savanna Sandstone)[1]

Pennsylvanian (Des Moines Series): Eastern Oklahoma.

Original reference: C. W. Wilson, Jr., 1935, Am. Assoc. Petroleum Geologists Bull., v. 19, no. 4, p. 503–520.

M. C. Oakes and M. M. Knechtel, 1948, Oklahoma Geol. Survey Bull. 67, p. 42–44, pl. 1. Reallocated to member status in McAlester formation. Sequence of lenticular sandstone and arenaceous shale beds, locally including one or more thin coal seams. Within town limits of Keota are two sandstone units, each comparable to that described as Keota sandstone member in Muskogee County; these two units and the intervening shale are considered as constituting the Keota within the Cowlington syncline in Haskell County; in the Sanbois and Stigler synclines, only one sandstone unit seems to be present at this horizon. Conformably overlies an unnamed shale that lies above Tamaha sandstone or above the horizon of the Tamaha where the Tamaha is not present; conformably underlies an unnamed shale in upper part of formation.

Type locality: Comprises town of Keota and area immediately adjacent to northwest, Haskell County.

†Keownville Limestone Member (of Ripley Formation)

Upper Cretaceous: Northeastern and east-central Mississippi.

N. F. Sohl, 1960, U.S. Geol. Survey Prof. Paper 331–A, p. 18–20. Commonly less than 100 feet thick and consists of yellowish-brown sandy limestone beds which are no more than 5 feet thick and are interbedded with yellow to dark-blue-gray fossiliferous sand units. At type section, 47 feet of yellow-brown sandy sideritic fossiliferous limestone in beds 1 to 3 feet thick alternate with yellow to gray micaceous fossiliferous layers of sand and represents full thickness of member. These beds are unconformably overlain by 8½ feet of fossiliferous sand and clay of Prairie Bluff chalk; below limestone sequence is about 120 feet of fossiliferous sand and sandstone beds of upper part of Ripley.

Type section: Roadcuts on Mississippi State Route 30, 1.4 to 2.1 miles south of Keownville, Union County, on north-facing slope of Willhite Creek valley and parallel to Daniel Creek, a north-flowing tributary of Willhite Creek, in E½ sec. 31, T. 6 S., R. 4 E.

Kerber Formation[1]

Pennsylvanian: Southern Colorado.

Original reference: W. S. Burbank, 1932, U.S. Geol. Survey Prof. Paper 169.

L. R. Litsey, 1958, Geol. Soc. America Bull., v. 69, no. 9, p. 1147 (fig. 2), 1159–1160. Composite Paleozoic section in northern Sangre de Cristo

Range shows Kerber formation, 0 to 150 feet thick, between Leadville limestone below and Minturn formation above. No fossil or plant remains. On basis of stratigraphic position, may be Morrowan or Atokan.

D. R. Williamson and Lorraine Burgin, 1960, Colorado School Mines Mineral Industries Bull., v. 3, no. 1, p. 11. Correlation chart shows Kerber formation underlying Sharpsdale formation (new).

Named for exposures along Kerber Creek, Bonanza district, Saguache County.

Kereford Limestone Member (of Oread Limestone)[1]

Pennsylvanian (Virgil Series): Eastern Kansas, southwestern Iowa, northwestern Missouri, and southeastern Nebraska.

Original reference: G. E. Condra, 1927, Nebraska Geol. Survey Bull. 1, 2d ser., p. 45.

R. C. Moore, 1948, Am. Assoc. Petroleum Geologists Bull., v. 32, no. 11, p. 2035 (fig. 5). Kereford limestone member of Oread limestone; overlies Heumader shale member; underlies Kanwaka formation. This is classification agreed upon by State Geological Surveys of Iowa, Kansas, Missouri, Nebraska, and Oklahoma, May 1947.

T. L. Welp, L. A. Thomas, and H. R. Dixon, 1957, Iowa Acad. Sci. Proc., v. 64, p. 418 (fig. 1), 419. Thickness 7 feet in section measured near Winterset, Madison County.

H. G. O'Connor, 1960, Kansas Geol. Survey Bull. 148, p. 40–41, pl. 1. In Douglas County, consists of 2½ to 9 feet of gray limestone and a calcareous shale beds, which weather light gray to tan. Underlies Jackson Park shale member of Kanwaka shale.

H. G. Hershey and others, 1960, Iowa Highway Research Board Bull. 15, p. 21, fig. 5. Commonly light to medium gray, fine grained and dense; occurs as one massive bed. Near Red Oak, Montgomery County, it is a 2-foot massive finely oolitic bed with *Osagia* in upper part, and fusulinids throughout. Overlies Heumader shale member; underlies Kanwaka shale. Absent in some areas.

Type locality: Kereford quarry at south edge of Atchison, Atchison County, Kans.

Kerens Member (of Wills Point Formation)[1]

Paleocene: Northeastern Texas.

Original reference: F. B. Plummer, 1933, Texas Univ. Bull. 3232, p. 530, 535, 559, 562.

Mackenzie Gordon, Jr., J. I. Tracey, Jr., and M. W. Ellis, 1958, U.S. Geol. Survey Prof. Paper 299, p. 25. Upper member of Wills Point formation. Includes Wortham aragonite lentil. Overlies Mexia member.

Type locality: Exposures along Trinity River north of St. Louis & Southwestern Railroad, east of Kerens, Navarro County.

Kern Park Formation

See Mon Bluff Formation.

Kern River Group,[1] Formation,[1] or Series[1]

Miocene, upper, to Pliocene, middle: Southern California.

Original reference: F. M. Anderson, 1905, California Acad. Sci. Proc., 3d ser., v. 2, p. 187–188, 191.

R. W. Wilson, 1937, Carnegie Inst. Washington Pub. 487, p. 13, 34. Middle Pliocene on the basis of vertebrate fauna.

C. C. Church, 1958, San Joaquin Geol. Soc. [Guidebook] Spring Field Trip May 17, p. 15. Formation in outcrop unconformably overlies Mon Bluff formation (new) in vicinity of Kern River. Unconformably overlies lower part of Round Mountain silt north of Poso Creek fault. There is evidence from downdip well sections that formation rests with transitional contact on Santa Margarita sand indicating transgression of upper part of unit onto its lower members and then onto middle Miocene rocks. Such relation indicates upper Miocene age for unit in downdip areas. Upper Miocene-Pliocene.

Exposed on Kern River, 2 to 6 miles east of Oil City, Kern County.

Kernville Series[1]

Pre-Cretaceous: Southern California.

Original reference: W. J. Miller, 1931, California Univ. Pub., Bull. Dept. Geol. Sci., v. 20, no. 9, p. 335–343.

W. J. Miller, 1946, Geol. Soc. America Bull., v. 57, no. 5, p. 512, table 4. Age not certain; probably Carboniferous. Intruded by Summit gabbro.

T W. Dibblee, Jr., and C. W. Chesterman, 1953, California Div. Mines Bull. 168, p. 18. Pampa schist (new) may be phase of Kernville series, but its relationship to Kernville is obscured by granitic intrusions.

E. M. MacKevett, Jr., 1960, U.S. Geol. Survey Bull. 1087–F, p. 176–180, 195, pl. 1. Consists mainly of mica schist and impure quartzite but includes some calc-hornfels and marble Older than Isabella granodiorite that is considered Late Cretaceous on basis of lead-alpha determinations.

Named for exposures in vicinity of Kernville, Kern County.

Kerr Ranch Schist

Pre-Franciscan (pre-Devonian?): Northwestern California.

G. A. Manning and B. A. Ogle, 1950, California Div. Mines Bull. 148, p. 7, 13–18, pls. 1, 2. Series of quartz-muscovite schists, green schists, semischists, and slates; only slightly metamorphosed. In fault contact with overlying Franciscan. Thickness undetermined. Name replaces term Redwood Creek schist, used by authors in unpublished theses.

Type locality: Near Kerr Ranch in southeastern part of Blue Lake quadrangle, Humboldt County.

Kerton Creek Coal Member (of Carbondale Formation)

Pennsylvanian: Northern and western Illinois.

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 35, 47 (table 1), pl. 1. Assigned member status in Carbondale formation (redefined). Occurs above Pleasantview sandstone member and below Summum coal (No. 4) member. Coal named by Ekblaw (1930, Illinois Acad Sci. Trans., v. 23, no. 3); Wanless (1957, Illinois Geol. Survey Bull. 82) credited name to W. V. Searight, unpublished manuscript. Presentation of new rock-stratigraphic classification of Pennsylvanian strata in Illinois.

Type locality: North side of Kerton Creek, NE¼NE¼ sec. 15, T. 3 N., R. 2 E., Fulton County.

Kessler Limestone Member (of Bloyd Shale)[1]

Kessler Limestone Lentil (in Bloyd Shale)

Lower Pennsylvanian (Morrow Series) : Northwestern Arkansas and northeastern Oklahoma.

Original reference: F. W. Simonds, 1891, Arkansas Geol. Survey Ann. Rept. 1888, v. 4, p. 26, 103-105.

C A. Moore, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 3, p. 430–432. Geographically extended into Adair County, Okla., where its maximum thickness is less than 10 or 12 feet. Lies immediately below the Atoka sandstone.

W. H. Easton, 1942, Arkansas Geol. Survey Bull. 8, p. 25–26. Referred to as a lentil within Bloyd shale.

L. G. Henbest, 1953, Am Assoc. Petroleum Geologists Bull., v. 37, no. 8, p. 1942. Bloyd shale consists of (ascending) Brentwood limestone member, Woolsey member (new), and an unnamed shale division which includes the Kessler limestone lentil and which represents upper half to two-thirds of formation. Kessler underlies Greenland sandstone member (new) of Atoka formation.

Named for Kessler Mountain, Washington County, Ark.

†Ketchikan Series[1]

Carboniferous and Upper Triassic: Southeastern Alaska.

Original reference: A. H. Brooks, 1902, U.S. Geol. Survey Prof. Paper 1, p 40–52, map.

Occurs along east margin of Gravina Island, west margin of Revillagigedo Island, and in vicinity of Ketchikan, on both sides of Tongass Narrows, on Cleveland Peninsula, along George Inlet, on east arm of Behm Canal, Ketchikan region.

Ketchum Bluff Conglomerate[1]

Pennsylvanian : Central southern Oklahoma.

Original reference: J. R. Bunn, 1930, Oklahoma Geol. Survey Bull. 4OPP, p. 11.

Exposed on Ketchum's Bluff along Red River, in sec. 24, T. 7 S., R. 6 W., and adjoining sections to the east in Jefferson County

Ketona Dolomite[1]

Upper Cambrian: Northern central Alabama.

Original references: C. Butts, 1910, U.S. Geol. Survey Bull. 400, p. 14; U.S. Geol. Survey Geol. Atlas, Folio 175, p. 3.

C. E. Resser, 1938, Geol. Soc. America Spec. Paper 15, p. 17. Coarsely crystalline light-gray thick-bedded dolomite 200 to 250 feet thick. Overlies Brierfield dolomite in Sixmile Creek; in western Alabama overlies *Blountia* zone of Nolichucky, here it is 400 to 600 feet thick. Underlies Bibb dolomite.

T. N. McVay and L. D. Toulmin, 1945, Alabama Geol. Survey Bull. 55, p. 23. Listed with formations of Cambrian or Ordovician age.

Named for exposures at Ketona, Jefferson County

Kettle Meta-Andesite[1]

Kettle Formation

Pennsylvanian: Northern California.

Original reference: J. S. Diller, 1908, U.S. Geol. Survey Bull. 353.

P. A. Lydon, T. E. Gay, Jr., and C W. Jennings, 1960, Geologic map of California Westwood sheet (1:250.000): California Div. Mines. Formation consists of fossiliferous andesite and dacite breccia, tuff, conglomerate, and sills or flows. Mapped with Jurassic and (or) Triassic metavolcanic rocks.

Named for development around Kettle Rock, northeast of Taylorsville, Plumas County.

Kettleman Lake Bed[1]

Pliocene(?): Southern California.

Original reference: J. G. Cooper, 1894, California Acad. Sci Proc., 2d ser., v. 4, p. 167.

Type locality not stated, but beds are probably the fresh-water deposits mentioned as occurring on west border of Kettleman Plains.

Kettle River Formation[1]

Oligocene(?): Southern British Columbia, Canada, and northeastern Washington.

Original reference: R. A. Daly, 1912, Canada Geol. Survey Rept. Mines Mem. 38, maps.

Mapped along Kettle River, British Columbia, north of 49th parallel.

Keuka Flagstone[1] (in Standish Formation)

Keuka Flagstone Lentil (in Starkey Tongue of Sherburne Formation)

Upper Devonian: West-central New York.

Original reference: I. W. Fox, 1932, Am. Assoc. Petroleum Geologists Bull., v. 16, no. 7, p. 677, 683, 687.

W. L. Grossman, 1944, Geol. Soc. America Bull., v. 55, no. 1, p. 67, pl. 1. Reallocated. Lentil occurs at top of Starkey tongue of Sherburne formation. Described as cross-laminated coarse quartz siltstone with considerable calcite.

Wallace de Witt, Jr., and G. W. Colton, 1959, Am. Assoc. Petroleum Geologists Bull., v. 43, no. 12, p. 2825. A highly cross-laminated, ripple-marked layer of siltstone 1 to 2 inches thick is present at base of upper third of West River shale member of Genesee in most exposures of member between Lake Erie and Canandaigua Lake. This key bed, which is present in more than 500 square miles in western and west-central New York, was traced eastward to Keuka Lake where it was found to be the 3- to 4-inch Bluff Point flagstone of Torrey (Torrey and others, 1932, Am. Petroleum Inst. Div. Production Paper 826–4A), the same bed that was named Keuka flagstone by Fox (1932).

Named for excellent exposures on all shores of Keuka Lake.

Kevin Shale Member (of Marias River Shale)

Upper Cretaceous: Northwestern Montana.

W. A. Cobban and others, 1959, Am. Assoc. Petroleum Geologists Bull., v. 43, no. 12, p. 2792 (fig. 3), 2795–2796; 1959, Billings Geol. Soc. [Guidebook] 10th Ann. Field Conf., p. 89 (fig. 1), 91–92. Subdivided into three units on basis of relative abundance of bentonite beds and on lithology of concretions. Lowest unit characterized by many beds of bentonite, grey limestone concretions and concretionary limestone, and some brown prismatic calcite having cone-in-cone structure. Middle unit has numerous concretionary layers of ferruginous limestone and dolostone that weather dark reddish brown to very dusky red. Also contains thin but very widespread conglomerate bed—MacGowan concretionary bed (new). Top unit contains several concretionary limestones that weather yellowish gray, some beds of concretionary dolostone that weather reddish brown, and a few thin layers of bentonite and shaly sandstone; upper half of unit locally calcareous. Thickness of member about 620 feet at type section. Top marked by thin persistent layer of gray bentonite on north side of Kevin-Sunburst dome. Disconformably overlies Ferdig shale member (new); underlies Telegraph Creek formation.

Type section: Composite from outcrops a few miles north and northwest of Kevin in secs. 3, 4, 12, 15, and 17, T. 35 N., R. 3 W., Toole County. Named from town of Kevin on Shelby-Sweetgrass branch of Great Northern Railway in SW¼ sec. 35, T. 35 N., R. 3 W., Toole County, Shelby quadrangle, northwest flank of Kevin-Sunburst dome.

Kewanee Group

Middle Pennsylvanian: Illinois.

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 8 (fig. 1), 26 (fig. 4), 31–36, 45–46 (table 1), pl. 1, geol. sections. Middle group of Pennsylvanian formations. Comprises Spoon (new) and Carbondale formations. Overlies McCormick group (new); underlies McLeansboro group. Characterized by widespread development of minable coals. Sandstones compose about 25 percent of group. Limestones commonly 1 to 5 feet thick. Presentation of new rock-stratigraphic classification of Pennsylvanian in Illinois. Cyclical classification is retained but is independent of rock-stratigrapic classification.

Type locality: Vicinity of Kewanee, Henry County.

Keweenawan Series[1]

Keweenawan Group

Precambrian: Michigan, Minnesota, and Wisconsin, and Canada.

Original references: T. B. Brooks, 1876, Am. Jour. Sci., 3d ser., v. 11, p. 206–211; F. D. Adams and others, 1905, Jour. Geology, v. 13, no. 2, p. 102.

F. F. Grout and G. M. Schwartz, 1939, Minnesota Geol. Survey Bull. 28, p. 12–15. Lower Keweenawan includes Puckwunge formation (as used by Winchell, 1897); middle Keweenawan includes Keweenaw Point volcanics (new) and Beaver Bay complex.

C. R. Stauffer and G. A. Thiel, 1941, Minnesota Geol. Survey Bull. 29, p. 10, 11–23. Geological column shows upper Keweenawan includes Lake Superior series, made up of Fond du Lac beds (Orienta) and Hinckley sandstone (Devils Island). The Keweenawan underlies St. Croixian series and occurs above the Huronian.

F. F. Grout and others, 1951, Geol. Soc. America Bull., v. 62, no. 9, p. 1017–1078. Keweenawan group overlies Animikie group. Group in Minnesota includes Puckwunge formation in lower part; Keweenaw Point volcanics, Beaver Bay complex and Logan intrusives, Duluth gabbro, and scattered intrusives in middle part; Fond du Lac beds and Hinckley sandstone in upper part. Unconformably underlies Cambrian (Upper Cambrian in Minnesota). Upper Keweenawan of Minnesota correlates with Oronto and Bayfield groups of Wisconsin and Michigan.

H. M. Gehman, 1958, Minnesota Univ. Center for Continuation Study, Gen. Ext. Div., Inst. of Lake Superior, Geology, Apr. 21–22, p. 1. Three gabbroic intrusions (Beaver River, Beaver Bay ferrogabbro, and Black Bay) with minor associated rock types form Beaver Bay complex in southeastern Lake County, Minn. The gabbros intrude middle Keweenawan North Shore volcanic group (new).

Named for occurrence on Keweenaw Peninsula, northern Michigan.

Keweenaw Point Volcanics

Precambrian (middle Keweenawan): Northern Michigan and eastern Minnesota.

F. F. Grout and G. M. Schwartz, 1939, Minnesota Geol. Survey Bull. 28, p. 12, 13. Term applied to series of Middle Keweenawan flows and associated sediments which are best known as they appear on Keweenaw Point (Michigan) in Lake Superior. Irving (1883, U.S. Geol. Survey Mon. 5) used term Keweenaw series, and Van Hise and Leith (1911, U.S. Geol. Survey Mon. 52) used phrase Keweenawan series for rocks here named Keweenaw Point volcanics. Irving limited his Keweenaw series to the volcanic and associated rocks and some sediments conformably above, using term Keweenawan series for all Keweenawan rocks, including sediments above, below, and interbedded with volcanics. Term Keweenaw Point volcanics should therefore be applied as a formation to flows and associated fragmental rocks included by Irving in lower division of Keweenaw series and by Van Hise and Leith in middle divisions of Keweenawan series. Table of formations shows Keweenaw Point volcanics above Puckwunge formation and below Beaver Bay complex.

G. M. Schwartz, 1949, Minnesota Geol. Survey Bull. 33, p. 18, 37. Estimated thickness 20,800 feet. Overlies Puckwunge formation.

F. F. Grout and others, 1951, Geol. Soc. America Bull., v. 62, no. 9, p. 1021 (table 3), 1053–1054. Included in middle part of Keweenawan group. Also referred to as Keweenawan Point volcanics.

Named for occurrence at Keweenaw Point (Michigan) in Lake Superior.

†Key Sandstone[1]

Lower Ordovician: Northern Arkansas.

Original reference: G. I. Adams and E. O. Ulrich, 1904, U.S. Geol. Survey Prof. Paper 24, p. 20, 95–97.

Named for Key, near Rogers, Benton County.

Keyhole Sandstone Member (of Fall River Formation)

Lower Cretaceous: Western South Dakota and northeastern Wyoming.

R. E. Davis and G. A. Izett, 1958, Am. Assoc. Petroleum Geologists Bull., v. 42, no. 11, p. 2745–2750. Generally light-brown to medium-brown very fine grained massively bedded cross-stratified sandstone, commonly containing iron-cemented concretions ranging from less than an inch to about 1 foot in diameter and, less commonly, gray calcareous concretions ranging from a few inches to nearly 4 feet in diameter. Thickness ranges from 15 to about 80 feet and averages about 30 feet; at type section 31.6 feet. Underlies upper silty unit of Fall River formation with sharp contact; overlies lower silty unit with gradational contact.

Type section: In NE¼SE¼ sec. 21, T. 51 N., R. 66 W., Crook County, Wyo., about one-fourth mile north of Keyhole Dam on Belle Fourche River. Carlile quadrangle. Traced throughout large part of northern Black Hills.

Key Largo Limestone[1]

Pleistocene: Southern Florida.

Original reference: S. Sanford, 1909, Florida Geol. Survey 2d Ann. Rept., p. 209, 214–218, table.

M. C. Schroeder and E. W. Bishop, 1953, Am. Assoc. Petroleum Geologists Bull., v. 37, no. 9, p. 2183. Pleistocene deposits older than Pamlico sand (which represents youngest Pleistocene) include Miami oolite, Fort Thompson formation, Anastasia formation and Key Largo limestone, all more or less contemporaneous in age.

Named for exposures in cuts and borrow pits on Key Largo, at frequent intervals from south shore of Lake Surprise to west end of island at Tavernier Creek, a distance of 15 miles.

Keyser Limestone

Keyser Group

Keyser Limestone (in Cayugan Group)

Keyser Limestone Member (of Helderberg Limestone)[1]

Upper Silurian and Lower Devonian(?): Northern West Virginia, western Maryland, Pennsylvania, and western Virginia.

Original reference: E. O. Ulrich, 1911, Geol. Soc. America Bull., v. 22, p. 563, 590, 591, pl. 28.

F. M. Swartz, 1929, U.S. Geol. Survey Prof. Paper 158–C, p. 29–38. In West Virginia, formation includes Big Mountain shale member (new); near Clifton Forge, Va., includes Clifton Forge sandstone member (new). Lower Devonian.

F. M. Swartz, 1939, Pennsylvania Geol. Survey, 4th ser., Bull. G–19, p. 29–91. Keyser limestone separated from Helderberg group and tentatively assigned to Silurian.

C. K. Swartz and F. M. Swartz, 1941, Geol. Soc. America Bull., v. 52, no. 8, p. 1182–1184. Term Keyser group proposed for three formations of Keyser age: Decker sandstone, Rondout limestone, and Manlius limestone. Group, as thus defined, extends from southeastern Pennsylvania to southeastern New York. Bossardville limestone immediately underlying Keyser group is uppermost formation of undoubted Silurian in area. Keyser limestone presents both Silurian and Devonian aspects. It is tentatively assigned to Silurian.

J. R. Mills and R. N. Taylor, 1949, Pennsylvania Acad. Sci. Proc., v. 23, p. 49–57. Silurian-Devonian relationships discussed in Schuylkill County. Keyser limestone (Silurian, Cayugan group) overlies Bossardville limestone; underlies Ridgeley sandstone (Devonian, Oriskany group).

F. G. Lesure, 1957, Virginia Polytech. Inst. Bull., Engineering Expt. Sta. Ser. 118, p. 19 (table 1), 20 (table 2), 42–45, pls. Formation described in Clifton Forge area where it includes Clifton Forge sandstone member in lower part. Thickness about 116 feet. Overlies Tonoloway limestone; underlies Coeymans limestone. Upper Silurian.

H. H. Arndt and others, 1959, Geol. Soc. America Guidebook Pittsburgh Mtg., p. 4–5, 13–14, 28. Keyser formation lies immediately above and is transitional with Tonoloway formation throughout most of Pennsylvania. Underlies Helderberg. Thickness 125 to 200 feet.

W. A. Oliver, Jr., 1960, U.S. Geol. Survey Bull. 1111–A, p. 4. Corals comparable to Beck Pond species are found in Coeymans limestone, Helderberg age, in New York, and in Keyser limestone. Late Silurian and Early Devonian(?) age, in Maryland and West Virginia. *Halysites* indicates Late Silurian age for at least part of the formation.

Named for exposures at Keyser, Mineral County, W. Va.

Keystone Sandstone (in Pocahontas Group)

Keystone Sandstone (in Pottsville Group)[1]

Pennsylvanian: Southern West Virginia.

Original reference: R. V. Hennen and R. M. Gawthrop, 1915, West Virginia Geol. Survey Rept. Wyoming and McDowell Counties, p. 237.

H. R. Wanless, 1939, Geol. Soc. America Special Paper 17, p. 88. Included in lower part of Pocahontas group.

Exposed at Keystone, McDowell County.

†Key West Oolite[1]

Pleistocene: Southern Florida.

Original reference: E. Sanford, 1909, Florida Geol. Survey 2d Ann. Rept., p. 209, 218–221, table opposite p. 50.

Crops out on shores of Harbor Key and Content Key, and on most of keys to south and southwest, and forms surface of Boca Grande, 10 miles west of Key West.

Kialagvik Formation[1]

Middle Jurassic: Southwestern Alaska.

Original reference: S. R. Capps, 1923, U.S. Geol. Survey Bull. 739, p. 90, 91, 94, map.

L. B. Kellum, 1945, New York Acad. Sci. Trans., ser. 2, v. 7, no. 8, p. 203 (table 1), 205, 208 (table 2). Subdivided into (ascending) Aleuts and Kolosh members (new). Thickness 1,600 feet. Underlies Tuxedni formation; overlies Bidarka formation (new). Lower Jurassic.

C. E. Kirschner and D. L. Minard, 1948, U.S. Geol. Survey Oil and Gas Inv Prelim. Map 95 [1949]. Oldest Jurassic marine strata exposed on Iniskin Peninsula. Consists of about 2,500 feet of siltstone, sandstone, and conglomerate. Divided into lower unnamed sandy shale member and upper unit, the Gaikema sandstone member (new). Siltstone member predominantly of dark-gray arenaceous siltstone which weathers light brown: fine-grained sandstone beds present throughout; approximately 1,600 feet thick.

R. W. Imlay, 1953, U.S. Geol. Survey Prof. Paper 249–B, table 5, facing p. 60. Age given as Middle Jurassic for exposures at Wide Bay. Underlies Shelikof formation. Gaikema sandstone and unnamed underlying members reassigned to Tuxedni formation.

Forms bluffs along beach of northwest shore of Kialagvik Bay from near mouth of Pass Creek to southwest end of bay. Recognized at least as far south along Alaska Peninsula as Wide Bay.

Kiamichi Formation (in Fredericksburg Group)

Kiamichi Clay Member (of Georgetown Formation)

Kiamichi Formation (in Washita Group)[1]

Lower Cretaceous (Comanche Series): Central southern and southeastern Oklahoma and northeastern Texas.

Original reference: R. T. Hill, 1891, Geol. Soc. America Bull., v. 2, p. 504, 515.

J. F. Smith, Jr., 1940, Geol. Soc. America Bull., v. 51, no. 4, p. 601 (fig. 2). Geologic map of Sierra Blanca area, Texas, shows Kiamichi as upper formation of Fredericksburg group. Overlies Finlay formation; underlies Washita group.

F. E. Lozo, Jr., 1943, Am. Assoc. Petroleum Geologists Bull., v. 27, no. 8, p. 1060–1080. Discussion of bearing of Foraminifera and Ostracoda on Lower Cretaceous Fredericksburg-Washita boundary of north Texas. On the basis of ostracode affinities, Kiamichi is uppermost formation of Fredericksburg group. At exposure studied, there is no conclusive physical evidence of hiatus between Kiamichi and overlying Duck Creek formation. Contact with underlying Goodland not exposed.

E. R. Leggat, 1957, Texas Board of Water Engineers Bull. 5709, p. 13 (table 2), 27–31, pls. In Tarrant County, Tex., the Kiamichi, uppermost formation of Fredericksburg group, crops out in narrow sloping band in bluffs overlooking Clear Fork and West Fork of Trinity River. Consists of dark-blue to brownish-yellow marl, thin limestone, and flaggy sandstone. Lower half is marly, contains thin limestone and sandstone layers, overlain by 8 feet of thin limestone ledges alternating with marl in which *Gryphaea navia* is abundant and distinctive. Upper part is marly and less fossiliferous. Thickness 0 to 40 feet; thins southward. Overlies Goodland limestone; underlies Duck Creek formation.

O. B. Shelburne, 1959, Texas Univ. Bur. Econ. Geology Pub. 5905, p. 105–130. Described in central Texas where it is uppermost formation in Fredericksburg group. Enclosed by Edwards limestone below and Georgetown limestone above. Thickness 25 feet near Blum in Hill County; thins southward along outcrop and disappears in southern McLennan County. Twenty stratigraphic sections measured and described from surface exposures in southern Fort Worth Prairie in Hill, Bosque, Coryell, McLennan, and Bell Counties.

B. F. Perkins, 1960, Geol. Soc. America Mem. 83, p. 9 (fig. 3), 12 (fig. 4), 22–24, pls. 1, 2. In this report [Fort Worth-Weatherford area], Kiamichi is considered basal formation in Washita group. Consists chiefly of yellow and bluish-gray calcareous and arenacous marls, flaggy limestone, and fissile sandstones. Thickness 25 to 35 feet. Underlies Duck Creek formation, possible unconformity; overlies Benbrook limestone member (new) of Goodland formation.

W. J. Fox and O. N. Hopkins, Jr., 1960, Baylor Geol. Soc. Guidebook 5th Field Conf., p. 88, 90, pl. 14. In this report [Grand and Black Prairies, east-central Texas], Kiamichi clay is considered basal member of Georgetown limestone; underlies Duck Creek member. Generally found in outcrops on streams that have cut into underlying Edwards and Comanche Peak formations. Thickness as much as 10 feet; consists of black to dark-gray clays with several 6- to 10-inch limestone beds.

Named for historic plains of Kiamitia (correctly spelled Kiamichi) River near Fort Towson, Choctaw County, Okla.

Kiawa Mountain Formation

Precambrian: Central northern New Mexico.

Fred Barker, 1958, New Mexico Bur. Mines Mineral Resources Bull. 45, p. 1, 10, 24, pl. 1. Defined as the quartzite including and overlying the Big Rock conglomerate and overlying the Moppin metavolcanic series from

Cleveland Gulch to Jawbone Mountain. Consists of (ascending) Big Rock (new) conglomerate member, lower quartzite member, amphibolite member, Jawbone (new) conglomerate member, and upper quartzite member, Several thousand feet thick.

Exposed on Kiawa Mountain and in other areas of Las Tablas quadrangle.

Kibbey Sandstone (in Big Snowy Group)

Kibbey Sandstone Member (of Quadrant Formation)[1]

Upper Mississippian: Central northern Montana.

Original reference: W. H. Weed, 1899, U.S. Geol. Survey Geol. Atlas, Folio 55.

W. H. Scott, 1935, Geol. Soc. America Proc. 1934, p. 367; 1935, Jour. Geology, v. 43, no. 8, pt. 2, p. 1026–1027. Included in Big Snowy group (new).

E. S. Perry, 1937, Montana Bur. Mines and Geology Mem. 3, p. 16. In type locality, Big Snowy group comprises (ascending) Kibbey, Otter, and Heath formations. Kibbey, 130 feet thick, consists of red to brown shaly or calcareous fine-grained sandstone.

O. A. Seager, 1942, Am. Assoc. Petroleum Geologists Bull., v. 26, no. 5, p. 863. In subsurface in Cedar Creek anticline, southeastern Montana, overlies Charles formation (new).

L. R. Laudon, 1955, Billings Geol. Soc. Guidebook 6th Ann. Field Conf., p. 210. Kibbey, Heath, Otter, and Amsden are believed to represent shore facies of various parts of early Pennsylvanian seas.

L. S. Gardner, 1959, Am. Assoc. Petroleum Geologists Bull., v. 43, no. 2, p. 333 (fig. 2), 334 (fig. 3), 341–342, 346–347. Thickness 220 feet in composite standard section of revised Big Snowy group. Underlies Otter formation; unconformably overlies Mission Canyon limestone of Madison group.

Named from Kibbey post office, Fort Benton region, central Montana.

Kickapoo Beds[1]

Pleistocene (Wisconsin): Central western Illinois.

Original reference: C. O. Sauer, 1916, Illinois Geol. Survey Bull. 27.

Well developed about mouth of North Kickapoo Creek, Illinois Valley.

†Kickapoo Limestone[1]

Pennsylvanian: Eastern Kansas.

Original reference: E. Haworth and J. Bennett, 1908, Kansas Acad. Sci. Trans., v. 21, pt. 1, p. 81.

Named for Kickapoo, Leavenworth County, Kans., 5 miles south of Iatan, Platte County, Mo.

†Kickapoo Marl[1]

Upper Cretaceous (Gulf Series): Northeastern Texas.

Original reference: R. T. Hill, 1894, Geol. Soc. America Bull., v. 5, p. 308.

Derivation of name not stated.

Kickapoo Creek Group

Pennsylvanian (Lampasas): North-central Texas (subsurface and surface).

M. G. Cheney, 1947, Jour. Geology, v. 55, pt. 2, p. 209–210. Proposed for section between Millsap Lake group (restricted) and Bend group; that is, from disconformity at or near top of Dennis Bridge limestone down to top of Smithwick. Upper 200 feet of group crops out between villages of Dennis and Lipan, but for the most part group must be studied from well samples. Well data indicate that approximately 2,600 feet of section should be assigned to group in southwestern Parker County and 3,500 feet or more in Fort Worth basin. Stratigraphic section assigned to group includes Rayville (new), Parks, and Caddo Pool formations which extend from depths of 380–1,350, 1,350–2,125, and 2,125–3,000 feet, respectively, in type wells. Kickapoo Creek group proposed in preference to elevation of Parks formation to group status as suggested in 1945.

Some reports place Kickapoo Creek group in Strawn series.

Type section: Logs of Gilbert No. 1 and Wheeler No. 1 wells of southeastern Parker County, 5 miles northeast of Lipan. Name derived from Kickapoo Creek of southwestern Parker and northwestern Hood Counties.

Kickapoo Falls Limestone (in Millsap Lake Formation)[1]

Kickapoo Falls Limestone Member (of Dickerson Formation)

Kickapoo Falls Limestone Member (of Lazy Bend Formation)

Pennsylvanian (Strawn): Central northern Texas.

Original reference: F. B. Plummer, 1919, Am. Assoc. Petroleum Geologists Bull., v. 3, p. 138.

M. G. Cheney, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 1, p. 66 (fig. 1). Shown on correlation chart as Kickapoo Falls limestone member of Lazy Bend formation. Occurs below Dennis Bridge limestone member; occurs above Dickerson formation.

M. G. Cheney and others, 1945, Am. Assoc. Petroleum Geologists Bull., v. 29, no. 2. p. 163. Kickapoo Falls limestone may be classified as top member of Dickerson formation in harmony with common practice in this region [Texas] of placing important limestone at top of formation.

Leo Hendricks, 1957, Texas Univ. Bur. Econ. Geology Pub. 5724, p. 12–13. On basis of studies in Kickapoo Creek valley and Dennis area on Brazos River, Kickapoo Falls limestone believed to occupy slightly higher stratigraphic position than Dennis Bridge limestone.

Named for prominent exposures at Kickapoo Falls on Kickapoo Creek, in northern edge of Hood County.

Kidd Member (of Salem Limestone)

Mississippian (Valmeyer Series): Southwestern Illinois.

J. W. Baxter, 1959, Dissert. Abs., v. 19, no. 11, p. 2910. Salem limestone subdivided into four members [sequence not indicated] to which names Kidd, Fults, Chalfin, and Rocher are assigned. Kidd member is skeletal calcarenite composed of medium- to coarse-grained crinoid columnals and fine bryozoan debris.

J. W. Baxter, 1960, Illinois Geol. Survey Circ. 284, p. 2, 6–7, 12, 19–22, pl. 1. Typically consists of gray or brownish-gray, fine- to coarse-grained limestone composed of fragmented fossils, chiefly crinoid columnals and bryozoan detritus. In most outcrops in Monroe County, only upper part of member can be observed because lower contact is either below level of bottomland or covered by faults. East of village of Kidd, Warsaw-Salem contact rises above talus slopes where an anticline intersects bluff southwest of Renault. At this location, the Kidd is about 90 feet thick. Underlies Fults member; overlies Warsaw formation.

Type section: NE¼ sec. 1, T. 5 S., R. 10 W., Monroe County. Named from village of Kidd.

Kiddville Limestone[1]

Lower or Middle Devonian: East-central Kentucky.

Original reference: A. F. Foerste, 1906, Kentucky Geol. Survey Bull. 7, p. 92, 93.

G. A. Cooper and others, 1942, Geol. Soc. America Bull., v. 53, no. 12, pt. 1, chart 4. Shown on correlation chart below Boyle limestone. Lower or Middle Devonian.

Named for hamlet 1 mile north of Indian Fields, Clark County.

Kiekie Volcanic Series

Pleistocene: Niihau Island, Hawaii.

H. T. Stearns, 1946, Hawaii Div. Hydrography Bull. 8, p. 91; H. T. Stearns and G. A. Macdonald, 1947, Hawaii Div. Hydrography Bull. 12, p. 14–15 (table), 19–24, 45–49; D. A. Davis and G. A. Macdonald *in* Jacques Avias and others, 1956, Lexique Strat. Internat., v. 6, Océanie, fasc. 2, p. 102–103. Olivine basalts and vitric-lithic tuff cones. Thickness above sea level as much as 290 feet; believed to rest on bench cut into Paniau lavas (new) 300 feet below sea level.

Form low coastal plain of Niihau.

Kiewitz shale zone (in Stoner Limestone Member of Stanton Formation)[1]

Pennsylvanian (Missouri Series): Southeastern Nebraska.

Original reference: G. E. Condra, 1927, Nebraska Geol. Survey Bull. 1, 2d ser., p. 42, 55.

G. E. Condra, 1949, Nebraska Geol. Survey Bull. 16, p. 32. Zone consisting of grayish calcareous fossiliferous shale 3 feet thick. Underlies unnamed limestone unit; overlies Dyson Hollow limestone zone or member (new).

Named for exposures in Kiewitz quarry located in Platte Valley bluffs west of Meadow Station, Sarpy County.

Kiger Group (in Cimarron Series)

Kiger division (in Cimarron Group[1] or Series)

Permian: Central southern Kansas and northwestern Oklahoma.

Original reference: F. W. Cragin, 1896, Colorado Coll. Studies, v. 6, p. 3, 39.

G. H. Norton, 1939, Am. Assoc. Petroleum Geologists Bull., v. 23, no. 12, p. 1803–1813. Cimarron series in Kansas includes all Permian redbeds overlying salt-bearing and gypsum-bearing gray shales of Wellington formation. These redbeds were earlier divided by Cragin into Salt Fork and Kiger divisions. The Kiger includes strata from base of Whitehorse sandstone to base of Big Basin formation.

G. E. Condra and E. C. Reed, 1943, Nebraska Geol. Survey Bull. 14, p. 25, 26. Referred to as group in Cimarron series. Data in this report are from subsurface records.

Named for Kiger Creek, Clark County, Kans.

Kigluaik Group[1]

Lower Paleozoic or older: Northwestern Alaska.

Original reference: A. H. Brooks, G. B. Richardson, and A. J. Collier, 1901, Reconn. in Cape Nome and Norton Bay regions, Alaska, in 1900: U.S. Geol. Survey Spec. Pub., p. 27, map.

J. T. Dutro, Jr., and T. G. Payne, 1957, Geologic map of Alaska (1:2,500,000): U.S. Geol. Survey. Appears on map legend.

First found in heart of Kigluaik Mountains, Seward Peninsula.

Kiheki Sandstone Member (of Vamoosa Formation)

Pennsylvanian (Virgil Series): Northeastern Oklahoma.

W. F. Tanner, 1956, Oklahoma Geol. Survey Circ. 40, p. 45, pl. 1. Name applied to single, more-or-less continuous sandstone ledge, 5 to 25 feet thick, that occurs in the shale interval between the Cheshewalla and the Labadie members. Commonly occurs within 30 feet below the Labadie, or within 50 to 75 feet above the Cheshewalla sandstone.

Type section: Along road in sec. 25, T. 26 N., R. 10 E., Osage County. Named for siding and cattle loading platform on Missouri, Kansas and Texas Railroad in sec. 3, T. 25 N., R. 10 E.

Kii Point Limestone

Pleistocene or Recent: Oahu Island, Hawaii.

C. K. Wentworth and J. E. Hoffmeister, 1939, Geol. Soc. America Bull., v. 50, no. 10, p. 1560–1561. Wedge-shaped mass of limestone composed chiefly of oyster and barnacle shells. Maximum thickness 30 feet; thickness 20 feet at sea level; pinches out at height of 45 feet. Basal 6 feet consists of irregularly imbricated oyster shells and large number of barnacle shells; in next 2 to 4 feet oysters become less numerous and barnacles more numerous; formation grades to calcareous sandstone composed of beach detritus.

G. A. Macdonald and D. A. Davis *in* Jacques Avias and others, 1956, Lexique Strat. Internat., v. 6 Océanie, fasc. 2, p. 103. Rests on eroded surface of Ulupau tuff; overlain by old alluvium. Pleistocene or Recent.

Type locality: Kii Point. Crops out as two small patches on east side of Ulupau Peninsula, one at Kii Point and the other about 1,000 feet to south; also small exposure on northwest side of peninsula.

Kilbeck Granite Gneiss

Precambrian: Southern California.

J. C. Hazzard and E. F. Dosch, 1937, (abs.) Geol. Soc. America Proc. 1936, p. 309. Defined as being younger than Fenner gneiss (new). In contact with lower member of Essex series (new).

Occurs in southern end of Old Woman Mountains, San Bernardino County.

Kilby Formation

Pleistocene: Eastern Virginia.

W. E. Moore, 1956, Virginia Acad. Sci., Geology sec., Field Trip Guidebook, no pagination. Composed of clayey sands and gravels; base characterized over wide areas by thin cobble and boulder zone which contains boulders of exceptional size. Plates and concretions of limonite occur at contact with Sedley formation (new). Overlies Sedley and directly underlies both Sunderland and Wicomico terrace surfaces. New formation names necessary because names Sunderland formation and Wicomico formation are meaningless. Both of these terraces are underlain by same formation, not two different formations as previously believed. Terrace as used here refers to land form only and does not refer to nor imply existence of any deposits genetically related to them.

Area discussed is south of James River.

Kilea Volcanics (in Lahaina Volcanic Series)

Pleistocene(?) : Maui Island, Hawaii.

H. T. Stearns *in* H. T. Stearns and G. A. Macdonald, 1942, Hawaii Div. Hydrography Bull. 7, p. 158 (table), 181. Fine-grained nepheline basanite flow 15 feet thick. Rests on consolidated older alluvial fan of Olowalu Stream.

G. A. Macdonald and D. A. Davis *in* Jacques Avias and others, 1956, Lexique Strat. Internat., v. 6, Océanie, fasc. 2, p. 103–104. Pleistocene(?).

Originated from cinder cone, Puu Kilea, one-half mile north of Olowalu on south bank of Olowalu Stream, West Maui Mountains.

Killarney Granite[1]

Precambrian: Western Ontario, Canada, and northern Michigan.

Original reference: W. G. Miller and C. W. Knight, 1914, Ontario Bur. Mines Report, v. 22, pt. 2, p. 125.

W. T. Stuart, E. A. Brown, and E. C. Rhodehamel, 1954, Michigan Dept. Conserv., Geol. Survey Div. Tech. Rept. 3, p. 11 (table 3). Table of geologic formations in Marquette district shows Killarney granite above Keweenawan, but footnote states stratigraphic position doubtful.

First described on north shore of Lake Huron, Ontario, Canada.

Killbuck Conglomerate Lentil (of Cattaraugus Formation)[1]

Devonian or Carboniferous: Southwestern New York.

Original references: L. C. Glenn, 1903, New York State Mus. Bull. 69, p. 977; 1904, Geol. Soc. America Bull., v. 14, p. 522–531.

Well exposed northeast and east of Kilbuck [Kill Buck], Cattaraugus County.

Killbuck shale facies (of Cuyahoga Formation)

Mississippian (Kinderhook) : Northeastern Ohio.

F. T. Holden, 1941, Illinois Acad. Sci. Trans., v. 34, no. 2, p. 172; 1942, Jour. Geology, v. 50, no. 1, p. 43 (fig. 2), 49–50. One of seven facies in the formation. Includes Black Hand shale member, Armstrong sandstone member, and Burbank member. Lies between River Styx conglomerate facies (new) to the northeast and Tobosa conglomerate facies to the southwest.

Occurs in Huron, Lorain, Medina, Ashland, and Wayne Counties.

Killians Member (of Genshaw Formation)

Killians Limestone[1]

Middle Devonian: Northeastern Michigan.

Original reference: A. S. Warthin, Jr., and G. A. Cooper, 1935, Washington Acad. Sci. Jour., v. 25, no. 12, p. 524–526.

A. S. Warthin, Jr., and G. A. Cooper, 1943, Am. Assoc. Petroleum Geologists Bull., v. 27, no. 5, p. 583–584. Rank reduced to member status in Genshaw formation (redefined).

G. V. Cohee, 1947, U.S. Geol. Survey Oil and Gas Inv. Prelim. Chart 28, footnote 22. Michigan Geological Survey considers Killians limestone a formation.

Type locality: Exposures along French Road, one-half mile south of Killians resort, Long Lake, Alpena County.

Killik Tongue (of Chandler Formation)

Lower Cretaceous: Northern Alaska.

R. L. Detterman *in* George Gryc and others, 1956, Am. Assoc. Petroleum Geologists Bull., v. 40, no. 2, p. 237–239, figs. 4, 5. Lower and thickest tongue of formation, formerly called the Hatbox tongue. Renamed and type locality changed because sequence is better exposed along Killik River than at Hatbox Mesa. Nonmarine in origin with some marginal facies. Separated into upper and lower part in southernmost exposures. Lower part at type locality is 1,095 feet thick and comprises abundance of thick-bedded bluff-forming sandstones. Above base, sandstones tend toward varous shades of yellow red in addition to "salt-and-pepper" appearance; also includes grayish micaceous carbonaceous siltstone and silt-shale with numerous thick coal seams. Upper part at type locality 1,720 feet thick and characterized by series of massive white quartz conglomerate ledges; rest of constituents quite similar to those of lower part. Overall thickness at type locality 2,815 feet. In most exposures, tongue underlies marine Ninuluk formation (new), overlies marine Tuktu formation (revised), and overlies and interfingers with marine Grandstand formation (new). Age shown on chart as Lower (?) and Upper(?) Cretaceous.

F. R. Collins, 1958, U.S. Geol. Survey Prof. Paper 305–F, p. 343. Lower Cretaceous.

Type locality: Along east bank of Killik River between lat 68°52′ N. and 68°55′ N., and long 153°26′W.

Killingworth Leucotonalite

Carboniferous(?), middle: South-central Connecticut.

W. G. Foye, 1949, Connecticut Geol. Nat. History Survey Bull. 74, p. 52–53, 54, pl. 1. Bluish-gray medium- to coarse-grained igneous rock with little foliation. Occurs at core of large batholithic area of Monson orthogneiss.

H. M. Mikami and R. E. Digman, 1959, Connecticut Geol. Nat. History Survey Bull. 86, p. 25–26. Present study shows that entire Killingworth dome should be mapped as one tonalite mass with peripheral zone of mixed rocks. Entire formation here designated Haddam tonalite.

Mapped in towns of Killingworth, Middlesex County, and Madison, New Haven County.

Kimball Formation (in Ogallala Group)

Kimball Member (of Ogallala Formation)

Pliocene, upper: Southwestern Nebraska, northern Colorado, and northwestern Kansas.

A. L. Lugn, 1938, Am. Jour. Sci., 5th ser., v. 36, no. 213, p. 224, 227; 1939, Geol. Soc. America Bull., v. 50, no. 8, p. 1262–1264. 1266 (table 2). Uppermost formation in group. Consists of silt, clay, and fine sand more or less cemented with caliche, with 1 or 2 algal limestone beds at top; pinkish to reddish. Thickness 25 to 50 feet. Overlies Sidney gravel (new). Very late Pliocene.

C. B. Schultz and T. M. Stout, 1948, Geol. Soc. America Bull., v. 59, no. 6, p. 553–588. Formation includes Sidney gravel and silt member. Discussion of Pleistocene mammals and terraces in Great Plains. Unconformity between Kimball and Broadwater formations is most significant stratigraphic break in upper Tertiary and Pleistocene deposits of western Nebraska and Great Plains in general. Faunal break between Kimball and

Broadwater is most important one paleontologically in same area. This break believed to be Pliocene-Pleistocene boundary.

R. C. Moore and others, 1951, Kansas Geol. Survey Bull. 89, p. 20. Member of Ogallala formation in Kansas.

Typical exposure: At the High Plains level about 2 miles south of Kimball, Kimball County, Nebr., in vicinity of adjoining corners of secs. 5, 6, 7, and 8, T. 14 N., R. 55 W.

Kimberling Shale[1]

Upper Devonian: Southwestern Virginia and southeastern West Virginia.

Original reference: M. R. Campbell, 1894, Geol. Soc. America Bull., v. 5, p. 171, 177, pl. 4.

Named for Kimberling Creek, Bland County, Va.

Kimbrel Bed[1]

Eocene, upper: Northwestern Louisiana.

Original reference: T. L. Casey, 1902, Science, new ser., v. 15, p. 716.

Named for outcrops on estate of T. W. Kimbrel, south of Montgomery, Grant County.

Kimmswick Limestone[1]

Middle Ordovician: Eastern Missouri, northern Arkansas, and southwestern Illinois.

Original reference: E. O. Ulrich, 1904, Missouri Bur. Geology and Mines, v. 2, 2d ser., p. 111.

E. O. Ulrich, 1939, Kansas Geol. Soc. Guidebook 13th Ann. Field Conf., p. 106 (correlation table), 107. In Cape Girardeau sections, overlies Plattin limestone. Decorah absent.

J. M. Weller *in* Stuart Weller and J. M. Weller, 1939, Illinois Geol. Survey Rept. Inv. 59, p. 7, pl. 1. Exposed in limited area in Kimmswick quadrangle where Ordovician rocks have been brought to surface in Mississippi River bluff at crest of Valmeyer anticline. Consists of pure white to flesh-colored crystalline limestone free from chert except in a zone about 8 feet thick near middle of formation. Thickness about 100 feet. Overlies Decorah limestone; underlies Maquoketa shale.

C. J. Wells, 1949, Arkansas Div. Geology Bull. 15, p. 9. In Independence County, Ark., formation is chiefly an even-bedded massive light-gray medium- to coarse-grained limestone with characteristic surgary texture. Overlies Plattin limestone; underlies Fernvale limestone.

E. R. Larson, 1951, Am. Assoc. Petroleum Geologists Bull., v. 35, no. 9, p. 2044 (fig. 2), 2064, 2066. In southeastern Missouri, disconformably overlies Decorah formation.

G. A. Cooper, 1956, Smithsonian Misc. Colln., v. 127, pt. 1, p. 116. Overlies Barnhart formation (new).

T. J. Laswell, 1957, Missouri Geol. Survey and Water Resources Rept. Inv. 22, p. 8–13. Described in Bowling Green quadrangle where it consists predominantly of limestone beds 3 feet thick; thinner beds of dolomitic limestone and shaly to silty limestone present near top. Thickness 80 feet, base not exposed. Unconformably underlies Maquoketa formation. On basis of fauna and stratigraphic position, considered to be Middle Ordovician (Trenton) in age and approximately correlative with lower part of Galena formation.

Named for exposures at Kimmswick, Jefferson County, Mo.

Kincaid Formation (in Midway Group)[1]

Paleocene: Eastern Texas and southern Arkansas.

Original reference: Julia Gardner, 1933, Am. Assoc. Petroleum Geologists Bull., v. 17, no. 6, p. 744.

C. W. Cooke and others, 1943, Geol. Soc America Bull., v. 54 no. 11, chart 12. Shown on correlation chart as underlying Wills Point formation. Paleocene.

Mackenzie Gordon, Jr., J. I. Tracey, Jr., and M. W. Ellis, 1958, U.S. Geol. Survey Prof. Paper 299, p. 11 (fig. 4), 13–25, pls. In Texas, comprises (ascending) Littig glauconitic, Pisgah, and Tehuacana members. Geographically extended into bauxite region of Arkansas where it is as much as 185 feet thick and consists of greenish- and dark-gray clay, sandy in places, interbedded with fossiliferous marl, sandy glauconite limestone, and calcareous sandstone. Not differentiated although equivalents of the Texas members are present. Underlies Wills Point formation Overlies Late Cretaceous (in some areas Arkadelphia marl). Paleocene.

Type exposure: On old Kincaid Ranch (Lewis Ranch), three-fourths mile above Bob Evan's apiary to one-quarter mile below it [Uvalde County], Tex.

Kinchloe Limestone[1]

Pennsylvanian: Western Kentucky.

Original reference: F. M. Hutchinson, 1912, Kentucky Geol. Survey Bull. 19, fig. 28.

Derivation of name not stated, but probably named for Kinchloes Bluff, Muhlenberg County.

Kindblade Formation (in Arbuckle Group)

Lower Ordovician: Southwestern Oklahoma.

C E. Decker, 1939, Oklahoma Geol. Survey Circ. 22, p. 15, 16 (table 1), 25–26, 47–48; 1939, Geol. Soc. America Bull., v. 50, no. 8, p. 1313, 1320, table 1. Name proposed to replace preoccupied Alden (Decker, 1933). Chiefly dark-gray limestones in groups of beds in which one or two thick ones alternate with zones of thinner beds. Thickness near type section about 956 feet; in Arbuckle Mountains aggregates 1,216 to 1,536 feet. Grades into Cool Creek formation below and West Spring Creek formation above.

Type section: Outcrop on Kindblade Ranch, E½ sec. 26, T. 6 N., R. 14 W., 10½ miles southwest of Carnegie, Comanche County. Well exposed along east side of ranch.

Kinderhook Series

Kinderhook Group[1]

Lower Mississippian: Mississippi Valley.

Original reference: F. B. Meek and A. H. Worthen, 1861, Am. Jour. Sci., 2d, v. 32, p. 288.

E. B. Branson, 1938, Missouri Univ. Studies, v. 13, no. 3, pt. 1, p. 5–6. Term Lower Mississippian used here as name for division of Mississippian to take place of term Kinderhook. Because several Devonian formations have been included in the Kinderhook, the name is not suitable for Mississippian division.

J. M. Weller, 1939, Kansas Geol. Soc. Guidebook 13th Ann. Field Conf., p. 131, 132. Basal series of Mississippian in Mississippi Valley. Varies greatly from place to place, and no standard section can be set up for it. Unconformable below Valmeyer series. Some units included are: Sulphur Springs formation in Missouri, Mountain Glen, and Springville shales in Illinois.

J. M. Weller and A. H. Sutton, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 5, p. 766 (fig. 1), 771, 777–793. Basal group of Iowa series. In standard section, includes (ascending) Grassy-Saverton shale, Louisiana limestone, Hannibal shale and sandstone, and Chouteau limestone. Underlies Osage group. This report follows classification of Illinois Geological Survey. Authors believe, however, that Mississippian should have threefold division, that Kinderhook should be raised to rank of series, and that Valmeyer series should be recognized.

J. M. Weller and others, 1948, Geol. Soc. America Bull., v. 59, no. 2, p. 100–101, chart 5. Series subdivided into two groups. Easley includes all Kinderhookian strata which are almost universally recognized to be of Mississippian age. Fabius consists of Kinderhookian strata which are believed by some to be Mississippian but by others to be Devonian. Standard section comprises (ascending) Grassy Creek shale, Saverton shale, Louisiana limestone, Maple Mill shale, Chouteau limestone, Sedalia limestone, and Gilmore City limestone. Underlies Osage (Osagean) series.

T. R. Beveridge and E. L. Clark, 1952, Missouri Geol. Survey and Water Resources Rept. Inv. 13, p. 71–79. Kinderhookian-Osagean boundary defined as being contact of Northview and the overlying Pierson formation. Both formations here considered co-extensive throughout western Missouri. Northview has commonly been considered Kinderhookian, but Pierson has been assigned to either Osagean or Kinderhookian by various writers.

L. E. Workman and Tracey [Tracy] Gillette, 1956, Illinois Geol. Survey Rept. Inv. 189, p. 8 (fig. 1), 12–38. In previous Illinois Geological Survey reports, Kinderhook strata have been considered a group in Iowa series. In this report, Kinderhook raised to series rank. Name Iowa dropped, following usage of Mississippian correlation chart (Weller and others, 1948). Series in northwestern, western, and central Illinois divided into three groups: North Hill above, Hannibal middle, and the Champ Clark (new) below. In eastern and southern Illinois, series is divided into two formations: Chouteau above and New Albany below. Name Valmeyer is accepted by Illinois Survey as a series name to include Osage and Meramec groups.

M. G. Mehl, 1960, Denison Univ. Jour. Sci. Lab., v. 45, art, 5, p. 92–94. Use of term Kinderhook discussed. If Louisiana limestone is Devonian, as believed by some stratigraphers, and is equivalent to McCraney, as is maintained by some, there is possibility that no strata of Mississippian Kinderhook age are exposed at Kinderhook. If term is interpreted in broad sense in which it was originally proposed, there is no necessity for new name or designation of type locality. Proposed here that Kinderhook be used to designate all strata of Mississippian age that are older than Osage. Recommended that terms Easley and Fabius groups be dropped from list of stratigraphic designations in Missouri. If there is no doubt of Mississippian age of a unit that is older than Osage, it may be called Kinderhook in age and, with somewhat more refinement, it may be designated as early of late Kinderhookian.

Named for exposures at Kinderhook, Pike County, Ill.

Kineo Rhyolite[1]

Devonian : West-central Maine.

Original reference: W. H. Perkins, 1925, Am. Jour. Sci., 5th ser., v. 10, p. 371

H. W. Fairbairn and P. M. Hurley, 1957, Am. Geophys. Union Trans., v. 38, no. 1, p. 104 (table 7), 106. Enclosed by Lower Devonian strata; age designated Lower Devonian.

Forms Mount Kineo and several other hills in Moosehead Lake quadrangle.

King Limestone[1]

Lower Ordovician (Beekmantown) : Southwestern Missouri.

Original reference: E. M. Shepard, 1898, Missouri Geol. Survey, v. 12, pt. 1, p. 49, 71–74.

Named for outcrops on King Branch and King Mound, Greene County.

Kingak Shale[1]

Lower-Upper Jurassic : Northeastern Alaska.

Original reference: E. D. Leffingwell, 1919, U.S. Geol. Survey Prof. Paper 109, p. 103, 119, map.

George Gryc and others, 1951, Washington Acad. Sci. Jour., v. 41, no. 5, p. 163 (fig. 2). Lower, Middle, and Upper Jurassic. Underlies Okpikruak formation (new).

Identified at Kingak Cliff, near Camp 263, at southeast end of Sadlerochit Mountains.

King City Formation

Pliocene: Southern California.

B. L. Clark, 1940, (abs.) Geol. Soc. America Bull., v. 51, no 12, pt. 2, p. 1956–1957. Name applied to series of deposits at base of Pliocene in Salinas Valley area. Unconformably overlies basement complex; underlies Poncho Rico formation.

B. L. Clark, 1943, California Div. Mines Bull. 118, pt. 2, p. 190 [preprint 1941]. Has basal arkosic sand which, in places, is more than 100 feet thick, overlain by series of white shale, in turn overlain by Poncho Rico formation.

Type area: East and southeast of King City between Peach Valley and Salinas Valley.

King Creek Marl Member (of Chappel Formation)

Mississippian : Central Texas.

F. B. Plummer, 1950, Texas Univ. Bur. Econ. Geology Pub. 4329, p. 26. Dark-gray colloidal nonlaminated fossiliferous partially cemented hard marl that fills depressions, cavities, and holes in Ellenburger surface on which Chappel formation was deposited. Commonly less than 1 foot thick and quite erratic in its distribution. Chappel comprises [ascending] King Creek marl, Ives conglomerate, Espey Creek limestone, and Whites Crossing coquina members.

P. E. Cloud, Jr., V. E. Barnes, and W. H. Hass, 1957, Geol. Soc. America Bull., v. 68, no. 7, p. 810–811 (footnote). "King Creek marl member" of Plummer's Chappel formation is argillaceous limestone surely identified only at its type site where it constitutes a few inches of Houy formation (new). Although it contains conodonts and megafossils of early Kinderhook sorts, type "King Creek marl" occurs beneath Ives breccia (here reallocated to member status in newly defined Houy formation) which has yielded only Devonian types of conodonts.

Typically exposed on King Branch on Sloan Ranch one-quarter mile northwest of King Spring and 300 feet east of road crossing, Lampasas County.

Kingdom Formation (in Ancell Group)

Middle Ordovician : Northern Illinois.

J. S. Templeton and H. B. Willman, 1952, Tri-State Geol. Soc. Guidebook 16th Ann. Field Conf., figs. 3, 12. Consists of argillaceous silty fine and coarse-grained sandstone about 9 feet thick. Shown on columnar section as underlying Daysville formation (new) and unconformably overlying St. Peter sandstone.

Occurs in Dixon-Oregon area.

King Ferry Shale Member (of Ludlowville Shale)[1]

Middle Devonian : Central New York.

Original reference: G. A. Cooper, 1930, Am. Jour. Sci., 5th ser., v. 19, p. 219, 228.

R. S. Boardman, 1960, U.S. Geol.. Survey Prof. Paper 340, p. 6–7. Generally considered lateral equivalent of Wanakah shale, Tichenor limestone, and Deep Run members. Trepostomatous Bryozoa discussed.

Type locality: At Clearview, King Ferry, Cayuga County, near Cayuga Lake.

†Kingfisher Formation (in Cimarron Group)[1]

Permian : Southern Kansas and central Oklahoma.

Original reference : F. W. Cragin, 1897, Am. Geologist, v. 19, p. 352–355.

C. C. Branson, 1957, Oklahoma Geology Notes, v. 17, no. 11, p. 101 Abandoned by Oklahoma Geological Survey.

Named for Kingfisher Creek and town in Kingfisher County, Okla.

King Hill Shale Member (of Lecompton Limestone)[1]

Pennsylvanian (Virgil Series) : Southeastern Nebraska, southwestern Iowa, northeastern Kansas, and northwestern Missouri.

Original reference: G. E. Condra, 1927, Nebraska Geol. Survey Bull. 1, 2d ser., p 44, 45, 47.

G. E. Condra, 1949, Nebraska Geol. Survey Bull. 16, p. 23; R. C. Moore and others, 1951, Kansas Geol. Survey Bull. 89, p. 66. Thickness 4 to 6 feet in Nebraska, about 20 feet in northwestern Missouri, and 5 to 20 feet in Kansas. Underlies Avoca limestone member; overlies Beil limestone member.

H G. Hershey and others, 1960, Iowa Highway Research Board Bull. 15, p. 19, fig. 5. Dark- to greenish-gray massive shale with seams of nodular limestone. Thickness 6 to 7½ feet. Underlies Avoca limestone member; overlies Beil limestone member.

Type locality: One and one-half miles south and 1 mile east of Rock Bluff, Cass County, Nebr. Name derived from King Hill, a high point in Missouri River bluffs.

King Lear Formation

Lower Cretaceous : Northwestern Nevada.

Ronald Willden, 1958, Am. Assoc. Petroleum Geologists Bull., v. 42, no. 10, p. 2381 (table 1), 2382–2391, 2394. Consists of clastic rocks, including pebble to boulder conglomerate with interbedded siltstone and graywacke and lenses of limestone. Basal part invariably poorly sorted conglomerate composed almost entirely of subrounded to rounded clasts of subjacent rock type overlain by pebble to cobble conglomerate with some interbedded red siltstone. Conglomerates typically bimodal. Basal conglomerate 200 to 300 feet thick and overlain by 300 to 500 feet of dusky-red and greenish-gray to brown siltstone interbedded with greenish-gray to brown sandstone and graywacke. Lenticular bodies of light- to dark-gray finely crystalline dense limestone occurs locally in basal conglomerate and overlying siltstone-sandstone unit. Siltstone-sandstone unit overlain by about 200 feet of pebble to cobble conglomerate interbedded with sandstone, graywacke, and siltstone which is in turn overlain by upper unit of uncertain thickness consisting of interbedded siltstone, graywacke, and sandstone. Total thickness 200 to 3,000 feet. Overlies pre-Cretaceous volcanic series at most localities where exposed. Unconformably underlies Pansy Lee conglomerate (new).

Type section: Along road south of DeLong mine, Jackson Mountains, Humboldt County. Named from exposures on southeast side of King Lear Peak. Also exposed west of crest of range in vicinity of Deer Creek Peak, Parrot Peak, and DeLong Peak.

Kingman Sandstone Member (of Harper Sandstone)

Permian (Leonard Series): Southern Kansas and northern Oklahoma.

G. H. Norton, 1937, (abs.) Am. Assoc. Petroleum Geologists Bull., v. 21, no. 12, p. 1557; 1939, v. 23, no. 12, p. 1785–1786. An 80-foot unit of silty red sandstone containing a 3-foot white sandstone at base. Overlies Chikaskia sandstone member (new). Top not distinct, but placed arbitrarily at bed of maroon shale at base of Salt Plain measures of Cragin.

Named for exposures in and around Kingman, Kingman County, Kans. U.S. Highway 54 cuts through ridge of the sandstone about three-fourths mile east of Kingman; here basal bed and lower part of member are exposed.

Kingman Series

Tertiary: Northwestern Arizona.

B. E. Thomas, 1949, Econ. Geology, v. 44, no. 8, p. 667, fig. 2. Comprises rhyolite tuffs, breccias, and flows. Disconformably overlies Bull Mountain series (new); unconformably underlies Big Wash andesite (new).

B. E. Thomas, 1953, Geol. Soc. America Bull., v. 64, no. 4, p. 408, pl. 1. Two northernmost mapped exposures contain visible section approximately 700 feet thick of coarse reddish breccias. Rocks distinctly stratified and well consolidated. In three exposures to the south, several hundred feet of strata must be represented, but maximum thickness of any one section is about 80 feet. Rock types present are (ascending) loosely consolidated grayish-yellow to light-brown tuff; welded tuff, 10 to 15 feet thick; and reddish-brown tuffaceous breccia, about 30 feet thick.

Best exposed in and around Kingman, Mohave County. Occurs discontinuously along east flank of Cerbat Mountains.

King Peak Rhyolite

Precambrian: West-central Arizona.

C. A Anderson, E. A. Scholz, and J. D. Strobell, Jr., 1955, U.S. Geol. Survey Prof. Paper 278, p. 12, pl. 3. Fine-grained nonporphyritic rock containing quartz and feldspar. Generally massive, and foliation is rare. White and sugary in appearance on unweathered surfaces, but outcrops typically are tan in western belt near Niagara Creek. Eastern exposures are brown. Distinguished from Dick rhyolite (new) by its nonporphyritic texture. Oldest intrusive in area. Mass of King Peak rhyolite exposed west of Niagara Creek is essentially concordant with southwestern belt of Bridle formation (new), but evidence proves that the rhyolite is intrusive. Pattern of outcrops indicates that the King Peak also intrudes Dick rhyolite.

Exposed on King Peak, for which the rock has been named, in southern part of Bagdad area, Yavapai County

Kings Limestone[1]

Devonian: Missouri.

Original reference: E. M. Shepard, 1904, Drury Coll., Bradley Geol. Field Sta. Bull., v. 1, p. 41.

Kings Branch Limestone[1]

Age (?) : Southwestern Missouri.

Original reference: E. M. Shepard, 1905, Drury Coll., Bradley Geol. Field Sta. Bull., v. 1.

Greene County.

Kingsbridge Marble[1]

Precambrian: Southeastern New York.

Original reference: L. D. Gale, 1839, New York Geol. Survey 3d Ann. Rept., p. 183.

Probably named for Kingsbridge on Manhattan Island.

Kingsbury Conglomerate Member (of Wasatch Formation)[1]

Eocene, lower: Northern Wyoming.

Original reference: N. H. Darton, 1906, U.S. Geol. Survey Prof. Paper 51, p. 13, 60.

R. P. Sharp, 1948, Jour. Geology, v. 56, no. 1, p. 1–14. Underlies Moncrief gravel (new).

J. D. Love and J. L. Weitz, 1951, U.S. Geol. Survey Oil and Gas Inv. Map OM–122. Underlies Moncrief gravel herein allocated to member status in Wasatch formation.

R. K. Hose, 1956, U.S. Geol. Survey Bull. 1027–B, p. 67–70. Described in Crazy Woman Creek area, Johnson County, where it unconformably overlaps Fort Union formation. North of mapped area, successively overlaps Lance formation, Bearpaw shale, and Parkman sandstone. Four miles north of mapped area, unconformably underlies Moncrief member. Thickness 400 to 600 feet in vicinity of Kingsbury Ridge.

W. J. Mapel, 1959, U.S. Geol. Survey Bull. 1078, p. 63–64. Described in Buffalo-Lake De Smet area where it is as much as 800 feet thick. Underlies Moncrief member with angular discordance near Bighorn Mountains; eastward both members grade laterally into conformable nonconglomerate sequence of sandstone, shale, and coal that makes up Wasatch formation east of area. Overlies Fort Union formation with angular unconformity.

Named for Kingsbury Ridge, 6 miles southwest of Buffalo, Johnson County

Kings Canyon Dolomite

Devonian (?) : Western Utah.

R. W. Rush, 1956, Utah Geol. and Mineralog. Survey Bull. 53, p. 12 (fig. 3), 23 (fig. 5), 26–27, 31 (fig. 6), 35 (fig. 7), 37 (fig. 8), 41 (fig. 9), 53 (fig.

11), 60. Proposed for light-gray microcrystalline dense laminated dolomite 460 feet thick that conformably overlies Decathon dolomite (new) and conformably underlies Simonson dolomite. No fossils. Considered Devonian because of stratigraphic position below Simonson and lithologic similarity to Sevy dolomite.

Type locality: Fantastic Canyon, sec. 13, T. 21 S., R. 15 W., 5 miles south of Kings Canyon in Confusion Mountains, Millard County. Also well exposed in eastern front of Confusion Mountains between Kings Canyon and Ibex.

†Kings Creek phase[1] or silex[1]

Eocene, upper, or Oligocene: Western South Carolina and southeastern Georgia.

Original references: E. Sloan, 1905, South Carolina Geol. Survey geognostic map of South Carolina, advance copies, published in 1908, in South Carolina Geol. Survey, ser. 4, Bull. 2; 1907, Summary of mineral resources of South Carolina, p. 12, 18, name only, not defined; 1908, South Carolina Geol. Survey, ser. 4, Bull. 2, p. 435, 464–465.

Occurs between Johnson's Landing, near mouth of Lower 3 Runs, Barnwell County, S.C., to point immediately south of King's Creek and about 1 mile west of river road.

Kingsdown Silt or **Formation** (in Sanborn Group)

Kingsdown Marl[1]

Pleistocene: Southwestern Kansas.

Original reference: F. W. Cragin, 1896, Colorado Coll. Studies, v. 6, p. 53–54.

H. T. U. Smith, 1940, Kansas Geol. Survey Bull. 34, p. 111–116. Cragin's loosely defined Kingsdown marl of supposed late Pliocene age, redefined as Kingsdown formation to include beds of Pleistocene age only. It was included in Tertiary marl as mapped by Hay (1890, U.S. Geol. Survey Bull. 57). Formation consists of light-colored sand and gravel grading upward into characteristically light-buff even-bedded silt and clay containing some small and scattered calcareous concretions. Thickness 64 feet at section measured in Clark County. Here the Kingsdown overlies Rexroad formation (new). Overlain by loess and seems locally to grade upward into loess from which it differs little except in its bedding.

J. C. Frye and C. W. Hibbard, 1941, Kansas Geol. Survey Bull. 38, pt. 13. p. 410–411. Redefined to include overlying loess. Overlies Meade formation (redefined).

C. W. Hibbard, 1944, Geol. Soc. America Bull., v. 55, no. 6, p. 745–752. Kingsdown marl apparently referred to by Cragin is divisible into an upper and lower part separated by a disconformity. Lower Kingsdown consists of light-buff silt and some sand and caliche pebbles, unconformable upon Meade formation and unconformably overlain by upper Kingsdown silt. Where well exposed in SE¼ sec. 17, T. 30 S., R. 23 W., Clark County, the lower Kingsdown is 25 feet thick. Here the Kingsdown is channelled into the Meade formation. Upper Kingsdown silt consists of light-tan silt and fine sand, thin-bedded at base grading upward into massive silt and loess. Well exposed in NE¼ sec. 13, T. 30 S., R. 23 W., Clark County (section measured by Smith, 1940).

C. W. Hibbard, 1949, Michigan Univ. Mus. Paleontology Contr., v. 7, no 4, p. 80–84. Formation redefined to include sands and gravels at base of silt not recognized by Cragin but included by Hibbard (1944) in lower Kingsdown silt. Term formation used here instead of marls because unit here defined as formation consists both of channel sands and gravels and flood-plain silts containing large amounts of calcium carbonate. Use of formation as here restricted and redefined, is not use of term as defined by Smith (1940). Typical section given by Smith is of beds younger than those described by Cragin as Kingsdown marls and belongs to later cycle of erosion and deposition named and defined in this paper as Vanhem formation. In some areas, overlies Meade formation; in others, Crooked Creek formation (new). Type locality designated

J. C. Frye and A. B. Leonard, 1952, Kansas Geol. Survey Bull. 99, p. 110. Kingsdown marl or formation listed among units that consist in part or entirely of deposits known to be of Illinoian or younger age, and which are properly classed at least in part as Sanborn formation.

C. W. Hibbard, 1958, Am. Jour. Sci., v. 256, no. 1, p. 55 (fig. 1). Lower formation in Sanborn group. Overlies Crooked Creek formation; underlies Vanhem formation.

Named for Kingsdown, Ford County.

Kingshill Marl

Kingshill Series

Oligocene and Miocene: St. Croix, Virgin Islands.

J. F. Kemp, 1926, New York Acad. Sci. Scientific Survey of Porto Rico and the Virgin Islands, v. 4, pt. 1, p. 49 (reprinted? from J. F. Kemp, 1923, Report to H. H. Hough, Captain, U.S.N., Governor, Virgin Islands. Printed at the Naval Station, St. Thomas [not seen]). Kingshill series consists of white or cream-colored soft limestones, chalky beds and marls. Thickness may be 500 or 600 feet. Rests on upturned edges of older Mount Eagle series.

D. J Cederstrom, 1941, Am. Jour. Sci., v. 239, no. 8, p. 556–557. Referred to as Kingshill marl. In test wells, overlies Jealousy formation (new). Oligocene to lower Miocene.

D. J. Cederstrom, 1950, U.S. Geol. Survey Water-Supply Paper 1067, p. 20–27, pl. 1. Exposed thickness of marl may be more than 600 feet. Subsurface thickness as much as 180 feet. In some areas directly overlies Mount Eagle volcanics. Calcareous conglomerate underlying Kingshill is exposed in stream beds near Jealousy. This is believed to be basal conglomerate of Jealousy formation. Oligocene-Miocene contact is within Kingshill marl and is at least 108 feet above base of formation in test well at Fair Plain.

Probably named for Kings Hill in western part of island.

Kingsley Red Shale Member (of New Milford Formation)[1]

Kingsley shale member (of Wellsburg monothem)

Upper Devonian: Northeastern Pennsylvania.

Original reference: Bradford Willard, 1936, Geol. Soc. America Bull., v. 47, no. 4, p. 571–589.

K E. Caster, 1938, Jour. Paleontology, v. 12, no. 1, p. 44, 45 (fig. 7), 46–47, 49–50, Reallocated to lower part of Wellsburg monothem and described in vicinity of Lanesboro. Not properly termed "red" shale. Stratigraphically restricted; basal 105 feet of shale in original definition included by inference in Starruca shale member. Underlies Lanesboro formational suite of Wellsburg monothem; overlies Starrucca shale member of Cayuta monothem.

Well exposed in railroad cut at Kingsley, Susquehanna County.

Kings Mill Sandstone[1]

Upper Devonian: Central Pennsylvania.

Original reference: E. W. Claypole, 1885, 2d Pennsylvania Geol. Survey Rept. F2, p. 73–77.

Bradford Willard, 1937, Pennsylvania Acad. Sci. Proc., v. 11, p. 33. Described as marine unit intercalated with Catskill continental facies in Perry County.

Exposed near King's Mill 2 miles northwest of Duncannon, Perry County.

Kings Mill Shale[1] and Sandstones

Upper Devonian: Central Pennsylvania.

Original reference: E. W. Claypole, 1885, Pennsylvania 2d Geol. Survey Rept. F–2, p. 77.

G. A. Cooper and others, 1942, Geol. Soc. America Bull., v. 53, no. 12, pt. 1, chart 4. Kings Mill shales and sandstones shown on correlation chart below Dellville sandstone.

Named for King's Mill, 2 miles northwest of Duncannon, Perry County.

†Kings Mountain Group,[1] Series,[1] or Slates[1]

Precambrian and Cambrian: Western North Carolina and northwestern South Carolina.

Original reference: O. M. Lieber, 1858, Rept. of survey of South Carolina for 1856, p. 23, 30.

Named for development on Kings Mountain, in Cleveland and Gaston Counties, N C.

Kings Mountain Quartzite[1]

Kings Mountain Group

Ordovician to Mississippian: Southern North Carolina and northwestern South Carolina.

Original reference: A. Keith and D. B. Sterrett, 1931, U.S. Geol. Survey Geol. Atlas, Folio 222.

J. L. Stuckey and S. G. Conrad, 1958, North Carolina Div. Mineral Resources Bull. 71, p. 30–31; J. L. Stuckey, 1958, Geologic map of North Carolina (1:500,000): North Carolina Div. Mineral Resources. Rocks of Kings Mountain group consist of two parts, one of highly siliceous rock and the other largely calcareous. They are mapped as Stokes County and Kings Mountain belts. Precambrian(?) or Lower Paleozoic(?).

U S. Geological Survey currently designates the age of the Kings Mountain Quartzite as Ordovician to Mississippian on the basis of a study now in progress.

Named for development in Kings Mountain, in Cleveland and Gaston Counties. N.C.

Kingsport Formation or **Dolomite** (in Knox Group)

Lower Ordovician: Eastern Tennessee and southwestern Virginia.

John Rodgers, 1943, Geologic map of Copper Ridge district, Hancock and Grainger Counties, Tennessee (1:24,000): U.S. Geol. Survey Strategic

Minerals Inv. Prelim. Map. Name appears on map legend. Occurs below Mascot dolomite (new).

C. R. L. Oder and H. W. Miller, 1945, Am. Inst. Mining Metall. Engineers Tech. Pub 1818, p. 1, 2–9. In Mascot-Jefferson City zinc district, Kingsport formation consists of four divisions: upper, 101 to 135 feet, fairly light to dark fine-grained dolomite with some interbedded brown limestone; underlying 44 to 50 feet, light-brownish-gray to nearly white fine-grained dolomite, some of which is lithographic in texture; variable zone 33 to 38 feet, light- to dark-gray to brownish fine-grained to finely crystalline dolomite and some brown limestone; lower 178 to 216 feet, mainly brown limestone locally altered to crystalline dolomite; interbedded with limestone is light- to dark-gray fine-grained dolomite; cherty layers numerous. Includes Grasselli dolomite (new) near top. Separated from overlying Mascot formation by chert matrix sand about 6 inches thick; overlies Longview formation. Name chosen, jointly by Josiah Bridge and Oder. [Description based on mine sections.]

John Rodgers and D. F. Kent, 1948, Tennessee Div. Geology Bull. 55, p. 25–27. Described in Lee Valley, Hawkins County, where it is 218 feet thick. Consists typically of thick-bedded compact blue to brown limestone below interbedded with and grading up into light- to dark-gray finely crystalline well-bedded dolomite. Thickness 218 feet. Underlies Mascot dolomite; overlies Longview dolomite

R. L. Miller and W. P. Brosgé, 1954, U.S. Geol. Survey Bull. 990, p. 26–28, pl. 1. Described in Jonesville district, southwestern Virginia, where it underlies Mascot dolomite and overlies Longview dolomite. Thickness 119 to 272 feet.

Josiah Bridge, 1956. U.S. Geol. Survey Prof. Paper 277, p. 49–54, pl. 1. Kingsport limestone replaces names Jefferson City formation (Oder, 1934, Jour. Geology, v. 42) and Forked Deer formation (Hall and Amick, 1934). As defined here, Kingsport includes units 459 to 519 of Thorn Hills section (Hall and Amick, 1934) and units 240 to 256 of Lee Valley section (Rodgers and Kent, 1948). Thickness at type locality, here designated, 280 feet. Discussion of boundaries of Kingsport as used here with boundaries drawn by Oder and Miller (1945).

Type section: On east side of U.S. Highway 23 just northwest of Kingsport, Sullivan County, Tenn. Top of formation is 0.55 mile north of traffic light at intersection of U.S. Highways 23 and 11W; base is 0.23 mile farther north.

Kings River Sandstone Member (of Everton Formation)[1]

Middle Ordovician: Northwestern Arkansas.

Original reference: A. H. Purdue and H. D. Miser, 1916, U.S. Geol. Survey Geol. Atlas, Folio 202.

U.S. Geological Survey currently considers the Everton Formation and its members Middle Ordovician in age.

Named for exposures along Kings River, Eureka Springs quadrangle, [Carroll County].

†Kingston Beds[1]

Lower Devonian: Eastern New York.

Original reference: J. M. Clarke and C. Schuchert, 1899, Science, new ser., v. 10, p. 874–878.

Typically exposed in vicinity of Kingston, Ulster County.

Kingston Conglomerate[1] (in Portage Lake Lava Series)

†Kingston Conglomerate (in Central Mine Group)

Precambrian (middle Keweenawan) : Northern Michigan.

Original reference: A. R. Marvine, 1873, Michigan Geol. Survey, v. 1, pt. 2, p. 114, chart.

W. S. White, H. C. Cornwall, and R. W. Swanson, 1953, U.S. Geol. Survey Geol. Quad. Map GQ–27. Shown on map legend as one of 16 units included in newly defined Portage Lake lava series

Named for occurrence on Kingston Farm, on Keweenaw Point.

Kingston Peak Formation

Precambrian (Pahrump Series) : Southern California.

D. F. Hewett, 1940, Washington Acad. Sci. Jour., v. 30, no. 6, p. 240; 1956, U.S. Geol. Survey Prof. Paper 275, p. 27, 28, pl. 1. Consists of sandstone and limestone with thick coarse conglomerate in middle. Conglomerate made up largely of subangular cobbles of limestone up to 12 inches in diameter with quartzite and granite cobbles predominating near base. Resembles debris, called fanglomerate, that forms fans on border of present valleys. About 1,900 feet thick along western part of outcrop belt but thickens toward east. Conformably overlies Beck Spring dolomite (new) ; underlies Paleozoic rocks that are Lower Cambrian in age.

D. F. Hewett, 1948, California Div. Mines Bull. 129, p. 199. In Kingston Range, San Bernardino County, underlies Cambrian Noonday dolomite.

L. A. Wright, 1952, California Div. Mines Spec. Rept. 20, p. 12. In Superior talc area, southern Death Valley-Kingston Range region, formation, at least 1,900 feet thick, consists of a lower one-fourth of quartzite and shale and an upper three-fourths of conglomeratic quartzite locally containing much diabase debris.

B. K. Johnson, 1957, California Univ. Pub. Geol. Sci., v. 30, no. 5, p. 360–369, fig. 3, 378 (fig. 7). Described in Manly Peak quadrangle, Death Valley region. In northern part of quadrangle, divided into three members (ascending) : Surprise (conglomerate subgraywacke), Sour Dough limestone, and South Park member (new) consisting of conglomerate, sandstone, and shale. Key to subdivision was Sour Dough limestone which forms prominent escarpments and hogbacks that contrast with smoother weathering members. Separation into members in southern part of area not possible, mostly because of insufficient time to trace outcrops of thinner and topographically less well defined Sour Dough in this rather inaccessible part of quadrangle. Base of thickest part of section not exposed, but it has minimum thickness of 2,700 feet in northern part of quadrangle; thickness decreases to a few tens of feet near Lotus mine. Base of formation exposed on west limb of anticline in Coyote Canyon and in Goler Wash; in both places, it rests unconformably on Archean gneiss or Archean metaconglomerate; throughout region, underlies Noonday dolomite with slight angular discordance; also pronounced color contrast marks contact—Noonday buff, Kingston Peak dark. Widely distributed over much of southern Death Valley region and exposed over more of western side of southern Panamint Range than any of other sedimentary formations; crops out discontinuously from Goler Wash at least as far north as Wildrose Canyon and Harrisburg Flat

Crops out in belt 20 miles long around north and east slopes of Kingston Range, Ivanpah quadrangle. Formation is interrupted by several faults. Name derived from Kingston Peak, highest point in range.

Kingston Range Monzonite Porphyry

Upper Cretaceous or Tertiary, lower: Southern California.

D. F. Hewett, 1948, California Div. Mines Bull. 129, p. 199–200; 1956, U.S. Geol. Survey Prof. Paper 275, p. 24, 26, 67–68, pl. 1. Uniform in composition and texture. In Kingston Range, Precambrian Pahrump series forms large dome in center of which is core of igneous rock, the Kingston Range monzonite porphyry.

Kingston Range, about 10 miles in diameter, lies near northeast corner of San Bernardino County.

†Kingstown Series[1]

Carboniferous: Central southern Rhode Island.

Original reference: A. F. Foerste, 1899, U.S. Geol. Survey Mon. 33, p. 331–347, pl. 31, map.

Typically exposed in South and North Kingstown, Washington County.

Kings Valley Siltstone Member (of Siletz River Volcanic Series)

Eocene, lower: West-central Oregon.

H. E. Vokes, D. A. Myers, and Linn Hoover, 1954, U.S. Geol. Survey Oil and Gas Inv. Map OM–150. Thin-bedded tuffaceous siltstone and water-laid tuffs that interfinger with volcanic rocks in upper part of Siletz River volcanic series. Thickness about 3,000 feet in vicinity of Kings Valley. Underlies Tyee formation.

Extensively exposed along east and south edges of Kings Valley in northwestern part of Corvallis quadrangle. No complete sequence exposed in map area.

Kinishba Beds (in Supai Formation)[1]

Permian: Southeastern Arizona.

Original reference: A. A. Stoyanow, 1936, Geol. Soc. America Bull., v. 47, no. 4, p. 533–536.

Named for occurrence in walls of old Indian pueblo, known as Kinishba, on bank of dry wash, southwest of White River settlement and northwest of Fort Apache, at foot of Kelly Butte, Navajo County.

Kinkaid Limestone[1]

Kinkaid Limestone (in Elvira Group)

Upper Mississippian (Chester Series): Southern and western Illinois, southern Indiana, and western Kentucky.

Original reference: S. Weller, 1920, Jour. Geology, v. 28, no. 4, p. 281–290; no. 5, p. 395–416.

J. M. Weller, 1939, Kansas Geol. Soc. Guidebook 13th Ann. Field Conf., p. 131, 136, 137; J. M. Weller and A. H. Sutton, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 5, p. 766 (fig. 1), 839–841. Assigned to Elvira group (new). Youngest formation of Chester series. In standard Mississippian section, overlies Degonia sandstone. In southwestern Indiana, Negli Creek limestone and the underlying shale are probably equivalent of Kinkaid formation.

C. A. Malott, 1952, Stratigraphy of the Ste. Genevieve and Chester formations of southern Indiana: Ann Arbor, Mich., The Edwards Letter Shop, p. 6. Name Kinkaid limestone extended into southern Indiana where it replaces term Negli Creek limestone. Local Indiana names of upper

Chester are dropped, and formations given names of standard Chester column.

T. G. Perry and N. M. Smith, 1958, Indiana Geol. Survey Bull. 12, pl. 1. Kinkaid limestone shown on stratigraphic column of upper Chester in Indiana as 20 to 35 feet of gray lithographic to medium-grained crystalline fossiliferous limestone and gray platy shale. Unconformable below Pennsylvanian Mansfield formation. Term Elvira group not used in Indiana.

Named for exposures along Kinkaid Creek and some of its tributaries in Jackson County, Ill.

Kinney Limestone Member (of Matfield Shale)

Kinney Limestone (in Chase Group)[1]

Permian: Southeastern Nebraska and eastern Kansas.

Original reference: G. E. Condra and J. E. Upp, 1931, Nebraska Geol. Survey Bull. 6, 2d ser., p. 37.

R. C. Moore and others, 1951, Kansas Geol. Survey Bull. 89, p. 45. Member of Matfield shale. Limestone and shale; generally an upper and lower gray fossiliferous limestone separated by gray fossiliferous shale. Thickness 1 to 24 feet. Underlies Blue Springs shale member; overlies Wymore shale member. Wolfcamp series.

M. R. Mudge and R. H. Burton, 1959, U.S. Geol. Survey Bull. 1068, p. 12 (table 2), 93–94, pls. Thickness 1 to 15 feet in Wabaunsee County, Kans. Overlies Wymore shale member; underlies Blue Springs shale.

Type locality: Burlington Railroad cut just east of Kinney, Gage County, Nebr.

Kinnick Formation[1]

Miocene, middle: Southern California.

Original reference: J. P. Buwalda, 1934, Pan-Am. Geologist, v. 61, no. 4, p. 310.

H. E. Wood, 2d, and others, 1941, Geol. Soc. America Bull., v. 52, no. 1, p. 23, pl. 1. Included in Hemingfordian and Barstovian ages.

J. P. Buwalda and G. E. Lewis, 1955, U.S. Geol. Survey Prof. Paper 264–G, p. 147–148. Described as consisting mainly of stratified green basic volcanic tuffs, largely ash beds with some coarse agglomerates; upper part gray sandy shale with, locally, white freshwater diatomaceous beds and cherts; some basic lava flows. Thickness not less than 1,500 feet. Strata moderately deformed with dips generally not more than 30°. Lies with strong angular unconformity across edges of Witnet formation; probably conformable with overlying Bopesta. Type locality designated; derivation of name given.

Type section: Base at unconformity north of confluence off Cache, Oil and Sand Creeks (SW cor. sec. 11, T. 32 S., R. 34 E.), thence northward through California Institute of Technology locality 503 in saddle west of Hill 5,015, Mojave quadrangle, in NW¼ sec. 34, T. 31 S., R. 34 E., M D B and M, Kern County. Named from Kinnick Ridge, north of Cache, Oil and Sand Creeks.

Kinnikinic Quartzite[1]

Upper Ordovician: Southern central Idaho and extreme southwestern Montana.

Original reference: C. P. Ross, 1932, Idaho correlation chart compiled by M. G. Wilmarth.

C. P. Ross, 1947, Geol. Soc. America Bull., v. 58, no. 12, pt. 1, p. 1102–1104, 1195, pl. 1. Described in Borah Peak quadrangle, Idaho, where it is about 3,000 feet thick, underlies Saturday Mountain formation and overlies Ramshorn(?) slate. Early part of Upper Ordovician.

L. L. Sloss and C. A. Moritz, 1951, Am. Assoc. Petroleum Geologists Bull., v. 35, no. 10, p. 2148. Described in extreme southwestern Montana along crest of Beaverhead Range where it is a few tens of feet thick. Exposed above Beltian quartzites.

Named for exposures along Kinnikinic Creek, which reaches the Salmon River at Clayton, Idaho.

Kinnison Shale Member (of Cherokee Formation)

Kinnison Shale Member (of Mulky Formation)

Kinnison Shale Member (of Senora Formation)

Pennsylvanian (Des Moines Series): Northeastern Oklahoma.

W. B. Howe, 1951, Am. Assoc. Petroleum Geologists Bull., v. 35, no. 9, p. 2092. Member of Cherokee formation. Shale, dark gray at base, lighter above; upper 2 feet calcareous, fossiliferous, containing nonpersistent rough limestone in which crinoid fragments and *Chonetes* are most abundant fossils; includes a dark- to medium-gray conglomeratic limestone about 6 inches thick at base. Thickness a little more than 6 feet. Underlies Breezy Hill limestone member; overlies Iron Post coal.

C. C. Branson, 1954, Oklahoma Geol. Survey Guidebook 2, p. 5. Listed as Kinnison shale member of Mulky coal cycle in Senora formation.

W. B. Howe, 1956, Kansas Geol. Survey Bull. 123, p. 84. Reallocated to member status in Mulky formation. Kinnison shale and underlying Iron Post coal pinch out abruptly approximately at latitude of Oklahoma-Kansas line.

Well exposed in W½SW¼ sec. 36, T. 29 N., R. 19 E., Craig County.

Kinsey Canyon Formation

Tertiary: Eastern Nevada.

J. C. Young, 1960, Intermountain Assoc. Petroleum Geologists Guidebook 11th Ann. Field Conf., p. 160, 163–164. Conglomerate and lacustrine beds. Oldest Tertiary unit in area. Underlies Kalamazoo volcanics (new). Rests with slight angular unconformity on underlying upper Paleozoic rocks, locally contact is conglomerate-filled channels in Ely limestone. Tentatively correlated with the Eocene and early Oligocene(?) Sheep Pass formation.

Named for exposures in Kinsey Canyon, Schell Creek Range area, Ely quadrangle.

Kinsman Quartz Monzonite (in New Hampshire Plutonic Series)

Kinsman Granodiorite[1]

Upper Devonian(?): Southwestern and west-central New Hampshire.

Original reference: C. R. Williams, 1934, Appalachia, v. 20, no. 4, p. 69–78.

M. P. Billings, 1937, Geol. Soc. America Bull., v. 48, no. 4, p. 506–507. Described as quartz monzonite.

M. P. Billings, 1955, Geologic map of New Hampshire (1:250,000): U.S. Geol. Survey. Includes Meredith granite of Lake Winnipesaukee region, also "Franconia" breccia. Belongs to New Hampshire plutonic series of Upper Devonian(?) age.

Named for Kinsman Notch in Moosilauke quadrangle.

Kintla Argillite[1] (in Missoula Group)
Kintla Formation (in Missoula Group)

Kintla Member (of Miller Peak Formation)

Precambrian (Belt Series): Northwestern Montana, and southeastern British Columbia, Canada.

Original reference: Bailey Willis, 1902, Geol. Soc. America Bull., v. 13, p. 316, 324.

C. L. Fenton and M. A. Fenton, 1937, Geol Soc. America Bull., v. 48, no. 12, p. 1901–1902. Rank reduced to member status in Miller Peak formation. Consists of argillites and argillaceous sandstones, thinly bedded, dominantly bright red; thin beds of quartzite and pinkish-gray limestone. Contains 30 to 40 feet of purplish amygdaloidal lava. Ripple marks, mud cracks, channels, rain prints, and casts of salt crystals characteristic. Thickness 860 to 900 feet. Type locality and good exposures cited. Underlies Roosville member; overlies Sheppard formation.

S. D. Theodosis, 1955, Billings Geol. Soc. Guidebook 6th Ann. Field Conf., p. 62, chart facing p. 62. In Glacier Park area, only 860 feet of Missoula group is present, represented by Kintla formation, a red argillite which occurs in Kintla Lake area in northwestern part of park.

C. P. Ross, 1959, U.S. Geol. Survey Prof. Paper 296, p. 43–44. Willis (1902) proposed name Kintla argillite for part of Belt series above Shepard formation in northern part of Glacier National Park. He observed thickness of 800 feet and, because he saw no beds above his Kintla, assigned no upper limit. It is now known that Missoula group extends thousands rather than hundreds of feet above Purcell basalt. Because there is no way of separating Kintla argillite of Willis from similar beds at horizons above those he saw, name Kintla not useful at present.

Type locality: Willis gives it as pyramidal peaks on 49th parallel, at head of Kintla drainage [Glacier National Park, Mont.]. Fenton and Fenton give pyramidal peaks of Akamina Ridge, west of Waterton Lakes National Park [British Columbia]. Well exposed on Mount Rowe, Mount Carthew, Mount Custer, and on Boulder Peak.

Kinzers Formation[1]

Lower Cambrian: Southeastern Pennsylvania, Maryland, and Virginia.

Original reference: G. W. Stose and A. I. Jonas, 1922, Washington Acad. Sci. Jour., v. 12, p. 359, 362–363.

A. I. Jonas, 1936, Geol. Soc. America Bull., v. 47, no. 10, p. 1668 (table 1). Correlation chart shows Kinzers (shale) in Appalachian Valley, Hagerstown, Md.

G. W. Stose and A. I. Jonas, 1938, Virginia Geol. Survey Bull. 51–A, p. 21, 22. Proposed to extend names Vintage dolomite, Kinzers formation, and Ledger dolomite to comparable Lower Cambrian formations in Austinville area, Wythe and Carroll Counties, Va. In this area, the Kinzers is about 850 feet thick. Consists of (ascending) massive white crystalline and blue to dove-colored fine-grained fossiliferous limestone, 200 feet thick; argillaceous to sandy ridge-making limestone, buff, and earthy-weathering impure limestone, thin shale, and thin dolomite, 150 feet; thin slabby, fine-grained to compact blue limestone, thick dolomite, and limestone conglomerates, thick-bedded coarse limestone conglomerates at base, 500 feet. Overlies Vintage limestone; underlies Ledger dolomite.

Named for exposures in Pennsylvania Railroad cut at Kinzers, Lancaster County, Pa.

Kinzua Creek Sandstone

†Kinzua Creek Sandstone (in Pottsville Formation)[1]

Pennsylvanian: Northwestern and central northern Pennsylvania.

Original reference: C. A. Ashburner, 1879, Geologic map of McKean County: Pennsylvania 2d Geol. Survey.

Henry Leighton, 1941, Pennsylvania Geol. Survey, 4th ser., Bull. M–23, p. 57, 103. Kinzua Creek sandstone (Pottsville series) is separated from overlying Johnson Run sandstone by Alton coal group and from underlying Olean conglomerate by Marshburg coal and clay. [Also referred to as Kinzua sandstone.]

Named for exposures in Kinzua Creek valley, McKean County. Also noted in Cameron and Clinton Counties.

Kiowa Shale[1]

Kiowa Shale Member (of Purgatoire Formation)

Lower Cretaceous: Central southern Kansas, eastern Colorado, and western Oklahoma.

Original reference: F. W. Cragin, 1894, Colorado Coll. Studies, 5th Ann. Pub., p. 49.

R. C. Moore and others, 1951, Kansas Geol. Survey Bull. 89, p. 28. Consists of light-gray, dark-gray, and black fissile shale; contains thin limestone beds throughout, with Champion shell bed at base in type area. Locally, lenticular sandstones occur at any position within shale. Thickens across central and western Kansas toward south and southwest. Thickness 60 to 150 feet. Overlies Cheyenne sandstone; underlies Dakota formation.

H. D. Miser and others, 1954, Geologic map of Oklahoma (1:500,000): U.S. Geol. Survey. Mapped in Cimarron County as member of Purgatoire formation and in northwestern Oklahoma as Kiowa shale.

T. G. McLaughlin, 1955, U.S. Geol. Survey Water-Supply Paper 1256, p. 99–100. Upper member of Purgatoire formation in Baca County, Colo. Commonly overlies Cheyenne sandstone member, although it overlies Morrison formation in Cimarron County, Okla. Underlies Dakota sandstone. Average thickness about 45 feet in southwestern part of Baca County; about 90 feet in places in northeastern part of county.

A. J. Myers, 1959, Oklahoma Geol. Survey Bull. 80, p. 43–46, pl. 1. Name Kiowa shale applied in Harper County to Cretaceous sandstones and shales unconformably overlying Cloud Chief formation. Consists of black to yellow resistant sandstones and thin white, somewhat chalky limestones. Maximum observed thickness 52 feet. Crops out as widely scattered outliers and is overlain by Quaternary sand dunes. Comanche series.

Named for Kiowa County, Kans.

Kipahulu Formation (in Hana Volcanic Series)

Pleistocene(?): Maui Island, Hawaii.

H. T. Stearns *in* H. T. Stearns and G. A. Macdonald, 1942, Hawaii Div. Hydrography Bull. 7, p. 91–92, pl. 18. Chiefly fine-grained aa in dense beds, some of which are columnar jointed. Total thickness may exceed 1,500 feet.

G. A. Macdonald and D. A. Davis *in* Jacques Avias and others, 1956, Lexique Strat: Internat., v. 6, Océanie, fasc. 2, p. 104. Pleistocene(?).

Fills deep ancestral Kipahulu Valley cut at end of Kula time. Exposed over an area 6 miles long by ½ to 1 mile wide, East Maui.

†Kirby Clay[1]

Lower Cretaceous (Comanche Series): Central southern Kansas.

Original reference: C. N. Gould, 1898, Am. Jour. Sci., 4th, v. 5, p. 170–174.

Named for Kirby, or C. W., or Fullington Ranch, on upper Medicine River, 10 to 12 miles west of Belvidere, Kiowa County.

Kirby Granite[1]

Age(?): Northeastern Vermont.

Original reference: C. H. Richardson, 1906, Vermont State Geologist 5th Rept.

On Kirby Mountain, eastern part of Kirby Township, Caledonia County.

Kirby Quartz Monzonite (in New Hampshire Plutonic Series)

Devonian: Northeastern Vermont.

J. H. Eric and J. G. Dennis, 1958, Vermont Geol. Survey Bull. 11, p. 28–29, pl. 1. Light-gray to white hypidiomorphic quartz monzonite consisting essentially of gray glassy quartz, biotite, microcline, albite-oligoclase, and, in some specimens, muscovite; in some places where microcline is abundant, rock is true granite. Emplaced after main period of Acadian deformation (Late Devonian).

Exposed in three small bodies, two on north border of Littleton quadrangle in town of Kirby, third near Stiles Pond in town of Waterford.

Kirby Lake Dolomite (in Arroyo Formation or Group)

Kirby Lake Dolomite (in Clear Fork Group)

Permian (Leonard): West-central Texas.

Gayle Scott and others, 1941, West Texas Geol. Soc. [Guidebook] Spring Field Trip, May 10–11, correction sheet. Proposed for preoccupied Cedar Creek. Name credited to [V. C.] Perini.

V. C. Perini, Jr., and J. R. Day, 1946, Abilene Geol. Soc. [Guidebook] November Field Trip, p. 5, 26. Stratigraphic section shows Kirby Lake dolomite in Arroyo formation above Lytle limestone and below Standpipe dolomites and limestone, or 145 feet above Lueders limestone. Page 26 states that Kirby Lake dolomite is member of Arroyo group.

Exposed at spillway at northwest corner of Kirby Lake, southwest of Abilene, Taylor County.

Kirker Tuff[1]

Oligocene: Western California.

Original reference: B. L. Clark, 1918, California Univ. Pub., Dept. Geol. Bull., v. 11, p. 54–111.

C. E. Weaver and others, 1944, Geol. Soc. America Bull., v. 55, no. 5, p. 585, chart 11. Shown on correlation chart as unconformable below Cierbo sandstone and uncomformable above a 50-foot unit termed "Kirker sandstone".

Type locality: On Kirker Creek, north Mount Diablo, San Francisco Bay region.

Kirkers Pass Beds[1]

Miocene: Western California.

Original reference: J. P. Smith, 1910, Jour. Geology, v. 18, table opposite p. 226.

Mount Diablo region.

Kirkfield Limestone or Formation

Kirkfield Limestone Group[1]

Middle Ordovician: Ontario, Canada, and northwestern New York.

Original reference: R. A. A. Johnson, 1911, Canada Geol. Survey Summ. Rept. 1910, p. 190.

G. M. Kay, 1943, Am. Jour. Sci., v. 241, no. 10, p. 598, 599. Along West Canada Creek, N.Y., Kirkfield limestone, 45 feet thick, disconformably overlies Rockland limestone and underlies Shoreham limestone. Name Kirkfield preferred to "Hull" of previous reports. Kirkfield has precedence over Hull. Type Hull at Hull, Quebec, has stratigraphic position of Kirkfield of southern Ontario and northwestern New York, for it lies between "*Triplesia* zone" (Rockland) and "*Cryptolithus* zone" (Shoreham); latter forms basal part of "*Prasopora* beds" (Sherman Fall) of Johnston and Raymond. There are faunal differences between the Hull and Kirkfield but the writer believes them equivalent. There has been assumption by some authors that all echinoderms at Hull, Quebec, are from Hull limestone and are synchronous with those described from type Kirkfield, whereas many are younger.

Marshall Kay, 1948, Am. Assoc. Petroleum Geologists Bull., v. 32, no. 8, p. 1411–1412. Summary of Middle Ordovician bordering Allegheny synclinorium. Lower Trentonian formations of northwestern New York and eastern Ontario, the Rockland and Kirkfield or Hull limestones, disconformably overlap Black River rocks, lying locally on Canadian and Cambrian along Mohawk River, and on Precambrian in Ontario; the Rocklandian and Kirkfieldian are considered to be stages.

G. W. Sinclair, 1954, Ohio Jour. Sci., v. 54, no. 1, p. 31–41. Formation studied in Ontario. Concluded that Kirkfield of central Ontario is same age as the Rockland of Ottawa Valley. No beds of Hull age have been recognized in central Ontario.

P. A. Chenoweth, 1952, Geol. Soc. America Bull., v. 63, no. 6, p. 523–525. Formation described in Black River valley, New York, where it is about 100 feet thick. Overlies Rockland formation; underlies Shoreham formation. Trentonian.

Named for occurrence in vicinity of Kirkfield, Victoria County, Ontario.

Kirkfieldian Stage or Substage

Middle Ordovician: Eastern North America.

Marshall Kay, 1948, Am. Assoc. Petroleum Geologists Bull., v. 32, no. 8, p. 1413–1414. Stage in lower Trentonian series. [Apparently replaces Hull stage.]

Marshall Kay, 1960, Internat. Geol. Cong., 21st, Copenhagen, pt. 7, p. 30, 33. Rocklandian and Kirkfieldian substages included in Nealmontian stage of Trentonian.

Name derived from Kirkfield, Victoria County, Ontario, Canada, for which Kirkfield limestone was named.

Kirkland Formation[1]

Silurian: Maryland, New York, and Pennsylvania.

Original reference: E. O. Ulrich, 1918, Geol. Soc. America Bull., v. 29, p. 82.

Kirkland Limestone and iron ore[1] (in Clinton Formation or Group)

Silurian: New York.

Original reference: G. H. Chadwick, 1918, Geol. Soc. America Bull., v. 29, p. 327–368.

Tracy Gillette, 1947, New York State Mus. Bull. 341, p. 107–111. The Kirkland at Clinton is fossiliferous hematitic limestone. Thickness 5½ feet on Dawes Quarry Creek; 54 inches at Willowvale. Lower limit of formation sharp. Separated from Dawes sandstone (new) at Clinton and Willowvale shale at Willowvale by unconformity. Underlies Herkimer sandstone.

Well exposed at town of Kirkland, Oneida County.

Kirkman Limestone

Permian: Northeastern Utah.

A. A. Baker and J. S. Williams, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 4, p. 623 (fig. 4), 625–626. Gray to black in part sandy fetid limestone, commonly finely laminated and locally containing some oolitic phosphate. Maximum thickness 1,350 feet; thins southward to 75 feet in Spanish Fork; estimated thickness 500 feet at mouth of Kirkman Hollow. Conformably underlies Diamond Creek sandstone (new); overlies Oquirrh formation.

H. J. Bissell, 1952, Am. Assoc. Petroleum Geologists Bull., v. 36, no. 4, p. 588–589. Described in Strawberry Valley quadrangle. Forms almost continuous outcrop band from Bennie Creek northeast of Mount Nebo in southern Wasatch Mountains northeastward through south-central Wasatch Mountains; disappears beneath Tertiary cover in area between Left Fork of Hobble Creek and Round Valley of Provo Canyon. Thickness 375 feet in North Strawberry Valley. Underlies Diamond Creek sandstone.

Named for exposures in Right Fork of Hobble Creek at mouth of Kirkman Hollow, Utah County.

Kirkwood Formation[1]

Miocene, middle: Eastern New Jersey.

Original reference: G. N. Knapp, 1904, New Jersey Geol. Survey Ann. Rept. State Geologist 1903, p. 81–82.

H. E. Wood 2d and others, 1941, Geol. Soc. America Bull., v. 52, no. 1, p. 23, pl. 1. Shown on plate 1 as Arikareean and Hemingfordian.

Named for exposures at Kirkwood, Camden County.

Kirschberg Evaporite (in Edwards Limestone)

Cretaceous: Central Texas.

V. E. Barnes, 1946, Texas Univ. Bur. Econ. Geology Pub. 4301, p. 40–43 [1944]. Name applied to bed of gypsum, approximately 35 feet thick, in Edwards limestone. Lies about 140 feet above base of Edwards.

Named for occurrence in Cherry Mountain area, Gillespie County. Deposits extend for 10 miles along east-west ridge of Edwards limestone northwest of Fredericksburg. Kirschberg is original German name for Cherry Mountain.

Kirtland Shale[1]

Upper Cretaceous: Northwestern New Mexico and southwestern Colorado.

Original reference: C. M. Bauer, 1916, U.S. Geol. Survey Prof. Paper 98–P.

Harley Barnes, E. H. Baltz, Jr., and P. T. Hayes, 1954, U.S. Geol. Survey Oil and Gas Inv. Map OM–149. Described in Red Mesa area, La Plata and Montezuma Counties, Colo. Consists of three members: unnamed lower shale, Farmington sandstone, and unnamed upper shale. Upper shale member includes 95 feet of pebble-bearing sandstone and sandy shale included in McDermott formation by Reeside (1924). Thickness about 1,125 feet. Overlies Fruitland formation; underlies Animas formation.

E. C. Beaumont and R. B. O'Sullivan, 1955, U.S. Geol. Survey Coal Inv. Map C–32. Mapped in Kirtland quadrangle. Upper and lower members composed principally of greenish-gray shale and separated by predominantly yellowish-green and gray Farmington sandstone member. Overlies Fruitland formation and underlies Ojo Alamo sandstone.

Named for exposures at Kirtland post office, San Juan County, N. Mex.

Kirtley Formation

Miocene: Central eastern Idaho.

A. L. Anderson, 1959, Idaho Bur. Mines and Geology Pamph. 118, p. 15, 21, 27–28, pl. 1. Proposed as substitute for name Carmen formation, which has been used elsewhere as formational name, and use here is discontinued. Although a little conglomerate occurs at or near base, formation characteristically without coarse clastic materials, consisting largely of moderately well-indurated thin-bedded fine-grained rocks, mostly shales with some intercalated sandstone and sandy shale. Good stratification in shales. Some beds highly siliceous; many are sandy. In Salmon quadrangle shale in places darkened by vegetable debris, otherwise, beds are white or light gray. Bentonitic beds not observed in North Fork quadrangle, though conspicuous farther south. Several hundred feet of beds exposed in southern part of North Fork quadrangle, but total thickness probably several times that amount. Text gives age as middle Miocene or younger; mapped as Miocene. Overlies Geertson formation.

Named from Kirtley Creek which flows across it near center of Salmon quadrangle. Extends less than 2 miles into southern part of North Fork quadrangle. Widespread south of lower Carmen Creek in more central part of Salmon Basin.

Kiser Gypsum Member (of Blaine Formation)[1]

Kiser Gypsum Member (of Flowerpot Shale)

Permian: Southwestern Oklahoma and western Texas.

Original reference: C. N. Gould, 1902, Oklahoma Geol. Survey 2d Bienn. Rept., p. 42, 55.

T. S. Jones, 1953, Stratigraphy of the Permian Basin of West Texas: West Texas Geol. Soc., p. 30. Shown on chart as member of Flowerpot shale in western Texas.

G. L. Scott, Jr., and W. E. Ham, 1957, Oklahoma Geol. Survey Circ. 42, p. 16, 17 (fig. 3), 18, pl. 1. Described in Carter area, Oklahoma, as greenish to reddish very shaly well-bedded gypsum, 2 to 5 feet thick. Occurs about 25 feet below top of Flowerpot; stratigraphically above Chaney gypsum member. Blaine formation redefined in this report.

Named for Kiser Salt Plain on Elm Fork of Red River, Greer County, Okla.

Kiskatom Formation[1] (in Hamilton Group)

Kiskatom Redbeds

Middle Devonian: Southeastern New York.

Original reference: G. H. Chadwick, 1932, Eastern States Oil and Gas Weekly, v. 1, no. 17, p. 7.

Winifred Goldring, 1943, New York State Mus. Bull. 332, p. 273–279 [1946]. Kiskatom beds typically consist of an alternation of red and greenish or gray sandstones with interbedded green and red shales, sometimes dark shales. Estimated 2,300 feet of beds in Catskill front where they have maximum thickness. In this area, they include entire Ludlowville and Moscow formations and upper part of Skaneateles formation; west of Kingston, probably no more than the Ludlowville and Moscow, if all of the former; in northern Helderbergs and on Durham quadrangle, the major part of Skaneateles, the Ludlowville, and the Moscow.

G. H. Chadwick, 1944, New York State Mus. Bull. 336, p. 119–122. Redbeds described in Catskill and Kaaterskill quadrangles. Beds here termed Kiskatom reds, with thickness of 2,300 feet, prove to be Middle Devonian, Hamilton age. They are, at least, approximately, the beds formerly taken here to be Oneonta of Naples age (lower "Portage"), though early mapped as "Chemung." Moreover they are the beds to which the name "Catskill" was first applied among these Middle and Upper Devonian red strata. Overlie Ashokan flagstones; underlie Kaaterskill sandstones.

Theodore Arnow, 1949, New York State Water Power and Control Comm. Bull. GW–20, p. 8 (table 1), 15. Formation at top of Hamilton group. Maximum thickness in Albany County about 1,000 feet. Overlies Ashokan formation; underlies Onteora formation. These are continental red beds which were formerly regarded equivalent in age to Oneonta sandstone. Middle Devonian.

Kiskatom is in Greene County.

Kitchen Brook Dolomite (in Stockbridge Group)

Lower Cambrian: Western Massachusetts.

Norman Herz, 1958, U.S. Geol. Survey Geol. Quad. Map GQ–108. Fine-grained white to light bluish-gray, or white-weathering, yellowish-gray massive dolomite; thinner bedded and quartz-feldspar-calcite rich in upper part. Thickness at type locality 450 feet; in Pontoosuc Lake-Town Brook valley thickness may be in excess of 1,800 feet. In vicinity of MacDonald Brook, in Cheshire, the Kitchen Brook is cut out altogether by an unconformity beneath Berkshire schist. Nowhere in quadrangle can complete cross section through dolomite be seen; lower contact, with Cheshire quartzite, and upper contact, with Clarendon Springs dolomite, were not observed in field.

Type section: Along Kitchen Brook, in village of Cheshire, Cheshire quadrangle, Berkshire County.

Kitchener Quartzite[1]

Precambrian (Belt Series): Southeastern British Columbia, Canada, and northern Idaho and northwestern Montana.

Original reference: R. A. Daly, 1905, Canada Geol. Survey Summ. Rept. 1904, p. 96–100.

Named for station on Canadian Pacific Railway (in Kootenay Province of British Columbia).

Kitchi Schist[1]

Precambrian: Northwestern Michigan.

Original reference: C. R. Van Hise and W. S. Bayley, 1895, U.S. Geol. Survey 15th Ann. Rept., p. 490, 492, 496.

W. T. Stuart, E. A. Brown, and E. C. Rhodehamel, 1954, Michigan Geol. Survey Tech. Rept. 3, p. 11 (table 3). Table of geologic formations of Marquette district shows Kitchi schist (Keewatin) below Palmer gneiss and above Mona schist.

Exposed on Kitchi Hills, in vicinity of Deer Lake, Marquette district.

Kite Group

Lower Devonian: South-central Oklahoma.

R. A. Maxwell, 1936, Northwestern Univ. Summ. of Doctoral Dissert., v. 4, p. 132, 134. Name applied to series of argillaceous limestone, cherty limestone, and shale. Thickness about 200 feet. Comprises Haragan formation below and Cravatt formation (new) above. Underlies Bois d'Arc limestone; unconformably overlies Henryhouse formation.

Occurs in Arbuckle Mountain region.

Kitsap Clay Member (of Orting Drift)

Pleistocene: Western Washington.

J. E. Sceva, 1957, U.S. Geol. Survey Water-Supply Paper 1413, p. 17–19, pl. 1. Consists chiefly of clay but contains strata of peat, sand, gravel, and glacial till. Member is well stratified; clay strata are, in most places, finely laminated, and sand and silt are in thin layers. Thickness less than 30 feet to more than 200 feet. Underlies Puyallup sand; overlies unnamed lower member of Orting gravel.

Type section: In sea cliff along Colvos Passage near Maplewood, in Pierce County, south of Kitsap County line, sec. 21, T. 22 N., R. 2 E.

Kittanning coal group (in Allegheny Formation)[1]

Pennsylvanian: Western Pennsylvania and Maryland.

Original reference: J. P. Lesley and I. C. White, 1876, Pennsylvania 2d Geol. Survey map of southern Butler County.

Named for town of Kittanning, Pa.

Kittanning Fire Clay (in Allegheny Formation)[1]

Pennsylvanian: Southwestern Pennsylvania.

Original reference: I. C. White, 1878, Pennsylvania 2d Geol. Survey Rept. Q.

See Lower Kittanning Clay.

Named for occurrence at Kittanning, Armstrong County.

Kittanning Formation[1] (in Allegheny Group)

Pennsylvanian: Western Pennsylvania.

G. H. Ashley, 1923, Eng. Mining Jour.-Press, v. 115, no. 25, p. 1108; 1926, Pennsylvania Geol. Survey, 4th ser., Topog. and Geol. Atlas 65, p. 28, pl. 4. Allegheny group comprises (ascending) Clarion, Kittanning, and Freeport formations. Kittanning formation extends from top of Upper Kittanning coal to base of clay under Lower Kittanning coal.

C. K. Graeber and R. M. Foose, 1942, Pennsylvania Geol. Survey, 4th ser., Topog. and Geol. Atlas 54, p. 37–40. Discussion of Brookville quadrangle. Kittanning formation comprises (ascending) Lower Kittanning clay, Lower Kittanning coal, Middle Kittanning coal, Upper Kittanning sandstone, and Upper Kittanning coal. Overlies Clarion formation (with Lower Kittanning sandstone at top); underlies Freeport formation. Allegheny group.

M. N. Shaffner, 1946, Pennsylvania Geol. Survey, 4th ser., Topog. and Geol. Atlas 55, p. 65, 67. Formation, in Smicksburg quadrangle, comprises (ascending) Lower Kittanning coal, Middle Kittanning coals, Johnstown limestone, and Upper Kittanning coal. Overlies Clarion formation which includes Vanport limestone at top; underlies Freeport formation. Allegheny group; Pittsburgh series.

R. R. Dutcher, 1959, Geol. Soc. America Guidebook Pittsburgh Mtg., p. 70 (fig. 5), 71, 82–114 (includes road log). Middle formation of Allegheny group. In area of present study [Armstrong, Cambria, Clearfield, and Jefferson Counties], formation is about 100 feet thick. Comprises (ascending) Lower Kittanning coal and clay, Middle Kittanning coal, and Upper Kittanning coal. About 50 feet of sedimentary rocks, principally sandstone and shale, lie between each of these beds. Recent studies indicate that at least three more beds are sufficiently distinctive and widespread enough to merit tentative names. Also subdivided into (ascending) unnamed lower part; Lower Kittanning marine shale; Middle Kittanning complex; Nicely Run siltstone and sandstone member (new); Upper Kittanning marine shale; and unnamed upper part. Formation is approximately equivalent to middle Des Moines rocks of Midcontinent region.

E. G. Williams, 1960, Jour. Paleontology, v. 34, no. 5, p. 910 (fig. 2). Includes Lower, Middle, and Upper Kittanning coals. Overlies Clarion formation; underlies Freeport formation.

Carlyle Gray and others, 1960, Geologic map of Pennsylvania (1 :250,000): Pennsylvania Geol. Survey, 4th ser. Mapped as middle formation of Allegheny group.

Named for Kittanning, Armstrong County.

Kittanning Limestone (in Allegheny Formation)[1]

Pennsylvanian: Ohio.

Original reference: E. Orton, Jr., and S. V. Peppel, 1904, Ohio Geol. Survey Bull. 3, p. 92.

Probably named for Kittanning, Armstrong County, Pa.

Kittanning Sandstone Member (of Allegheny Formation)[1]

Pennsylvanian: Western Pennsylvania and eastern Ohio.

Original reference: I. C. White, 1878, Pennsylvania 2d Geol. Survey Rept. Q.

W. O. Hickok 4th and F. T. Moyer, 1940, Pennsylvania Geol. Survey, 4th ser., Bull. C–26, p. 71. Kittanning (Clarion) sandstone discussed in Allegheny group in this report [Fayette County]. In standard section for southwestern Pennsylvania, both Kittanning and Clarion sandstones lie between Lower Kittanning and Clarion coals. Since the sandstones are normally separated by Vanport limestone, which is absent in Fayette County, it is difficult to say definitely whether sandstone lying below Lower Kittanning coal is the Kittanning or Clarion, but, because sandstone commonly occurs in upper part of interval, it is here called Kittanning. Average thickness about 10 feet.

Named for Kittanning, Armstrong County, Pa.

Kittanning Shale (in Allegheny Formation)[1]

Pennsylvanian: Western Pennsylvania.

Original reference: I. C. White, 1878, Pennsylvania 2d Geol. Survey Rept. Q.

See Lower Kittanning shale.

Named derived from Kittanning, Armstrong County.

Kittatinny Limestone[1]

Upper Cambrian and Ordovician: Northern New Jersey and eastern Pennsylvania.

Original reference: H. D. Rogers, 1840, New Jersey Geol. Survey 2d and Final Rept., p. 112.

R. L. Miller, 1937, Geol. Soc. America Bull., v. 48, no. 11, p. 1694 (fig. 1), 1700 (fig. 2), 1704 (fig. 4). Figures 1, 2, and 4 (geol. maps) show Kittatinny limestone in eastern Pennsylvania. New Jersey term, Kittatinny, used here to include dolomitic limestones of Cambrian and Beekmantown age.

B. F. Howell and others, 1944, Geol. Soc. America Bull., v. 55, no. 8, chart 1. Shown on correlation chart as Upper Cambrian.

M. E. Johnson, 1950, geologic map of New Jersey (1:250,000): New Jersey Dept. Conserv. Econ. Devel. As mapped, consists of three units: lower—massive blue, blue-gray limestone with yellowish or silvery shale (Lower Cambrian); middle—light and dark medium-bedded limestones with cryptozoon heads (Upper Cambrian), unconformity; upper—thin and thick, gray or blue cherty magnesian limestone (Beekmantown), unconformity. Underlies Jacksonburg limestone; overlies Hardyston sandstone. Cambro-Ordovician.

F. B. Howell, Henry Roberts, and Bradford Willard, 1950, Geol. Soc. America Bull., v. 61, no. 12, pt. 1, p. 1357, 1366. New Jersey Survey designates its Cambrian and Ordovician limestone collectively as Kittatinny. This collective term not applicable in eastern Pennsylvania, and Cambrian sequence includes Hardyston quartzite (Chickies quartzite in Buckingham Valley), Leithsville limestone, Limeport formation (new), and Allentown formation.

First described in Kittatinny Valley, N.J.

†Kittatinny Sandstone[1]

Silurian: New Jersey.

Original reference: H. D. Rogers, 1840, New Jersey Geol. Survey 2d and Final Rept., p. 112.

Kittery Quartzite[1] (in Merrimack Group)

Kittery Formation

Probably Ordovician and Silurian: Southwestern Maine and southeastern New Hampshire.

Original reference: F J. Katz, 1917, Washington Acad. Sci. Jour., v. 7, p. 198.

M. P. Billings, 1955, Geologic map of New Hampshire (1:250,000): U.S. Geol. Survey. Included in Merrimack group in New Hampshire. Probably Ordovician and Silurian.

M. P. Billings, 1956, Geology of New Hampshire, pt. 2, Bedrock geology: Concord, New Hampshire State Plan. Devel. Comm., p. 39–40. Age tentatively considered Silurian.

H. H. Woodward, 1957, Jour. Geology, v. 65, no. 1, p. 61, 67–69. Termed formation. Not quartzite according to usual definition.

Named for exposures in Kittery, York County, Maine.

†Kittitas System[1]

Eocene: Western central Washington.

Original reference: I C. Russell, 1893, U.S. Geol. Survey Bull. 108.

Well exposed in western part of Kittitas County.

Klamath Gravels[1]

Pleistocene: Northern California.

Original reference: N. E. A. Hinds, 1933, California Jour. Mines and Geology, v. 29, nos. 1, 2, p. 120–121.

Type locality: Near Red Bluff, Tehama County. Named for Klamath Mountains.

†Klamath Schists[1] or Schist Series[1]

Precambrian (?): Northern California.

Original reference: O. H. Hershey, 1901, Am. Geologist, v. 27, p. 225–245. Klamath Mountains.

Kline Member (of Nesson Formation)

Jurassic: Subsurface in North Dakota and Montana, and Manitoba, Canada.

J. W. Nordquist, 1955, Billings Geol. Soc. Guidebook 6th Ann. Field Conf., p. 104, 105–106, fig. 2. Uppermost member of formation; overlies Picard member (new); underlies Piper formation. At type section, consists of (descending) 34 feet of light-gray to white earthy dolomite and fine-grained sandstone; 13 feet of gray-green to purple calcareous shale containing white gypsum; 37 feet of light- to dark-brown finely crystalline limestone, oolitic in part and becoming shaly toward base; 63 feet of light-gray to buff fine- to medium crystalline limestone, earthy, gypsiferous and fossiliferous in part. Pinches out by nondeposition short distance east of Big Snowy uplift and wedges out in like manner on west flank of Bowdoin dome. On west margin of Williston Basin, unconformably overlies either Mississippian, Pennsylvanian, or Triassic beds.

Type section: Interval 4,386 to 4,533 feet in Price Drilling Co. No. 1, Kline well, center SE¼SE¼SE¼ sec. 16, T. 157 N., R. 85 W., Ward County, N. Dak.

Klondike Member (of Columbus Formation)[1]

Middle Devonian: Central Ohio.

Original reference: L. G. Westgate, 1926, Ohio Geol Survey, 4th ser., Bull. 30, p. 17, 22–25.

Wilber Stout and R. A. Schoenlaub, 1945, Ohio Geol. Survey, 4th ser., Bull. 46, p. 21. In southwestern Delaware County overlies Eversole chert member. Thickness about 45½ feet.

J. W. Wells, 1947, Ohio Jour. Sci., v. 47, no. 3, p. 121 (fig. 1). Chart shows Delhi (Klondike) as uppermost member of Columbus. Overlies Eversole member.

Well exposed at quarry of Scioto Lime & Stone Co., popularly known as Klondike quarry, Delaware County.

Klondike Mountain Formation

Oligocene: Northeastern Washington.

Hunting Geophysical Services, Inc., 1960, *in* Washington Div. Mines and Geology Rept. Inv. 20, p. 6. Youngest bedrock formation (aside from certain dikes) in Curlew quadrangle. Unconformably overlies Sanpoil volcanic rocks (new). Consists principally of layers of coarse clastic and pyroclastic rocks with local tuffaceous sandstone, conglomerate, and mudstone in lower part and thick black to gray glassy flows (calcic in composition) in upper part; locally lower part contains black glass, and upper part contains volcanic breccia Includes Tom Thumb member (new) at base. Republic quadrangle and part of Aeneas quadrangle mapped by Muessig and Quinlan (1959, U.S. Geol. Survey Open-file Rept.); Curlew quadrangle mapped by Calkins, Parker and Disbrow (1959, U.S. Geol. Survey Open-file Rept.).

Report discusses parts of Okanogan and Ferry Counties.

Klutina Group[1]

Carboniferous or older: Southeastern Alaska.

Original reference: F. C. Schrader, 1900, U.S. Geol. Survey 20th Ann. Rept., pt. 7, p. 410, 413.

J. T. Dutro, Jr., and T. G. Payne, 1957, Geologic map of Alaska (1:2,500,000): U.S. Geol. Survey. Appears on map legend under Mississippian rocks undifferentiated.

Forms most of mountains about Lake Klutina, Copper River region.

Knapp Formation[1]

Knapp Formation (in Conewango Group)

Devonian or Carboniferous: Southwestern New York and northern Pennsylvania.

Original reference: L. C. Glenn, 1903, New York State Mus. Bull. 69, p. 967–989.

G. A. Cooper and others, 1942, Geol. Soc. America Bull., v. 53, no. 12, pt. 1, chart 4. Knapp sandstone shown on correlation chart as Devonian or Mississippian.

Bradford Willard, 1946, Geol. Soc. America Bull., v. 57, no. 9, p. 781–796. Discussion of continental-marine Mississippian relations in northern Pennsylvania. Marine Mississippian consists of Knapp formation including Kushequa shale and Marvin Creek "limestone." In region of marine-continental transition, Mississippian system represented by approximately 150 feet of beds. Marine fossils disappear eastward as discoidal-pebble conglomerates and sandstones of the Knapp merge with Pocono sandstone and conglomerate. Underlies Pottsville (or Olean); overlies Mount Pleasant shale or Oswayo formation.

I. H. Tesmer, 1954, Hobbies, v. 35, no. 2, p. 30, 33–34. Uppermost formation in Conewango group. Approximate thickness 20 feet in Chautauqua County, N.Y Overlies Oswayo formation. Upper Devonian.

Most eastern exposure is at Knapp's Creek Station, Cattaraugus County, N.Y.

Knapp formational suite[1]

Devonian or Carboniferous: Southwestern New York and northwestern Pennsylvania.

Original reference: K. E. Caster, 1934, Bulls. Am. Paleontology, v. 21, no. 71, p. 111, table opposite p. 60.

Knapp monothem[1]

Devonian or Carboniferous: Southwestern New York and northwestern Pennsylvania.

Original reference: K. E. Caster, 1934, Bulls Am. Paleontology, v. 21, no. 71, p. 103–104.

Kneeling Nun Rhyolite Tuff

Miocene(?): Southwestern New Mexico.

F. J. Kuellmer and others, 1953, *in* New Mexico Geol. Soc. Guidebook 4th Field Conf., p. 42 (map), 50 (map). Name appears on map explanations.

H L. Jicha, Jr., 1954, New Mexico Bur. Mines Mineral Resources Bull. 37, p. 39 (table 3), 44–45, pl. 1. Pale lavender-gray and dark-brown welded tuffs with prominent quartz phenocrysts, columnar jointing. Thickness 10 to 200 feet. Disconformable contacts with Sugarlump tuffs below and Mimbres Peak formation above. Derivation of name.

W. E Elston, 1957, New Mexico Bur. Mines Mineral Resources Bull. 38, p. 17 (table 1), 25–27, pl. 1. In Dwyer quadrangle, Kneeling Nun consists of at least two distinct rhyolite beds. Thickness 200 to 400 feet. Conformable with Sugarlump tuffs and could be considered their uppermost member. Underlies Mimbres Peak formation.

Named after prominent rock monument which overlooks town of Santa Rita, Grant County. Kneeling Nun is isolated column of welded rhyolite tuff which stands short distance in front of high escarpment of same rock.

Knickerbocker Andesite

Pliocene or Pleistocene: Western Nevada.

V. P. Gianella, 1936, Nevada Univ. Bull, v. 30, no. 9, p. 33 (table), 73–76, pl. 1. Dark, almost black, massive pyroxene andesite. In vicinity of Knickerbocker shaft, phenocrysts constitute two-fifths of rock; groundmass is light-brown transparent glass. Thickness 200 feet. In general, this andesite overlies Alta andesite breccias (new). Older than American Flat basalt (new). Late Pliocene.

F. C. Calkins and T P. Thayer, 1945, Preliminary geologic map of the Comstock Lode district, Nevada: U.S. Geol. Survey. Upper Pliocene or Pleistocene.

G. A. Thompson, 1956, U.S. Geol. Survey Bull. 1042–C, p. 57, pl. 3. Calkins (oral commun.) states that lava at Knickerbocker shaft is Alta formation and that what Gianella (1936) described as Knickerbocker is best represented by outcrops on Basalt Hill. Knickerbocker andesite unit, as represented by exposures on Basalt Hill, has general resemblance to pyroxene andesite member of Alta, but on fresh surface it is darker and on weathered surface is covered by characteristic buff-colored rind. Dikes of it cut Kate Peak formation. Geographical limits discussed. Age shown on plate as Pliocene or Pleistocene.

Typical occurrence is in vicinity of Knickerbocker shaft and another about 1,500 feet further to west. Distinguished only in Comstock Lode district, Virginia City quadrangle.

†Knife Slates[1]

Precambrian: Northeastern Minnesota.

Original reference: C. R. Van Hise and J. M. Clements, 1901, U.S. Geol. Survey 21st Ann. Rept., pt. 3, p. 401–409, map.

Named for Knife Lake, Vermilion district, where they are well developed.

Knife Lake Group

Knife Lake Series[1]

Precambrian: Northeastern Minnesota.

Original reference: F. F. Grout, 1933, Geol. Soc. America Bull., v. 44, no. 5, p. 992–995.

J. T. Stark and V. G. Sleight, 1939, Geol. Soc. America Bull., v. 50, no. 7, p. 1029–1041. Knife Lake series divided into (ascending) Moose Lake conglomerate (or Saddlebag Lake conglomerate), Dike Lake slate, Ogishke group (including Peebles conglomerate, West Gull conglomerate, and Zeta Lake conglomerate), and Knife Lake slate (including tuffaceous slate and graywacke, Agawa iron-formation, argillite, tuff and agglomerate).

J. W. Gruner, 1941, Geol. Soc. America Bull., v. 52, no. 10, p. 1583 (table 1), 1519–1618, pl. 1. Knife Lake series is continental in origin and comprises rocks formerly called Ogishke conglomerate, Agawa iron-formation, and Knife Lake slates. Includes many members (table 1 lists 20); these cannot be separated into three former divisions. No basal conglomerate exists in the sense in which Ogishke conglomerate exists. No distinct Agawa formation present. Conglomerates appear at any horizon in series, and small lenses of iron formation are not restricted to any particular horizon. Named units include (not in sequence): Disappointment Mountain and Moose Lake greenstone conglomerates, Jasper Lake greenstone conglomerates and agglomerates, Ogishke granite pebble conglomerate, Amoeba Lake graywackes, slates, and tuffs, Ensign Lake green slates, tuffs, and graywackes, Kekekabic Lake tuffs, agglomerates, slates, and andesite porphyry, Ensign-Snowbank Lake agglomerates, Ester Lake graywackes, slates and tuffs, Crooked Lake granite pebble conglomerate, and Agamok sediments. Unconformable below Animikie series and above Laurentian series.

F. F. Grout and others, 1951, Geol. Soc. America Bull., v. 62, no. 9, p. 1031–1036, 1073–1074, 1075. Summary discussion. In Minnesota, Knife Lake group rests unconformably on Keewatin greenstone and an old granite intrusive into the greenstone; it is intruded by Algoman granite; both the Knife Lake and Algoman granite are overlain unconformably by Animikie group. Thickness 11,500 to 21,000 feet. Correlation with Huronian groups is not certain.

Type locality: Knife Lake, on boundary of Minnesota and Ontario. Exposed westward to vicinity of Lake of the Woods.

†Knife Lake Slates[1]

Precambrian : Northeastern Minnesota.

Original reference: C. R. Van Hise and J. M. Clements, 1901, U.S. Geol. Survey 21st Ann. Rept., pt. 3, p. 401–409, map.

J. W. Gruner, 1941, Geol. Soc. America Bull., v. 52, no. 10, p. 1640. Knife Lake slates included in Knife Lake series.

U.S. Geological Survey has abandoned the term Knife Lake Slates. Approved name is Knife Lake Group.

Named for exposures at Knife Lake.

Knifeton Formation or cyclothem (in Cherokee Group)

Pennsylvanian (Des Moines Series) : Southeastern Kansas.

G. E. Abernathy, 1937, Kansas Geol. Soc. Guidebook 11th Ann Field Conf., p. 18, 20, 22; 1938, Kansas Acad Sci. Trans., v. 41, p. 193, 196. Cherokee group divided into 15 cyclic formational units. The Knifeton, fifth in sequence (ascending), occurs above the Bluejacket and below the Weir. Average thickness about 24 feet. Includes 8-inch coal bed here named Knifeton. [For complete sequence see Cherokee group.]

Type locality and derivation of name not given. Cherokee outcrop in Kansas covers area of about 1,000 square miles and includes parts of Labette, Bourbon, Crawford, and Cherokee Counties.

Knight Conglomerate

Knight Formation (in Wasatch Group)[1]

Knight Member (of Wasatch Formation)

Eocene : Southwestern Wyoming and northeastern Utah.

Original reference : A. C. Veatch, 1907, Jour. Geology, v. 15, p. 547–549.

J. H. Donavan, 1950, Wyoming Geol. Assoc. Guidebook 5th Ann. Field Conf., p. 60, 61, 62–63. In south-central Sublette County, considered member of Wasatch formation. Overlies New Fork tongue (new) of Wasatch. Conformably underlies Fontenelle member (new) of Green River formation. Early Eocene.

A. J. Eardley, 1952, Utah Geol. Soc. Guidebook 8, p. 52. In northeastern Utah, where Fowkes formation is absent, Knight conglomerate unconformably overlies Almy conglomerate; underlies Norwood tuff and related Park City volcanics. Middle Eocene.

W. J. Morris, 1955, Dissert. Abs., v. 15, no. 3, p. 394. Name Knight extended from Bridger basin into Washakie basin to include dominantly fluviatile Wasatchian deposits. Includes Hiawatha member and Cathedral Bluffs tongue.

M. C. McKenna, 1955, Wyoming Geol. Assoc. Guidebook 10th Ann. Field Conf., p. 105. Term Knight formation rejected as junior synonym of Wasatch formation.

B. E. Lofgren, 1955, Utah Geol. Soc. Guidebook 10, p. 74 (table 1), 75. Discussion of Tertiary stratigraphy in Ogden Valley. Thickness of Knight conglomerate about 1,200 feet. In Echo Canyon, Eardley (1944) mapped Almy conglomerate and subdivided it into Saw Mill conglomerate and underlying Pulpit conglomerate, these being separated by angular discordance of 5° to 30°. Since Eardley's original mapping, he and thesis students have remapped area and now consider Saw Mill conglomerate as Knight.

N. C. Williams and J. H. Madsen, Jr., 1959, Intermountain Assoc. Petroleum Geologists Guidebook 10th Ann. Field Conf., p. 123 (fig. 1). In Coalville area, Utah, Knight formation, 2,000 feet thick, unconformably overlies Echo Canyon conglomerate (new).

J. I. Tracey, Jr., and S. S. Oriel, 1959, Intermountain Assoc. Petroleum Geologists Guidebook 10th Ann. Field Conf., p. 128, 129, 130. Discussion of stratigraphy of Fossil basin, Wyoming. Confusion in original definition of Almy, Fowkes, and Knight formations as subdivisions of Wasatch group, and their areal distribution as mapped in much of basin, has led to serious doubt as to the validity of these names, particularly as the names Almy and Knight have been widely used in distant areas. It is hoped that future work will clarify the subdivisions of the Wasatch in the area and perhaps relate them to subdivisions in Bridger basin. At present, use of names Almy and Knight seem inadvisable without explicit statements as to their meaning.

Named for Knight Station, Uinta County, Wyo.

Knight Ranch Conglomerate (in Strawn Group)

Pennsylvanian: Central Texas.

F. B. Plummer, 1950, Texas Univ. Bur. Econ. Geology Pub. 4329, pl. 20. Shown on columnar section as thin conglomerate about 250 feet below Rochelle conglomerate.

Occurs in Brady area, McCulloch County.

Knik Glaciation

Pleistocene: Alaska.

T. N. V. Karlstrom, 1957, Science, v. 125, no. 3237, p. 74 (fig. 1). Named on correlation chart of glacial events. Recognized in Cook Inlet area. Y[illegible]er than Eklutna glaciation and older than Naptowne glaciation.

R. D. Miller and Ernest Dobrovolny, 1959, U.S. Geol. Survey Bull. [illegible] 12–54, pl. 3. Youngest pre-Wisconsin glaciation in Anchorage [illegible] Represented by sorted and unsorted drift that forms deposits of a[illegible] outwash, lateral moraine, ground moraine, pitted outwash, and g[illegible]vial and ice-contact deposits. Includes Bootlegger Cove clay (new), [illegible] locally separates Knik from overlying Naptowne deposits. Till and advance outwash of Knik glacier locally overlie truncated surface of Eklutna till.

Knob Creek facies[1] (of Carwood Formation)

Lower Mississippian: Southern Indiana.

Original reference: P. B. Stockdale, 1931, Indiana Dept. Conserv., Div. Geology Pub. 98, p. 77, 163–167.

J. M. Weller and others, 1948, Geol. Soc. America Bull., v. 59, no. 2, p. 127–128, pl. 1. Facies nomenclature discussed. Knob Creek facies listed in Carwood formation.

Name derived from Knob Creek, near Edwardsville, Floyd County.

Knob Hill Andesite

Eocene: North-central Washington.

L. B. Wright, 1947, Am. Inst. Mining Metall. Engineers Tech. Pub. 2197, p. 5. Felspar-rich series of flows about 525 feet thick. Overlain by Miocene shales; underlain by tuffaceous and coarsely fragmental flows resting on folded Paleozoic basement.

Occurs at Knob Hill mine, Republic mining district. Traced along crest of low northward-plunging Republic anticline.

Knob Lick Granite[1]

Precambrian : Southeastern Missouri.

Original reference: C. R. Keyes, 1895, Missouri Geol. Survey Sheet Rept. 4, v. 9, p. 18, 19, 24.

Named for Knob Lick, St. Francois County.

†Knob Noster Group[1]

Pennsylvanian : Central western Missouri.

Original reference: G. C. Broadhead, 1873, Missouri Geol. Survey Prelim. Rept. on Iron Ores, pt. 2, p. 169, 176.

Named for exposures at Knob Noster, Johnson County.

Knobsville (continental) Beds[1]

Middle Devonian : South-central Pennsylvania.

Original reference: Bradford Willard, 1935, Geol. Soc. America Bull., v. 46, Proc. Pal. Soc. Feb. 28, p. 202, 214, 215, 221.

Bradford Willard, 1939, Pennsylvania Geol. Survey, 4th ser., Bull. G–19, p. 199–200. Knobsville continental beds are phase of Mahantango formation and are made up of red and green beds devoid of marine organic remains except for a few poorly preserved specimens of dubious identity which occur at margins of deposit where it passes over into marine strata. This passage is gradual and determines Hamilton age of lower part of the Knobsville. Continental beds thicken eastward until lost through erosion toward Franklin County line.

Well developed between Knobsville and Hustontown, Fulton County, and northward toward Fort Littleton, where they are exposed in highway cuts.

Knobtown Sand[1] or Sandstone (in Pleasanton Group)

Pennsylvanian (Missouri Series) : Western Missouri and eastern Kansas.

Original reference: F. C. Greene, 1933, Missouri Bur. Geology and Mines 57th Bienn. Rept., p. 13, 19, App. 2, pl. 2.

R. C. Moore and others, 1951, Kansas Geol. Survey Bull. 89, p. 91. In Linn and Miami Counties, upper part of Pleasanton group partly occupied by massive sandstone (Knobtown) which is locally as much as 25 feet thick.

F. C. Greene and W. B. Howe, 1952, Missouri Geol. Survey and Water Resources Inf. Circ. 8, p. 6, 16. Lies above position of Exline limestone. Thickness about 5 feet in Kansas City area.

Named for outcrop north of Knobtown, Jackson County, Mo., on U.S. Highway 50, sec. 22, T. 48 N., R. 32 W.

Knowlton Amygdaloid[1] (in Central Mine Group)

Precambrian (Keweenawan) : Northern Michigan.

Original reference: B. S. Butler and W. S. Burbank, 1929, U.S.. Geol. Survey Prof. Paper 144 (chart compiled by M. G. Wilmarth).

Named for occurrence in Knowlton mine, Ontonagon County.

Knowlton Flow[1]

Precambrian (Keweenawan) : Northern Michigan.

Original reference: B. S. Butler and W. S. Burbank, 1929, U.S. Geol. Survey Prof. Paper 144 (chart compiled by M. G. Wilmarth).

Copper district of Keweenaw Point.

Knox Dolomite[1] **or Group**

Upper Cambrian and Lower Ordovician: Eastern Tennessee, northwestern Georgia, western North Carolina, and southwestern Virginia.

Original reference: J. M. Safford, 1869, Geology of Tennessee, p. 151, 158–159, 203–226.

Charles Butts and Benjamin Gildersleeve, 1948, Georgia Geol. Survey Bull. 54, p. 16–18, geol. map. Knox dolomite used in this report for map unit that corresponds nearly to Knox dolomite of type region. Difference is that Newala limestone, which in Georgia overlies the Knox of the region, is included in the typical Knox. Knox of Georgia includes rocks that in Alabama, Tennessee, and Virginia have been separated into (ascending) Copper Ridge dolomite, Chepultepec dolomite or limestone, and Longview or Nittany dolomite. While these units have been recognized in Georgia, the conditions of exposures and scarcity of fossils make their accurate separation impossible without much more detailed investigation than time permitted for present report. Knox of Georgia includes Longview at top and Chepultepec next below. Whatever Knox there is below the Chepultepec and down to the Conasauga is Copper Ridge. Estimated thickness 3,500 feet. Cambrian and Ordovician (U.S. Geological Survey) or Ozarkian and Canadian (of Ulrich).

John Rodgers and D. F. Kent, 1948, Tennessee Div. Geology Bull. 55, p. 14–32. Referred to as group in Lee Valley, Hawkins County. Comprises (ascending) Copper Ridge dolomite, Chepultepec dolomite, Longview dolomite, Kingsport limestone, and Mascot dolomite.

R. L. Miller and W. P. Brosgé, 1950, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 104, 2 sheets. Group, in Jonesville district, Lee County, Va., comprises Copper Ridge, Chepultepec, Longview, Kingsport, and Mascot dolomites. Overlies Chances Branch dolomite member of Maynardville limestone; underlies Dot limestone (new).

A. C. Munyan, 1951, Georgia Geol. Survey Bull. 57, p. 38–49. Mapped as Knox dolomite in Dalton quadrangle. Undifferentiated. Overlies Conasauga formation; underlies Newala formation.

R. B. Neuman, 1951, Am. Jour. Sci., v. 249, no. 10, p. 744 (table 1). Discussion of Great Smoky fault. Generalized stratigraphic sequence shows Knox group, undivided, 2,000 feet thick. Underlies Mosheim and Lenoir limestones; overlies Rome formation, sequence broken by fault.

John Rodgers, 1953, Tennessee Div. Geology Bull. 58, pt. 2, p. 53–64, pls. For present map, the Knox extends from top of Maynardville limestone to marked disconformity, observable everywhere in east Tennessee between Lower and Middle Ordovician rocks. Where Knox is divided into formations, it is referred to as group; where not subdivided, it is considered a formation, Knox dolomite. Where fully subdivided, consists of (ascending) Copper Ridge dolomite, Chepultepec dolomite, Longview dolomite, Kingsport formation, and Mascot dolomite.

A. T. Allen, 1953, Georgia Geol. Survey Bull. 60, p. 178–179. Report gives measured sections of Knox dolomite near Graysville. Comprises (ascending) Copper Ridge, Chepultepec, Longview, and Newala formations. Approximate total thickness 4,500 feet. Contact between Copper Ridge and underlying Conasauga indefinite at this locality. Top of Knox overlain by Blackford formation.

R. L. Miller and J. O. Fuller, 1954, Virginia Geol. Survey Bull. 71, p. 41–62, table 1, pls. Group described in Rose Hill district, Lee County, where it is about 2,300 feet thick and comprises (ascending) Copper Ridge, Chepultepec, Longview, Kingsport, and Mascot dolomites. Underlies Murfreesboro limestone; overlies Chances Branch member (new) of Maynardville limestone.

J. M. Cattermole, 1955, U.S. Geol. Survey Geol. Quad. Map GQ-76. In Shooks Gap quadrangle, Tennessee, group composed of 2,600 to 3,000 feet of dolomite and limestone. Comprises (ascending) Copper Ridge dolomite, Chepultepec, Longview, and Newala (Kingsport and Mascot undifferentiated).

Josiah Bridge, 1956, U.S. Geol. Survey Prof. Paper 277, p. 7 (fig. 2), 21-24, pl. 1. Knox group as used in this report [Mascot-Jefferson City Zinc district, Tennessee] comprises all strata above Maynardville limestone member of Nolichucky shale and below Lenoir limestone or its Mosheim member. It is virtually the Knox dolomite of Knoxville, Maynardville, and Morristown folios (Keith, 1895, 1901, 1896). Divided into (ascending) Copper Ridge dolomite of Late Cambrian age and Chepultepec, Longview, Kingsport, and Mascot formations of Early Ordovician age. Historical summary of usage of name.

P. B. King and H. W. Ferguson, 1960, U.S. Geol. Survey Prof. Paper 311, p. 28 (table), 55-57, pl. 1. Group, in northeasternmost Tennessee, comprises Conococheague limestone and Jonesboro limestone. Overlies Conasauga group; underlies rocks of Middle Ordovician age (Lenoir limestone at base). Thickness about 3,000 feet in Denton Valley.

Named for development in Knox County, Tenn.

Knox Gneiss[1]

Precambrian: Central southern and eastern Maine.

Original reference: E. H. Perkins and E. S. C. Smith, 1925, Am. Jour. Sci., 5th, v. 9, p. 204-288.

L. A. Wing, 1957, Maine Geol. Survey GP. and G. Survey 1, sheet 1. Mentioned in report on aeromagnetic and geologic reconnaissance survey of parts of Hancock and Penobscot Counties. Appears to be older than surrounding formations but not necessarily equivalent to Ellsworth.

Probably named for occurrence in town of Knox, Waldo County.

†Knox Group[1]

Lower, Middle, and Upper Cambrian and Lower Ordovician: Eastern Tennessee, northern Alabama, northwestern Georgia, and western North Carolina.

Original reference: J. M. Safford, 1869, Geology Tennessee, p. 151, 158-159, 203-226.

Crops out in greater part of surface of East Tennessee Valley. Probably named for Knox County, Tenn.

†Knox Sandstone[1]

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

Original reference: J. M. Safford, 1869, Geology of Tennessee, p. 151, 158-159, 203-226.

Named for Knox County, Tenn.

†Knox Shale[1]

Middle and Upper Cambrian: Eastern Tennessee, northern Alabama, northwestern Georgia, and western North Carolina.

Original reference: J. M. Safford, 1869, Geology of Tennessee, p. 151, 158–159, 204–226.

Named for Knox County, Tenn.

Knox Mountain Granite[1]

Age (?) : Northeastern Vermont.

Original reference: C. H. Richardson, 1906, Vermont State Geologist 5th Rept.

V. R. Murthy, 1957, Vermont Geol. Survey Bull. 10, p. 79–81. Outcrop area extends from East Barre area [this report] northward into Plainfield and St. Johnsbury quadrangles. Although a separate name is given to this granite, Knox Mountain granite and Barre granite may be separate outcrops of single plutonic body. No positive evidence to attest such relationship attainable for this report. Age not stated Rb/Sr age determination on Barre granite gave 330±25 million years. This suggests a Silurian age for the granite, but it is only slightly higher for Middle Devonian.

Named for Knox Mountains in East Barre quadrangle.

Knoxville Formation[1]

Knoxville Series

Upper Jurassic: California and Oregon.

Original reference: C. A. White, 1885, U.S. Geol. Survey Bull. 15, p. 19–32.

F. M. Anderson, 1943, California Div. Mines Bull. 118, pt. 2, p. 184 (fig. 68) [reprint 1941]; 1945, Geol. Soc. America Bull., v. 56, no. 10, p. 909–1014. Knoxville series subdivided into (ascending) Elder Creek, Grindstone, and Newville groups (all new). Maximum thickness more than 16,000 feet. Underlies Paskenta group, Shasta series. Jurassic (early-middle Portlandian to latest Tithonian).

N. L. Taliaferro, 1943, Am. Assoc. Petroleum Geologists Bull., v. 27, no. 2, p. 109–219. Franciscan-Knoxville problem discussed. Term Knoxville used here for sediments and volcanics above what is commonly regarded as Franciscan and below Lower Cretaceous. As commonly described, Knoxville consists of thick series of shales, with minor amounts of sandstone and conglomerate. This is adequate description of bulk of Knoxville in many localities, but it ignores certain important rocks in some localities and entire sections in other regions. Although there is a lithologic difference between Franciscan and Knoxville in many areas, this difference is not universal and types commonly regarded as Franciscan are in many places found in what must be called Knoxville on basis of fauna. The unconformity between Franciscan and Knoxville reported by many writers, is not supported by field evidence. Knoxville is here regarded as upper phase of the Franciscan, and it is suggested that name Franciscan-Knoxville group be used for entire sequence.

C. E. Weaver, 1949, Geol. Soc. America Mem. 35, p. 18 (table 3), 31–39, pls. In this report [Coast Ranges immediately north of San Francisco Bay region], Knoxville formation is included in Shasta series. In some areas, Knoxville formation, as used here, may include the Horsetown. Thickness about 11,000 to 13,230 feet. No depositional contact noted with Franciscan formation; most areas contacts are along thrust or normal faults.

M. D. Crittenden, Jr., 1951, California Div. Mines Bull. 157, p. 22 (fig. 4), 26–30, pl. 1. Generalized stratigraphic column (fig. 4) and geologic map of San Jose-Mount Hamilton area shows Knoxville formation above Franciscan formation and below Oakland conglomerate(?). Discussion of unit under heading of Knoxville(?) formation.

J. C. Brice, 1953, California Div. Mines Bull. 166, p. 11, 12 (fig. 2), pl. 1. For purposes of mapping in Lower Lake quadrangle, Franciscan-Knoxville group as defined by Taliaferro has been separated into two units, Franciscan group and Knoxville group. Knoxville, which consists mostly of shale, is about 10,000 feet thick. Underlies undifferentiated Cretaceous which in turn is overlain by Martinez formation. Upper Jurassic.

G. D. Robinson, 1956, U.S. Geol. Survey Geol. Quad. Map GQ–88. Formation, in Hayward quarangle, unconformably overlies Franciscan group and underlies Oakland conglomerate. Late Jurassic.

W. P. Irwin, 1957, Am. Assoc. Petroleum Geologists Bull., v. 41, no. 10, p. 2284–2297. Franciscan group is widely held to be restricted to Late Jurassic age, the Knoxville formation to be an upper shaly phase of the Franciscan group, and the two to be overlain unconformably by detrital strata of Cretaceous age. Paleontologic evidence indicates this view to be incorrect. Rather, Franciscan group seems mainly to have been deposited contemporaneously with the Knoxville, Paskenta, Horsetown, and lower upper Cretaceous strata. Franciscan group of Coast Ranges and strata of Sacramento Valley section may represent two facies of same stratigraphic section.

R. W. Imlay and others, 1959, Am. Assoc. Petroleum Geologists Bull., v. 43, no. 12, p. 2776, 2783. Name Riddle formation (new) replaces Jurassic part of Knoxville formation as used by Diller and Kay (1924, U.S. Geol. Survey Geol. Atlas, Folio 218) in southwestern Oregon. Name Days Creek formation (new) replaces Horsetown formation and Cretaceous part of Knoxville formation as used by Diller and Kay.

Named for exposures at Knoxville, Napa County, Calif.

†Knoxville Marble[1]

Lower Ordovician (late Chazy): Eastern Tennessee.

Original reference: J. M. Safford and J. B. Killebrew, 1900, Elements of geology of Tennessee, p. 105, 117, 121.

Named for Knoxville, Knox County, near which it is exposed.

Knoxville Member (of Pascagoula Formation)

Miocene: Southwestern Mississippi.

Mississippi Geol. Soc., 1940, Mississippi Geol. Soc. [Guidebook] Field Trip, Feb. 10–11, p. 4. Referred to as Knoxville zone in Pascagoula formation.

G. F. Brown and W. F. Guyton, 1943, Mississippi Geol. Survey Bull. 56, p. 22. Name Knoxville preoccupied; unit renamed Homochitto member. Underlies Fort Adams members.

Present in Franklin and Wilkinson Counties.

Kodak Sandstone (in Clinton Group)

Kodak White Sandstone[1]

Middle Silurian: Western New York.

Original reference: G. H. Chadwick, 1935, Am. Assoc. Petroleum Geologists Bull., v. 19, no. 5, p. 702.

D. W. Fisher, 1953, Buffalo Soc. Nat. Sci. Bull., v. 21, no. 2, p. 29. Chadwick (1935) was of opinion that Thorold sandstone was absent at Rochester because grayish-white sandstone there did not contain *Arthrophycus*, which he regarded as indicative of the Thorold. To this presumably younger sandstone beneath Maplewood shale he applied name Kodak white sandstone. There is no necessity for name Kodak because *Arthrophycus* has since been found in this sandstone at Rochester.

D. W. Fisher, 1959, New York State Mus. Sci. Service Geol. Survey Map and Chart Ser. 1. Because "Thorold" of Gillette (1947) is not continuous with type Thorold at Thorold, Ontario, name Kodak (Chadwick, 1920 [?]) is revived for basal sandstone of Clinton group in New York, Ontarian stage. Middle Silurian.

Type exposure: Lower Genesee Gorge from lower falls to Kodak Park, Rochester, Monroe County.

Koehler Limestone (in Traverse Group)

Middle Devonian: Northern Michigan.

W. A. Kelly and G. W. Smith, 1947, Am. Assoc. Petroleum Geologists Bull., v. 31, no. 3, p. 448 (fig. 1), 450 (fig. 2), 454–455. Defined to include gray bedded dense limestones of sublithographic texture, which are known to overlie Killians black limestone member of Genshaw formation (redefined), and unconformably underlie Gravel Point limestone. Estimated thickness (substantiated by well cuttings) 30 to 40 feet.

Type locality: Abandoned quarry of Campbell Stone Co., 1 mile north of village of Afton, Koehler Township, Cheboygan County.

Kofa Volcanics

Cretaceous: Southwestern Arizona.

E. D. Wilson, 1960, Geologic map of Yuma County, Arizona (1:375,000): Arizona Bur. Mines. Flows, dikes, and plugs of andesitic to rhyolitic composition.

Type locality and derivation of name not given.

Kogosukruk Tongue (of Prince Creek Formation)

Upper Cretaceous: Northern Alaska.

George Gryc, W. W. Patton, Jr., and T. G. Payne, 1951, Washington Acad. Sci. Jour., v. 41, no. 5, p. 166, figs. 2, 3. Nonmarine unit consisting largely of clay, silt, and shale. Bony coal and bentonitic beds common. Sandstone rare and only one conglomerate, 15 feet thick, has been mapped. Uppermost tongue of formation. Total thickness along Colville River is 2,340 feet but this includes marine units of Sentinel Hill member (new) of Schrader Bluff formation (new). In outcrop belt, overlies Tuluga member (new) of Schrader Bluff formation and is covered by thin mantle of Gubik formation.

C. L. Whittington *in* George Gryc and others, 1956, Am. Assoc. Petroleum Geologists Bull., v. 40, no. 2, p. 253, fig. 4. Overlies and intertongues with Sentinel Hill member of Schrader Bluff formation.

Named from Kogosukruk River, along which it is well exposed. Equally good if not better exposures readily accessible along Colville River from near its confluence with Anaktuvuk River to Ocean Point just north of 70th parallel.

Koipato Formation[1] or **Group**

Permian and Lower Triassic: Northern Nevada.

Original references: Clarence King, 1876, U.S. Geol. Expl. 40th Par. Atlas, map V; 1878, U.S. Geol. Expl. 40th Par., v. 2, p. 267–278.

H. E. Wheeler 1939, Jour. Paleontology, v. 13, no. 1, p. 105–107. Permian and possibly Triassic at least in part. Thickness 14,000 feet in Humboldt Range.

S. W. Muller and H. G. Ferguson, 1939, Geol. Soc. America Bull., v. 50, no. 10, p. 1590. Disconformably underlies Star Peak formation.

H. G. Ferguson, S. W. Muller, and R. J. Roberts, 1951, Geology of the Winnemucca quadrangle, Nevada: U.S. Geol. Survey Geol. Quad. Map [GQ–11]. Rhyolite and trachyte flows, breccias, and tuffs, some andesite, small amounts of conglomerate, sandstone, and tuffaceous slate. In East Range in lower plate, thickness over 4,500 feet; in Sonoma Range, in upper plate, thickness 300 feet or less, in places missing. Permian.

R. E. Wallace and others, 1959, U.S. Geol. Survey Mineral Inv. Field Studies Map MF–220. Rank raised to group. In Buffalo Mountain quadrangle, includes Rochester trachyte below and Weaver rhyolite above. Underlies Star Peak group. Permian, Permian(?), and Triassic.

U. S. Geological Survey currently considers the Koipato to be Permian(?) and Lower Triassic in age.

First described from West Humboldt Range. Koipato is Indian name for West Humboldt Range.

†Koipatoan series[1]

Middle(?) Triassic: Northern Nevada.

Original reference: C. R. Keyes, 1923, Pan-Am. Geologist, v. 40, p. 52, 59, 79.

Named for exposures in West Humboldt Range, Humboldt County, the Indian name for which is Koipato.

Kokernot Formation

Recent: Southwestern Texas.

C. C. Albritton, Jr., and Kirk Bryan, 1938, (abs.) Geol. Soc. America Bull., v. 49, no. 12, pt. 2, p. 1863. On basis of disconformities in valley-fill complex the Quaternary (late Pleistocene) has been divided into (ascending) Neville, Calamity, and Kokernot formations.

C. C. Albritton, Jr., and Kirk Bryan, 1939, Geol. Soc. America Bull., v. 50, no. 9, p. 1441–1442, 1445–1446, 1450–1451, 1453–1454. Consists predominantly of uncemented quartz sand and silt with interbedded gravel lentils, Contains cultural material at top and bottom; pottery in upper layers shows that beds were deposited within interval 1100–1400 A. D. Thickness varies from less than 1 foot to 13 feet. At type locality, rests disconformably on both Neville and Calamity formations.

Type locality: West bank of Calamity Creek 1 mile northwest of Neville's ranchhouse, Brewster County. Exposed in section at top of Arroyo banks. Named for Kokernot Ranch.

Koko Volcanics[1] (in Honolulu Volcanic Series)

Pleistocene, upper, or Recent: Oahu Island, Hawaii.

Original reference: H. T. Stearns, 1935, Hawaii Div. Hydrography Bull. 1.

G. A. Macdonald and D. A. Davis *in* Jacques Avias and others, 1956, Lexique Strat. Internat., v. 6, Océanie, fasc. 2, p. 104–105. Well-bedded gray to brown tuff, partly palagonitized, forming row of cones including Koko Head; and five associated small lava flows of alkali olivine basalt. Includes Koko Crater tuff, Koko Head tuff, Hanauma Bay tuff, and Kaohikaipu lava (Winchell, 1947, Geol. Soc. America Bull., v. 58, no. 1), none of which are regarded as formal names. Overlies Koolau volcanic series with steep erosional unconformity; also soil-covered emerged reef of plus 25-foot (Waimanalo) stand of sea. Extent noted.

Named for Koko Head and Koko Crater, which are cones composed of the tuff. Covers area of about 3 square miles extending northeastward from Koko Head, 2 to 5 miles southwest of Makapuu Head.

Kokomo Limestone[1]

Upper Silurian: Central Indiana.

Original reference: A. F. Foerste, 1904, Indiana Dept. Geology and Nat. History 28th Ann. Rept., p. 33.

J. B. Patton, 1949, Indiana Div. Geology Prog. Rept. 3, p. 13. Gray to brown banded dolomitic limestone, much of which is finely laminated. Although usually described as argillaceous, analyses show little alumina. At Kokomo and near Peru, upper beds are contorted, faulted, and recemented. Unconformably overlies Liston Creek, Mississinewa, and Niagaran reefs; underlies Kenneth limestone or Middle Devonian limestone. Has been considered Cayugan, but upper part may be Devonian.

Named for exposures at Kokomo, Howard County.

Kolekole Volcanics

Pleistocene(?): Oahu Island, Hawaii.

H. T. Stearns, 1946, Hawaii Div. Hydrography Bull. 8, p. 77. Lavas and cinders from secondary eruptions on Waianae Range. Probably correlative with secondary eruptions on Koolau Range. Pleistocene.

G. A. Macdonald and D. A. Davis *in* Jacques Avias and others, 1956, Lexique Strat. Internat., v. 6, Océanie, fasc, 2, p. 105. Overlie Waianae volcanic series and decomposed alluvium with erosional disconformity. Thickness about 6 feet. Pleistocene(?).

Crops out near Kolekole Pass in Waianae Range.

†Kolmakof Series[1]

Late Paleozoic to Tertiary(?): Southern Alaska.

Original reference: J. E. Spurr, 1900, U.S. Geol. Survey 20th Ann. Rept., pt. 7, p. 161–163, 182.

Crops out along right bank of Kuskokwim River between Kolmakof and beginning of low silt plain just above entrance to Yukon portage route above Kalchagamut.

Koloa Volcanic Series

Koloa Series

Pleistocene and Recent: Kauai Island, Hawaii.

N. E. A. Hinds, 1930, Bernice P. Bishop Mus. Bull. 71, p. 57, 58. Term Koloa series applied to lavas and pyroclastics erupted during Koloa volcanic episode.

H. T. Stearns, 1946, Hawaii Div. Hydrog. Bull. 8, p. 85, 87–89. Volcanic series composed of olivine basalts and ultrabasic rocks carrying nepheline and melilite. Separated from Waimea and Haupu volcanic series (new) by angular erosional unconformity.

G. A. Macdonald, D. A. Davis, and D. C. Cox, 1964, Volcano Letter 526, p. 2 (fig. 1). Overlies Waimea Canyon series [replaces term Waimea series]. Underlies Palikea formation (new).

D. A. Davis and G. A. Macdonald *in* Jacques Avias and others, 1956, Lexique Strat. Internat., v. 6, Océanie, fasc. 2, p. 105–106. Pleistocene and Recent. Type locality stated.

G. A. Macdonald, D. A. Davis, and D. C. Cox, 1960, Hawaii Div. Hydrography Bull. 13, p. 52–87, table facing p. 20, pl. 1. Koloa volcanic series, as herein defined, is that series of volcanic rocks and closely associated sedimentary rocks laid down on rocks of Waimea Canyon volcanic series and separated from them by profound erosional unconformity. Series includes lava flows of olivine basalt, nepheline basalt, melilite-nepheline basalt, and basanite, related cinder and tuff cones and ash beds, and closely associated or intercalated sedimentary breccia and conglomerates (Palikeo formation). Maximum exposed thickness 2,100 feet. A large part of the series was during Pleistocene epoch, but it is possible that Koloa eruptions began during the Pliocene.

Type locality: Vicinity of town of Koloa, on south side of island. Widely distributed over eastern two-thirds of island.

Kolosh Member (of Kialagvik Formation)

Lower Jurassic: Southwestern Alaska.

L. B. Kellum, 1945, New York Acad. Sci. Trans., ser. 2, v. 7, no. 8, p. 203 (table 1). Upper part of member of platy to massive medium-grained to conglomeratic greenish-gray sandstone 200 feet thick. Lower part of interbedded sandstone and shale becoming predominantly sandstone at top; 300 feet thick. Overlies Aleuts member (new); underlies Cynthia Falls member (new) of Tuxedni formation.

Kialagvik formation is recognized on Iniskin-Chinitna Peninsula.

Kona Dolomite[1]

Precambrian: Northwestern Michigan.

Original reference: C. R. Van Hise and W. S. Bayley, 1895, U.S. Geol. Survey 15th Ann. Rept., p. 523.

S. A. Tyler and others, 1940, Geol. Soc. America Bull., v. 51, no. 10, p. 1436 (table 1), 1461. Palmer gneiss, previously considered pre-Huronian, consists of metamorphic Mesnard quartzite, Kona dolomite, Wewe slate, and Ajibik quartzite. Table 1 shows lower Huronian sequence in Marquette area (ascending) Mesnard, Kona, Wewe. Palmer gneiss not listed on this table.

Composes Kona Hills, on east shore of Goose Lake, Marquette district.

Kona Tuff Formation

Pleistocene(?) and Recent: Hawaii Island, Hawaii.

C. K. Wentworth, 1938, Hawaiian Volcano Observatory 3d Spec. Rept., p. 90–91. Very fine grained yellow-brown palagonite ash with small amounts of fragments of olivine and feldspar crystals. Thickens gradually upslope from few inches to 5 feet; forms continuous mantle on mountain; grades into cinder cones at summit.

H. T. Stearns and G. A. Macdonald, 1946, Hawaii Div. Hydrography Bull. 9, p. 142; D. A. Davis and G. A. Macdonald *in* Jacques Avias and others, 1956, Lexique Strat. Internat., v. 6, Océanie, fasc. 2, p. 106. Included in Hualalai volcanic series (new).

Type locality: Kona district on west side of island. Exposed on southwest slope of Hualalai volcano.

Konawa Formation[1] (in Pontotoc Group)

Permian: East-central Oklahoma.

Original reference: G. D. Morgan, 1924, Bur. Geol. [Oklahoma] Bull. 2, p. 140–141, pls. 3, 27, map.

W. F. Tanner, 1956, Oklahoma Geol. Survey Bull. 74, p. 108–115, pl. 1. Further described in type area. Composed of shales, sandstones, and conglomerates. Shales are thick, varied in color, with red predominating; sandstones are commonly soft, and buff in color; includes two distinctively colored chert assemblages: dark chert conglomerates, here named Maud chert conglomerate member, and multicolored chert conglomerates, here named Jarvis Church conglomerate member. Thickness 600 to 800 feet; formation thickens downdip. Rests with local unconformity on Vanoss (uppermost Pennsylvanian) formation; contact at top of formation (Asher-Konawa following Morgan) appears to be marked by local unconformity.

A. E. West, 1960, Shale Shaker, v. 11, no. 3, p. 4–7. In this report [Lincoln County], formation includes (ascending) Brownville, Americus(?), Long Creek, and Red Eagle limestone members. For purposes of this report, base of formation is defined as top of Grayhorse limestone; top of formation not distinguishable in area. Pennsylvanian and Permian(?).

Type locality: Town of Konawa, Seminole County, located on extreme western edge of outcrop.

Konocti Volcanics (in Clear Lake Volcanic Series)

Quaternary: Northern California.

J. C. Brice, 1953, California Div. Mines Bull. 166, p. 12 (fig. 2), pl. 7. Quartz-, olivine-, and sanidine-bearing dacitic and andesitic lavas 100 to 1,500 feet thick. Shown on columnar section as uppermost unit of series above 50–700 foot unit of obsidian, but age relations of individual units of series are imperfectly known because some units are isolated and contacts of contiguous flows are commonly obscured by sliding.

Covers about 15 square miles south of Clear Lake, Lower Lake quadrangle, in Coast Ranges about 70 miles north of San Francisco. Volcanics also extend beyond quadrangle boundary where they build up Mount Konocti.

Koochiching Granite[1]

Precambrian (Laurentian): Northern Minnesota.

Original reference: A. N. Winchell, 1897, Am. Geologist, v. 20, p. 293–299.

Occurs 2 miles west of Rainy Lake.

Koolau Volcanic Series[1]

Koolau Basalt Series

Pliocene(?): Oahu Island, Hawaii.

Original reference: C. K. Wentworth, 1926, Bernice P. Bishop Mus. Bull. 30.

H. T. Stearns, 1946, Hawaii Div. Hydrog. Bull. 8, p. 75 (table), 77 (chart), 78. Exposed thickness of flows about 3,000 feet. Consists of thin-bedded pahoehoe and aa with small amount of ash. Includes Kailua volcanic series, lavas of which are believed to have accumulated in caldera of Koolau volcano. Separated from Waianae volcanic series by erosional unconformity. Older than Honolulu volcanic series.

C. K. Wentworth and Horace Winchell, 1947, Geol. Soc. America Bull., v. 58, no. 1, p. 49–78. Referred to as Koolau basalt series.

G. A. Macdonald and D. A. Davis, 1956, *in* Jacques Avias and others, Lexique Strat. Internat., v. 6, Océanie, fasc. 2, p. 106–107. Name Koolau volcanic series preferable because consonant with terminology used in describing rocks on other Hawaiian Islands. Includes all lava flows, intrusive rocks, pyroclastics, breccias, and intercalated soil beds making up Koolau Range except those (Honolulu volcanic series) concurrent with erosion of great valleys on its slope. Pliocene(?). Age assignment on basis of degree of weathering and erosion, and unconformable relationships to later Pleistocene rocks and shore lines. Notes on distribution.

No single type locality designated. Well exposed in Nuuanu Pali, the cliff that faces northeastward along northeastern side of range. Crops out over about 500 square miles.

Kootenai Formation[1]

Lower Cretaceous: Southern Alberta and British Columbia, Canada, and Montana.

Original references: Notes and News (J. W. Dawson?), Sci., v. 5, 1885, p. 531–532; G. M. Dawson, 1886, Canada Geol. Survey, new ser., v. 1, p. 126B–134B, 162B–167B.

W. A. Cobban, 1945, Am. Assoc. Petroleum Geologists Bull., v. 29, no. 9, p. 1268–1270. Discussion of marine Jurassic formations of Sweetgrass arch, Montana. Overlying Ellis group (herein redefined to include Sawtooth, Rierdon, and Swift formations) are continental beds of Upper Jurassic and Lower Cretaceous age. These beds, 348 to 1,300 feet thick, are divisible into three units. Lower unit, as much as 310 feet thick, rests conformably on Swift formation and consists chiefly of fine-grained rocks, largely clay shale and mudstone, dense gray limestone, and fine to very fine-grained gray and brown sandstone. This unit is considered as Morrison and the other two units, as much as 1,000 feet thick, as Kootenai. West of Kevin-Sunburst dome, the Kootenai rests unconformably on Morrison, Swift, and Rierdon formations. Understanding of this unconformity is important in interpretation of Morrison-Kootenai beds. Cut Bank sandstone is base of Kootenai locally, and younger Sunburst sandstone or bentonitic mudstone is base of formation over rest of Sweetgrass arch area.

R. W. Brown, 1946, Am. Assoc. Petroleum Geologists Bull., v. 20, no. 2, p. 238–248. Fossil plants support hypothesis that an unconformity in basal part of Kootenai formation in Montana, as it has been generally defined in the literature, and at base of Blairmore formation in Canada, marks Jurassic-Cretaceous boundary. Comparison of floras on both sides of unconformity heightens probability that the part of the Kootenai below the unconformity is to be included in the Morrison, which then is likely equivalent in whole or in large part to Kootenay of Canada, and that the part of the Kootenai of the United States corresponds in large part with lower Blairmore of Canada. Flora of upper part of the Kootenai and of lower Blairmore is an accepted Lower Cretaceous flora.

W. R. Lowell and M. R. Klepper, 1953, Geol. Soc. America Bull., v. 64, no. 2, p. 241. Beaverhead formation (new) unconformably overlies Cretaceous Kootenai, Triassic Dinwoody, and Permian Phosphoria. Angular disconcordance of about 25° between Beaverhead and Kootenai exposed in SW¼SE¼ sec. 11, T. 8 S., R. 10 W., near junction of Grasshopper Creek and Beaverhead River, Mont.

W. A. Cobban, 1955, Billings Geol. Soc. Guidebook 6th Ann. Field Conf., p. 107–109. Marine formation, chiefly mudstone, siltstone, and sandstone. Crops out along north flank of Little Belt Mountain uplift, along Disturbed belt, and in part of Sweetgrass Hills. Thickens southwestward from about 350 feet near Sweetgrass Hills to more than 1,300 feet in Disturbed belt. Made up of two major members. Lower member, as much as 250 feet thick, composed of several widespread units, each characterized by some lithologic feature. Upper member, as much as 800 feet thick, not readily subdivided. Lower boundary, on northwest flank of Sweetgrass arch, marked by erosional unconformity. Here, basal bed is Cut Bank sand, which is characterized by black chert grains. Across area from Cut Bank oil and gas field to vicinity of Summit, the Kootenai rests unconformably on beveled edges of marine Rierdon and Swift formations and on siltstone and mudstone that may represent the Morrison. In Disturbed belt between Birch Creek and Missouri River, massive coarse-grained crossbedded sandstone that overlies the Morrison is taken as base of Kootenai. Along north flank of Little Belt Mountain uplift, a salt-and-pepper sandstone resting on the Morrison is considered base of Kootenai. In subsurface over much of Sweetgrass arch, the Sunburst sand, a conspicuous white fine- to coarse-grained sandstone is commonly taken as base of Kootenai. Underlies Colorado shale.

M. R. Klepper, R. A. Weeks, and E. T. Ruppel, 1957, U.S. Geol. Survey Prof. Paper 292, p. 4 (table), 24–26, pl. 1. In southern Elkhorn Mountains, Mont., is 400 to 650 feet thick and comprises basal unit characterized by "pepper and salt" sandstone, a medial unit characterized by red and green shale and siltstone, and an upper unit characterized by gray limestone. Nonmarine origin. Overlies Morrison formation; underlies Colorado formation. Lower Cretaceous.

Name derived from tribe of Indians who hunted over that part of Rocky Mountains.

†Kosciusko Sand or Formation (in Claiborne Group)

†Kosciusko Sandstone Member (of Lisbon Formation)[1]

Eocene: Mississippi.

Original reference: C. W. Cooke, 1925, U.S. Geol. Survey Prof. Paper 140, p. 133–135.

E. P. Thomas, 1942, Mississippi Geol. Survey Bull. 48, p. 40–47. Rank raised to formation. Redefined to include all beds above Zilpha shale and below Wautubbee formation. Formation is heterogeneous highly lenticular nonmarine section in which sand and shale are dominant facies. Basal interval of 50 to 200 feet typically composed of massive to highly crossbedded sands colored red, brown, yellow, purple, pink, violet, gray, and white on outcrop. Shales increase in abundance above basal sand until they usually predominate over sand in upper part of section. Thickness increases along strike from 85 feet at Alabama line to maximum of 400 feet in Attala, Holmes, and Carroll Counties.

H. A. Tourtelot, 1944, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 6. Mapped as Kosciusko sand in Claiborne group.

G. F. Brown, 1947, Mississippi Geol. Survey Bull. 65, p. 45–48. Kosciusko sand crops out in belt 6 to perhaps more than 20 miles wide in northern Mississippi, western or upper boundary flanking alluvial plain in Carroll, Grenada, Tallahatchie, and Panola Counties. Sand extends beneath plain, except for small area adjacent to Bluff Hills where alluvium rests on Zilpha clay. In Carroll County, the massive sand overlaps Zilpha clay and part of Winona sand; farther north, there is evidence that it rests on Basic City shale member of Tallahatta and that near Tennessee line, it may overlap Meridian sand member of Tallahatta. Thickness of exposed section about 100 feet in Carroll County. U.S. Geological Survey currently uses term Sparta sand in preference to term Kosciusko sand.

Named for exposures in vicinity of Kosciusko, Attala County.

Kosk Member (of Modin Formation)

Upper Triassic: Northern California.

A. F. Sanborn, [1953], Stanford Univ. Abs. Dissert., v. 27, p. 436. Upper member of formation. Overlies Devils Canyon member (new); underlies Arvison formation (new).

A. F. Sanborn, 1960, California Div. Mines Spec. Rept. 63, p. 6, 11, pl. 1. Formal proposal of name. Dominantly thin-bedded dark-gray to black argillite. Two beds composed of andesitic flows, coarse tuffs, and agglomerates present; both beds approximately 300 feet thick. Thickness about 3,600 feet at type locality. Overlies Devils Canyon member; underlies Arvison formation.

Type locality: Along Kosk Creek and Devils Canyon from point on Kosk Creek about 1 mile north of Arvison Flat, where upper contact of member is exposed, to its lower contact about one-quarter mile west of junction of Devils Canyon and Alder Creek, Big Bend quadrangle, Shasta County.

Koster (joint) Clays[1]

Upper Cretaceous (Gulf Series): Southwestern Arkansas.

Original reference: R. T. Hill, 1888, Arkansas Geol. Survey Ann. Rept. 1888, v. 2, p. 79, 81.

Named for occurrence at or near Nicholas Koster's house, sec. 13, T. 7 S., R. 21 W., Clark County.

†Kotlo Series[1]

Precambrian and lower Paleozoic: Southeastern Alaska.

Original reference: A. H. Brooks, 1900, U.S. Geol. Survey 21st Ann. Rept., pt. 2, p. 357.

Kotsina Conglomerate[1]

Jurassic or Cretaceous: Central southern Alaska.

Original reference: O. Rohn, 1900, U.S. Geol. Survey 21st Ann. Rept., pt. 2, p. 431, map, pl. 52.

F. H. Moffit, 1938, U.S. Geol. Survey Bull. 894, p. 68, pl. 2. Maximum thickness in mountains north of Ellicott Creek not less than 1,500 feet and in all probability is much more, possibly 2,000 or 2,500 feet. Mapped as Middle or Upper Jurassic.

R. W. Imlay and J. B. Reeside, Jr., 1954, Geol. Soc. America Bull., v. 65, no. 3, chart 10–d facing p. 246, column 17. Upper Cretaceous on correlation chart.

Occurs on Kotsina River.

†Kougarok Group[1]

Ordovician, Silurian, and Devonian(?): Northwestern Alaska.

Original reference: A. J. Collier, 1902, U.S. Geol. Survey Prof. Paper 2, p. 21, map.

Ko Vaya Quartz Monzonite

Age not stated: Central southern Arizona.

Leonid Bryner, 1958, Dissert. Abs., v. 19, no. 6, p. 1341. Intrudes Jaeger diorite complex (new). Older than clastic sediments of continental, fluviatile origin, which are inferred to be Lower Cretaceous.

In South Comobabi Mountains and Ko Vaya Hills, Papago Indian Reservation, Pima County.

Kowak Clay[1]

Pleistocene: Northwestern Alaska.

Original reference: W. H. Dall and G. D. Harris, 1892, U.S. Geol. Survey Bull. 84, p. 265, 327, map.

Occurs in clay bluff, three-quarters mile long and 150 feet high, on left bank of Kowak River, at about long 158°.

Koyukuk Group[1]

Lower Cretaceous: North-central Alaska.

Original reference: F. C. Schrader, 1902, Soc. America Bull., v. 13, p. 246.

J. T. Dutro, Jr., and T. G. Payne, 1957, Geologic map of Alaska (1:2,500,000): U.S. Geol. Survey. Appears on map legend.

Occurs along Koyukuk River and may have very wide extent over Koyukuk Basin.

Kramer Lake Beds (in Ricardo Formation)

Miocene, upper: Southern California.

H. S. Gale, 1946, California Jour. Mines and Geology, v. 42, no. 4, p. 326. Series of borate-bearing beds. Members identified (descending) as "green shale," "blue shale," which includes borates and dark-gray shale. These overlies basaltic lava (Saddleback basalt). Maximum thickness of beds about 350 feet.

Present in vicinity of Kramer, southeastern Kern County.

Krebs Formation (in Cherokee Group)

Krebs Group

Pennsylvanian (Des Moines Series): Central and northeastern Oklahoma, southeastern Kansas, and western Missouri.

M. C. Oakes, 1953, Am. Assoc. Petroleum Geologists Bull., v. 37, no. 6, p. 1523–1524. Name introduced for lower group of Des Moines series in Oklahoma. Includes all rocks that crop out between top of Atoka formation below and top of Boggy formation above. Comprises (ascending) Hartshorne sandstone, McAlester formation, Savanna formation, and Boggy formation. Extends from northeast flank of Arbuckle Mountains northeastward to Kansas-Oklahoma line and eastward in McAlester basin to Arkansas-Oklahoma line. Thickness about 6,000 feet west of McAlester, along axis of McAlester basin; more than 8,000 feet thick in eastern part of basin; thins southwestward along northeast flank of Arbuckle Mountains; also thinner northeastward, being about 549 feet along Arkansas River and 340 feet along Kansas-Oklahoma line. Conformable on Atoka formation wherever Atoka is present, but unconformable on older rocks both in Arbuckle Mountains, where Boggy formation rests on Ordovician Fernvale limestone, and in northeastern Oklahoma; unconformable below Cabaniss group (new). Krebs and Cabaniss rocks together are nearly but not quite the same, stratigraphically, as Cherokee rocks of southeastern Kansas.

W. V. Searight and others, 1953, Am. Assoc. Petroleum Geologists Bull., v. 37, no. 12, p. 2748 (fig. 1). Group shown on northern Midcontinent composite stratigraphic section as including (ascending) Riverton, Warner, Rowe (new), Dry Wood (new), Bluejacket, and Seville formations.

T. K. Searight, 1954, Missouri Geol. Survey and Water Resources Rept. Inv. 15, p. 23. In southwestern Missouri, group conforms to Midcontinent stratigraphic column. Only Riverton and Warner formations present in Humansville quadrangle.

W. B. Howe, 1956, Kansas Geol. Survey Bull. 123, p. 22 (fig. 5), 27–44. Term Cherokee readopted, and Krebs reduced to rank of subgroup in Cherokee group. Average thickness of outcrop area in Kansas between 200 and 250 feet. Comprises about half of pre-Marmaton Desmoinesian section in Kansas.

J. M. Jewett, 1959, Graphic column and classification of rocks in Kansas: Kansas Geol. Survey. Shown on chart as formation in Cherokee group. Includes Warner sandstone and Bluejacket sandstone together with several coal beds. Underlies Cabaniss formation.

Named for town of Krebs, in T. 5 N., R. 15 E., central Pittsburg County, Okla.

Kreyenhagen Shale[1] or **Formation**

Eocene and Oligocene: Southern California.

Original reference: F. M. Anderson, 1905, California Acad. Sci. Proc., 3d ser., v. 2, p. 163–168.

R. D. Reed and J. S. Hollister, 1936, Am. Assoc. Petroleum Geologists Bull., v. 20, no. 12, p. 1566 (fig. 9). In Devils Den area, overlies Point of Rocks sandstone (new).

H. E. Vokes, 1939, New York Acad. Sci. Annals, v. 38, p. 13 (table 1). Formation overlies Domengine formation and underlies Tumey shale.

J. A. Cushman and S. S. Siegfus, 1942, San Diego Soc. Nat. History, v. 9, no. 34, p. 385–426, pls. Shale described at Garza Creek, Kings County. This section compares favorably with type locality at Canoas Creek, originally designated by Anderson (1905). In present work, the two localities together are considered type area of Kreyenhagen. Formation divided lithologically into 10 members (A to J inclusive), lowest (J) is Canoas siltstone member. Thickness about 1,000 feet. Overlies Avenal sandstone; underlies Vaqueros(?) sand. Upper part of Kreyenhagen down to base of sandy "D" member considered equivalent in part at least of Tumey formation of Atwill (1935). Because type Kreyenhagen shale south of Coalinga, referred to as "Kreyenhagen" by Atwill, was not believed to include any correlative of Tumey formation, he believed term "Tumey formation" justified, although term "Wagon Wheel formation" had been proposed some years earlier (Johnson, 1909) for beds occupying a similar position in geologic column. Lower part of formation is Eocene; future work may show that part of Kreyenhagen is Oligocene.

I. F. Wilson, 1943, California Jour, Mines and Geology, v. 39, no. 2, p. 210–213. Kreyenhagen shale is group of foraminiferal calcareous, siliceous clay-shales with some interbedded sandstones and limestone. Occurs on both limbs of Butts Ranch syncline in San Benito quadrangle. Thickness 400 to 1,800 feet on northeast limb; 1,500 to 2,500 feet on southwest limb. On southwest side of syncline, shows following units: lower, 300 to 1,000 feet thick, foraminiferal clay-shales and platy shales with some interbedded sandstone and limestone, and thin glauconitic sandstone at base, equivalent to Canoas siltstone member of Coalinga district; Bear Canyon sandstone member (new), 100 to 300 feet thick; siliceous and calcareous foraminiferal platy shales with some limestone, 500 to 1,500 feet thick. Rests everywhere on Domengine sandstone; underlies Temblor group. Upper Eocene.

B. L. Clark, 1943, California Div. Mines Bull. 118, pt. 2, p. 189 (fig. 73) [preprint 1941]. Correlation chart shows "Kreyenhagen proper" underlying Tumey formation and overlying Canoas silt.

P. P. Goudkoff, 1943, California Div. Mines Bull. 118, pt. 2, p. 248 (fig. 99A), 250 [preprint 1941]. Kreyenhagen shale (formation) shown on correlation chart as underlying Tumey shale and overlying Nortonville claystone in Coalinga area. Forms middle member of Kreyenhagen group and upper part of Clarke and Vokes' (1936) Tejon and Transition stages.

Ralph Stewart, 1949, U.S. Geol. Survey Oil and Gas Inv. Prelim. Chart 34. Formation, in area covered by this report, contains much sand and is divided into (ascending) Nortonville shale, Markley sandstone, and "Sidney" shale members. Overlies Domengine formation. Upper Eocene.

L. I. Briggs, Jr., 1953, California Div. Mines Bull. 167, p. 12 (fig. 2), 41–44, pl. 1. Kreyenhagen formation of this report [Ortigalita Peak quadrangle] includes Kreyenhagen shale as described by Anderson and Pack (1915, U.S. Geol. Survey Bull. 603) and laminated sandstone and shale, radiolarian shale, and pebbly greensand which are termed lower member of formation. Thickness about 700 feet. Overlies Tesla(?) formation; underlies San Pablo formation.

J. E. Schoellhamer and D. M. Kinney, 1953, U.S. Geol. Survey Oil and Gas Inv. Map OM–128. In this report [Tumey and Panoche Hills, Fresno County], all strata lying between Domengine sandstone and overlying Temblor formation of Miocene age are included in Kreyenhagen shale. Atwill's sandstone unit of Tumey formation is here called sandstone member of Kreyenhagen. Where sandstone member is absent, the Kreyenhagen consists of about 1,300 feet of thin-bedded chocolate-brown to white soft punky diatomaceous shale and mudstone, with interbedded medium- to coarse-grained sandstone near base and abundant sandstone dikes throughout. Sandstone member is 105 feet thick in Tumey Gulch. Citing of two type areas in original description and assignment of formation to Miocene when later work has shown it to be Oligocene(?) and Eocene in age have led to considerable confusion and extensive bibliography. Woodring and others (1940, U.S. Geol. Survey Prof. Paper 195) described differences in interpretation of Kreyenhagen in general areas and problems that have arisen from them.

H. P. Smith, 1956, California Univ. Pubs. Geol. Sci., v. 32, no. 2, p. 67, 68 (fig. 2), geol. map. Formation, in Devils Den area, consists of tan, buff, and chocolate-brown argillaceous silts about 1,000 feet thick. Van Couvering and Allen's (1943) Welcome formation designated as member of

Kreyenhagen. Conformable on Point of Rocks sandstone; underlies Wagonwheel formation. Eocene or Oligocene.

V. S. Mallory, 1959, Lower Tertiary biostratigraphy of the California Coast Ranges: Tulsa, Okla., Am. Assoc. Petroleum Geologists, p. 55–73, fig. 7. Included in Narizian stage (redefined).

Type locality: At Kreyenhagen wells, on Canoas Creek in central part of Reef Ridge area, about 12 miles south of town of Coalinga, Fresno County.

Krider Limestone Member (of Nolans Limestone)

Krider Limestone (in Sumner Group)[1]

Permian: Southeastern Nebraska and eastern Kansas.

Original reference: G. E. Condra and J. E. Upp, 1931, Nebraska Geol. Survey Bull. 6, 2d ser., p. 60.

R. C. Moore, J. C. Frye, and J. M. Jewett, 1944, Kansas Geol. Survey Bull. 52, pt. 4, p. 163; R. C. Moore and others, 1951, Kansas Geol. Survey Bull. 89, p. 41. Member of Nolans limestone. Commonly two beds of limestone separated by bed of shale, each about 1 foot thick; in southern Kansas, the separating shale is somewhat thicker. Underlies Paddock shale member; overlies Odell shale. Wolfcamp series.

Type locality: Roadcut one-fourth mile south of Krider, Gage County, Nebr.

Kriley Formation

Eocene(?): Central eastern Idaho.

A. L. Anderson, 1959, Idaho Bur. Mines and Geology Pamph. 118, p. 15, 21–22. Chiefly thick conglomerate, basal part of which occurs in clifflike exposures more than 100 feet high near Kriley Creek. Coarsely textured conglomerate composed of boulders up to 1 foot in diameter firmly cemented in silty and sandy matrix. The generally well water-worn boulders largely derived from Lemhi quartzite with some admixture of granitic rocks. Near Kriley Creek, thick massive bed of conglomerate overlain by light-colored well-stratified beds of sandy shale and sandstone. South of Boyle Creek, conglomerate thicker than usual, showing better developed bedding along lower few tens of feet and made up mostly of boulders ranging up to 6 inches. Thickness of formation over 600 feet. Unconformably overlies Lemhi quartzite near Kriley Creek and unconformably underlies Challis volcanics. Directly underlies Geertson formation south of Boyle Creek. No fossils to date formation. Either deposited in response to Laramide uplifts in Paleocene time, or deposited with post-Laramide Eocene conglomerates. Age given as Paleocene(?) on geologic map and Eocene(?) on composite stratigraphic table.

Named from its position near Kriley Creek, in North Fork quadrangle, Lemhi County. Best and perhaps only exposures are along east side of Salmon River, both north and south of Boyle Creek. Exposures north of Boyle Creek extends nearly to Kriley Creek.

Kriz Lens (in Hueco Formation)

C. O. Dunbar, 1953, Am. Jour. Sci., v. 251, no. 11, p. 799 (fig. 1), 801 (fig. 2), 802–803, pl. 1. Limestone lens about 600 feet across and 150 feet thick at top of Hueco formation. Lower part of Hueco grades upward into light-gray limestone mostly in thin even beds, but with a few thick layers, upper one of which locally thickens to form the Kriz lens.

Occurs in east slope of Victorio Peak in Sierra Diablo, Trans-Pecos Texas. Kriz lens forms convenient landmark near Ellis Porter ranchhouse.

Kruger alkaline body[1]

Kruger Alkaline Syenites

Tertiary: Central northern Washington, and southern British Columbia, Canada.

Original reference: R. A. Daly, 1906, Geol. Soc. America Bull., v. 17, p. 349.

C. D. Campbell, 1939, Am. Jour. Sci., v. 237, no. 9, p. 531–549. Further described as Kruger alkaline syenites. Intrudes Anarchist series; intruded by Similkameen granite.

Occurs on Washington-British Columbia boundary. Probably named from Kruger Mountain, British Columbia.

Kruger Schist[1]

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

Original reference: R. A. Daly, 1906, Geol. Soc. America Bull., v. 17, p. 329–376.

Probably named for occurrences on roughly tabular Kruger Mountain, British Columbia.

Kruger Mountain Malignite

Mesozoic: Northeastern Washington.

A. C. Waters and Konrad Krauskopf, 1941, Geol. Soc. America Bull., v. 52, no. 9, p. 1368–1369, pl. 1. Dark coarse-grained rock, consisting dominantly of augite, hastingsite, and microcline. Listed as intrusive rock older than Colville batholith.

Exposures limited to two small hills on either side of Okanogan Valley about 4 miles south of international boundary, Okanogan County.

†Kugruk Group[1]

Ordovician, Silurian, and Devonian(?): Northwestern Alaska.

Original reference: A. J. Collier, 1902, U.S. Geol. Survey Prof. Paper 2, p. 21, map.

Probably named for Kugruk Mountain and Kugruk [Kougarok] River, Seward Peninsula.

Kuhiwa Basaltic Andesite (in Hana Volcanic Series)

Pleistocene(?): Maui Island, Hawaii.

G. A. Macdonald *in* H. T. Stearns and G. A. Macdonald, 1942, Hawaii Div. Hydrography Bull. 7, p. 230 (table), 249–251, pl. 1. Single aa flow; locally two or more flow-units separated by clinker are present. Basal clinker generally thin and absent. Sparingly vesicular, locally nonporphyritic, but usually with a few phenocrysts of brownish-green olivine. Maximum thickness in drill holes east of Makapipi Stream 75 feet. Overlies Mossman basalt (new), generally with several inches of soil at contact. Each member of series underlain by local erosional unconformity.

G. A. Macdonald and D. A. Davis *in* Jacques Avias and others, 1956, Lexique Strat. Internat., v. 6, Océanie, fasc. 2, p. 107. Pleistocene(?).

Named for exposures along Kuhiwa Gulch near highway, Haleakala (East Maui) volcano. Occupies most of area east of Makapipi Stream; tongue between east and west forks of Makaino Stream is similar in composition and stratigraphic relations and is probably branch of same lava flow.

Kukpowruk Formation (in Nanushuk Group)

Lower Cretaceous: Northwestern Alaska.

E. G. Sable, 1956, Am. Assoc. Petroleum Geologists Bull., v. 40, no. 11, p. 2637–2640, figs. 2, 3. Largely marine inshore deposit of interbedded shale, siltstone, and sandstone with minor amounts of claystone, conglomerate, and carbonaceous shale. Rock types vary in abundance both laterally and vertically; thick resistant sandstone units most abundant in southern part of outcrop area, south of type locality. Thins eastward and northward from about 5,000 feet on upper Kukpowruk River to about 2,000 feet along lower Utukok River. Base of formation rises in stratigraphic section by intertonguing with Torok formation, as traced northeastward. Basal contact placed at lowest persistent sandstone beds which form break in slope above lowlands underlain by Torok formation. Underlies nonmarine Corwin formation with gradational contact.

R. M. Chapman and E. G. Sable, 1960, U.S. Geol. Survey Prof. Paper 303–C, p. 64–101, pl. 8. Described and mapped in Utukok-Corwin region. Chiefly marine rocks (inshore facies) with some nonmarine rocks (coastal facies) in upper part and in southernmost exposures. Dominant rock types are shale, siltstone, sandstone, and claystone. Northeastward facies changes from sandstone to shale in basal part of formation, which overlies and intertongues with Torok formation. Thins northeastward from more than 5,000 feet to about 2,000 feet. Similar to Grandstand formation of Nanushuk group mapped in areas further east.

Type locality: Along Kukpowruk River between long 162° 42′ and 162° 44′ W., about 34 miles above river mouth. Lower part better exposed in foothills south of type locality. Named from river.

Kula Volcanic Series

Tertiary, upper (?) : Maui Island, Hawaii.

H. T. Stearns *in* H. T. Stearns and G. A. Macdonald, 1942, Hawaii Div. Hydrography Bull. 7, p. 65 (table), 67 (table), 69, 74–90, pls. 1, 15, 16. Chiefly aphanitic dense gray to steel-blue andesitic type aa flows with thick clinker beds. Lenticular bedding common. Thin-bedded aa and pahoehoe present near summit, but pahoehoe scarce farther seaward, except in transition zone at bottom of series. Flows average about 20 feet in thickness near summit and 50 feet near periphery; some flows 200 feet thick. Numerous erosional unconformities and interstratified soil beds indicate that upper Kula lavas accumulated in waning phase of a volcano when time interval between flows became progressively longer; as the lavas changed to more siliceous composition, they became progressively more viscous and their flows shorter; thus they accumulated chiefly about summit where they attained thickness of 2,000 feet or more. Underlie Hana lavas (new) at shallow depths; in deep valleys, were probably removed by erosion before Hana time because here Hana lavas lie on alluvium or on Honomanu basalts (new). Overlie and generally transitional into Honomanu volcanic series.

G. A. Macdonald *in* H. T. Stearns and G. A. Macdonald, 1942, Hawaii Div. Hydrography Bull. 7, p. 285–291. Discussion of petrography.

G. A. Macdonald and D. A. Davis *in* Jacques Avias and others, 1956, Lexique Strat. Internat., v. 6, Océanie, fasc. 2, p. 107–108. Late Tertiary (?).

Named for settlement along upper and lower road leading to Kula Sanatorium on west slope.

Kulthieth Formation

Eocene and Oligocene(?): Southeastern Alaska.

D. J. Miller, 1957, U.S. Geol. Survey Oil and Gas Inv. Map OM–187, sheets 1 and 2. Nonmarine and marine sandstone and siltstone with many intercalated thin beds of high-rank coal. Includes three predominantly sandy units at type locality—upper 1,400 feet and the intervals, 1,900 to 3,200 feet and 3,600 to 5,400 feet below top. These alternate with three predominantly or conspicuously silty units. About 65 percent of section at type locality of sandstone, most abundant type being massive to crossbedded and arkosic that is gray to olive gray on fresh surfaces and weathers yellowish gray to brown. Total thickness at least 9,300 feet. Underlies Poul Creek formation with apparent conformity.

Type locality: In vicinity of small lake at head of northeasternmost branch of Kulthieth River where what is believed to be the most complete and least disturbed section occurs.

Kummer Series[1]

Kummer Formation (in Puget Group)

Eocene: Western Washington.

Original reference: G. W. Evans, 1912, Washington Geol. Survey Bull. 3, p. 42–49.

C. E. Weaver, 1937, Washington [State] Univ. Pubs. in Geology, v. 4, p. 55, 56–57. Uppermost formation of group in Green River area. Consists of alternating layers of well-stratified sandy, carbonaceous shales, and medium- to coarse-grained massive brownish-gray sandstone; intercalated with these strata are thin seams of coal, bone, and impure carbonaceous material; includes 475-foot sandstone at base. [Referred to as Kummer sandstone by Evans.] Maximum thickness 1,800 feet. Overlies Franklin formation. Formations in Green River Canyon are involved in anticlinal and synclinal folds whose axes trend northeast.

Name derived from Kummer, King County.

Kupikipikio Basalt[1]

See **Black Point Basalt.**

Kupikipikio Black Ash[1]

See Diamond Head Black Ash.

Kure Sandstone

Pleistocene, upper: Eastern North Carolina.

W. B. Wells, 1944, Elisha Mitchell Sci. Soc. Jour., v. 60, no. 2, p. 129–130, pls, 63, 64. Vertical cliff exposes four layers (or horizons) which show progressively decreasing consolidation upward; each lies unconformably on the preceding. Maximum exposed thickness of exposure slightly more than 9 feet. Kure sandstone constitutes a hard base layer with its surface averaging about 1 foot above high-tide level. It is of medium texture, infiltrated, in upper few feet, with organic matter and iron and sufficiently consolidated above to be classified as rock. It is so resistant to sandfilled wave and current erosion as to form a shelf extending out into the strand. Locally as much as 14 to 18 feet exposed without base being exposed. Underlies Castalia sand (new); unconformably overlies a coquina rock here designated Cape Fear coquina.

Exposed between Kure's Beach fishing pier and Ethyl Dow Bromine Plant on lower Cape Fear Peninsula.

Kushequa Shale Member[1] (of Knapp Formation or monothem)

Devonian or Carboniferous: Northwestern Pennsylvania.

Original reference: K. E. Caster, 1934, Bulls. Am. Paleontology, v. 21, no. 71, p. 47, 103, table opposite p. 61.

C. R. Fettke, 1938, Pennsylvania Geol. Survey, 4th ser., Bull. M–21, p. 26. Caster considered the Kushequa the basal member of the Knapp and placed base of Mississippian at bottom instead of top of Knapp. In this report, Knapp beds tentatively listed under Mississippian.

Probably named for Kushèqua, McKean County.

Kushtaka Formation[1]

Eocene: South-central and southeastern Alaska.

Original reference: G. C. Martin, 1905, U.S. Geol. Survey Bull. 250, p. 14.

J. T. Dutro, Jr., and T. G. Payne, 1957, Geologic map of Alaska (1:2,500,000): U.S. Geol. Survey. Eocene.

Exposed in valley of Bering River and its tributaries and on shores of Lake Kushtaka, Controller Bay region.

†Kuskokwim Gravels and Silts[1]

Pleistocene: Central southern Alaska.

Original reference: J. E. Spurr, 1900, U.S. Geol. Survey 20th Ann. Rept., pt. 7, p. 175–176.

Fills bottom of Ptarmigan Valley on west side of divide between the Skwentna and the Kuskokwim.

Kuskokwim Group

Lower and Upper Cretaceous: Southwestern Alaska.

W. M. Cady and others, 1955, U.S. Geol. Survey Prof. Paper 268, p. 21 (table), 35–47, pl. 1. Graywacke and closely related rocks make up practically all of group. Rocks called graywacke are variety of sandstone. Shales, which are about half as abundant, are a siltstone facies of the graywacke which is intimately interbedded with the sandstone. Breccias and conglomerates, also facies of the graywacke, present in a few localities. All rocks are dark. Rocks altered to hornfels in contact-metamorphic zones adjacent to stocks. In general, angularity of grain and poor sorting of grains characterize the group. Estimated thickness between 40,000 and 65,000 feet. Thickest continuous, most readily observed, and essentially unrepeated sections of group exposed in transecting gorge of lower course of Holokuk River downstream from mouth of Chineekluk Creek. Group thins appreciably to the southwest of central Kuskokwim region and also thins northeastward in Kuskokwim Mountain belt. Basal zones of group, comprising 5,000 to 10,000 feet of massive graywacke and shale, overlie and flank rocks of Gemuk group (new) along axis of Gemuk anticlinorium. Overlies Holitna group (new) in some areas, with fault contact. Unconformably underlies Iditarod basalt (new), Holokuk and Waterboot basalts (new). Lower (?) and Upper Cretaceous.

J. M. Hoare and W. L. Coonrad, 1959, U.S. Geol. Survey Misc. Geol. Inv. Map I–285. In Bethel quadrangle, Kuskokwim group restricted to sedimentary rocks. Fossils of Middle Jurassic age found in volcanic rocks formerly included in the Kuskokwim. Group is Lower and Upper Cretaceous.

Named for Kuskokwim River.

Kuskulana Formation[1]

Upper Triassic: Alaska.

Original reference: O. Rohn, 1900, U.S. Geol. Survey 21st Ann. Rept., pt. 2, p. 423, 424, 433.

Occurs along valley of Kuskulana River and its tributaries in Kotsina-Kuskulana district.

Kuzitrin Formation[1]

Devonian (?): Northwestern Alaska.

Original reference: A. H. Brooks, G. B. Richardson, and A. J. Collier, 1901, Reconnaissance in Cape Nome and Norton Bay regions, Alaska, in 1900: U.S. Geol. Survey Spec. Pub. 28, map.

Typically exposed in Kigluaik Mountains, Seward Peninsula. Named for Kuzitrin River.

Kwaguntan series

Precambrian: Northern Arizona.

Charles Keyes, 1938, Pan-Am. Geologist, v. 70, no. 2, p. 107 (chart), 109. Comprises (ascending) Oveja, Solitude, Carbon Butte, Echo, Walhalla, and Nunkoweap formations. Consists of sandstones, shales, and limestones. Thickness 1,750 feet. Younger than Chuaran series.

Grand Canyon region.

Kyle sandstone[1]

Tertiary: Southeastern Nevada.

Original reference: C. R. Keyes, 1923, Pan-Am. Geologist, v. 40, p. 52, 79.

Occupies abandoned canyon of Old Virgen [Virgin] River. Named for exposures at Kyle Station, in Meadow Valley, below Caliente, Lincoln County.

Kyrock Conglomerate

Pennsylvanian: Central Kentucky.

H. R. Wanless, 1939, Geol. Soc. America Spec. Paper 17, p. 89; A. C. McFarlan, 1943, Geology of Kentucky: Lexington, Ky., Kentucky Univ., p. 109. Massive conglomeratic sandstone impregnated with asphalt. Equivalent to lower conglomerate of Caseyville and part of channel which connected Eastern Interior and Appalachian coal fields.

Exposed on Nolin River at Kyrock, Edmonson County. Traced eastward into Hart, Green, Taylor, and Larue Counties.

Labadie Limestone Member (of Vamoosa Formation)

Labadie Limestone Member (of Nelagoney Formation)[1]

Pennsylvanian (Virgil Series): Northeastern Oklahoma.

Original reference: C. F. Bowen, 1918, U.S. Geol. Survey Bull. 686–F, p. 45.

W. F. Tanner, 1956, Oklahoma Geol. Survey Circ. 40, p. 41, 45–47, pl. 1. Reallocated to Vamoosa formation. Described as gray to white limestone characterized by wavy bedding. Commonly 6 to 8 feet thick; in sec. 17, T. 27 N., R. 10 E., total thickness (measured and estimated) about 35 feet; here the Labadie is approximately 170 feet below Middle Oread limestone. Top of Labadie is 60 to 80 feet above Cheshewalla sandstone member at base of formation.

Named for exposures at and near Labadie Point, sec. 9, T. 26 N., R. 10 E., Osage County.

Labahia Member (of Goliad Formation)[1]

Pliocene: Central Texas.

Original reference: F. B. Plummer, 1933, Texas Univ. Bull. 3232, p. 530, 752, 754.

J. H. Quinn, 1955, Texas Univ. Bur. Econ. Geology Pub. 5516, p. 69–71. Top member of Goliad. Overlies Lagarto member. Contains middle Pliocene fauna.

Typically exposed along San Antonio River near La Bahia Mission, south of Goliad, Goliad County.

Laberdie Limestone Member (of Pawnee Formation)

Pennsylvanian (Des Moines Series): Eastern Kansas.

J. M. Jewett, 1941, Kansas Geol. Survey Bull. 38, pt. 11, p. 315, 320–321, pl. 1. Light-gray crystalline limestone; thin wavy irregular beds in upper part; more massive in lower. Thickness 8 to 30 feet, thickens southward. Overlies Mine Creek shale where that member is present; underlies Bandera shale.

J. M. Jewett, 1946, Kansas Geol. Survey Bull. 58, p. 65. Discussed as cyclothem in Pawnee megacyclothem.

F. C. Greene and W. V. Searight, 1949, Missouri Geol. Survey and Water Resources Rept. Inv. 11, p. 7; L. M. Cline and F. C. Greene, 1950, Missouri Geol. Survey and Water Resources Rept. Inv. 12, p. 30. Laberdie member is lateral equivalent of Coal City limestone of Iowa. Name Laberdie suppressed in favor of Coal City which has priority.

Type exposure: In quarry in SW cor. sec. 6, T. 23 S., R. 25 E., 1 mile west of Prescott, Linn County. Name derived from Laberdie Creek, which is about 100 feet west of quarry.

†Labette Beds[1]

Pennsylvanian: Eastern Kansas.

Original reference: L. C. Wooster, 1905, The Carboniferous rock system of eastern Kansas.

Labette Shale[1] (in Marmaton Group)

Labette Shale (in Henrietta Group)

Labette Shale Member (of Henrietta Formation)[1]

Pennsylvanian (Des Moines Series): Eastern Kansas, southwestern Iowa, western Missouri, and northeastern Oklahoma.

Original reference: E. Haworth, 1898, Kansas Univ. Geol. Survey, v. 3, p. 36–37, 92, 94, 100.

J. M. Jewett, 1941, Kansas Geol. Survey Bull. 38, pt. 11, p. 309–312. Comprises beds between Fort Scott and Pawnee limestones. Thickness 40 to 80 feet in Kansas. Includes Englevale sandstone member. Included in Marmaton group. Pro tempore type exposure designated.

L. M. Cline, 1941, Am. Assoc. Petroleum Geologists Bull., v. 25, no. 1, p. 26–27 (fig. 2). Columnar section shows Labette shale in Henrietta group.

M. C. Oakes, 1952, Oklahoma Geol. Survey Bull. 69, p. 26–28, measured sections. South of T. 23 N., Oklahoma, Pawnee and Altamont limestones merge to form Oologah limestone, whose base marks top of Labette from that point southward to vicinity of Broken Arrow, Tulsa County, where Oologah grades abruptly into calcareous shale. In Tulsa County, consists of clay shale, silty to sandy shale, and lenticular sandstone. Thickness

180 to 250 feet. Conformably overlies Fort Scott limestone. In Marmaton group.

H. G. Hershey and others, 1960, Iowa Highway Research Board Bull. 15, p. 32–33, fig. 5. Comprises rocks between Pawnee and Fort Scott formations. Not subdivided, but Mystic and Marshall coals recognized. Thickness 6 feet in Appanoose County; 15 feet in Madison County. Marmaton group.

Type exposure (pro tempore): Exposure beginning near middle of north line and extending to point near NE cor. sec. 22, T. 33 S., R. 20 E., near town of Labette. Named for exposures at Labette, Labette County, Kans.

La Boca Formation

La Boca Marine Member (of Panamá Formation)

Miocene, lower: Panamá.

[T. F. Thompson], 1943, Panamá Canal, Spec. Eng. Div., 3d Locks Proj., pt. 2, chap. 3, p. 16–17. Name La Boca formation applied to group of marine-deposited sediments stratigraphically overlying Culebra formation, as originally defined. Composed largely of medium-hard silty or sandy dark-gray tuffaceous shales, with occasional massive crossbedded sandstone members present in lower parts.

W. P. Woodring and T. F. Thompson, 1949, Am. Assoc. Petroleum Geologists Bull., v. 33, no. 2, p. 231–242, 246 (fig. 2). Strata assigned to La Boca were formerly referred to Culebra formation, Emperador limestone member of Culebra formation, and Caimito formation. Maximum thickness 600 feet.

W. P. Woodring, 1955, U.S. Geol. Survey Misc. Geol. Inv. Map I–1; 1957, U.S. Geol. Survey Prof. Paper 306–A, p. 40–41. Rank reduced to member status in Panamá formation. Consists principally of silty or sandy tuffaceous mudstone, flaggy tuffaceous sandstone, calcareous tuffaceous sandstone, conglomerate, and coralliferous limestone. Agglomerate and tuff, presumed to represent tongues from Pedro Miguel agglomerate member and main part of formation, respectively, are other constituents. Overlies Cucaracha formation or interfingers with upper part of formation. Nevertheless if La Boca is correctly identified, it also overlaps Cucaracha and Culebra formations and rests directly on Bas Obispo formation.

Type region: Miraflores Locks area, Canal Zone. Name derived from La Boca, near entrance of Balboa Harbor.

Laborcita Formation (in Magdalena Group)

Pennsylvanian and Permian: South-central New Mexico.

Carel Otte, Jr., 1959, New Mexico Bur. Mines Mineral Resources Bull. 50, p. 16–17, 28–58, 68–69, 95–96, 98–105, pls. 1–9, 12–14; 1959, Soc. Econ. Paleontologists and Mineralogists and Roswell Geol. Soc. Guidebook Joint Field Conf., p. 196–207. Thompson (1942) described strata overlying upper Virgilian beds in La Luz Canyon. These beds, composed of red and gray shale, sandstone, conglomerate, and a few limestones, contain fusulinids of early Wolfcampian age in upper part. Beds of similar age occurring in central New Mexico directly below Abo formation received three different names in 1946. Kelley and Wood introduced name Red Tanks member of Madera limestone in Lucero uplift; Stark and Dapples assigned name Aqua Torres formation in Los Pinos Mountains; Wilpolt and others designated same sequence Bursum formation which term has been widely adopted. Lloyd (1949) and Pray (1952, unpub. thesis [1954, New Mexico Geol. Soc. Guidebook 5th Field Conf.]) applied name Bursum to Thompson's sequence of "transition beds" that overlie the strata of Fresnal group in La Luz Canyon. In Sacramento Mountains, "transition beds" consist largely of marine sequence of fossiliferous gray shale, limestone, and sandstone, whereas in central New Mexico Bursum formation is predominantly red beds that occur interbedded with a few thin fusulinid-bearing limestones. In addition, upper part of "transition beds" occurring north of Tularosa are younger than "Bursum" age. Term Laborcita proposed for strata consisting largely of gray and red mudstones, gray limestones, sandstones, and conglomerates between top of Holder formation and top of highest marine limestone underlying main mass of Abo red beds. Thickness approximately 480 feet at type section; 536 feet in central area, base and top exposed; about 1,000 feet in northern area.

Type section: Near mouth of Laborcita Canyon, Otero County. Base of section is 700 feet southeast center sec. 13, T. 15 S., R. 10 E., at north side of canyon; top is about 1 mile northeast of base.

Lacey Member (of Mount Simon Formation)

Upper Cambrian: Northern Illinois (subsurface).

J. S. Templeton, Jr., 1950, Illinois Acad. Sci. Trans., v. 43, p. 153 (fig. 2), 154 (fig. 3), 155. Name applied to conglomeratic sandstone overlying Mayfield member (new). Type section extends from depths of 1,880 to 2,070 feet. Thickness 176 to 230 feet. Underlies Gunn member (new).

Type well: McQueen No. 1 (well 6), in SW¼NE¼NE¼ sec. 27, T. 42 N., R. 3 E., DeKalb County. Name derived from Lacey School, 2½ miles east of type well.

Lackawanna Sandstone (in Pocono Formation)[1]

Mississippian: Northeastern Pennsylvania.

Original reference: I. C. White, 1881, Pennsylvania 2d Geol. Survey Rept. G_5, p. 56–57, 235.

Along Roaring Branch, Lycoming County.

Lackawaxen Conglomerate[1]

Upper Devonian: Pennsylvania, western Maryland, and eastern West Virginia.

Original reference: I. C. White, 1882, ser. 2, Pennsylvania Geol. Survey Rept. G_6. p. 73.

G. A. Cooper and others, 1942, Geol. Soc. America Bull., v. 53, no. 12, pt. 1, chart 4. Listed as unit in upper part of Chemung sandstone of western Maryland, eastern West Virginia, and south-central Pennsylvania. Underlies Upper shale and sandstone of Chemung; overlies Middle Chemung (Wellsburg sandstone).

Exposed a short distance below Lackawaxen village and at other places in Lackawaxen Township, Pike County, Pa.

Lackey Creek Stage

Pleistocene (Wisconsin): Central Colorado.

G. M. Richmond, 1953, Friends of the Pleistocene Rocky Mountain Sec. [Guidebook] 2d Ann. Field Trip, Oct. 4–5, Correlation chart. In proposed time-stratigraphic standard for Rocky Mountains, Lackey Creek stage occurs in Tazewell-Cary interval between Bull Lake stage and Pinedale stage.

Twin Lake area.

Lac La Belle Conglomerate (in Portage Lake Lava Series)

Lac La Belle Conglomerate[1]

Precambrian (Keweenawan): Northern Michigan.

Original reference: L. L. Hubbard, 1898, Michigan Geol. Survey, v. 6, p. 67–72, pl. 4.

H. R. Cornwall, 1954. U.S. Geol. Survey Geol. Quad. Map GQ–51. Included in Portage Lake lava series. One of several sedimentary rock units which constitute excellent reference planes for stratigraphic subdivision of formation.

Occurs just north of Lac la Belle, Keweenaw County.

Laclede Sandstone[1]

Upper Cambrian: Central Missouri.

Original reference: G. H. Scherer, 1905, Bradley Geol. Field Sta. Drury Coll. Bull., v. 1, pt. 2, p. 59, 61, 62.

Probably named for Laclede County.

Lacomb Gravels

Pleistocene, lower: Northwestern Oregon.

I. S. Allison, 1953, Oregon Dept. Geology and Mineral Industries Bull. 37, p. 9, geol. map. Name applied to high-level gravel remnants on hills between Albany and Jefferson. Thickness about 100 feet. Older than Leffler gravels. Name credited to [W. M.] Felts (unpub. thesis).

Type locality: Lacomb, Linn County, about 15 miles southeast of Albany quadrangle.

Lacorocah meta-andesite tuff member (of greenstone complex)

Precambrian: North-central New Mexico.

Parry Reiche, 1949, Geol. Soc. America Bull., v. 60, no. 7, p. 1186, 1188. Light gray, crudely bedded, and weakly schistose, with clastic texture and rare or no quartz. Some beds crowded with light-gray slaty flattened pebbles. Member shows great diversity; ranges from altered acidic lava, now quartz-albite rock, to talc-tremolite aggregate presumably of very basic igneous origin. Such extreme types not common. Thickness unknown, but certainly more than 2,000 feet.

Extends northeasterly across NW¼ sec. 22, T. 8 N., R. 5 E., Bernalillo County.

La Cruz Peak Formation (in Mesaverde Group)

Upper Cretaceous: West-central New Mexico.

W. H. Tonking. [1954], Geologic map and sections of the Puertecito quadrangle, New Mexico (1:48,000): New Mexico Bur. Mines Mineral Resources [preprint?] Bull. 41, pl. 1; 1958, New Mexico Bur. Mines Mineral Resources Bull. 41, p. 19–20, 21 (fig. 6), pl. 1. Sequence of olive- to bluish-gray marine shales, sandy shales, and gray to yellow crossbedded quartzose sandstones and subgraywackes. In western half of region, includes three persistent massive grayish-yellow sandstone beds which contain abundant *Halymenites*. Thickness over 600 feet. Top is placed at top of Gallego sandstone of Winchester (1920) which ranges from 0 to 80 feet in thickness; because this sandstone is not present in eastern half of area, upper contact of the La Cruz Peak is drawn at top of marine beds which are generally 75 to 125 feet below coal beds of overlying Crevasse

Canyon formation. Unconformably overlies Tres Hermanos(?) sandstone member in west and Mancos shale in east.

D. B. Givens 1957, New Mexico Bur. Mines Mineral Resources Bull. 58, p. 10. As mapped in Dog Springs quadrangle, differs from formation as defined by Tonking, in that shale, which he included at base of formation, is here included in Mancos shale.

Named for La Cruz Peak in secs. 13 and 24, T. 2 N., R. 6 W. Socorro County.

La Cygne Shale Member[1] (of Marmaton Formation)

Pennsylvanian: Eastern Kansas.

Original reference: R. C. Moore, 1920, Kansas Geol. Survey Bull. 6, pt. 2, p. 18, 21, 28.

Named for town of La Cygne, Linn County.

Ladd Formation

Upper Cretaceous: Southern California.

W. P. Popenoe, 1937, Jour. Paleontology, v. 11, no. 5, p. 380. Named on generalized section of formations in Santa Ana Mountains. Thickness about 1,700 feet. Comprises two members, Baker (at base) and Holz. Unconformably underlies Williams formation (new); overlies Trabuco formation.

W. P. Popenoe, 1942, Am. Assoc. Petroleum Geologists Bull., v. 26, no. 2, p. 166, 168 (fig. 2), 170–171. In this report, name Baker member altered to Baker Canyon member. (Baker Canyon member has also been referred to as Baker conglomerate). Type locality designated.

W. P. Woodring and W. P. Popenoe, 1945, U.S. Geol. Survey Oil and Gas Inv. Prelim. Chart 12. Stratigraphic section shows the Ladd underlying Silverado formation (new).

Type locality: Region immediately west of mouth of Ladd Canyon, tributary of Silverado Canyon, Santa Ana Mountains, Orange County.

Ladentown Diabase[1]

Upper Triassic: Southeastern New York.

Original reference: C. A. Hartnagel, 1912, New York State Handb. 19, p. 92.

Near Ladentown, Rockland County.

Ladiga Sandstone[1]

Lower Cambrian: Eastern Alabama.

Original reference: E. A. Smith, 1888, Alabama Geol. Survey Rept. Prog. 1884–1888, geographic map of Alabama.

C. E. Resser, 1938, Geol. Soc. America Spec. Paper, 15, p. 4. Shown as abandoned in list of stratigraphic terms of southern Appalachians.

Named for Ladiga, Calhoun County.

Ladore Shale (in Kansas City Group)[1]

Ladore Shale (in Bronson Group)

Ladore Shale Member (of Kansas City Formation)[1]

Pennsylvanian (Missouri Series): Eastern Kansas, southwestern Iowa, northwestern Missouri, and southeastern Nebraska.

Original reference: G. I. Adams, 1904, U.S. Geol. Survey Bull. 238, pls. 1, 2.

R. C. Moore, J. C. Frye, and J. M. Jewett, 1944, Kansas Geol. Survey Bull. 52, pt. 4, p. 193. Ladore shale included in Bronson group. Thickness 2 to 50 feet. Overlies Hertha limestone; underlies Swope limestone

R. C. Moore, 1948, Am. Assoc. Petroleum Geologists Bull., v. 32, no. 11, p. 2031 (fig. 4); F. C. Greene and W. V. Searight, 1949, Missouri Geol. Survey and Water Resources Rept. Inv. 11, p. 11. Ladore formation underlies Swope formation and overlies Hertha formation. Kansas City group. Bronson reduced to subgroup of Kansas City group. This is classification agreed upon by Geological Surveys of Iowa, Kansas, Missouri, Nebraska, and Oklahoma, May 1947.

G. E. Condra, 1949, Nebraska Geol. Survey Bull. 16, p. 41. Thickness of formation 14 feet in south-central Iowa; about 5 feet in Sarpy County, Nebr.

H. G. Hershey and others, 1960, Iowa Highway Research Board Bull. 15, p. 28, fig. 5. Ladore, in Madison County, near Winterset, is a 14½-foot complex of shale separated by siltstones containing limestone nodules. Upper shales are greenish; basal unit red and silty. Cores from Pottawattamie County show this shale to have same lithology as in Madison County but only 8 feet thick. Underlies Swope formation; overlies Hertha limestone.

Named for exposures at Ladore, Neosho County, Kans.

Ladronesian series[1]

Carboniferous: New Mexico.

Original references: C. R. Keyes, 1906, Science, new ser., v. 23, p. 921; 1906, Am. Jour. Sci., 4th, v. 21, p. 298–300.

Probably named for Sierra Ladrones, 30 miles north of Socorro, Socorro County.

Ladson Formation

Pleistocene: Southeastern South Carolina.

H. E. Malde, 1959, U.S. Geol. Survey Bull. 1079, p. 36–54, pls. 1, 5. Consists of sand and clay, coarse grained or conglomeratic at base. Divided into four members (ascending) characterized, respectively, by phosphate, fine sand, medium-grained sand, and coarse sand. Thickness in type section 33½ feet. Rests on eroded Tertiary deposits (Cooper marl). Pleistocene sequence in area is (ascending) Ladson sand on Tenmile Hill, Pamlico formation, and terrace deposits along Goose Creek. Outcrops in lower part of formation identified by Cooke (1936) as Talbot formation. Sloan (1908) had variously identified beds of Ladson with Lafayette phase, Hampton clays, Tenmile sands, and Accabee gravels—names no longer used. Type section measured from drill hole.

Type section: Auger hole 242, 1 mile N. 58° W. of Ladson, Charleston County. Weathered parts of all units crop out in west bank of Poppenheim swamp west of Ladson.

†Lady Washington Sandstone[1]

Pennsylvanian: Southwestern Indiana.

Original reference: E. T. Cox, 1871, Indiana Geol. Survey 2d Ann. Rept., p. 145, 146, 160, 298.

Forms high bluff on Ohio River at Rockpoint [Rockport], Spencer County, known familiarly as "The Lady Washington."

†Lafayette Formation[1]

Lafayette Gravel

Late Cenozoic: Central Lowland, Interior Low Plateau, Ozark Plateau province, Mississippi embayment part of Coastal Plain province.

Original reference: E. W. Hilgard, 1891, Am. Geologist, v. 8, p. 130.

P. E. Potter, 1955, Jour. Geology, v. 63, no. 1, p. 1–35; v. 63, no. 2, p. 115–132. Discussion of petrology and origin of Lafayette gravel and history and present status of term Lafayette. Lafayette gravel, as used in this study, refers to distinctive deposit found in Central Lowland, Interior Low Plateau, Ozark Plateau province, and Mississippi embayment part of Coastal Plain province. Consists primarily of insoluble components: chert, sandstone, quartz and quartzite pebbles, cobbles, and boulders associated with noncalcareous sands, silts, and clays, which in the aggregate are either stained or, less commonly, cemented by oxides of iron and manganese. Occurs as local blanket deposits in western Kentucky in area of 1,300 square miles as lenticular terrace and channel deposits, generally poorly exposed beneath glacial drift, and in glaciated regions. Thickness rarely exceeds 50 feet except in axial parts of lower Mississippi delta. In regions underlain by pre-Mesozoic rocks, Lafayette gravel commonly restricted either to higher terraces of more prominent streams, to abandoned channels of previous stream cycles, or to isolated exposures, which in Central Lowland province occupy positions on some of highest and oldest erosion surfaces. By contrast, in Coastal Plain province the gravel is considerably more extensive.

Named for Lafayette County, Miss., where first recognized.

Lafayette Granite Porphyry[1]

Late Carboniferous (?): Northwestern New Hampshire.

Original reference: C. R. Williams, 1934, Appalachia, v. 20, no. 4, p. 69–78.

Extends length of Franconia Ridge trail from Mount Lafayette, in Franconia quadrangle, to Little Haystack.

Lafayette Serpentine[1]

Precambrian: Southeastern Pennsylvania.

Original reference: T. D. Rand, 1900, Philadelphia Acad. Nat. Sci. Proc. 1900, pt. I.

Named for occurrence at Lafayette, Montgomery County.

Lafferty Limestone[1]

Silurian: Central northern Arkansas.

Original reference: H. D. Miser, 1920, U.S. Geol. Survey Bull. 715–G.

C. K. Swartz and others, 1942, Geol. Soc. America Bull., v. 53, no. 4, chart 3. Shown on correlation chart as Middle Silurian (Niagaran).

Well exposed at Tate Spring, 1¼ miles north of Penters Bluff Station, Izard County. Named for West Lafferty Creek which is half a mile east of exposure.

Lagarto Clay[1]

Lagarto Member (of Goliad Formation)

Miocene (?): Southern and eastern Texas.

Original reference: E. T. Dumble, 1894, Jour. Geology, v. 2, p. 560.

H. B. Stenzel, F. E. Turner, and C. J. Hesse, 1944, Am. Assoc. Petroleum Geologists Bull., v. 28, no. 7, p. 977–1011. Geographically restricted to exclude outcrops around Burkeville. On basis of new age determinations, it is believed that term Fleming formation is applicable to these beds.

A. W. Weeks, 1945, Am. Assoc. Petroleum Geologists Bull., v. 29, no. 12, p. 1724–1725, 1727. Lagarto of Dumble considered member of Goliad formation. Lagarto (emended) by Plummer (1933, Texas Univ. Bull. 3232) is discarded. Part of section assigned to Lagarto (emended) is here included in Cuero formation (new). Unit termed Lower Lagarto by Weeks (1933, Am. Assoc. Petroleum Geologists Bull., v. 17, no. 5) herein assigned to Cuero formation (new). Goliad is considered Pliocene.

Named from Lagarto Creek, Live Oak County, where typically exposed.

Lagarto Creek Beds (in Goliad Sand)[1]

Pliocene: Southern Texas.

Original reference: F. B. Plummer, 1933, Texas Univ. Bull. 3232, p. 530, 753, 754.

Crop out on Lagarto Creek, which flows through parts of Live Oak and Jim Wells Counties.

Lagonda Sandstone Member (of Cherokee Shale)[1]

Lagonda Formation (in Cabaniss Group or Cherokee Group)

Lagonda Member (of Senora Formation)

Pennsylvanian (Des Moines Series): Western Missouri, southeastern Kansas, and northern Oklahoma.

Original reference: C. H. Gordon, 1893, Missouri Geol. Survey Sheet Rept. 2, (v. 9), p. 19 [1896].

H. S. McQueen, 1943, Missouri Geol. Survey and Water Resources, 2d ser., v. 28, p. 90–93, pl. 5. Rank raised to formation in Cherokee group. Restricted at top by transfer of Squirrel sandstone to Henrietta group. Thickens in northwesterly direction and in northwestern Missouri may attain thickness of nearly 50 feet. Unconformably overlies Bevier formation; unconformably underlies section of shale the base of which is usually marked by Squirrel sandstone.

A. G. Unklesbay, 1952, Missouri Geol. Survey and Water Resources, 2d ser., v. 33, p. 86–90. Formation described in Boone County. In this report, term Lagonda not used in original sense but includes beds between Bevier coal (except fossiliferous shales on the coal) and top of the Cherokee (to base of Fort Scott). It here includes "Squirrel" sandstone, Mulky coal, and Breezy Hill limestone. Thickness as much as 30 feet. Overlies "Bevier formation"; in some places unconformably underlies Blackjack Creek limestone member of Fort Scott.

W. B. Howe and W. V. Searight, 1953, Missouri Geol. Survey and Water Resources Rept. Inv. 14, pl. 1. In Livingston and Carroll Counties, formation overlies Bevier formation and underlies Excello formation. Cabaniss group.

W. V. Searight and others, 1953, Am. Assoc. Petroleum Geologists Bull., v. 37, no. 12, p. 2748 (fig. 1). Overlies Bevier formation; underlies Mulky formation. Cabaniss group.

C. C. Branson, 1954, Oklahoma Geol. Survey Guidebook 2, p. 5. Listed as Lagonda coal cycle in Senora formation in Oklahoma. Includes Lagonda sandstone, Lagonda shale, upper Lagonda sandstone, and Iron Post coal. Overlies Bevier coal cycle; underlies Mulky coal cycle. Cabaniss group.

R. D. Alexander, 1954, Oklahoma Geol. Survey Circ. 31, p. 13, 16 (fig. 2). Geographically extended into northeastern Oklahoma where it is allocated to member status in Senora formation. Occurs above Verdigris member and below Breezy Hill member.

W. V. Searight, 1955, Missouri Geol. Survey and Water Resources Rept. Inv. 20, p. 29 (fig. 19), 37. Base of formation is at top of Bevier coal bed, and in Missouri top is beneath base of Breezy Hill limestone. As presently regarded, formational definition is identical with Gordon's (1893) definition of Lagonda sandstones and shales. The "Squirrel" sandstone is widely recognized zone in this formation. McQueen's (1943) redefinition of Lagonda is not followed. Thickness 29 feet in Vernon County, Mo. Cabaniss group.

W. B. Howe, 1956, Kansas Geol. Survey Bull. 123, p. 22 (fig. 5), 80–84 strat. sections. Formation includes beds above Bevier coal and extending to top of Iron Post coal. In Oklahoma-Kansas-Missouri area, formation includes a lower limestone and shale member, shale, sandstone, and underclay, and Iron Post coal bed. Only two of these divisions are persistent throughout area; they are the thick shale and overlying sandstone units. Lower limestone and shale member is well developed only in southeastern Kansas and is not known in Oklahoma. Iron Post coal is present only in Oklahoma. In Kansas and Missouri, underlies Breezy Hill limestone member of Mulky formation, Cabaniss subgroup of Cherokee group.

Named for exposures at Lagonda, Chariton County, Mo.

†Lagrange Formation[1]

Eocene: Western Tennessee, southern Alabama, southern Illinois, Mississippi, and southeastern Missouri.

Original reference: J. M. Safford, 1864, Am. Jour. Sci., 2d, v. 37, p. 361, 369–370.

Named for exposures at Lagrange, Fayette County, Tenn.

†La Grange Sandstone (in Chester Group)[1]

Mississippian: Northwestern Alabama.

Original reference: E. A. Smith, 1879, Alabama Geol. Survey Prog. Rept. 1877 and 1878, p. 17, 34, 36.

Named for La Grange, Colbert County.

Lagro Formation

Pleistocene: Indiana.

H. H. Gray, R. D. Jenkins, and R. M. Weidman, 1960, Indiana Geol. Survey Bull. 20, p. 19 (fig. 3). Named on diagram showing formations of Pleistocene age in Indiana. Name appears above Trafalgar formation (new). Name credited to W. J. Wayne (in preparation).

Type locality and derivation of name not given.

Laguna Basalt Flow[1]

Pleistocene: New Mexico.

Original reference: R. L. Nichols, June 1934, Geol. Soc. America Proc. 1933, p. 453.

Occurs in San Jose Valley, Valencia County.

Laguna Formation[1]

Pliocene(?): Northern California.

Original reference: A. M. Piper and others, 1939, U.S. Geol. Survey Water-Supply Paper 780, p. 33 (table), 57–61, pl. 1.

G. H. Davis and others, 1959, U.S. Geol. Survey Water-Supply Paper 1469, p. 46–47, pls. Complex assemblage of silt, clay, sand, and minor lenticular gravel. Maximum thickness 400 feet. Overlies Mehrten formation. Apparently at least in part coeval with Tulare formation on west of San Joaquin Valley and with Kern River formation near southern end of valley. General stratigraphic relations and paleontologic data suggest Pliocene(?) and possibly early Pleistocene age.

Type locality: North bank of Hadselville Creek, short distance from its junction with Laguna Creek, San Joaquin County.

Laguna Latite Series

Eocene, middle or younger, or Pliocene(?): Northern Utah.

D. R. Cook, 1957, Utah Geol. Soc. Guidebook 12, p. 65 (fig. 6). As shown on chart, middle Eocene Laguna latite series (new) overlies Packard rhyolite series and is overlain by Swansea quartz monzonite.

J. M. Foster, 1959, Brigham Young Univ. Research Studies, Geol. Ser., v. 6, no. 4, p. 35, 36, 39, pl. 4. Principal types of extrusive rocks in area consist of (ascending) Packard rhyolite series, Laguna latite sequence, and sequence of basalt flows. Age of material just preceding basalt flows probably middle Eocene or younger, possibly as young as Pliocene.

Present in Bismark Peak area, north Tintic district, Utah County.

Laguna Seca Formation

Paleocene and Eocene: West-central California.

M. B. Payne, 1951, California Div. Mines Spec. Rept. 9, p. 11–13, 16 (fig. 9), 23, pl. 4. Fine-grained gray massive abundantly micaceous concretionary homogeneous sand section, semiplaty in part. Thickness 1,120 feet. Underlies Domengine sandstone; lower contact progressively transgresses northward upon lower members of Moreno formation; in some areas unconformably overlies Cima sandstone lentil of Dos Palos shale of Moreno formation. Is not exact correlative of Martinez and cannot be traced into type locality of Martinez which is about 100 miles north of Laguna Seca Canyon. Cannot be mapped south into type Lodo in Panoche Creek. Cima sandstone and Laguna Seca sandstone of this report were included in "Tejon" (Domingene) by Anderson and Pack (1915, U.S. Geol. Survey Bull. 603).

L. I. Briggs, Jr., 1953, California Div. Mines Bull. 167, p. 37–39, pls. 1, 3. Described in Ortigalita Peak quadrangle as underlying Tesla(?) formation.

Type locality: North branch of Laguna Seca Creek, near NE cor. sec. 18, T. 12 S., R. 11 E., in southeast Panoche Hills, Fresno County.

Lagunita Formation (in San Andres Group)

Permian: North-central New Mexico.

W. F. Tanner, 1956, Jour. Sed. Petrology, v. 26, no. 4, p. 307–308. Contorted brecciated vuggy limestone. Has overall appearance similar to travertine. Fragments in formation are pink, red, gray, dark blue, green, and yellow. Commonly occur in pebble and cobble size ranges. Thickness ranges from a few inches to about 90 feet, but generally does not exceed 20 feet. Represents middle unit of group; underlies Bernal formation; overlies Glorieta formation. Typical beachrock, altered slightly by later solution and recrystallization.

Named from village of Lagunita, near Santa Fe Railroad between Las Vegas and Santa Fe (approximately 35°23′, 105°14′). Better and more accessible exposure at northwest corner of base of Chapelle Hill, on Santa Fe Railroad, between villages of Chapelle and Bernal (approximately sec. 36, T. 14 N., R. 15 E.).

Lagunitas Clastic Member (of Treasure Mountain Rhyolite)

Miocene, upper: Northwestern New Mexico.

W. R. Muehlberger, 1960, New Mexico Geol. Soc. Guidebook 11th Field Conf., p. 100–101. Interbedded and parallel-bedded volcanic sandstone, volcanic conglomerate, tuffaceous mudstone, and tuffaceous breccia. Thickness 232 feet. Overlies Toltec andesite member (new); underlies Osier Mountain member (new). Name credited to E. L. Trice (unpub. thesis).

Crops out in Chama area, northern Rio Arriba County.

La Habra Formation

La Habra Conglomerate[1]

Pleistocene, upper: Southern California.

Original reference: R. Eckis, 1934, California Dept. Pub. Works, Div. Water Resources Bull. 45, p. 38, 49.

D. L. Durham and R. F. Yerkes, 1959, U.S. Geol. Survey Oil and Gas Inv. Map OM–195. Lower part of formation consists of poorly bedded to massive sandy pebble to cobble conglomerate. Overlying the conglomerate are friable massive reddish-colored silty sandstone and siltstone beds. Maximum exposed thickness in eastern Puente Hills [this report] about 600 feet. Nonmarine. Rests with widespread unconformity upon fossiliferous marine strata ranging in age from Pliocene to early Pleistocene. Formation assigned late Pleistocene age.

Type area: Foothills south of Whittier fault between Brea and Carbon Canyons, Los Angeles County. Name derived from town of La Habra.

Lahabia Member (of Goliad Formation)[1]

Pliocene: Central Texas.

Original reference: F. B. Plummer, 1933, Texas Univ. Bull. 3232, p. 530, 752, 754.

J. H. Quinn, 1955, Texas Univ. Bur. Econ. Geology Pub. 5516, p. 69–71. Top member of Goliad. Overlies Lagarto member. Contains middle Pliocene fauna.

Typically exposed along San Antonio River near La Bahia Mission, south of Goliad, Goliad County.

Lahaina Volcanic Series

Pleistocene or Recent(?): Maui Island, Hawaii.

H. T. Stearns *in* H. T. Stearns and G. A. Macdonald, 1942, Hawaii Div. Hydrography Bull. 7, p. 65 (table), 180–181, pl. 1. Comprises firefountain deposits and lava flows emitted after erosion approached present stage. Chiefly picritic basalts and nepheline basanite. Commonly lie on gravel deposits and appear to be late Pleistocene or Recent. Comprise Kekaa cinder cone, Laina volcanics, Kilea volcanics, and Hele cinder cone.

G. A. Macdonald and D. A. Davis *in* Jacques Avias and others, 1956, Lexique Strat. Internat., v. 6, Océanie, fasc. 2, p. 108–109. Pleistocene or Recent(?).

Named from town of Lahaina. Lie on leeward side of West Maui.

LaHood Formation

Precambrian (Belt Series) : Southwestern Montana.

R. G. Alexander, Jr., 1955, Yellowstone-Bighorn Research Proj. Contr. 195, p. 14, 17–36, pl. 3. At type section, consists of arkosic sandstone and conglomerate with very minor amounts of silt shale distributed irregularly throughout unit. Upper 820 feet of section composed of sandstone with only occasional erratic boulders. Next lower 775 feet varies from upper part mainly in being slightly harder so that its exposures are more pronounced. Below this unit is 930 feet of arkosic sandstone containing irregular conglomeratic lenses, of which the largest observed was 240 feet long and 30 feet thick. Combined thickness over 2,700 feet. Underlies Flathead sandstone in type section. In some localities interfingers with, and underlies Greyson shale with transitional contact. Base obscured.

Type section: Along creek which crosses U.S. Highway 10S from the northeast approximately three-fifths mile southeast of LaHood Park, in Jefferson Canyon, sec. 12, T. 1 N., R. 3 W., and sec. 7, T. 1 N., R. 2 W., Jefferson County.

La Huerta Siltstone Member (of Salado Formation)

Permian: Southeastern New Mexico (subsurface).

W. B. Lang, 1942, Am. Assoc. Petroleum Geologists Bull., v. 26, no. 1, p. 63, 68, 72–74. Halite and silt. Massive, variably textured. Dull reddish-brown shale makes 35 percent of core in places. Fine stringers and needle crystals of white anhydrite. Shale makes irregular local bands. Thickness 5 feet.

Described from Fletcher No. 1 well in lot 4, sec. 1, T. 21 S., R. 28 E., Eddy County. Name taken from La Huerta townsite north of Carlsbad, where member would crop out if it were present at surface.

Laina Volcanics (in Lahaina Volcanic Series)

Pleistocene or Recent(?) : Maui Island, Hawaii.

H. T. Stearns *in* H. T. Stearns and G. A. Macdonald, 1942, Hawaii Div. Hydrography Bull. 7, p. 158 (table), 180–181. In exposure on north bank of Kahoma stream, consists of 10 feet of vesicular thin-bedded pahoehoe resting on 8 inches of firefountain debris and 3 feet of alluvial soil. Soil overlies 30 feet of bouldery conglomerate, which in turn rests on Wailuku basalts (new). A few thin flows are intercalated with cinders in cone, and on north side 2 feet of pahoehoe overlies 8 feet of fine cinders, which in turn rests on 4 feet of soil and partly decomposed feldspar olivine Wailuku basalt. Laina lavas are covered with 1 to 1½ feet of soil underlain with a few inches of partly decomposed rock.

G. A. Macdonald and D. A. Davis *in* Jacques Avias and others, 1956, Lexique Strat. Internat., v. 6, Océanie, fasc. 2, p. 109. Pleistocene or Recent(?).

Lavas form valley-fill 60 feet thick on inland side of Puu Laina cone where they pooled in pre-eruption valley of Kahoma stream. Cone is 1 mile northeast of Mala at altitude of 650 feet. Fan on which cone rests is middle or late Pleistocene.

Laird Sandstone

Miocene(?) : Northwestern California.

C. E. Weaver, 1949, Geol. Soc. America Mem. 35, p. 17 (table 3), 65–67, pl. 9. Proposed for light-brownish-gray massive sandstone locally containing shale layers in upper part and subordinate conglomerate at base. Underlies Monterey shale; rests on quartz diorite. Thickness ranges from 10 to over 100 feet.

Name derived from Lairds Landing on Tomales Bay, Marin County. Exposed on Point Reyes Peninsula.

La Jara shale[1]

Upper Cretaceous: New Mexico.

Original reference: C. R. Keyes, 1915, Conspectus of geologic formations of New Mexico: Des Moines, Robert Henderson, State Printer, p. 2, 8.

Around southern end of Rocky Mountains. Derivation of name not given.

La Jara Peak Member (of Datil Formation)

Miocene, upper(?): Southwestern New Mexico.

W. H. Tonking, 1954, Dissert. Abs., v. 14, no. 2, p. 340. Composed of flows and flow breccias of basalt in lower parts and basaltic andesite in upper part. Overlies Hells Mesa member (new); underlies Santa Fe formation.

W. H. Tonking, 1957, New Mexico Bur. Mines Mineral Resources Bull. 41, p. 26, 30–32, fig. 2, pl. 1 [preprint? 1954?]. Flows are dark- to medium-gray aphanophyres, which are in part red, oxidized, and scoriaceous. Lower part of member has distinctive red speckled appearance. Horizontal sheeting common, giving rock stratified appearance. Crude columnar jointing developed in more massive outcrops. Flow breccias, as well as block flows (aa type), abundant throughout section. Three volcanic sandstone and conglomerate beds intercalated in uppermost part of member. Consists of a number of flows; exact number not determined. Maximum thickness about 2,500 feet. Type section contains 1,175 feet of lava and 25 feet of intercalated volcanic conglomerate and sandstone. Type section designated.

Type section: Measured in northern Bear Mountain, in secs. 27 and 34, T. 2 N., R. 5 W., 3 to 3.5 miles south-southwest of La Jara Peak, Puertecito quadrangle, Socorro County. Named for La Jara Peak in secs. 11 and 14, T. 2 N., R. 5 W.

La Jolla Formation[1]

Eocene, middle: Southern California.

Original reference: B. L. Clark, 1926, California Univ. Pub., Dept. Geol. Sci. Bull., v. 16, no. 5, p. 103, 111, 117.

L. G. Hertlein and U. S. Grant 4th, 1939, California Jour. Mines and Geology, v. 35, no. 1, p. 65–67. Comprises Delmar sand, Torrey sand, and Rose Canyon shale members. Delmar and Torrey members not positively identified in San Diego quadrangle. Rose Canyon shale attains thickness of at least 300 feet. Underlies Poway conglomerate and in some areas San Diego formation. Middle Eocene.

Named for exposures in La Jolla quadrangle, San Diego County.

Lak Member (of Sundance Formation)

Lak Member (of Rierdon Formation)

Upper Jurassic: Northwestern Wyoming and South Dakota.

R. W. Imlay, 1947, Am. Assoc. Petroleum Geologists Bull., v. 31, no. 2, p. 257–259. Defined as 25 to 100 feet, or more, of dominantly red fine-grained sandstone and siltstone gradationally overlying Hulett sandstone member and underlying Redwater shale member (both new). At type section, consists of at least 80 feet of soft maroon sandstone and siltstone including 2-foot bed of greenish-gray siltstone 15 feet below top.

J. A. Peterson, 1954, Am. Assoc. Petroleum Geologists Bull., v. 38, no. 4, p. 466 (table 2), 475, 482. Reallocated to member status in Rierdon formation herein assigned to Sundance group.

Type section: On west side Stockade Beaver Creek about 5 miles northeast of New Castle, Wyo., in sec. 18, T. 45 N., R. 60 W. Named after Lak Reservoir on L. A. K. Ranch. Reservoir is about 3 miles south of type section.

Lake Amygdaloid[1] (in Central Mine Group)

Precambrian (Keweenawan): Northern Michigan.

Original reference: B. S. Butler, 1929, U.S. Geol. Survey Prof. Paper 144.

Named for occurrence in Lake mine, Ontonagon County.

Lake Basalt

Pliocene(?) and Pleistocene: Northern California.

H. A. Powers, 1932, Am. Mineralogist, v. 17, no. 7, p. 262–266. Basalt porphyry. Older than Warner basalt.

C. A. Anderson, 1941, California Univ. Dept. Geol. Sci. Bull., v. 25, no. 7, p. 364–365, geol. map. Map legend shows Lake basalt younger than Warner basalt.

Type locality: Eastern floor of Medicine Lake basin where it crops out in low glaciated mounds which protrude through mantle of pumice and lake gravel, Modoc Lava-Bed quadrangle.

Lake Flow[1]

Precambrian (Keweenawan): Northern Michigan.

Original reference: B. S. Butler, 1929, U.S. Geol. Survey Prof. Paper 144.

Named for occurrence in Lake mine, Ontonagon County.

†Lake Gneiss[1]

Precambrian(?) to Carboniferous: Eastern New Hampshire.

Original reference: C. H. Hitchcock, 1874, Geology New Hampshire, pt. 1, p. 508–545.

Lake Winnipesaukee region.

†Lake Quartzite Schist[1]

Lower Paleozoic or older: Northern Alaska.

Original reference: F. C. Schrader, 1900, U.S. Geol. Survey 21st Ann. Rept., pt. 2, p. 474.

Named for great prominence at Chandalar Lake, Chandalar Lake region.

Lake Quartz Syenite[1]

Devonian or Carboniferous: East-central New Hampshire.

David Modell, 1936, Geol. Soc. America Bull., v. 47, no. 12, p. 1895. 1905–1906, pl. 1. Medium-grained subporphyritic to seriate-textured quartz syenite. Subporphyritic aspect most characteristic. Coarser and more equigranular in Diamond Island exposures. Contains inclusions of fine-grained diorite locally. Older than Albany quartz syenite; younger than Sawyer quartz syenite. Assigned to White Mountain magma series.

Excellent exposures on Rattlesnake and Diamond Islands in Lake Winnipesaukee. Also found at Gerrish Point and to the north.

Lake Agassiz Clays[1]

Pleistocene: Mississippi Valley.

Original reference: W. J. McGee, 1888, Am. Jour. Sci., 3d, v. 35, p. 462.

Lake Agnes Quartz Monzonite

Tertiary: Northeastern Colorado.

K. A. Gorton, 1953, Wyoming Geol. Assoc. Guidebook 8th Ann. Field Conf., p. 89–90. Light-gray coarsely crystalline equigranular rock with speckled appearance due to sharp contrast between dark hornblende and biotite and light-colored orthoclase and plagioclase. In contact with Precambrian gneiss and with Pierre shale. Later than Laramide thrust faulting.

Well exposed near Lake Agnes in sec. 15, T. 6 N., R. 76 W., Cameron Pass area.

Lake Albany Clays[1]

Pleistocene: Eastern New York and western Vermont.

Original reference: G. H. Chadwick, 1910, New York State Mus. Bull. 140, p. 157–160.

Lake Ardmore Formation (in Springer Group)

Lake Ardmore Sandstone Member (of Springer Formation)[1]

Lower Pennsylvanian: Central southern Oklahoma (subsurface and surface).

Original reference (subsurface): R. Roth, 1928, Econ. Geology, v. 23, p. 45.

C. W. Tomlinson, 1929, Oklahoma Geol. Survey Bull. 46, p. 17–19. Surface outcrop noted; derivation of name given.

R. C. Moore and others, 1944, Geol. Soc. America Bull., v. 55, no. 6, chart 6 (column 37). Shown on correlation chart as Lake Ardmore sandstone; here the Springer is considered a group. Lower Pennsylvanian.

C. W. Tomlinson and William McBee, Jr., 1959, *in* Ardmore Geol. Soc., Petroleum geology of southern Oklahoma—a symposium, v. 2: Tulsa, Okla., Am. Assoc. Petroleum Geologists, p. 6 (fig. 2), 11–13. About 500 to 700 feet above Overbrook sandstone is Tomlinson's (1929) Lake Ardmore sandstone member, a persistent unit which is only 15 to 20 feet thick at locality where it was named (NE¼NW¼SE¼ sec. 2, T. 4 S., R. 2 E.). Northeast of town of Springer (NW¼SW¼ sec. 4, T. 3 S., R. 2 E.), three separate sandstone members crop out in uppermost 500 feet of Springeran series as here defined—the 500 feet of section next below Primrose sandstone. One of these, possibly the second from top, may be identical with original Lake Ardmore member. But it is possible that this member has split into several sandstones with intervening shales. Interval between base of Primrose sandstone above and top of Overbrook sandstone some distance below, has increased here to about 1,000 feet, as compared to 800 feet at Lake Ardmore. Name Lake Ardmore formation suggested for these three sandstones in top 500 feet of Springer series near Springer. Formation regarded as extending from base of the Primrose down to base of lowest of the three sandstones of Lake Ardmore formation there. Includes Target limestone of Bennison (1954) as member. Springer group.

Type locality (formation) NW¼SW¼ sec. 4. T. 3 S., R. 2 E., Carter County. Named for a sportsman's lake in sec. 2, T. 4 S., R. 1 E., where it forms narrow peninsulas and islets.

Lake Bonneville Beds[1]

Lake Bonneville Group

Pleistocene: Northern Utah and southeastern Idaho.

Original reference: G. K. Gilbert, 1875, U.S. Geol. and Geog. Survey Terr. W. 100th M., v. 30, p. 89.

K. C. Bullock, 1951, Utah Geol. and Mineralog. Survey Bull. 41, p. 21–22. Deposits laid down by Lake Bonneville are divided into three formations each of which represents a different stage in the level of the lake. These are (ascending) Alpine, Bonneville, and Provo, Gilbert (1890, U.S. Geol. Survey Mon. 1) referred to these as Intermediate, Bonneville, and Provo stages of Lake Bonneville.

C. B. Hunt, H. D. Varnes, and H. E. Thomas, 1953, U.S. Geol. Survey Prof. Paper 257–A, p. 1, 17–29, pl. 1. Pleistocene Lake Bonneville group, which includes Alpine, Bonneville, and Provo formations, is unconformable above unnamed pre-Lake Bonneville deposits and below unnamed post-Provo deposits. Lake Bonneville was product of last glacial period and is believed to be of Wisconsin age.

Northern Utah Valley.

Lake Bridgeport Shale[1] (in Graford Formation)

Pennsylvanian: North-central Texas.

Original reference: G. Scott and J. M. Armstrong, 1932, Texas Univ. Bull. 3224, p. 29.

H. L. Strimple, 1951, Jour. Paleontology, v. 20, no. 2, p. 200–207. Crinoid fauna described.

Probably named for occurrence near Bridgeport, Wise County.

Lake Charles Formation

Recent: Southern Texas.

W. A. Price, 1939, (abs.) Am. Assoc. Petroleum Geologists Bull., v. 23, no. 12, p. 1875. Lake Charles formation and Ingleside formation (new) replace Beaumont formation.

Report discusses Rio Grande delta; states that Lake Charles formation is not present on delta.

Lake Church Formation[1]

Middle Devonian: Southeastern Wisconsin.

Original reference: E. R. Pohl, 1929, Pub. Mus. City Milwaukee Bull., v. 11, p. 7–8.

G. A. Cooper and others, 1942, Geol. Soc. America Bull., v. 53, no. 12, pt. 1, p. 1770, chart 4. Age given on correlation chart as Middle Devonian.

Well exposed in and about Lake Shore stone quarry near Lake Church, Ozaukee County.

Lake City Limestone

Lake City Limestone (in Claiborne Group)

Eocene, middle: Subsurface in northern and central Florida and southern Georgia.

P. L. Applin and E. R. Applin, 1944, Am. Assoc. Petroleum Geologists Bull., v. 28, no. 12, p. 1681–1682, 1693–1698, 1704 (fig. 25). Name applied to limestone facies of early middle Eocene in northern Florida and the peninsula. Made up of alternating layers of dark-brown and chalky limestone with gypsum or chert present in some wells and in Cosden's Lawson well No. 1, Marion County, a 25-foot bed of lignite. Lateral gradational lithologic change from limestone facies of the peninsula into clastic facies which contains a fauna related to that of Cook Mountain formation of Claiborne age is noted in wells from Wakulla County west to Walton County. Starting as highly glauconitic chalky limestone, the rock becomes increasingly sandy until it develops into chalky glauconitic sand. Normally 400 to 500 feet thick in Tallahassee area; in Pierce County, Ga., and southern part of peninsula 200 to 250 feet. In north Florida and north half of peninsula, underlies Tallahassee limestone (new) and equivalent nonfossiliferous limestone; along northeast coast and in south half of peninsula, underlies Avon Park limestone (new); in west Florida, where late middle Eocene beds are not definitely known to be present, early middle Eocene clastic facies of Cook Mountain age underlies Ocala limestone; overlies lower Eocene unit. Oldsmar limestone (new), Avon Park limestone, Tallahassee limestone (with its equivalent nonfossiliferous facies), and Lake City limestone represent Claiborne group in peninsular Florida, and where all three units are present they appear to make in most places, a conformable sequence.

R. O. Vernon, 1951, Florida Geol. Survey Bull. 33, p. 88–89, 90–94. In Claiborne group. As used by Applin and Applin (1944), Lake City limestone is predominantly chalky to granular limestone, containing chert and gypsum in some areas. The limestone grades laterally into clastic facies in series of wells extending from Wakulla County westward to Walton County. In practice, the Lake City is commonly identified from its fauna, the top being marked by first appearance of *Dictyoconus americanus* (Cushman) and as thus used it was faunal zone. Recently, present writer [Vernon] has found, particularly in Citrus and Levy Counties, that formation was lithologic unit having diagnostic lithologic characteristics as well as distinct fauna. Formation characterized by several lithologies which probably occur as thin beds in thick carbonate section. These beds include a pseudo-oolite, a brown to coffee-colored chert, a bentonitic(?) clay, and a brownish-gray laminated finely crystalline dolomite containing seams of black carbon and flattened decalcified specimens of *Fabularia vaughani, Coskinolina* sp., *Archaias columbiaensis,* and larger *Valvulinidae* giving it a mottled and laminated appearance. Occasionally last mentioned rock is seamed with peat and not fossiliferous. Applin and Applin (p. 1739) assigned 411 feet of dolomite in Florida Oil Discovery-Sholtz well, Levy County, to the nonfossiliferous limestone [lying between the Lake City and Avon Park], but it is herein considered dolomitized Lake City limestone and included in that formation. Thickness in wells in Levy and Citrus Counties 575 to 923 feet.

Characteristically shown in samples from Lake City well, Columbia County, Fla., No. W–299, of Florida Geological Survey.

Lake Coahuila deposits

Pleistocene, upper: Southern California.

L. A. Tarbet and W. H. Holman, 1944, (abs.) Am. Assoc. Petroleum Geologists Bull., v. 28, no. 12, p. 1782. A thin veneer of lake marls covering most of surface below ancient beach line. Thickness as much as 100 feet.

T. W. Dibblee, Jr., 1954, California Div. Mines Bull. 170, chap. 2, p. 23 (fig. 2), 25 (fig. 2). Shown on columnar sections as unconformably overlying

Brawley formation (new) or as unconformably overlying Ocotillo conglomerate (new).

This may or may not be the same deposit referred to as Coahuila silt (Hanna, 1926).

Occurs on west side of Imperial Valley.

Lake Creek Coal Member (of Modesto Formation)

Pennsylvanian: Southeastern Illinois (subsurface).

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 37, 49 (table 1), pl. 1. Name applied to coal encountered at depth of 86½ feet in drill hole. Occurs above Pond Creek coal member (new) and below West Franklin limestone member. Coal has been referred to informally as 3rd Cutler Rider coal. Name credited to Cady (unpub. ms.). Piasa limestone and DeGraff, Pond Creek, and Lake Creek coals may be included in complex West Franklin limestone in eastern part of area. Presentation of new rock-stratigraphic classification of Pennsylvanian of Illinois. Cyclical classification is retained but is entirely independent of rock-stratigraphic classification.

Type locality: Consolidated Coal Co. drill hole 91 in SW¼NE¼NE¼ sec. 21, T. 8 S., R. 3 E., Williamson County. Name derived from Lake Creek Township in which drill hole is located.

Lake Creek Formation

Pleistocene (Cary-Mankato): Central Colorado.

G. M. Richmond, 1953, Friends of the Pleistocene, Rocky Mountain sec. 2d Ann. Field Trip, Oct. 4–5, correlation chart, geol. map. Consists of lower and upper member. Overlies Twin Mountain formation (new); underlies Mount Champion formation (new).

Twin Lakes region, Lake County.

Lake Creek Member (of Wood River Formation)

Pennsylvanian (Virgilian): Central and eastern Idaho.

M. R. Thomasson, 1959, Dissert. Abs., v. 20, no. 3, p. 999. Older than Wilson Creek member (new); younger than Slate Creek member (new).

Deposited in Muldoon trough, aligned N. 30° W.

Lake Creek Shale Member (of Pierre Shale)[1]

Upper Cretaceous: Northwestern Kansas.

Original reference: M. K. Elias, 1931, Kansas Univ. Bull., v. 32, no. 7.

R. C. Moore and others, 1951, Kansas Geol. Survey Bull. 89, p. 22, 23 (fig. 11). Thin-bedded flaky dark-gray and black shale with limestone concretions, zones of concretionary limonite, and locally gypsum. Thickness 200 feet. Overlies Weskan shale member; underlies Salt Grass shale member.

Named for Lake Creek, in northwestern part of Wallace County, along which most extensive outcrops occur.

Lake Crockett Formation

Cretaceous (Eagle Ford): North-central Texas.

C. L. McNulty, 1954, Am. Assoc. Petroleum Geologists Bull., v. 38, no. 2, p. 335–337. Suggested that name Fish Bed conglomerate (Taff, 1893, Texas Geol. Survey 4th Ann. Rept), which is misleading nongeographic and limited in definition, be abandoned and replaced by Lake Crockett formation. Proposed that formation consist of an upper Lake Crockett member, which shall be the silty shale lying between basal Austin chalk and former Fish Bed conglomerate, and of a lower Lake Crockett sand member, which shall be the Fish Bed stratum and the underlying gray sand, and which is equivalent to the former sub-Clarksville of east Texas basin. At Lake Crockett, underlies Ector formation and is about 26½ feet thick.

Named for exposures in ravine below spillway of Lake Crockett, Fannin County.

Lake Enchantment sediments

Precambrian : Northern Michigan.

Justin Zinn and others, 1955, Studies of stratified rocks occurring below the Huronian succession in the Marquette district, Michigan: Minnesota Univ. Center for Continuation Study, Inst. of Lake Superior Geology [no pagination]. Remnant of metamorphosed stratified rock. Older than Mesnard quartzite; unconformably overlies Keewatin greenstones.

Along margin of Marquette syncline or adjacent to nearby Huronian synclines in Marquette district.

Lake Flirt Marl[1]

Pleistocene and Recent: Southern Florida.

Original reference: E. H. Sellards, 1919, Florida Geol. Survey 12th Ann. Rept., p. 73–74.

C. W. Cooke, Julia Gardner, and W. P. Woodring, 1943, Geol. Soc. America Bull., v. 54, no. 11, chart 12. Lake Flirt [spelled Flint], Pleistocene, overlies Pamlico formation.

G. G. Parker and C. W. Cooke, 1944, Florida Geol. Survey Bull. 27, p. 70. In some places, Miami oolite is overlain by thin fresh-water marl and limestone here classified as Lake Flirt marl. Very late Pleistocene or Recent in age.

M. C. Schroeder, 1954, Southeastern Geol. Soc. 8th Field Trip, p. 18, 20–22. Maximum thickness about 8 feet along Caloosahatchee River in old Lake Flirt bottom. It is doubtful whether use of name is justified outside of Caloosahatchee River area. In many places in upper Everglades, the fresh-water marl lies between the rock floor and overlying organic soils. Although marl is not the same everywhere, some being indurated, it has all been included in the Lake Flirt by Parker and Cooke.

J. R. DuBar, 1958, Gulf Coast Assoc. Geol. Soc. Trans., v. 8, p. 133 (table 1), 135, 136, 147. Typically overlies Pamlico formation unconformably, but reworking of sediments at many localities makes separation of the two formations difficult. In this report, beds containing abundant fresh-water mollusks definitely assigned to the Lake Flirt. Pleistocene (Wisconsin).

Named for occurrences at Lake Flirt, De Soto County.

Lake Fork Quartz Latite

Lake Fork Andesite[1]

Miocene (?) : Southwestern Colorado.

Original references: W. Cross and E. S. Larsen, 1923, U.S. Geol. Survey Prof. Paper 131, table opposite p. 184; 1923, U.S. Geol. Survey Bull. 718, table opposite p. 12.

E. S. Larsen, Jr., and Whitman Cross, 1956, U.S. Geol. Survey Prof. Paper 258, p. 14, 64–68, pls. 1, 2. Defined as a group of dark quartz latites, in part flows, in part clastic beds, that immediately preceded deposition of San Juan tuff. Thickest part—about 4,000 feet—is east of Lake Fork of Gunnison River near heads of Indian and Trout Creeks; from this area, it thins out rapidly in all directions, and 5 or 6 miles from central area is only a few hundred feet thick. Central part not overlain by younger rocks; flanks overlain by San Juan or Potosi rocks. Directly overlies Precambrian and Paleozoic rocks.

Named for exposures in Lake Fork of Gunnison River in Uncompahgre quadrangle. Exposures are confined to area in central part of quadrangle about 20 miles across.

Lake Hanbury Slate Group[1]

Huronian: Northern Michigan.

Original reference: C. Rominger, 1881, Mich. Geol. Survey, v. 4, pt. 2, p. 182.

Crops out north of Norway, Quinnesec, and Chapin mines, Menominee iron region.

Lake Kemp Formation (in Lueders Group)

Lake Kemp Limestone (in Lueders Formation)[1]

Permian (Leonard Series): Central northern Texas.

Original reference: M. M. Garrett, A. M. Lloyd, and G. E. Laskey, Geologic map of Baylor County: Texas Bur. Econ. Geology.

M. G. Cheney, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 1, p. 66 (fig. 1). Given formational status in the Lueders herein designated as group. Overlies Maybelle limestone; underlies Arroyo formation of Clear Fork group.

R. C. Moore, 1949, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 80, sheet 2. Examination of type outcrops of Maybelle and Lake Kemp beds affords no satisfactory ground for classing the limestones as parts of the Lueders. No basis found for recognizing any limestone beds of the Lueders in Colorado River area [mapped in this report] as corresponding to Maybelle and Lake Kemp beds, respectively.

Occurs at east end of Lake Kemp, Baylor County.

†Lake Lahontan Beds[1]

Pleistocene: Northwestern Nevada.

Original reference: I. C. Russell, 1885, U.S. Geol. Survey Mon. 11, p. 143.

U.S. Geological Survey has abandoned the term Lake Lahontan beds.

Sediments deposited in Lake Lahontan.

Lake Lytle Limestone[1]

Permian: Texas.

Original reference: J. Hornberger, Jr., 1932, Texas Bur. Econ. Geology, geol. map of Throckmorton County.

Lake Missoula Beds[1]

Pleistocene: Southwestern Montana.

Original reference: C. M. Langton, 1935, Jour. Geology, v. 43, p. 34–35.

Missoula, Ravalli, and Granite Counties.

Lake Monongahela deposits[1]

Pleistocene: Southwestern Pennsylvania.

Original reference: R. R. Hice, 1905. Am. Ceramic Soc. Trans., v. 7, pt. 1.

Near mouth of Beaver River.

Lakemont Formation[1]

Middle Silurian: Pennsylvania.

Original reference: E. O. Ulrich, 1923, Maryland Geol. Survey, Silurian Volume, index.

Named from section near Lakemont Park, between Hollidaysburg and Altoona, Blair County.

Lake Murray Formation (in Dornick Hills Group)

Pennsylvanian (Atoka Series) : Southern Oklahoma.

B. H. Harlton, 1956, *in* Ardmore Geol. Soc., Petroleum geology of southern Oklahoma—a symposium, v. 1: Tulsa, Okla., Am. Assoc. Petroleum Geologists, p. 137 (fig. 2), 139–140. Proposed for strata from top of Otterville to top of Frensley limestone. Attains maximum development in Harrisburg trough where it is over 3,300 feet thick. Not a single sequence and may be divided into three units which are uniform throughout the trough; they are (ascending) Bostwick, Griffin sandstone (new), and Frensley members. Unconformably underlies Big Branch formation (redefined) ; unconformably overlies Golf Course formation (new).

Named for exposures south of south shore of Lake Murray, Murray County.

Lake Neosho Shale Member (of Altamont Limestone)

Pennsylvanian (Des Moines Series) : Eastern Kansas, southwestern Iowa, and northwestern Missouri.

J. M. Jewett, 1941, Kansas Geol. Survey Bull. 38, pt. 11, p. 329, 331–332, pl. 1. Defined as shale between Tina limestone member below and Worland limestone member above. Contains oblong, irregularly shaped phosphatic concretions. Thickness in Kansas 2½ to 6 feet.

F. C. Greene and W. V. Searight, 1949, Missouri Geol. Survey and Water Resources Rept. Inv. 11, p. v (fig. 1), 8. Overlies Amoret limestone member (Amoret replaces name Tina).

H. G. Hershey and others, 1960, Iowa Highway Research Board Bull. 15, p. 31, fig. 5. Geographically extended into southwestern Iowa, upper part of shale is dark gray and fossiliferous; beneath shale is persistent coal streak underlain by clay that is gray above and red below. Thickness about 6 feet. Overlies Amoret limestone member; underlies Worland limestone member.

Type section: Southeast of Lake Neosho in Neosho County State Park, SW sec. 23, T. 30 S., R. 20 E., Neosho County, Kans.

Lake Newark Formation

Miocene, upper, and (or) Pliocene: Northeastern Nevada.

T. E. Eakin, 1960, Nevada Dept. Conserv. Nat. Resources Rept. 1, p. 26. Bedded rhyolite tuff and coarser pyroclastics; in part lacustrine. Thickness 430 feet. Unconformably underlies Belmont fanglomerate (new) ; unconformably overlies Illipah formation (new). Name credited to F. L. Humphrey (in press).

F. L. Humphrey, 1960, Nevada Bur. Mines Bull. 57, p. 43–45, pl. 1. Formal proposal of name. Succession of bedded rhyolite tuffs and pyroclastics Includes both bedded tuffs which were deposited on lake floor and subaerial pyroclastics which were deposited above level of lake. Materials in both types of deposits are of same age and source, but the two members are differentiated because of different depositional conditions which accompanied their formation. Member 1 includes bedded tuffs which are present up to an altitude of about 7,400 feet. Unbedded pyroclastics are found above this elevation. Member 1 has maximum thickness of about 350 feet. Member 2 is as much as 80 feet thick in places. Unconformably overlies Illipah formation (new); older than Lampson formation (new); underlies Belmont fanglomerate (new). On basis of fossils, tentatively considered upper Miocene or Pliocene. As mapped, includes Lampson formation.

In Newark Valley, White Pine County.

Lake Pinto Sandstone Member (of Mineral Wells Formation)[1]

Lake Pinto Sandstone Member (of Salesville Formation)

Middle Pennsylvanian: Central northern Texas.

Original references: F. B. Plummer and R. C. Moore, 1922, Jour. Geology, v. 30, p. 25, 31; Texas Univ. Bull. 2132, p. 77, charts.

M. G. Cheney, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 1, p. 66 (fig. 1), 88. Salesville raised to formational status and expanded below to base of Lake Pinto sandstone, Lake Pinto underlies Dog Bend limestone member of Salesville and overlies Village Bend limestone member of East Mountain shale. Name Mineral Wells dropped in this report.

Leo Hendricks, 1957, Texas Univ Bur. Econ. Geology Pub. 5724, p. 23–24, fig. 3, pl. 1. In this report [Parker County], Lake Pinto considered basal member of Salesville, although author does not wholly agree with Cheney's reclassification. Sandstone and associated beds show facies changes across county. Thickness as much as 50 feet. Underlies unnamed shale member, that includes Dog Bend limestone bed in lower part; overlies shale in East Mountain formation.

J. W. Shelton, 1958, (abs.) Geol. Soc. America Bull., v. 69, no. 12, pt. 2, p. 1515–1524, pl. 1. In eastern Palo Pinto County, Strawn-Canyon boundary placed at base of Lake Pinto sandstone which overlies Village Bend limestone.

Named for Lake Pinto, one-half mile west of Mineral Wells, Palo Pinto County.

Lakeport Limestone[1]

Silurian: Central New York.

Original reference: G. H. Chadwick, 1918, Geol. Soc. America Bull., v. 29, p. 327–368.

Lakeport hole, Madison County.

†Lake Shore trap[1]

Precambrian (Keweenawan): Northern Michigan and Wisconsin.

Original reference: R. D. Irving, 1883, U.S. Geol. Survey Mon. 5, p. 186, pls. 17, 18.

Named for exposures on shore of Lake Superior at Keweenaw Point, Mich.

Lakeside Clay (in Golden Valley Formation)

Eocene: Eastern Montana.

Great Northern Railway Co. Mineral Research and Development Department, 1958, Great Northern Railway Co. Mineral Research and Devel. Dept. Rept. 5, p. 7, map. Gray clay about 6 feet thick. White Earth clay, South Ross clay, and East Tioga clay occurs in same general area.

Occurs one-half mile north of Lakeside Station, in SW¼SW¼ sec. 18, T. 27, N., R. 59 E., on Great Northern mainline, Roosevelt County.

†Lake Superior Group[1]

[Upper Cambrian] : Northern Michigan.

Original reference: A. Winchell, 1871, Michigan Geol. Survey Rept. Prog., p. 26–27.

Upper Peninsula.

Lake Superior Sandstone[1]

Lake Superior Sandstone Member (of St. Croixan Formation)

Upper Cambrian : Northern Michigan and eastern Minnesota.

Original reference: D. Houghton, 1840, Michigan Geol. Survey 3d Rept. for 1839, H. Doc. 8, p. 13.

A. C. Lane and A. E. Seaman, 1907, Jour. Geology, v. 15, p. 691–692, table facing p. 681. In view of uncertainty of relation of the three parts of Lake Superior sandstone, as used by Houghton, separate names seem useful. Term Freda is proposed for that west of Cooper Range; term Jacobsville for that east of Cooper Range and term may apply to all the Lake Superior sandstone skirting the coast at intervals to Grand Island; term Munising sandstone is to apply to upper 250 feet of Lake Superior sandstone which crosses bluffs back of Munising.

S. G. Bergquist, 1937, Michigan Acad. Sci., Arts and Letters Papers, v. 22, p. 421 (footnote). Ulrich seems to have good evidence to support view that St. Croixan formation of Wisconsin area extends into Superior region of Alger County, Mich. So-called Lake Superior sandstone would thus be included as a member of the formation.

See Lake Superior Series.

Named for occurrence on south shore of Lake Superior, northern Michigan.

Lake Superior Series

Precambrian (Keweenawan) : Northeastern Minnesota.

C. R. Stauffer and G. A. Thiel, 1941, Minnesota Geol. Survey Bull. 29, p. 10, 11–13. In addition to lava flows and other igneous rocks included in the Keweenawan, the thick sediments along south shore of Lake Superior should be included in the series. They are mainly sandstones and shales with occasional important conglomerates, the whole of which may be several thousand feet in thickness. These are the beds which Houghton (1840) called Lake Superior sandstone, part of which was designated by Irving (1883, U.S. Geol. Survey Mon. 5) as the Western sandstone. Since this deposit of arenaceous sediments has been divided into several formations, the earlier term is used as a series name. Although these sandstones and shales have occasionally been considered Cambrian in age, their lack of fossils makes classification more or less indeterminate. They definitely underlie St. Croixian series and may be interbedded with Keweenawan lava flows. Made up of Fond du Lac beds below and Hinckley sandstone above. Precambrian.

Named for occurrence in Lake Superior district.

Laketown Dolomite[1]

Middle and Upper Silurian: Northeastern and western Utah, southern Idaho, and southwestern Wyoming.

Original reference: G. B. Richardson, 1913, Am. Jour. Sci., 4th, v. 36, p. 407, 410.

C. P. Ross, 1937, U.S. Geol. Survey Bull. 877, p. 11 (table), 19, 23–25. In Bayhorse region, Idaho, overlies Saturday Mountain formation and underlies Jefferson dolomite. Thickness about 2,500 feet.

J. S. Williams, 1948, Geol. Soc. America Bull., v. 59, no. 11, p. 1137–1138, pl. 1. Described in Logan quadrangle, Utah, where it is 1,150 feet thick, disconformably underlies Water Canyon formation (new) and disconformably overlies Fish Haven dolomite. Middle Silurian.

J. D. Love, J. L. Weitz, and R. K. Hose, 1955, Geologic map of Wyoming (1:500,000); U.S. Geol. Survey. Mapped in southwestern Wyoming.

J. K. Rigby, 1958, Utah Geol. Soc. Guidebook 13, p. 28 (fig. 4), 33–34. Described in Stansbury Mountains where it is 614 to 664 feet thick; underlies Sevy dolomite and overlies Fish Haven dolomite. In some areas, as in vicinity of Dolomite, lower part of formation is exposed below Stansbury formation (new).

U.S. Geol. Survey currently considers the Laketown dolomite Middle and Upper Silurian on the basis of studies now in progress.

Named for exposures in Laketown Canyon, Rich County, Utah.

Lake Trammel Sandstone[1]

Permian: Central northern Texas.

Original reference: W. E. Wrather, 1917, Southwestern Assoc. Petroleum Geologists Bull., v. 1, p. 95–96, pl.

Occurs west of Aspermont, Stonewall County, and west of Sweetwater, Nolan County.

Lake Valley Limestone[1]

Lower Mississippian: Southern New Mexico.

Original reference: E. D. Cope, 1882, Eng. and Min. Jour., v. 34, p. 214.

L. R. Laudon and A. L. Bowsher, 1941, (abs.) Tulsa Geol. Soc. Digest, v. 9, p. 73–75; 1941, Am. Assoc. Petroleum Geologists Bull., v. 25, no. 12, p. 2114, 2125–2158. Restricted at base to exclude unit herein named Caballero formation. Subdivided into (ascending) Alamogordo, Arcente, and Dona Ana members. Underlies Magdalena formation. Thickness 29 to 420 feet. Osage.

L. P. Entwistle, 1944, New Mexico Bur. Mines Mineral Resources Bull. 19, p. 13, 22, pl. 2. In Boston Hill mining district, disconformably underlies Magdalena formation disconformably overlies Percha shale. Thicknesses: 657 feet; 325 feet. Not subdivided in this area.

P. F. Kerr and others, 1950, Geol. Soc. America Bull., v. 61, no. 4, p. 283 (fig. 5), 284. In Santa Rita district, underlies Oswaldo limestone (lower Magadalena) and overlies Percha shale.

V. C. Kelley and Caswell Silver, 1952, New Mexico Univ. Pubs. in Geology 4, p. 31 (table), 83–85. In some parts of Caballo Mountains, underlies Red House formation (new) of Magdalena group; overlies Percha formation. Alamogordo and Nunn members recognized. Thickness 49 feet.

Well exposed in Lake Valley mining district, Sierra County.

Lake Vantage Lavas

Miocene, upper: Central Washington.

G. F. Beck, 1936, Northwest Sci., v. 10, no. 3, p. 22. Name applied to pillow lavas, in which petrified logs from Vantage forest have been buried, together with underlying sediments. Horizon occurs about 800 feet down in Yakima basalt and extends over an area of 6 miles in diameter.

Occurs near Vantage, on Columbia River.

Lakeview Limestone[1]

Middle Cambrian: Northern Idaho.

Original reference: E. Sampson, 1928, Idaho Bur. Mines and Geology Pamph. 31, p. 9.

C. E. Resser, 1938, Smithsonian Misc. Colln., v. 97, no. 3, p. 3, 4. Overlies Rennie shale. Not overlain by other beds. Consists of two rock types: cliff-forming massive beds which vary from nearly pure limestone to nearly pure dolomite; and shaly beds containing thin-bedded fossiliferous limestone. Fossils described.

Named for exposures at town of Lakeview, near southeast end of Pend Oreille Lake.

Lakeview Quartz-Hornblende Diorite[1]

Lakeview Tonalite

Triassic(?) or Upper Jurassic(?): Southern California.

Original reference: P. H. Dudley, 1935, California Jour. Mines and Geology, v. 31, no. 4, p. 491, 502, map.

R. H. Merriam, 1941, Am. Jour. Sci., v. 239, no. 5, p. 366–371. Termed Lakeview tonalite in Ramona quadrangle.

E. S. Larsen, Jr., 1948, Geol. Soc. America Mem. 29, p. 57. Replaced by Lakeview Mountain tonalite (new).

Occurs throughout greater part of Lakeview Mountains, Riverside County.

Lakeview Mountain Tonalite

Cretaceous: Southern California.

E. S. Larsen, Jr., 1948, Geol. Soc. America Mem. 29, p. 57–58, pl. 1. Replaces name Lakeview quartz-hornblende diorite as proposed by Dudley (1935) and term Lakeview tonalite as used by Merriam (1941). Uniform rather coarse-grained nearly white rock with scattered black plates of biotite and stout prisms of hornblende. In contact with Bonsall tonalite; character of contact indicates Bonsall tonalite intrudes Lakeview Mountain tonalite, but the two probably not very different in age.

Richard Merriam, 1958, California Div. Mines Bull. 177, p. 13–14, 16 (fig. 2), pl. 1. Described and mapped in Santa Ysabel quadrangle. Younger than Green Valley tonalite. Contacts with rocks other than Green Valley tonalite poorly exposed; hence, no definite age determination could be made.

Occurs in Elsinore, San Jacinto, Ramona, and Santa Ysabel quadrangles. Underlies most of Lakeview Mountains in Elsinore quadrangle.

Lake Waco Formation

Cretaceous (Gulf Series): Central Texas.

W. S. Adkins and F. E. Lozo *in* F. E. Lozo, 1951, Fondren Sci. Series, no. 4, p. 119, 120, 133 (fig. 14), 137 (fig. 16), 139 (fig. 17). Proposed for section [of Eagle Ford] underlain by Woodbine sand or Pepper shale and overlain by emended South Bosque formation. Consists of grayish-white to brownish wavy-bedded limestones and dark silty shales with bentonite layers. Thickness 60 to 80 feet. Includes (ascending) newly defined members Bluebonnet, Cloice, and Bouldin.

Type area and section: West-facing Bosque Escarpment from Lake Waco Dam spillway south to the Moody Hills between McGregor and Moody, McLennan County; type section in Cloice Branch, from cement plant to old South Bosque brickyard pit.

†Lake Winnipesaukee Gneiss[1]

Precambrian(?) to Carboniferous: Eastern New Hampshire.

Original reference: C. H. Hitchcock, 1874, Geology New Hampshire, pt. 1, p. 508–545.

Lake Winnipesaukee region.

Lake Wolford Leucogranodiorite

Cretaceous: Southern California.

E. S. Larsen and N. B. Keevil, 1947, Geol. Soc. America Bull., v. 58, no. 6, p. 490. Named in report on study of batholith of southern California.

E. S. Larsen, Jr., 1948, Geol. Soc. America Mem. 29, p. 82–85, pl. 1. Described as fine-grained light-colored rock with average composition of leucogranodiorite. Makes up several widely separated bodies that differ considerably from place to place in each of main masses. Older than Woodson Mountain granodiorite and believed younger than San Marcos gabbro. Derivation of name given.

Named from its characteristic outcrops about Lake Wolford in western part of Ramona quadrangle. Occurs in San Luis Rey quadrangle, where it underlies an area of about 45 square miles.

Lakota Formation (in Inyan Kara Group)

Lakota Formation (in Dakota Group)

Lakota Sandstone (in Inyan Kara Group)[1]

Lower Cretaceous: Western South Dakota, northeastern Nebraska, and eastern Wyoming.

Original reference: N. H. Darton, 1899, Geol. Soc. America Bull., v. 10, p. 387.

G. E. Condra and E. C. Reed, 1943, Nebraska Geol. Survey Bull. 14, p. 15 (fig. 7). Shown on columnar section as basal formation in Dakota group. Underlies Fuson shale.

K. M. Waagé, 1959, U.S. Geol. Survey Bull. 1081–B, p. 18–25, 32–33, 34–50, 84–86, strat. sections. Subdivision and nomenclature of Inyan Kara group adjusted to conform with its twofold lithogenetic division; Fall River formation redefined to correspond to upper part, and term Lakota extended to include entire lower part. Regional transgressive disconformity [see Dakota group] is contact between Lakota and Fall River formations. Lakota comprises Minnewaste limestone member and Fuson shale member. Name Lakota should not be used outside Black Hills region. Type section at Lakota Peak not considered adequate for reference or comparison; standard reference section herein designated. At standard reference section, where only Minnewaste member is present, formation is 460 feet thick; overlies Unkpapa sandstone and disconformably underlies Fall River formation. Sequence of Lakota rocks in southern part of Black Hills is markedly different from that in northwestern part. Additional beds are added progressively at base of formation as it thickens eastward and southeastward. Relationship of these beds to underlying Morrison not completely understood, but they do interfinger.

Base of Lakota is an arbitrary, indefinite, and inconstant boundary generally drawn at base of first appreciable sandstone bed above Sundance formation, the local distinctive Unkpapa sandstone excepted.

W. J. Mapel and G. B. Gott, 1959, U.S. Geol. Survey Mineral Inv. Field Studies Map MF-218. Referred to as formation—heterogeneous sequence of light-gray to light- to dark-gray siltstone, variegated sandy mudstone and claystone, and some limestone. Thickness as much as 550 feet in Cascade Springs and Angostura Reservoir quadrangles at southern end of Black Hills; thins irregularly westward to less than 100 feet along parts of Inyan Kara Creek and Government Canyon. In some areas, overlies Morrison formation, and in others, Unkpapa sandstone; underlies Fall River formation.

W.A. Pettyjohn, 1960, (abs.) South Dakota Acad. Sci. Proc., v. 38, p. 34–38. Dakota controversy discussed. Suggested that term Dakota group be used to include Lakota, Fuson, Fall River, Skull Creek, and Newcastle formations.

Type locality: Lakota Peak, a summit hogback range, 4 miles northwest of Hermosa, Custer County, S. Dak. Composite reference section. Exposures in valley of Fall River in center W½NW¼ sec. 33, NE½NE¼ sec. 32, and adjacent parts sec. 29, T. 7 S., R. 6 E., Fall River County, Hot Springs quadrangle, South Dakota. Exposures are between 4 and 5 miles south of Hot Springs.

Lalor Sands[1]

Quaternary (probably Recent): Southern New Jersey.

Original reference: J. B. Woodworth, 1911, Harvard Univ. Peabody Mus. American Arch. and Eth. Papers, app., p. 238–241.

Named for Lalor farm, near Riverview Cemetery, Trenton, Mercer County.

Lamar Limestone Member (of Bell Canyon Formation)

Lamar Limestone Member (of Delaware Mountain Formation)[1]

Upper Permian (Guadalupe Series): Western Texas and southeastern New Mexico.

Original reference: W. B. Lang, 1937, Am. Assoc. Petroleum Geologists Bull., v. 21, no. 7.

P. B. King, 1942, Am. Assoc. Petroleum Geologists Bull., v. 26, no. 4, p. 583–586, pl. 2; 1948, U.S. Geol. Survey Prof. Paper 215, p. 57–58, pl. 3. Reallocated to member status in Bell Canyon formation (new). Separated from underlying Rader limestone member (new) by several thousand feet of sandstone beds; separated from overlying Castile formation by about 20 feet of fine-grained slabby sandstone. Thickness at type locality about 15 feet; about 150 feet at mouth of McKittrick Canyon.

G. E. Hendrickson and R. S. Jones, 1952, New Mexico Bur. Mines Mineral Resources Ground-Water Rept. 3, p. 18. Crops out at base of reef escarpment just north of south county line of Eddy County, N. Mex.

N. D. Newell and others, 1953, The Permian reef complex of the Guadalupe Mountains region Texas and New Mexico; San Francisco, W. H. Freeman and Co., p. 15, 53. Separated from underlying Rader member by McCombs limestone member (new).

Type locality: Escarpment north of Lamar Canyon, where canyon is crossed by Western Gas pipeline, about 15 miles due east of Guadalupe Point, Delaware Basin, Tex.

Lamb Dolomite[1]

Middle(?) and Upper Cambrian: Western Utah.

Original reference: T. B. Nolan, 1930, Washington Acad. Sci. Jour., v. 20, no. 17, p. 421–432.

U.S. Geological Survey currently designates the age of the Lamb Dolomite as Middle(?) and Upper Cambrian on the basis of a study now in progress.

Named for exposures in Lamb Gulch, on north side of Dry Canyon, Gold Hill district.

Lamb Point Tongue (of Navajo Sandstone)

Jurassic and Triassic(?): Southwestern Utah.

Paul Averitt and others, 1955, Am. Assoc. Petroleum Geologists Bull., v. 39, no 12, p. 2521. Applied by R. F. Wilson (in press) to rocks in Kanab area, formerly classified as Wingate by Gregory (1950). Consists of grayish-white to grayish-orange fine-to very fine-grained crossbedded sandstone. Base of tongue approximately 300 feet above top of Springdale sandstone member of Moenave throughout Kanab area; east of Sevier fault in vicinity of Moccasin, Ariz., eolian structures are absent in tongue; it is pale reddish-brown sandstone and is assigned to Kayenta formation. Approximately 400 feet thick in Kanab Canyon; 520 feet to east in Johnson Canyon; still farther east, thickens and coalesces with basal part of main body of Navajo; southwest of Kanab, thins from 400 to 142 feet in 5 miles; 93 feet at Moki Mountain southwest of Kanab. Since Lamb Point tongue thins westward from Kanab and since Shurtz tongue (new) thins southward from Cedar City, it is possible that they join somewhere between the two localities. Overlain by Tenney Canyon tongue (new) of Kayenta formation.

Type locality and derivation of name not stated.

Lamoille Glacial Stage[1]

Pleistocene: Northeastern Nevada.

Original reference: E. Blackwelder, 1931, Geol. Soc. America Bull., v. 42, p. 911, 918.

Ernst Antevs, 1945, Am. Jour. Sci., v. 243A, table 2. Listed on correlation chart of mountain glaciations in western United States.

Largest glacier of this stage issued from Lamoille Canyon, Ruby Mountains, northeastern Nevada.

Lamotte Sandstone[1]

Upper Cambrian: Eastern and central Missouri.

Original reference: A. Winslow, 1894, Missouri Geological Survey, v. 6, p. 331, 347–358.

G. F. Brightman, 1938, Jour. Geology, v. 46, no. 3, p. 250 (table 1), 254. Underlies Tom Sauk member (new) of Bonneterre formation.

E. B. Branson, 1944, Missouri Univ. Studies, v. 19, p. 16–18. Largely quartz grains varying in color through light gray, reddish brown, red, green, and shades of yellow. Shale layers a few inches thick common throughout formation. Underlies Bonneterre formation. Oldest Cambrian formation that appears at surface in Missouri. No complete section exposed.

Named for Mine La Motte Station, Madison County.

Lamoureux[1] or Lamoureaux shale[1]

Devonian: Nevada.

Original reference: C. R. Keyes, 1923, Pan-Am. Geologist, v. 40, p. 52, 79.

Named for exposures in Lamoureux Canyon, Eureka district.

Lampasas Series

Pennsylvanian: Texas.

M. G. Cheney, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 1, p. 66 (fig. 1), 81–82. Proposed for beds younger than Morrow but older than type Strawn. Series forms extensive wedge between eastward-dipping type Marble Falls and westward-dipping Strawn beds. Type Marble Falls belongs to Morrow series, but Marble Falls beds in McCulloch and Kimble Counties are for most part believed to be post-Morrow. In southeastern Oklahoma, regional unconformities at top of Morrow and at base of Savanna are considered as marking lower and upper boundaries of Lampasas. Upper Pottsville and lower Allegany beds of older classifications included in Lampasas. Includes Big Saline (new) and Smithwick groups. Epoch marks first appearance of family Fusulinidae, possibly excepting genus *Stafella*. Development of *Fusiella* and *Fusinella* occurred during Big Saline time and early types of *Wedekindellina* and *Fusulina* species during Smithwick epoch. Genus *Mesolobus*, characteristic of Strawn (Des Moines) series, is thought to be absent in Lampasas.

M. G. Cheney and others, 1945, Am. Assoc. Petroleum Geologists Bull., v. 29, no. 2, p. 156–164. Type section and correlatives discussed. Proposed that Lampasas-Strawn boundary in Brazos River outcrop section be placed at base of conglomerate which rests on Dennis Bridge limestone at Dennis highway bridge in southwestern Parker County. Placement of Connoquenessing, Mercer, and Clarion groups of Pennsylvanian in Kanawha series (upper Pottsville) favors inclusion of approximately equivalent Big Saline, Smithwick, and Parks groups in correlative series of Mid-Continent region.

F. B. Plummer, 1945, Texas Univ. Bur. Econ. Geology Pub. 4401, p. 76. Name Lampasas has been applied by Cheney in place of restricted Bend. Type outcrops designated by Cheney are same as those near Bend, type locality for the Bend. Seems confusing to substitute a new name for Bend, a term long in good usage by State and Government surveys.

R. C. Spivey and T. G. Roberts, 1946, Am. Assoc. Petroleum Geologists Bull., v. 30, no. 2, p. 181–186. Lampasas not appropriate as series name because in type area it is only partly exposed and because, as defined it includes beds of Des Moines age and excludes part of Marble Falls which is post-Morrow in age.

Type section: Around Llano uplift of central Texas and in area to north. Best outcrops of beds are in western Lampasas and eastern San Saba Counties near village of Bend. McAnnelly's Bend in vicinity of village of Bend has been used as type area of Bend division.

Lampkins Sandstone Member[1] (of Carwood Formation)

Mississippian: Southern Indiana.

Original reference: P. B. Stockdale, 1931, Indiana Dept. Conserv. Div. Geology Pub. 98, p. 77, 118, 178, 183, 291.

J. M. Weller and others 1948, Geol. Soc. America Bull., v. 59, no. 2, pl. 2 facing p. 126. Member of Carwood formation. Part of Gent facies of formation.

Named for Lampkins Bridge across Salt Creek, south-center sec. 15, T. 8 N., R. 1 E., 3 miles southwest of Belmont, Monroe County.

Lampson Formation

Pliocene and (or) Pleistocene: Northeastern Nevada.

F. L. Humphrey, 1960, Nevada Bur. Mines Bull. 57, p. 45–46. Consists of bedded tuffs and gravels containing basalt pebbles. Thickness in some areas as much as 300 feet. Younger than Lake Newark formation (new). Underlies Belmont fanglomerate (new). Mapped with Lake Newark formation.

Named for exposures in Lampson Canyon, White Pine mining district, White Pine County.

La Muda Limestone Member (of Frailes Formation)

La Muda Limestone[1]

Upper Cretaceous: Puerto Rico.

Original reference: C. P. Berkey, 1915, New York Acad. Sci. Annals, v. 26, p. 22.

C. A. Kaye, 1959, U.S. Geol. Survey Prof. Paper 317–A, p. 7 (table), 10 (fig. 4), 18–19, pl. 2. Rank reduced to member status in Frailes formation (new). La Muda as used in this report follows usage of Berkey and not Meyerhoff and Smith (1931, New York Acad. Sci. Scientific Survey of Porto Rico and the Virgin Islands, v. 2, p. 3); their La Muda is referred to Trujillo Alto limestone. Texture varies; fine-grained pure limestone; solution openings and veins of coarsely crystalline calcite common; thin sections show Foraminifera, Radiolaria, and small broken grains of calcareous algae. Thickness 35 to 60 feet. Forms lenticular limestone in lower part of Frailes and is not a single bed or stratigraphic horizon. In type area, directly overlies Tortugas andesite (new) in vicinity of El Laberinto; to the northwest, rests on what seems to be the Guaynabo (without the intervening andesite); in type section of Frailes, the La Muda is separated from Tortugas andesite by about 200 feet of noncarbonate rock of Frailes.

Type locality: Vicinity of La Muda, a roadside settlement that fringes highway for a mile or more southeast of intersection of Highways 1 and 20, San Juan area.

Lana Conglomerate[1]

Precambrian: Northwestern Vermont.

Original reference: W. G. Foye, 1919, Vermont State Geologist 11th Rept., p. 85.

Occurs just above Falls of the Lana, north of Silver Lake, southern part of Addison County.

Lana Shale[1]

Precambrian: Northwestern Vermont.

Original reference: E. J. Foyles, 1929, Vermont State Geologist 16th Rept., p. 284.

Probably named for Falls of the Lana, Addison County.

Lanai Volcanic Series

Lanai Basalt[1]

Pliocene and Pleistocene(?) : Lanai Island, Hawaii.

Original reference: C. K. Wentworth, 1925, Bernice P. Bishop Mus. Bull. 24, p. 34.

H. T. Stearns, 1946, Hawaii Div. Hydrography Bull. 9, p. 67; G. A. Macdonald and D. A. Davis *in* Jacques Avias and others, 1956, Lexique Strat. Internat., v. 6, Océanie, fasc. 2, p. 110. Thin-bedded and pahoehoe basaltic flows, a few mixed cinder and spatter cones; about 375 feeding dikes. Composes cone of Lanai volcano. Thickness above sea level 3,370 feet; base not exposed. Includes Lanai basalt and Manele basalt. Overlain by marine limestone of probable Pleistocene age.

Well exposed in Kaholo Pali (cliff) on southwest side of island, and in deep canyons on northeastern slope. Covers area of about 135 square miles and comprises entire island except for small areas of alluvium.

†Lancaster Limestone[1]

Cambrian and Ordovician: Eastern Pennsylvania.

Original reference: J. P. Lesley and P. Frazer, Jr., 1880, Pennsylvania 2d Geol. Survey Rept. C_3, map of Lancaster County.

Lance Formation[1]

Upper Cretaceous: Colorado, Montana, North Dakota, South Dakota, and Wyoming.

Original reference: J. B. Hatcher, 1903, Am. Geologist, v. 31, p. 369–375.

W. R. Calvert, 1912, U.S. Geol. Survey Bull. 471, p. 189–198. In eastern Montana and southwestern North Dakota, includes Colgate sandstone member (new).

E. R. Lloyd, 1914, U.S. Geol. Survey Bull. 541, p. 249–250. In Cannonball River lignite field, North Dakota, includes Cannonball marine member (new), 250 to 300 feet thick, in upper part. Eocene(?).

E. R. Lloyd and C. J. Hares, 1915, Jour. Geology, v. 23, no. 6, p. 527–547. In western part of North Dakota and South Dakota, comprises (ascending) unnamed lower part, Ludlow lignitic member (new), and Cannonball marine member.

G. S. Rogers and Wallace Lee, 1923, U.S. Geol. Survey Bull. 749, p. 19–34. In Tullock Creek coal field, Montana, includes Tullock member (new), about 300 feet thick, in upper part.

W. T. Thom, Jr., and C. E. Dobbin, 1924, Geol. Soc. America Bull., v. 35, p. 490, 491–493. Restricted to exclude Colgate sandstone which is allocated to member status in underlying Fox Hills sandstone. Comprises Hell Creek, Tullock, Ludlow lignitic, and Cannonball members.

C. E. Dobbin and J. B. Reeside, Jr., 1929, U.S. Geol. Survey Prof. Paper 158–B, p. 9–25. Discussion of contact of Fox Hills and Lance formations. Writers [Dobbin and Reeside] advocate view that Laramie, Arapahoe, and Denver formations of Denver Basin are represented in Lance formation. Contact between Lance and Fox Hills is conformable except where local unconformities are present along minor erosion planes at many horizons within both formations. Measured sections show Lance present in Montana, Wyoming, North Dakota, and South Dakota.

E. M. Schlaikjer, 1935, Harvard Coll. Mus. Comp. Zoology Bull., v. 76, no. 2, p. 31–54, 65. In Goshen County, Wyo., includes Torrington member (new), 60 to 100 feet thick, as top member.

W. G. Pierce, 1936, U.S. Geol. Survey Bull. 847–B, p. 53–57, pl. 11. In Rosebud coal field, Montana, comprises (ascending) Hell Creek and Tullock members. Underlies Fort Union formation. Age has long been in controversy. Since decision in 1914 by U.S. Geological Survey to refer the Lance tentatively to the Tertiary, there has been much paleontologic and structural evidence which seems to warrant placing at least part of the Lance in the Cretaceous. Tertiary age used in this report inasmuch as studies of age of Lance still in progress. Mapped as Eocene(?).

E. P. Rothrock, 1937, South Dakota Geol. Survey Rept. Inv. 28, p. 4, 6–13. Described in Harding County where it includes Hell Creek and Ludlow members. Thickness 800 feet. Overlies Fox Hills formation; underlies Fort Union.

C. W. Wilson, Jr., 1938, Am. Assoc. Petroleum Geologists Bull., v. 22, no. 1, p. 106–108. In Carbon County, Mont., comprises (ascending) Hell Creek and Tullock members. Thickness 690 feet. Overlies Colgate sandstone; underlies Fort Union formation.

M. H. Stow, 1938, Geol. Soc. America Bull., v. 49, no. 5, p. 735–736, 744–745, pls. 1, 2. Upper Cretaceous Lance formation comprises Hell Creek and Tullock members. Underlies Lebo member of Fort Union; overlies Lennep sandstone. Area of report Big Horn Basin.

A. J. Collier and M. M. Knechtel, 1939, U.S. Geol. Survey Bull. 905, p. 10–11, pl. 3. In McCone County, Mont., where Lance is about 300 feet thick, it is underlain by Fox Hills sandstone of Upper Cretaceous age and underlies Fort Union formation of Eocene age. Footnote (page 10) states that since present report was written the Hell Creek and Tullock members have been raised to rank of formation in official classification of the Geological Survey, the Hell Creek being assigned to the Cretaceous and the Tullock to the Cretaceous or Eocene. Lance is Eocene(?).

Erling Dorf, 1940, Geol. Soc. America Bull., v. 51, no. 2, p. 213–236. Discussion of relationship between floras of type Lance and Fort Union formations. Paleobotanical evidence supports known vertebrate evidence in placing boundary between true Lance and "Fort Union" at base of nondinosaur-bearing Tullock, Ludlow, or Bear formations or their equivalents; that is, at top of *Triceratops*-bearing Hell Creek or Lance formations as originally defined. Such a view is not contradicted by marine invertebrates of Cannonball beds, which interfinger with the Ludlow and the lower "Fort Union." In proposed revision, Lance formation (equivalent to Hell Creek formation) is restricted to Upper Cretaceous; Tullock formation (equivalent to Ludlow formation and Cannonball marine member) is basal formation of Paleocene Fort Union group. Lance overlies Fox Hills sandstone.

V. H. Kline, 1942, Am. Assoc. Petroleum Geologists Bull., v. 26, no. 3, p. 338. Generalized columnar section for North Dakota shows that Lance, 0 to 800 feet thick, comprises (ascending) Hell Creek, Cannonball, and Ludlow members. Overlies Fox Hills sandstone; underlies Fort Union formation. Tertiary.

O. A. Seager and others, 1942, Am. Assoc. Petroleum Geologists Bull., v. 26, no. 8, p. 1415, 1416. There has been little agreement and no accepted solution of "Lance-Laramie" problem. In North Dakota, lithology and paleontology of strata formerly classified as "Lance" permit subdivision into formations whose stratigraphic positions are quite definite. Classification shows Cannonball and Ludlow as members of Paleocene Fort Union formation and the Hell Creek a formation in Upper Cretaceous.

Erling Dorf, 1942, Carnegie Inst. Washington Pub. 508, pt. 2, p. 83–159, pls. At type locality, consists of about 2,600 feet of dull-gray sandy shales alternating irregularly with lenticular light-colored sandstones and thin lignite beds. Along Lance and Lightning Creeks are numerous exposures which show that individual units are very irregular, sandstones passing laterally into shales and vice versa. Overlies Fox Hills sandstone; underlies Fort Union group, lower limit of which, in Lance Creek area, is equivalent to Tullock formation. Upper limit drawn at top of dinosaur-bearing beds. This horizon coincides with marked change, without a recognized erosional or structural unconformity, from the characteristic dull-gray shales and shaly sandstones of typical Lance formation to sequence of more persistent ridge-forming yellowish sandstones, yellowish sandy shales, and coal beds. Formation at Lance Creek has yielded abundant fossil remains of vertebrates, invertebrates, and plants. Flora described. Upper Cretaceous.

R. W. Brown, 1943, Geol. Soc. America Bull., v. 54, no. 1, p. 79–80. Lance of Wyoming equivalent to Laramie formation (redefined) of Denver Basin.

J. B. Reeside, Jr., 1944, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 10. Discussion of thickness and general character of Cretaceous deposits in Western Interior of United States. Correlation chart shows Lance in northern Great Plains, overlies Fox Hills sandstone and underlies Ludlow formation and Cannonball formation. Upper Cretaceous. [Ludlow and Cannonball previously considered members of Lance.]

H. E. Summerford and others, 1947, *in* Wyoming Geol. Assoc. Guidebook 2d Ann. Field Conf., p. 19. Road log of Bighorn Basin mentions Ilo Ridge member of Lance formation on east flank of Grass Creek anticline. Basal unit of formation; overlies Meeteetse formation.

G. B. Downs, 1947, Wyoming Geol. Assoc. Guidebook 2d Ann. Field Conf., p. 140. In Bighorn Basin area, name Lance applied only to Cretaceous or Hell Creek part of "Lance" of early writers. Youngest Mesozoic sequence of Bighorn Basin. Underlies Fort Union formation with angular disconformity; distinguished from underlying Meeteetse formation by general absence of coal beds, absence of coarse sediments, and presence of dark-brown concretions which weather from the sandstone of the Lance. The Lance is predominantly sand or poorly consolidated sandstone with lesser amounts of sandy clay and shale which range in color from gray and drab to light brown. Maximum thickness 1,400 feet.

L. A. Hale, 1950, Wyoming Geol. Assoc. Guidebook 5th Ann. Field Conf., p. 55. Area of report, Rock Springs uplift, Sweetwater County, Wyo. Along east side of uplift continental sediments lie conformably on marine Lewis shale and unconformably beneath Wasatch formation. This sequence of beds was named Black Butte coal group by Schultz and later Laramie formation. A thickness of 1,500 feet was given but nowhere is entire formation exposed. Proposed here that term Lance formation be applied in favor of Laramie formation in order to conform with currently accepted terminology of post-Montana pre-Tertiary formation in Wyoming.

Lance consists of basal member of light to yellowish-gray sandstone locally 80 feet thick. This member rests upon Lewis shale and forms prominent hills and precipitous cliffs along contact. Overlying beds consist of sandstone, clay shale, and thin coal beds that are less resistant to weathering than basal sandstone. Formation exposed only on east side of uplift between North Table Mountain and Black Butte Creek. Elsewhere the Wasatch lies unconformably in turn upon the Lewis, Almond, Ericson, and in one locality (T. 15 N., R. 104 W.) upon Rock Springs formation.

R. K. Hose, 1955, U.S. Geol. Survey Bull. 1027–B, p. 65, pls. 6, 8. Described in Crazy Woman Creek area, Johnson County, Wyo., where it overlies Bearpaw shale and underlies Fort Union formation. Thickness 1,950 to 2,200 feet. Contact with Bearpaw arbitrarily placed at top of 6-inch bentonite bed in Bearpaw. Lower 600 feet, which contains dinosaur bones, is of Late Cretaceous age. No fossils found in upper part within mapped area and assignment of entire Lance to Upper Cretaceous is one of convenience. Lower 100 feet may, in part, be equivalent to Fox Hills sandstone which is recognized about 20 miles south of mapped area.

W. J. Mapel, 1959, U.S. Geol. Survey Bull. 1078, p. 59–60, pls. 1, 3. At type locality, Lance beds conformably overlie Fox Hills sandstone and underlie Fort Union formation. Fox Hills sandstone not distinguished in Buffalo-Lake De Smet area, Wyoming [this report], and beds here classified as Lance rest directly on Bearpaw shale. Contact between Bearpaw and Lance placed arbitrarily at top of bed of grayish-yellow bentonite 1 foot thick underlain by 2 to 3 feet of fine-grained light-gray sandstone; this sandstone carries marine fauna. Underlies Fort Union formation. Thickness 1,970 feet 5 miles south of mapped area. Upturned edges of steeply dipping beds in Lance are exposed in southwestern, west-central, and northwestern parts of area in an outcrop band a quarter to a half mile wide trending northwestward parallel to Bighorn Mountain front.

Type locality: Lance Creek area, north-central part Niobrara County (formerly a part of Converse County), Wyo. Mouth of Lance Creek is in sec. 11, T. 39 N., R. 62 W.

†Lance Creek Beds[1]

Upper Cretaceous: Wyoming, northwestern Colorado, Montana, western North Dakota, and South Dakota.

Original reference: J. B. Hatcher, 1903, Am. Geologist, v. 31, p. 369–375.

Named for exposures on Lance Creek, Niobrara County (formerly part of Converse County), Wyo.

Lancha Limestone (in Pacheta Member of Lowell Formation)

Lower Cretaceous: Southeastern Arizona.

A. A. Stoyanow, 1949, Geol. Soc. America Mem. 38, p. 12. Grayish, bluish-gray, and pinkish limestone in places arenaceous or partly silicified. Thickness 11 feet. Underlies unnamed yellow dolomite. Overlies Morita formation.

In standard section of Lowell formation in Ninety One Hills. Type locality of formation also designated as Ninety One Hills area, immediately north of international border in vicinity of international monument No. 91, southeast of Bisbee Junction on Southern Pacific Railway, Cochise County.

Landaff Granite[1]

Upper Devonian or Upper Carboniferous: West-central New Hampshire.

Original reference: M. P. Billings, 1935, Geology of Littleton and Moosilauke quadrangles, New Hampshire, p. 28, Moosilauke map.

M. P. Billings, 1937, Geol. Soc. America Bull., v. 48, no. 4, p. 511, pl. 12. Fine-grained pink to gray hastingsite granite. May be part of White Mountain magma series.

Mapped largely in Landaff Township, Moosilauke quadrangle, Grafton County.

Lander Sandstone Member (of Bighorn Dolomite)[1]

Lander Sandstone

Upper Ordovician: Western Wyoming.

Original reference: A. K. Miller, 1930, Am. Jour. Sci., 5th, v. 20, p. 196–213.

J. D. Love, 1939, Geol. Soc. America Spec. Paper 20, p. 18, 19. Well exposed in several localities on southern margin of Absaroka Range. Thickness commonly about 7 feet. Underlies middle massive dolomite member. In some areas, rests with slight erosional unconformity on Gallatin limestone.

E. B. Branson and C. C. Branson, 1941, Am. Assoc. Petroleum Geologists Bull., v. 25, no. 1, p. 124 (table 1), 126 (fig. 2), 129. Referred to as Lander sandstone. Overlies Gallatin formation; underlies Bighorn dolomite. Thickness as much as 20 feet.

A. B. Shaw and C. R. DeLand, 1955, Wyoming Geol. Assoc. Guidebook 10th Ann. Field Conf., p. 41. Overlies Open Door limestone (new) of Gallatin group.

Named from exposures about 10 miles southwest of Lander.

Landes Limestone[1]

Middle Devonian: Northeastern West Virginia.

Original reference: D. B. Reger, 1924, West Virginia Geol. Survey Rept. on Mineral and Grant Counties, p. 313, 745.

G. A. Cooper and others, 1952, Geol. Soc. America Bull., v. 53, no. 12, pt. 1, chart 4. Shown on correlation chart below Genesee shale and above Hamilton shale.

Named for occurrence in public road along North Mill Creek, 0.2 mile north of Landes, Grant County.

Landgraff Sandstone (in Pocahontas Formation)[1]

Pennsylvanian: Southern West Virginia.

Original reference: R. V. Hennen and R. M. Gawthrop, 1915, West Virginia Geol. Survey Rept. Wyoming and McDowell Counties, p. 235.

Once quarried at Landgraff, McDowell County.

Landisburg Sandstone[1]

Silurian: Central Pennsylvania.

Original reference; J. P. Lesley, 1892, Pennsylvania 2d Geol. Survey Summ. Final Rept., v. 2, p. 761–777.

Landisburg, Perry County.

Landrum Member (of Cook Mountain Formation)

Landrum Shale Member (of Crockett Formation)

Eocene, middle (Claiborne) : Eastern Texas.

H. B. Stenzel, 1938, Texas Univ. Bur. Econ. Geology Pub. 3818, p. 20 (table), 125, 134–148. Series of brown lignitic shales and marls about 100 feet thick, overlying Wheelock marl member (new) and underlying Spiller sand member (new) of Crockett formation. Lower and upper boundaries transitional and interfingering.

H. B. Stenzel, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 9, p. 1665–1671. Reallocated to member status in Cook Mountain formation. Includes bentonite-bearing Hurricane marine lentil (new).

Type locality: On north-flowing tributary of Two-Mile Creek which enters Two-Mile Creek on William Johnson Survey; Two-Mile Creek flows through the J. L. Landrum survey near Two-Mile Church, Leon County.

Landston formation[1]

Middle Cambrian: Utah.

Original reference: C. R. Keyes, 1924, Pan-Am. Geologist, v. 41, p. 38.

Derivation of name not stated.

Lane Shale (in Kansas City Group)

Lane Shale (in Lansing Group)[1]

Lane Shale Member (of Lansing Formation)[1]

Pennsylvanian (Missouri Series): Eastern Kansas, southwestern Iowa, northwestern Missouri, and southeastern Nebraska.

Original references: E. Haworth, 1895, Kansas Univ. Quart., v. 3, p. 277, pl. facing p. 290; 1895, Am. Jour. Sci., 3d, v. 50, p. 460, pl. facing p. 466.

J. R. Clair, 1943, Missouri Geol. Survey and Water Resources, 2d ser., v. 27, pl. 1. Columnar section, Jackson and Cass Counties, Mo., shows Lane shale in Lansing group. Includes (ascending) Island Creek shale, Farley limestone, and Bonner Springs shale members. Underlies Plattsburg limestone; overlies Iola limestone which includes (ascending) Frisbie limestone, Quindaro shale, and Argentine limestone members.

R. C. Moore, 1948, Am. Assoc. Petroleum Geologists Bull., v. 32, no. 11, p. 2031 (fig. 4), 2032–2033; F. C. Greene and W. V. Searight, 1949, Missouri Geol. Survey and Water Resources Rept. Inv. 11, p. 13–14. Settlement of "Iola problem" has led to several changes in Missouri Survey's classification of middle and upper Kansas City beds so as to bring interstate agreement in nomenclature. Liberty Memorial shale (Clair, 1943), overlying Raytown limestone, is no longer considered uppermost member of Chanute shale but is suppressed as junior synonym of Lane shale. Frisbie limestone, Quindaro shale, and Argentine limestone, which were indicated as members of Iola limestone are classified with overlying Island Creek shale and Farley limestone as members of Wyandotte formation. Island Creek shale and Farley limestone, which were associated with overlying Bonner Springs shale as members of Lane shale, are included in Wyandotte formation. Bonner Springs shale is recognized as formational unit between Wyandotte and Plattsburg formations. Hence, Lane shale in Missouri is removed from Lansing group and placed in Kansas City group where it occupies interval between Iola limestone and Wyandotte limestone.

G. E. Condra, 1949, Nebraska Geol. Survey Bull. 16, p. 35. Thickness of formation 14 feet in Sarpy County, Nebr. Overlies Iola formation; underlies Frisbie limestone member of Wyandotte formation. Kansas City group.

T. L. Welp, L. A. Thomas, and H. R. Dixon, 1957, Iowa Acad. Sci. Proc., v. 64, p. 418 (fig. 1), 420. Thickness of Lane formation about 10½ feet in Madison and Adair Counties, Iowa. Overlies Iola formation; underlies Frisbie limestone member of Wyandotte formation. Kansas City group.

H. G. Hershey and others, 1960, Iowa Highway Research Board Bull. 15, p. 25, fig. 5. Recognized in Madison County as an olive to dark-gray fossiliferous shale containing limestone lenses; at some localities, has thin bed of maroon and green shale at base. In Union County, consists of greenish-gray to yellow calcareous shale with lenses of gray fossiliferous shale. Thickness 7 feet, Madison County; about 10 feet, Union County. Underlies Wyandotte limestone; overlies Iola limestone. Kansas City group.

Named for exposures at Lane, Franklin County, Kans.

Lanes Tongue (of Ankareh Formation)

Triassic: Eastern Idaho and western Wyoming.

Bernhard Kummel, 1954, U.S. Geol. Survey Prof. Paper 254–H, p. 173, 175 (fig. 18), pl. 38. Prominent tongue of Ankareh in upper part of Thaynes formation pinches out westward toward Fort Hall.

Present in Sheep Creek section, Grays Range, Idaho.

Lanesboro formational suite (of Wellsburg monothem)

Lanesboro Member (of New Milford Formation)[1]

Upper Devonian: Northeastern Pennsylvania.

Original reference: Bradford Willard, 1936, Geol. Soc. America Bull., v. 47, no. 4, p. 571–589.

K. E. Caster, 1938, Jour. Paleontology, v. 12, no. 1, p. 45 (fig. 7), 46. Termed formational suite; upper unit in monothem. Further described as typically containing massive sandstone or flaggy zone at top, a predominantly shaly zone in middle, and a prominent sandstone zone at base. Newly named Drinker Creek sandstone occurs at base.

Named for exposures near Lanesboro, Susquehanna County.

†Laneville Shale[1]

Pennsylvanian: Eastern Kansas and northwestern Missouri.

Original reference: E. Haworth and M. Z. Kirk, 1894, Kansas Univ. Quart., v. 2, p. 108.

Named for exposures at Laneville, Labette County, Kans.

Laney Shale Member (of Green River Formation)[1]

Eocene, middle: Southwestern Wyoming.

Original reference: A. R. Schultz, 1920, U.S. Geol. Survey Bull. 702.

J. J. Donavan, 1950, Wyoming Geol. Assoc. Guidebook 5th Ann. Field Conf., p. 63–64. Overlies Fontenelle member (new) of Green River.

W. H. Bradley, 1959, Am. Assoc. Petroleum Geologists Bull., v. 43, no. 5, p. 1072–1074. At type locality and around Washakie basin and southward into Colorado, Laney shale member is characterized by buff laminated, or massive marlstone, buff tuffaceous sandstone, and soft marly shale, in which ostracods are fairly common. Interbedded with these rocks are moderate number of oil shale and organic marlstone, algal, and oolitic layers; fish bones, plant fragments, and snail or fresh-water clam shells are characteristic. In Bridger basin, beds that have been called Laney are predominantly white dolomitic marlstone, oil shale, or greenish-gray dolomite; though regularly bedded or laminated, they characteristically lack fossils, algal deposits, and oolites. This unit differs from type Laney in having thick and extensive saline facies; no saline facies of any kind are known in the Laney beyond limits of Bridger basin. Concluded from this study that what has been called Laney shale member in Bridger basin is older than type Laney and is time equivalent of Cathedral Bluffs and New Fork tongues of Wasatch formation. Beds in Bridger basin formerly thought to be Laney shale member of Green River herein renamed Wilkins Peak member. Recognition of Wilkins Peak member and its equivalence to Cathedral Bluffs tongue of Wasatch forces recognition of equivalence of Morrow Creek member with Schultz' type Laney shale member; hence, Morrow Creek member is abandoned, and name Laney shale member substituted. Laney shale member rests on Wilkins Peak member or one or another of tongues of Wasatch formation that are approximate time equivalents of Wilkins Peak member. Laney is overlain by Bridger formation. Tower sandstone lentil of Green River formation is redefined as lentil in Laney shale member.

Named for Laney Rim. Sweetwater County.

†Lang division[1]

Tertiary: Southern California.

Original reference: O. H. Hershey, 1902, Am. Geologist, v. 29, p. 349–372.

Named for exposures at Lang, Los Angeles County.

Langdon Shale (in Wabaunsee Group)

Pennsylvanian (Virgil Series): Northwestern Missouri, southwestern Iowa, south-central Kansas, and southeastern Nebraska.

G. E. Condra and E. C. Reed, 1943, Nebraska Geol. Survey Bull. 14, p. 42. Proposed for shale between base of Dover limestone above and top of Maple Hill limestone below. Thickness at type locality about 19 feet; 50 feet or more in north-central Kansas; thinner in southeastern Nebraska; replaces name Table Creek shale.

G. E. Condra, 1949, Nebraska Geol. Survey Bull., v. 14, p. 15. Occurrence, from southwestern Iowa, southeastern Nebraska, and northwestern Missouri to south-central Kansas.

R. C. Moore and M. R. Mudge, 1956, Am. Assoc. Petroleum Geologists Bull., v. 40, no. 9, p. 2275–2276. Pillsbury shale (new) replaces Langdon shale (Condra and Reed, 1943); investigations have established Langdon shale, at its type section, as correlative with Wamego shale member of Zeandale limestone (new); accordingly name Langdon shale is abandoned.

Type locality: In Missouri River valley bluffs southeast of Langdon, Atchison County, Mo., or northwest of Craig, Holt County, Mo.

Langston Limestone[1]

Middle Cambrian: Southeastern Idaho and northeastern Utah.

Original reference: C. D. Walcott, 1908, Smithsonian Misc. Colln., v. 53, no. 1804, p. 6, 7.

Charles Deiss, 1938, Geol. Soc. America Bull., v. 49, no. 7, p. 1114–1115, 1117 (fig. 4), 1119–1120. Walcott's Blacksmith Fork section emended.

Langston consists of series of interbedded dull-tan, blue- and white-gray limestones, and dolomites which weather to red brown, and a basal 75- to 80-foot zone of white-gray calcareous quartzitic thin-bedded sandstone, 75-foot zone of buff-weathering thick-bedded dolomite occurs 68 feet below top of formation. Thickness 575 feet in type section which was measured on spurs that form sides of lower one-half mile of North Cottonwood Canyon on north side of Blacksmith Fork. Overlies Brigham quartzite; underlies Ute limestone (emended).

J. S. Williams and G. B. Maxey, 1941, Am. Jour. Sci., v. 239, no. 4, p. 279–281; J. S. Williams, 1948, Geol. Soc. America Bull., v. 59, no. 11, p. 1132–1133, pl. 1. In Logan quadrangle, Utah, includes Spence shale (formerly considered member of Ute formation) near base. At type locality, essentially two tan-weathering dolomites with an intermediate limestone member. Thicknesses 340 to 380 feet. Northward formation as a whole thickens slightly, but basal dolomite thins and disappears as *Ptarmigania* limestone and Spence shale appear and thicken at base of formation. Overlies Brigham quartzite; underlies Ute formation.

G. B. Maxey, 1958, Geol. Soc. America Bull., v. 69, no. 6, p. 649–650, 654–655, 656, 657–658, 662, 663, 664, 665, 669–671, 673 (fig. 3). Subdivided to include Naomi Peak limestone member (new). Several measured sections given. Section on north side of High Creek Canyon, sec. 11, T. 14 N., R. 2 E., near Richmond, Utah, considered most typical. Here both Naomi Peak and Spence members are present. Thickness 484 feet. Overlies Pioche formation. Some beds formerly assigned to Ophir and Maxfield formations are here assigned to Langston. Lower and Middle Cambrian.

Most accessible locality is Blacksmith Fork Canyon, Cache County, Utah, but strike of beds carries formation into valley of Langston Creek, Bear County, Idaho.

†Lang Syne Beds[1]

Eocene, lower: Central South Carolina.

Original reference: E. Sloan, 1908, South Carolina Geol. Survey, ser. 4, Bull. 2, p. 449, 451–452.

Named for exposures at Lang Syne plantation, Calhoun County.

Lanoria Quartzite[1]

Precambrian: Western Texas.

Original reference: G. B. Richardson, 1909, U.S. Geol. Survey Geol. Atlas, Folio 166.

T. S. Jones, 1953, Stratigraphy of the Permian basin of West Texas: West Texas Geol. Soc., p. 1. Overlies Red Bluff granite and unconformably underlies about 1,500 feet of red rhyolite porphyry.

R. L. Harbour, 1960, Am. Assoc. Petroleum Geologists Bull., v. 44, no. 11, p. 1786 (fig. 1), 1790. Overlies Mundy breccia (new). Consists of 2,600 feet of quartzite, siltstone, and shale. Underlies unnamed rhyolite.

Named for exposures just west of old settlement near base of Franklin Mountains, 8 miles northeast of El Paso, El Paso County.

†Lanphier Beds (in Cheyenne Sandstone)[1]

Lower Cretaceous (Comanche Series): Central southern Kansas.

Original reference: F. W. Cragin, Am. Geologist, v. 16, p. 361, 367.

Named for draw running through Lanphier claim (which may be called Lanphier Draw), in southeast corner of Kiowa County.

Lansdale Shale (in Newark Group)[1]

Upper Triassic: Southeastern Pennsylvania.

Original references: B. S. Lyman, 1893, Pennsylvania Geol. Survey geol. and topog. map of Bucks and Montgomery Counties; 1895, Pennsylvania 2d Geol. Survey Summ. Final Rept., v. 3, pt. 2, p. 2589–2638.

Underlies Lansdale, Montgomery County.

L'Anse Series[1]

Age (?) : Northeastern Michigan.

Original reference: T. B. Brooks, 1873, Michigan Geol. Survey, v. 1, pt. 1, p. 151–155.

L'Anse iron district, Baraga County.

Lansing Group[1]

Lansing Formation[1]

Pennsylvanian (Missouri Series): Eastern Kansas, southwestern Iowa, northwestern Missouri, and southeastern Nebraska.

Original reference: H. Hinds, 1912, Missouri Bur. Geology and Mines, v. 11, 2d ser., p. 7.

R. C. Moore, 1936, Kansas Geol. Survey Bull. 22, p. 45 (fig. 8), 123–137. Group includes strata from base of Plattsburg to top of Stanton limestone. Average thickness about 75 feet; more than 150 feet in parts of southern Kansas. Overlies Bonner Springs shale of Kansas City group; underlies Weston shale of Pedee group.

H. S. McQueen and F. C. Greene, 1938, Missouri Geol. Survey and Water Resources, 2d ser., v. 25, p. 27, pl. 5. Group in Missouri includes (ascending) Lane shale which comprises Island Creek shale, Farley limestone, and Bonner Springs shale members, Plattsburg limestone, Vilas shale, and Stanton limestone. Underlies Weston shale of Pedee group; overlies Iola limestone of Kansas City group.

R. C. Moore, 1948, Am. Assoc. Petroleum Geologists Bull., v. 32, no. 11, p. 2031 (fig. 4), 2033–2034. Interstate agreement recognized Lansing group as defined by Moore, that is, comprising Plattsburg limestone, Vilas shale, and Stanton limestone.

F. C. Greene and W. V. Searight, 1949, Missouri Geol. Survey and Water Resources Rept. Inv. 11, p. vi (fig. 2), 14. Lansing group revised for Missouri to accord with interstate agreement. Island Creek shale, Farley limestone, and Bonner Springs shale, formerly included in Lansing group, now included in upper part of Kansas City group.

G. E. Condra, 1949, Nebraska Geol. Survey Bull. 16, p. 31–34. Exposed thickness of group about 52 feet in Nebraska; average thickness 70 feet in northwestern Missouri.

H. G. Hershey and others, 1960, Iowa Highway Research Board Bull. 15, p. 24, fig. 5. Group in southwestern Iowa comprises Plattsburg limestone, Vilas shale, and Stanton limestone. Thickness about 29 feet. Underlies Kansas City group. Pedee-Douglas groups not differentiated.

Type locality: Lansing, Leavenworth County, Kans.

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Lansingan series

Paleozoic (Cambric): Arkansas, Iowa, Minnesota, and Missouri.

C. R. Keyes, 1941, Pan-Am. Geologist, v. 75, no. 1, p. 74–76. Oneota limestone and Richmond sandstone beneath constitute valid, though imperfect taxonomic series for which term Lansingan is proposed. In eastern Missouri, Delassus sandstone, Potosi dolomite, and Eminence cherty dolomite are assigned to the series.

Lantern Hill Silexite

Lantern Hill quartz rock[1]

Age not stated: Southeastern Connecticut.

Original reference: H. E. Gregory, 1906, Connecticut Geol. Nat. History Survey Bull. 6, p. 136.

W. G. Foye, 1949, Connecticut Geol. Nat. History Survey Bull. 74, p. 64–65. Referred to as silexite. Resistant mass of almost pure silica located in Lantern Hill; smaller mass occurs to north. Derivation of name.

Named for Lantern Hill located on boundary between towns of North Stonington and Ledyard, New London County.

Lantz Mills facies (of Edinburg Formation)

Middle Ordovician: Western Virginia.

B. N. Cooper and G. A. Cooper, 1946, Geol. Soc. America Bull., v. 57, no. 1, p. 78, 79, 82. Edinburg formation (new) embraces two equivalent facies: one of cobbly to nodular buff-weathering limestone, the Lantz Mills facies, which is mainly developed in northern and western parts of Shenandoah Valley; and relatively thicker body of black limestone and shale, Liberty Hall facies (new), typically developed in Harrisonburg-Staunton area. Thickness, where typically exposed, 188 feet.

Typically exposed along Swover Creek near Lantz Mills, 4.6 miles N. 69° W. of Edinburg, Shenandoah County.

Laona Sandstone[1]

Laona Siltstone Member (of Canadaway Formation)

Upper Devonian: Western New York.

Original reference: J. Hall, 1841, New York Geol. Survey 5th Ann. Rept., p. 177.

Wallace de Witt, Jr., and G. W. Colton, 1950, U.S. Geol. Survey Geol. Quad. Map GQ–30. In Silver Creek quadrangle, Laona sandstone overlies Gowanda member of Perrysburg formation.

J. F. Pepper and Wallace de Witt, Jr., 1951, U.S. Geol. Survey Oil and Gas Inv. Chart OC–45. Laona sandstone of Hall overlies Perrysburg formation (new).

I. H. Tesmer, 1955, New York State Mus. Sci. Service Circ. 42, p. 10 (fig. 2), 17. Referred to as siltstone member of Canadaway formation. Overlies Gowanda member; underlies Westfield member. Name credited to L. C. Beck (1840, Fourth annual report on the mineralogical and chemical department of the Survey of New York, p. 57–58).

Named for exposures at Laona, Chautauqua County.

Lapa Lava Member (of Robles Formation)

Upper Cretaceous: Puerto Rico.

H. L. Berryhill, Jr., R. P. Briggs, and Lynn Glover 3d, 1960, Am. Assoc. Petroleum Geologists Bull., v. 44, no. 2, p. 144, 145. Present in siltstone-sandstone facies of formation. Rests on rocks of volcanic complex in its southernmost outcrops; toward the north, overlies a lower tongue of siltstone of the Robles. Its stratigraphic position within formation becomes increasingly higher as this siltstone thickens. Thickness of lava ranges from a few inches to more than 1,000 feet; thickest in central and southern parts of island; pinches out toward the east, north, and northwest. Diagnostic features are pillowed structure and prominent phenocrysts. Appears to represent two lava effusions which in southern part of island are separated by thin layers of siltstone. Name credited to Berryhill and Glover (in press).

H. L. Berryhill, Jr., and Lynn Glover 3d, 1960, U.S. Geol. Survey Misc. Geol. Inv. Map I–319. Intertongues with Cayey siltstone member (new) in Cayey quadrangle. Thickness about 350 meters at type locality.

Type section: U.S. Military Reservation; begins at base of hill at point 1.2 kilometers N.40°W. of road intersection at Rabo del Buey and extends up ridge southwestward in Coamo quadrangle. Named for exposures in hills west of Río Lapa in Barrio Lapa between Rabo del Buey and Capilla de Santa Marta.

Lapara Sand Member (of Goliad Sand)[1]

Pliocene: Southern Texas.

Original reference: E. T. Dumble, 1893, Brown coal and lignite of Texas, p. 154.

A. W. Weeks, 1945, Am. Assoc. Petroleum Geologists Bull., v, 29, no. 12, p. 1727. In southwestern Texas, from central Duval County to the Rio Grande, divisions of the Goliad have been mapped. Section of sand and gravel at the base of the Goliad, ordinarily unconsolidated but in some places cemented to a firm siliceous conglomerate where it overlaps older beds sufficiently to rest on the Catahoula, is considered Lapara; upper section considered Lagarto. More work needed to determine full relations of these units to the Lapara and Lagarto divisions of Dumble in Live Oak County.

Type locality: Exposures along Lapara Creek in Live Oak County.

La Perla Shale Member (of Yegua Formation)

Eocene (Claiborne): Southern Texas.

J. M. Patterson, 1942, Am. Assoc. Petroleum Geologists Bull., v. 26, no. 2, p. 259 (fig. 2), 264, Green and gray sandy bentonitic shale characterized by abundance of oyster beds. Thickness ranges from 50 to 150 feet. Basal member of formation. Overlies Falcon sandstone member (new) of Cook Mountain formation; underlies Mier sandstone tongue (new) of Yegua formation.

Named for La Perla ranchhouse, located on bank of Rio Grande, north part of San Ygnacio quadrangle.

†La Plata Sandstone[1]

Upper Jurassic: Southwestern Colorado and southeastern Utah.

Original reference: W. S. Cross *in* C. W. Purington, 1898, U.S. Geol. Survey 18th Ann. Rept., pt. 3, p. 759.

M. I. Goldman and A. C. Spencer, 1941, Am. Assoc. Petroleum Geologists Bull., v. 25, no. 9, p. 1746–1751. Five members differentiated in section covered by name La Plata sandstone. Unit 1 is correlated with Entrada sandstone; other units are considered members of Morrison and named (ascending) Pony Express limestone, Bilk Creek sandstone (new), Wanakah marl (restricted usage of Burbank's original Wanakah), and Junction Creek sandstone (new).

E. B. Eckel, 1949, U.S. Geol. Survey Prof. Paper 219, p. 28. Term Wanakah as used in this report [La Plata district, Colorado] is equivalent to La Plata limestone and middle La Plata shale as these terms are applied by local miners, and to middle part of La Plata sandstone as defined in La Plata folio (no. 60) and other reports on parts of southwestern Colorado. In La Plata district and elsewhere, rocks here placed in Wanakah were formerly regarded as part of Morrison formation.

Named for extensive development in La Plata Mountains, Colo.

Lapoint horizon (in Duchesne River Formation)[1]

Eocene (Duchesnean) : Eastern Utah.

Original reference: J. L. Kay, 1934, Carnegie Mus. Annals, v. 23, p. 357–359.

H. E. Wood 2d and others, 1941, Geol. Soc. America Bull., v. 52, no. 1, p. 23, pl. 1. Overlies Halfway horizon. Eocene (Duchesnean).

Typically exposed along head of Halfway Hollow, east and north of Lapoint, Uintah County.

La Posta Quartz Diorite[1]

Late Mesozoic : Southern California.

Original reference: W. J. Miller, 1935, California Jour. Mines and Geology, v. 31, no. 2, p. 115–141.

W. J. Miller, 1946, Geol. Soc. America Bull., v. 57, no. 5, p. 485, table 4. Described under Late Mesozoic plutonics. In sequence in San Diego County, La Posta quartz diorite is younger than Descanso granodiorite or Stonewall diorite and older than Rattlesnake granite.

Typical exposures occur in general vicinity of La Posta Valley, southern Peninsular Range, San Diego and Imperial Counties.

Lar Quartz Diorite

Pre-Cretaceous (?) : Southern California.

G. J. Neuerburg, 1953, California Div. Mines Spec. Rept. 33, p. 3, 7 (table 1), 11–12, pl. 1. Fine- to medium-grained quartz diorite in Lar pluton. Separated into three parts: foliated biotite quartz diorite, massive biotite quartz diorite, and sheared biotite quartz diorite. Present also as large blocky inclusions in Feliz pluton and as microbreccia in Cahuenga Peak fault block; makes up entire exposure in Riverside fault block. Suggested sequence of intrusion in area is Vermont quartz diorite (new), Lar quartz diorite, and Feliz granodiorite (new).

Occurs in Griffith Park area, city of Los Angeles.

Laramie Formation[1]

Upper Cretaceous: Eastern Colorado.

Original reference: C. King, 1876, U.S. Geol. Expl. 40th Par. Atlas, maps 1, 2,.

C. H. Dane and W. G. Pierce, 1936, Am. Assoc. Petroleum Geologists Bull., v. 20, no. 10, p. 1310 (fig. 2), 1313–1320. In southeastern part of Denver basin, underlies Dawson arkose; in vicinity of Denver, underlies Arapahoe formation; overlies Fox Hills sandstone.

R. L. Nace, 1936, Wyoming Geol. Survey Bull. 26, p. 9–16. Note on type locality.

R. W. Brown, 1943, Geol. Soc. America Bull., v. 54, no. 1, p. 65–86. Discussion of Cretaceous-Tertiary boundary in Denver basin, Colorado. Stratigraphic and paleontologic evidence show that Laramie formation, Arapahoe formation, and the Cretaceous parts of Denver formation and Dawson arkose comprise a unit correlative with Lance formation and its equivalents. Proposed herein that the Laramie be redefined to include all the Upper Cretaceous sequence between top of Fox Hills and base of the Paleocene in Denver basin; that term Arapahoe as Arapahoe conglomerate member be retained for the conglomerate immediately overlying present Laramie formation; that terms Denver formation and Dawson arkose be restricted to the Tertiary strata. The Laramie as expanded is equivalent to typical Lance formation and Hell Creek formation; to Medicine Bow formation plus basal part. of Raton formation with the exception that both the Medicine Bow and Vermejo as now defined may include in their basal parts some strata that should be referred to Fox Hills sandstone.

J. T. Stark and others, 1949, Geol. Soc. America Mem. 33, p. 56–57, pl. 1. Described in South Park, Colo., where it consists of sandstone, shale, volcanic tuff, and coal. Maximum thickness 375 feet. Overlies Fox Hills formation; unconformably underlies Denver formation.

L. A. Hale, 1950, Wyoming Geol. Assoc. Guidebook 5th Ann. Field Conf., p. 55. Along east side of Rock Springs uplift, continental sediments lie conformably on marine Lewis shale and unconformably beneath Wasatch formation . This sequence of beds was named Black Butte coal group by Schultz and later Laramie formation. Proposed here to use term Lance formation in preference to Laramie to conform with currently accepted terminology of post-Montana pre-Tertiary formations in Wyoming.

S. O. Reichert, 1956, Geol. Soc. America Bull., v. 67, no. 1, p. 107–112, pl. 1,. Discussion of post-Laramie correlations in Denver basin, Colorado. In view of limits set for Arapahoe, Denver, and Dawson formations, the Laramie should be restricted to definition used by Emmons, Cross, and Eldridge (1896, U.S. Geol Survey Mon. 27) rather than extended as proposed by Brown (1943).

Type locality not designated in original description. Since name Laramie is now restricted to strata in Denver Basin of Colorado, it may be considered that type locality is in Denver Basin region east of Front Range of Colorado.

Laredo Formation (in Claiborne Group)

Eocene, middle: Southern Texas and northern Mexico.

Julia Gardner, 1938, Washington Acad. Sci. Jour., v. 28, no. 7, p. 297–298. Proposed for part of measured section of Claiborne group, that in the report on "Geology and ground-water resures of Webb County, Tex.," by Lonsdale and Day (1937), is included under name Cook Mountain formation, and for all beds of equivalent age in Rio Grande embayment. Overlies Mount Selman formation; underlies Yegua formation. Beds include both soft and indurated, glauconitic sandstone, glauconitic marl and clay, and thin limestones, commonly concretionary. In Laredo district, sands and sandstones make up more than 50 percent of formation; farther north, upper third of formation includes more clay than sandstone. Thickness near Laredo about 630 feet.

Area in which name is to apply extends from Frio, McMullen, and Live Oak Counties, Tex., into Mexico.

Lares Limestone [1] (in Río Guatemala Group)

Oligocene: Puerto Rico.

Original references: B. Hubbard, 1920, Science, new ser. v. 51, no. 1320, p. 396; 1923, New York Acad. Sci. Scientific Survey of Porto Rico and the Virgin Islands, v. 2, pt. 1, p. 42–44. [States name first used by author in paper presented before New York Academy of Sciences in 1917. Maury (1919, Am. Jour. Sci., 4th, v. 48) used term Lares limestone for beds overlying Sebastian shale; no distribution or stratigraphic limits given.]

A. D. Zapp, H. R. Bergquist, and C. R. Thomas, 1948, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 85. Included in Río Guatemala group. Limestone occurs in two bioherms. The western, which is more extensive, averages about 400 meters in thickness between the Rio Manati on the east and the Río Guajataca on the west, a distance of about 50 kilometers; westward, thinning is accomplished by lateral intertonguing of lower beds with San Sebastián formation and of upper beds with Cibao marl. Eastern bioherm has maximum thickness of about 250 meters between longitude lines through towns of Morovis and Corozal, a distance of about 10 kilometers; here, too, wedging out is by lateral intertonguing with the San Sebastian and Cibao. Locally underlies Aguda limesonte (new).

Type locality: North of Lares, where it forms the Cuesta and an extensive area of haystack or *pepino* hills.

Lares Shales[1]

Tertiary: Puerto Rico.

Original reference: C. P. Berkey, 1915, New York Acad. Sci. Annals, v. 26, p. 61.

†Largo Beds[1]

Eocene, lower: Northwestern New Mexico.

Original reference: Walter Granger, 1914, Am. Mus. Nat. History Bull., v. 33, p. 205–207.

G. G. Simpson, 1948, Am. Jour. Sci., v. 246, no. 6, p. 368, 369, 370–374. In type region of San Jose formation (new) are two distinguishable clay facies, corresponding to Granger's (1914) Almagre and Largo beds. "Largo" facies forms upper part of formation throughout type region except where it has been removed by erosion. Intergrades with "Almagre" facies below and no sharp distinction can be made.

Exposed principally in area drained by head of Largo Arroyo, in high bluff west of Ojo San Jose. Simpson measured section near where continental divide crosses pass between head of the Largo and southwest branch of "Almagre" Arroyo, mostly in NE¼ sec. 8, T. 23 N., R. 1 W., Rio Arriba County.

Larimer Sandstone Member (of Pierre Shale)[1]

Upper Cretaceous: Central northern Colorado.

Original reference: M. W. Ball, 1924, Am. Assoc. Petroleum Gologists Bull., v. 8, no. 1, p. 81–87.

G. R. Scott and W. A. Cobban, 1959, Rocky Mountain Assoc. Geologists 11th Field Conf. Symposium, p. 128, 129 (fig. 3). Olive-gray fine-grained massive sandstone with brown calcareous sandy concretions. Commonly consists of two to four thin ledge-forming brown sandstone beds separated by thicker units of softer and lighter colored sandstone. Thickness 141 feet near Douglas Lake; 78 feet at Fossil Creek, Separated from younger Richard sandstone member by 171 feet of sandy shale near Douglas Lake; 115-foot concealed interval between members at Fossil Creek; separated from older Rocky Ridge sandstone member by 164 to 187 feet of soft yellowish-gray sandstone and sandy shale with gray sandstone concretions. Large and varied invertebrate fauna.

Named for exposures in Larimer County Canal 4 miles north of Fort Collins, Larimer County. Well developed from Round Butte southward nearly to Boulder.

Larke Dolomite[1] (in Beekmantown Group)

Lower Ordovician: Central Pennsylvania

Original reference: Charles Butts, 1918, Am. Jour. Sci., 4th v. 46, p. 527, 534, 537.

Charles Butts, 1945, U.S. Geol. Survey Geol. Atlas Folio 227. Described in Hollidaysburg-Huntingdon area where it overlies Mines dolomite and underlies Nittany dolomite. Total thickness 200 feet.

Well exposed at Larke, 3 miles south of Williamsburg, Blair County.

Larrabee Member (of Glens Falls Formation)

Middle Ordovician (Mohawkian): Eastern New York and western Vermont.

G. M. Kay, 1947, Geol. Soc. America Bull., v. 48, no. 3, p. 262–263. Constitutes lower part of Glens Falls formation that is of Hull age, the upper Glens Falls being lowest Sherman Fall. At type section, member is composed of about 20 feet of bedded relatively pure limesones above Isle la Motte limestone; underlies *Cryptolithus*-bearing upper Glens Falls, the Shoreham member (new) of lowest Sherman Fall age. Larrabee varies in lithology and thickness; in lower Mohawk Valley, composed of thin-bedded limestones with coarse-textured ledges in upper part; thickness 15 to 25 feet between Patterson and Fultonville; lies on Lowville to west and on Amsterdam toward east.

R. B. Erwin, 1957, Vermont Geol. Survey Bull. 9, p. 30–31, 61–62, 69–71, 73–74, pls. 1, 2. Described on Isle La Motte and South Hero Islands, Vt., where it is about 70 to 75 feet thick.

Type section: Quarry one-fourth mile south of Larrabee Point, Addison County, Vt.

Larsh Shale Member (of Deer Creek Limestone)

Larsh Shale (in Deer Creek Limestone[1] Member of Shawnee Formation)

Pennsylvanian (Virgil Series): Southeastern Nebraska, southwestern Iowa, northeastern Kansas, and northwestern Missouri.

Original reference: G. E. Condra, 1927, Nebraska Geol. Survey Bull. 1, 2d ser., p. 40, 43, 49, 50.

G. E. Condra and E. C. Reed, 1937, Nebraska Geol. Survey, 2d ser., Bull. 11, p. 8, 12, 16, 20, 54, fig. 2. Member of Deer Creek limestone in Shawnee group. Overlies Rock Bluff limestone member; underlies Haynies limestone member.

R. C. Moore, J. C. Frye, and J. M. Jewett, 1944, Kansas Geol. Survey Bull. 52, p. 179. Referred to as Larsh-Burroak shale member of Deer Creek limestone. Average thickness 3½ feet. Underlies Ervine Creek limestone member; overlies Rock Bluff limestone member.

R. C. Moore, 1948, Am. Assoc. Petroleum Geologists Bull., v. 32, no. 11, p. 2035 (fig. 5). Interstate agreement recognizes Larsh shale member of Deer Creek formation. Overlies Rock Bluff limestone member; underlies Haynies limestone member.

F. C. Greene and W. V. Searight, 1949, Missouri Geol. Survey and Water Resources Rept. Inv. 11, p. vii (fig. 3), 17–18. In Missouri, interval between Rock Bluff limestone member and uppermost limestone of Deer Creek is occupied by shale. This shale has been referred to as Rock Bluff-Ervine Creek shale with implication that intervening Haynies limestone is absent in Missouri. Shale is here called Larsh-Burroak. Missouri Survey recognizes the possibility that Burroak shale may be absent in Missouri and that uppermost limestone of Deer Creek may include both Haynies and Ervine Creek members.

H. G. Hershey and others, 1960, Iowa Highway Research Board Bull. 15, p. 18, fig. 5. Larsh shale, in southwestern Iowa, is gray to olive green argillaceous and blocky to thin bedded in upper part; lower part black and fissile. Thickness about 2 feet throughout entire area where Burroak and Larsh slates are differentiated. Overlies Rock Bluff limestone member; underlies Haynies limestone member. In some areas referred to as Burroak-Larsh shale.

Type locality: Ervine Creek valley, 2½ miles east and 1¼ miles north of Union, Cass County, Nebr.

LaSalle cyclothem (in Bond-Mattoon Formation)

LaSalle cyclothem (in McLeansboro Group)

Pennsylvanian: Northern Illinois.

J. M. Weller and A. H. Bell, 1936, Illinois Geol. Survey Rept. Inv. 40, p. 26 (fig. 5). LaSalle cyclothem in McLeansboro formation shown on columnar section. Occurs above Macoupin cyclothem.

J. M. Weller and W. A. Newton, 1938, (abs.) Geol. Soc. America Proc. 1937, p. 329. Upper part of McLeansboro, from Shoal Creek limestone up to highest Pennsylvanian strata is divided into following cyclothems (descending): Merom, Shumay, Woodbury, Gila, Greenup, Newton, Upper Bogota, Lower Bogota, Cohn, LaSalle, Macoupin, Flannigan, and Shoal Creek.

J. M. Weller and A. H. Bell, 1941, Illinois Geol. Survey Rept. Inv. 76, p. 7. In Effingham, Fayette, and Shelby Counties, includes LaSalle limestone.

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 52 (table 2), 55 (table 3). In Bond-Mattoon formations (both new).

Type locality not given, but type locality of LaSalle limestone is in sec. 14, T. 33 N., R. 1 E., LaSalle County.

†La Salle Formation[1]

Pennsylvanian: Northeastern Illinois.

Original reference: F. W. De Wolf, 1910, Illinois Geol. Survey Bull. 16, p. 180.

Named for La Salle County.

LaSalle Limestone (in McLeansboro Group)

LaSalle Limestone Member (of Bond Formation)

LaSalle Limestone Member (of McLeansboro Formation)[1]

Middle and Upper Pennsylvanian: Northeastern Illinois.

Original reference: G. H. Cady, 1908, Illinois Geol. Survey Bull. 8, p. 128–134.

H. R. Wanless and Raymond Siever, 1956, Illinois Geol. Survey Circ. 217, p. 12, pl. 1. Included in LaSalle cyclothem, McLeansboro group. Type locality stated.

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 39, 50 (table 1), pl. 1. Reallocated to member status in Bond formation (new). LaSalle and Hall limestone members are only named units in formation in northern Illinois. Presentation of new rock-stratigraphic classification of Pennsylvanian strata in Illinois.

Type locality: Sec. 14, T. 33 N., R. 1 E., La Salle County.

Lasca Formation

Cretaceous: Western Texas.

R. M. Huffington, 1947, Harvard Univ. Summ. of Theses, 1943–45, p. 196. Lasca formation, 600 feet thick, most likely late Washita in age. Overlies Tarantula formation (new); underlies Etholen formation.

Area of report is northern Quitman Mountains, southern Hudspeth County.

Las Cascades Agglomerate

Las Cascades (Cascadas) Formation[1]

Oligocene(?): Panamá.

Original references: D. F. MacDonald, 1913, Isthmian geology, ann. Rept. Isthmian Canal Comm., app. S, p. 568; 1913, Geol. Soc. America Bull., v. 24, p. 708.

W. P. Woodring and T. F. Thompson, 1949, Am. Assoc. Petroleum Geologists Bull., v. 33, no. 2, p. 228–229, 236, 246 (fig. 2). Las Cascadas agglomerate, Bas Obispo formation, and Bohío formation, all tentatively considered early Oligocene in age, are oldest formations along the Canal. Las Cascadas agglomerate and pyroclastic Bas Obispo formation are interpreted to represent accumulation of volcanic products at periphery of a volcanic pile. Unconformably underlies Culebra formation.

W. P. Woodring, 1957, U.S. Geol. Survey Prof. Paper 306–A, p. 28, 31–32, pl. 1. Overlies Bas Obispo formation Las Cascadas agglomerate and the Bas Obispo probably would ordinarily be combined as one formation; however, they differ in induration. Matrix of Las Cascadas consists of soft fine-grained altered tuff and bentonitic clay. Thickness not determined. According to plate 1, near Gamboa agglomerate rests on Bohío formation, Gatuncillo formation, or basement complex; confirmation of this overlap is needed; in eastern part of Gatun Lake area, appears to grade into Caimito formation. No fossils present; doubtfully referred to Oligocene because of inferred relations to Bohío and Caimito formations.

Type region: Northern part of Gaillard Cut, C. Z.

Las Cruces Formation

Mississippian (Meramec); Western Texas and central southern New Mexico.

L. R. Laudon and A. L. Bowsher, 1949, Geol. Soc. America Bull., v. 60, no. 1, p. 11, 12, 17, 37–38. Hard, dense, black, sublithographic, even-bedded, gray-weathering, sparsely fossiliferous limestone. Distinguished by relatively thin, remarkably even beds from 4 to 16 inches thick, averaging about 10 inches. Free of chert in type section. Maximum thickness approximately 60 feet in type area; 59 feet in type section. Unconformably overlies "Percha" shale (Canutillo formation of Nelson, 1940) and unconformably underlies Rancheria formation (new) in Franklin Mountains. Also overlies Lake Valley formation in some sections in southern part of area.

Type section: On southwest side of small fork of shallow canyon that leaves west slope of Franklin Mountains almost directly east of Vinton, Tex. (SW¼ sec. 67, S. Blk. 82, El Paso County, Tex.). Named from town of Las Cruces, N. Mex. Exposed mainly in Franklin Mountains; also in San Andres Mountains in Bear Canyon.

Las Feveras Formation

Tertiary or Quaternary: Northeastern New Mexico.

G. O. Bachman, 1953, U.S. Geol. Survey Oil and Gas Inv. Map OM–137. Sequence of brownish-red alluvium and gravel. Rests on Sangre de Cristo formation; overlain by basalt flow emitted in part from Ocate volcanic cone. Thickness more than 150 feet about 1 mile northwest of Ocate, but this is not complete representation of formation.

Named for Las Feveras Canyon which drains into northwestern part of Ocate Valley, Mora County. Well exposed in sides of three small basalt-capped buttes west of road about 2 miles north of Ocate.

La Sierra Tonalite

Cretaceous: Southern California.

E. S. Larsen, Jr., and N. B. Keevil 1947, Geol. Soc. America Bull., v. 58, no. 6, p. 488. Named in report on study of the batholith of southern California.

E. S. Larsen, Jr., 1948, Geol. Soc. America Mem. 29, p. 71–72, pl. 1. Described as light-gray tonalite. Intruded by Woodson Mountain granodiorite. Derivation of name given.

Named for its occurrence in hills of La Sierra, north and east of Corona, Riverside County.

Las Juntas Shale

Eocene, lower: Northwestern California.

C. E. Weaver, 1953, Washington [State] Univ. Pubs. in Geology, v. 7, p. 19 (chart), 30–31, pls. 4A, 4B, 4C. Name introduced for clay shales, silty shales, and interbedded sandstones between Vine Hill sandstone (new) below and Muir sandstone (new) above. Thickness at type section 1,017 feet. Las Juntas shale underlying Vine Hill sandstone of this report were classified and mapped jointly as Martinez group in San Francisco folio (Lawson, 1914) and the former as Capay shale in Carquinez quadrangle in 1949 (Weaver, Geol. Soc. America Mem. 35).

B. Y. Smith, 1957, California Univ. Pub., Geol. Sci., v. 32, no. 3, p. 144–146, 147. Since Pacheco syncline generally accepted as type area for the Martinez, it is particularly difficult to follow Weaver's (1953) omission of that term as an appropriate designation for lower part of sequence, and it seems desirable that Weaver's new units, Vine Hill, Las Juntas, and

Muir, be included either as members within Martinez formation or as formations within Martinez group. Systematic description of Foraminifera.

Type section: In east limb of Pacheco syncline in highway cuts and hillside outcrops east and southeast of Martinez, Contra Costa County. Only part of beds are exposed in west limb of fold where they lie adjacent to and along east side of Southampton fault.

Las Marías Limestone

Las Marías Limestone Member (of Río Blanco Formation)

Upper Cretaceous: Puerto Rico.

R. C. Mitchell, 1954, Puerto Rico Univ. Agr. Expt. Sta. Tech, Paper 13, p. 47, 48 (table 4), 94 (cross section). Distinctive grayish-blue limestone. [May be synonymous with Atalaya limestone.]

P. H. Mattson, 1960, Geol. Soc. America Bull., v. 71, no. 3, p. 344, pl. 1. Referred to as member of Río Blanco in Mayagüez area. Occurs as lenses of massive hematite-stained fragmental limestone in southern part of Río Blanco outcrop.

First mentioned in Lares district.

Las Posas Formation[1]

Pleistocene: Southern California.

Original reference: E. D. Pressler, 1929, California Univ. Pub., Dept. Geol. Sci. Bull., v. 18, no. 13, p. 325–345.

T. L. Bailey, 1943, Geol. Soc. America Bull., v. 54, no. 10, p. 1557. Name abandoned. San Pedro as defined in this paper synonymous with Pressler's (1929) Las Posas except that his so-called Kalorama member is retained in Santa Barbara formation.

Manley Natland, 1953, Pacific Petroleum Geologist, v. 7, no. 2, p. 2. Included in upper part of newly defined Hallian stage in Ventura Basin.

Probably named from Las Posas Hills, Ventura County.

Lassen Dacites[1]

Cenozoic: Northern California.

Original reference: Howel Williams, 1932, California Univ. Pub., Bull. Dept. Geol. Sci., v. 21, no. 5, p. 71 (map).

O. P. Jenkins, 1943, California Div. Mines Bull. 118, p. 679. Cenozoic.

Occur in Mount Lassen region.

Lassen sequence, suite, volcanic rocks

Age not stated: Northern California

J. A. S. Adams, 1955, Geochim. et Cosmochim. Acta., v. 8, p. 74–85. Collective term used for volcanic rocks in Lassen Volcanic National Park. Includes a number of named units.

Howel Williams (1932, California Univ. Pub., Bull. Dept. Geol. Sci., v. 21, no. 8) used term lava sequence of Lassen region.

Lasso Limestone

Aquitanian: Mariana Islands (Tinian).

Risaburo Tayama, 1939, Correlation of the strata of the South Sea Islands: Geol. Soc. Japan Jour., v. 46, no. 549, p. 346 (correlation chart) [English translation in library of U.S. Geol. Survey]. Raso limestone named on correlation chart. Correlated with Tapotchau [Tappotcho] limestone on Saipan, and Hirippo limestone on Rota. Miocene.

Risaburo Tayama, 1952, Coral reefs in the South Seas: Japan Hydrog. Office Bull., v. 11, p. 54, table 4 [English translation in library of U.S. Geol. Survey, p. 65]. Lasso limestone. Oligocene.

S. Hanzawa *in* Jacques Avias and others, 1956, Lexique Strat. Internat., v. 6, Océanie, fasc. 2, p. 42. Name Lasso limestone credited to M. Kodaira (unpub. ms.) who applied name to pink-colored limestone and underlying limestone conglomerate which unconformably overlies andesitic agglomerate and unconformably underlies Mariana limestone. Aquitanian.

Exposed along base of cliff bounding western margin of Carolinas Plateau in Kanat Tadung.

Last Chance Andesite[1]

Tertiary: New Mexico.

Original reference: H. G. Ferguson, 1927, U.S. Geol. Survey Bull. 787.

Named for exposures at Last Chance mine, south of Silver Creek, Mogollon district.

Last Chance Quartz Monzonite

Post-Pennsylvanian; Northern Utah.

Bronson Stringham, 1953, Geol. Soc. America Bull., v. 64, no. 8, p. 965. Medium fine-grained granitoid rock. Texture and mineral composition much more uniform than Bingham granite with which it is associated.

Occurs in Last Chance intrusive stock. Crops out in area west, southwest, and south of Bingham copper mine, Salt Lake County.

Las Tetas Lava Member (of Robles Formation)

Upper Cretaceous: Puerto Rico.

H. L. Berryhill, Jr., R. P. Briggs, and Lynn Glover 3d, 1960, Am. Assoc. Petroleum Geologists Bull., v. 44, no. 2, p. 144, 145–146. Varies from pillow lava to very massive igneous rock that could be in part intrusive. Thickness about 1,000 feet in vicinity of Cayey; southward, thins and pinches out. Represents several effusions; in southernmost outcrops, layers are separated by lenses or tongues of volcanic siltstone, volcanic sandstone, and volcanic conglomerate. Lies about 900 feet above Lapa lava member (new) and separated from it by thick middle tongue of siltstone within the formation. Name credited to Berryhill and Glover (in press).

H. L. Berryhill, Jr., and Lynn Glover 3d, 1960, U.S. Geol. Survey Misc. Geol. Inv. Map I–319. Overlies Cayey siltstone member (new); underlies Colloa member (new).

Named for exposures at and near prominent topographic features, Las Tetas, which lie west of Highway 1 at point 650 meters southwest of intersection of Highway 1 and Highway 162, Cayey quadrangle.

Las Vigas Formation[1]

Lower Cretaceous: Northern Mexico and southwestern Texas.

Original references: R. H. Burrows, 1909, Min. and Sci. Press, v. 99, p. 293; 1910, Soc. Geol. Mexicana, Bol. t. 7, p. 93.

Gayle Scott, 1939, Texas Univ. Bur. Econ. Geology Pub. 3945, p. 973 (chart), 977, 978. Discussion of correlation of Trinity strata on basis of cephalopod fauna. Las Vigas formation, which underlies the Cuchillo, is older than any Trinity sediments cropping out anywhere else in Texas except in Torcer formation of Malone Mountain area.

Named for exposures in Conchos River valley, northern Chihuahua, Mex., west of Presidio, Tex.

Las Virgenes Sandstone[1]

Eocene, lower: Southern California.

Original reference: R. N. Nelson, 1925, California Univ. Pub., Dept. Geol. Sci. Bull., v. 15, no. 11, p. 400–401, map.

Named for typical development at head of Las Virgenes Canyon, on south side of Simi Hills, Ventura County.

Latah Formation[1]

Miocene, middle or upper: Eastern Washington and western Idaho.

Original reference: J. T. Pardee and Kirk Bryan, 1926, U.S. Geol. Survey Prof. Paper 140, p. 4–12.

J. W. Hosterman, 1960, U.S. Geol. Survey Bull. 1091, p. 7–8, pls. 2, 3, 4. In general vicinity of clay deposits in Washington and Idaho, the Latah is interbedded with Columbia River basalt and is divided into an upper an lower part by the unit of basalt on which residual clay is developed.

Typical exposure on slope west of Latah Creek, a short distance south of Spokane, Spokane County, Wash.

Latham Shale

Lower Cambrian: Southern California.

J. C. Hazzard, 1954, California Div. Mines Bull. 170, chap. 4, p. 30 (table 1), pl. 2. Greenish-gray platy shale with thin buff-weathering sandy limestone layers. Thickness 55 to 75 feet. Underlies Chambless limestone; overlies Prospect Mountain quartzite. Replaces preoccupied name Kelso.

Type locality: About a mile southwest of Latham's cabin in northern Providence Mountains, San Bernardino.

Latir Peak Latite

Tertiary: Central northern New Mexico.

P. F. McKinlay, [1955?], New Mexico Bur. Mines Mineral Resources Bull. 42, p. 14, pl. 1. Occurs as thick flows, sills, and dikes. Is porphyritic with an aphanitic to glassy groundmass. Color in most outcrops is light gray, but near Latir Peak much of rock is reddish. Intrusive into rocks of pre-Tertiary age and closely associated with the andesite series of mid-Tertiary(?) age.

Named after Latir Peak, where the rock is well exposed. Makes up most of Latir Peak and high ridges that lie to south of peak. One of the largest exposures is near headwaters of Cabresto and Bitter Creeks, along southern edge of Latir Peak quadrangle, Taos County.

Latonia Shale (in Eden Group)[1]

Upper Ordovician: Northern Kentucky and southwestern Ohio.

Original reference: N. M. Fenneman, 1916, Ohio Geol. Survey, 4th ser., Bull. 19, p. 63.

Wilber Stout, Karl Ver Steeg, and G. F. Lamb, 1943, Ohio Geol. Survey, 4th ser., Bull. 44, chart facing p. 108. Shown on chart as formation including (ascending) Economy, Southgate, and McMicken members. Underlies Fairview formation; overlies Fulton formation.

Named for Latonia, Kenton County, Ky.

Latour Formation[1]

Miocene, middle or upper: Northern Idaho.

Original reference: O. H. Hershey, 1912, Geol. Soc. America Bull., v. 23, p. 529–536.

Deposited in [ancient] Lake Latour, Coeur d'Alene region.

Latrania Sand Member (of Imperial Formation)

†Latrania Sands[1]

Miocene, middle, to Pliocene, lower: Southern California.

Original reference: G. D. Hanna, 1926, California Acad. Sci. Proc., 4th ser., v. 14, no. 18, p. 435.

A. M. Keen and Herdis Bentson, 1944, Geol. Soc. America Spec. Paper 56, p. 21 (fig. 4). Listed as sand member of Imperial formation.

Exposed on Coyote Mountain, Imperial County.

La Tuna Member (of Magdalena Formation)

Pennsylvanian: Western Texas.

L. A. Nelson, 1937, Colorado Univ. Studies, v. 25, no. 1, pl. 89. In Franklin Mountains, Tex., Magdalena formation divided into (ascending) La Tuna, Berino, and Bishops Cap member (all new).

L. A. Nelson, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 1, p. 167, 170. Thickness about 361 feet. Basal part is massive light- to dark-gray limestone, 340 feet thick. Underlies Berino member; overlies Helms shale. Derivation of name given.

M. L. Thompson, 1942, New Mexico Bur. Mines Mineral Resources Bull. 17, p. 23. On basis of fusulinid studies, it seems inadvisable to apply Nelson's terms to Pennsylvanian rocks of central New Mexico.

Named for town of La Tuna, Tex., on Santa Fe Railroad at Texas-New Mexico line.

†Lauderdale Chert[1]

Mississippian: Northern Alabama.

Original reference: E. A. Smith, 1892, Sketch of geology of Alabama: Birmingham, Ala., Roberts & Son, pamph., 36 p.

Named for development in Lauderdale County.

Laughery Formation (in Richmond Group)[1]

Upper Ordovician: Southeastern Indiana.

Original reference: A. F. Foerste, 1912, Denison Univ. Sci. Lab. Bull., v. 17, p. 22.

Exposed along Laughery Creek in Ripley County.

†Laulau Limestone

Miocene (Aquitanian): Mariana Islands (Saipan).

Risaburo Tayama, 1938, Geomorphology, geology, and coral reefs of Saipan Island: Tropical Industry Inst., Palau, South Sea Islands, Bull. 1 [English translation in library of U.S. Geol. Survey, p. 56–60.] Variegated, white, black, red, brown, and yellow, tuffaceous, marly, arenaceous, limestones. As exposed at Laulau railway cut, limestone is conglomeratic in lower part; arenaceous, white, and stratified in middle; upper part, hard pink unstratified limestone. Has been called *Eulepidina* limestone. Unconformably overlies Densinyama beds.

Josiah Bridge *in* W. S. Cole and Josiah Bridge, 1953, U.S. Geol. Survey Prof. Paper 253, p. 9–10. Grades laterally into water-laid Donni tuff. Miocene (Aquitanian).

P. E. Cloud, Jr., R. G. Schmidt, and H. W. Burke, 1956, U.S. Geol. Survey Prof. Paper 280–A, p. 63. Included in Tagpochau limestone of this report.

Named for exposures in railway cuts on south side of Laulau Mountains northwest of village of Laulau on north side of Laulau (Magicienne) Bay.

Laupahoehoe Volcanic Series

Pleistocene and Recent(?) : Hawaii Island, Hawaii.

G. A. Macdonald, 1945, Am. Jour. Sci., v. 243, no. 4, p. 212 (fig. 1), 213, 214. Largely andesites with lesser amounts of olivine basalts. Separated from older Hamakua volcanic series (new) by erosional unconformity.

H. T. Stearns and G. A. Macdonald, 1946, Hawaii Div. Hydrog. Bull. 9, p. 153 (table), 159–166. Comprises two members: lower, largely lava flows, predominantly andesitic with lesser amounts of olivine basalts, Pleistocene; and upper, a few andesite flows, Recent.

D. A. Davis and G. A. Macdonald *in* Jacques Avias and others, 1956, Lexique Strat. Internat., v. 6, Océanie, fasc. 2, p. 110. Maximum exposed thickness about 200 feet; total thickness probably more than 1,000 feet. Pleistocene and Recent(?) ; age assignment depends on relation to Pahala ash and to glaciation.

Named for exposures at Laupahoehoe Peninsula where typical andesite flow has built lava delta. Comprises entire upper part of Mauna Kea with some flows extending onto lower slopes.

Laurel Dolomite[1] or Limestone[1]

Laurel Limestone Member (of Wayne Formation)

Laurel Limestone Member (of Bainbridge Formation)

Laurel Member (of Alger Formation)

Middle Silurian; Southern Indiana, west-central Kentucky, southeastern Missouri, Ohio, and west-central Tennessee.

Original reference: A. F. Foerste, 1896, Cincinnati Soc. Nat. History Jour., v. 18, p. 190–192.

Wilber Stout, 1941, Ohio Geol. Survey, 4th ser., Bull. 42, p. 35, table facing p. 46. In Ohio considered member of Alger formation. Underlies Massie member and overlies Osgood. Thickness 5 to 9 feet; average 6 feet.

J. R. Ball, 1942, Am. Assoc. Petroleum Geologists Bull., v. 26, no. 1, p. 10–11. Laurel limestone geographically extended into southeastern Missouri where it is considered member of Bainbridge formation; overlies Osgood member. Characteristically massive, light-gray, with pinkish calcite crystals.

C. W. Wilson, Jr., 1949, Tennessee Div. Geology Bull. 56, p. 248–249. Laurel limestone included in Wayne group. In central Tennessee, uniformly bedded limestone with beds that range from a few inches to a foot or more in thickness. Fine-grained and light gray with varying amounts of red and pink grains; locally entirely dolomitic; in some areas, contains silt, also may be oolitic at top. Average thickness 30 feet. Conformably overlies Osgood formation; conformably underlies Waldron shale or unconformably underlies Chattanooga shale.

J. B. Patton, T. G. Perry, and W. J. Wayne, 1953, Indiana Geol. Survey Field Conf. Guidebook 6, pl. 1. In Indiana, Laurel formation underlies Waldron and overlies Osgood. Consists of limestone, pale-tan to gray, dense to finely crystalline, thin-bedded, cherty, moderately dolomitic. Thickness 27 to 40 feet. In Clinton group.

Named for Laurel, Franklin County, Ind.

Laurel Gneiss or Pseudomigmatite

Laurel Migmatite

Age unknown (post-Glenarm Series): Maryland.

Ernst Cloos and C. H. Broedel, 1940, Geologic map of Howard County and adjacent parts of Montgomery and Baltimore Counties (1:62,500): Maryland Geol. Survey. Migmatite—granitized schist mixed with impure granite; muscovite and biotite granite.

R. W. Chapman, 1942, Geol. Soc. America Bull., v. 53, no. 9, p. 1300–1328. Although Laurel gneiss resembles a true migmatite, term pseudomigmatite is more appropriate. Gneiss is bounded on north by Guilford granite and Wissahickon formation, on northeast by gabbro, on east by Cretaceous gravels, on south by gneiss, and on west by the Wissahickon.

Ernst Cloos *in* Ernst Cloos and C. W. Cooke, 1953, Geologic map of Montgomery County and District of Columbia (1:62,500): Maryland Dept. Geology, Mines and Water Resources. Mapped in Montgomery County as Laurel gneiss. Very similar to Sykesville formation and possibly its equivalent southwest of Woodstock anticlinorium.

Occurs in vicinity of Laurel, about 17 miles southwest of Baltimore.

Laurel Canyon Formation

Paleozoic: California.

E. B. Mayo, 1934, California Jour. Mines & Geology, v. 30, no. 1, pl. 2. Crystalline limestone (marble). Devonian in part.

O. P. Jenkins, 1938, Geologic map of California (1:500,000): California Div. Mines, sheet 4. Shown on map legend.

Mapped in Laurel and Convict basins, Mono County.

Laurens Member (of Trimmers Rock Sandstone)

Laurens Member[1] (of Tully Limestone)

Upper Devonian: Eastern New York and eastern Pennsylvania.

Original references: G. A. Cooper, 1933, Am. Jour. Sci., 5th, v. 26, p. 544; 1934, Am. Jour. Sci., 5th, v. 27, p. 10.

G. A. Cooper and others, 1942, Geol. Soc. America Bull., v. 53, no. 12, pt. 1, chart 4. Shown on correlation chart as Middle Devonian.

M. E. Johnson and Bradford Willard, 1957, Geol. Soc. America Guidebook for Atlantic City Mtg., Trip 4, fig. 1. Shown on columnar section as member at base of Trimmers Rock sandstone.

Well exposed in Houghtaling's Glen, 1½ miles northeast of Laurens, Otsego County, N.Y.

Laurentian Series[1]

Precambrian: Lake Superior region.

Original reference: W. E. Logan, 1854, Canada Geol. Survey Rept. Prog. 1852–1853, p. 7, 8.

F. F. Grout and others, 1951, Geol. Soc. America Bull., v. 62, no. 9, p. 1029. Term Laurentian widely used but variously defined. Originally used by Logan (1854) to refer to exposures of gneiss, granite, and other old rocks north of St. Lawrence River. Special committee (Hays and others, 1905, Jour. Geology, v. 13, no. 2) approved term for "granites and gneissoid granites which antedate or protrude through the Keewatin, and which are pre-Huronian;" also for granites of unknown age. Cooke (1920, Jour. Geology, v. 28, no. 4) urged that term Laurentian be reserved for those granites that cut all rocks below base of Huronian and that other terms be found for those that cut only Keewatin. Tendency since that time, even among Canadian writers, is to use term Laurentian for oldest granites. Radioactivity determinations may show seven or more Precambrian granites. In Minnesota [Minnesota Geological Survey], three groups are recognized: the first post-Keewatin and pre-Knife Lake; second (Algoman) post-Knife Lake and pre-Animikie; and third Keweenawan. Term Laurentian is commonly used for oldest group (our [Minnesota Geological Survey] pre-Knife Lake granites), but some of them may be older than others.

Named for occurrence north of St. Lawrence River. Area has been named Laurentides in early history of Canada.

La Vaca Formation

Miocene, middle: Panamá.

Incidental mention: R. A. Terry, 1956, California Acad. Sci. Occasional Paper 23, p. 59.

W. P. Woodring *in* R. Hoffstetter and others, 1960, Lexique Strat. Internat., v. 5, Amérique Latine, fasc. 2a, p. 337. An undefined name. Miocene(?).

On Burica Peninsula, Chiriquí Province.

Lava Falls Tongue (of Muav Formation)

Lower and (or) Middle Cambrian: Northwestern Arizona.

E. D. McKee, 1945, Carnegie Inst. Washington Pub. 563, p. 14 (fig. 1), 29, 95. Consists partly of aphanitic limestone and partly of fine-grained dolomite, but nearly everywhere weathers into a resistant cliff with red-brown surface. At type section, divisible into three units; basal ledge-forming dolomitic limestone; middle slope-forming unit of green shale and brown siltstone; and upper cliff-forming carbonate unit. Eastward extension of carbonate deposits from Spencer Canyon member (new) of Muav formation. Thickness at Granite Park 20 feet; farther east at Toroweap 17½ feet, and at Gateway Canyon 16½ feet. Older than Parashant tongue (new); younger than Garnet Canyon tongue (new).

Type locality: About 1 mile east of Lava Falls at foot of Toroweap Valley, Grand Canyon.

Lavender Member (of Fort Payne Chert)

Lavender Shale Member (of Fort Payne Chert)

Mississippian: Northwestern Georgia.

Charles Butts *in* Charles Butts and Benjamin Gildersleeve, 1948, Georgia Geol. Survey Bull. 54, p. 42–45. Dark compact massively bedded calcareous shale or argillaceous limestone with small amount of limy material interbedded in Fort Payne chert. Thickness about 50 feet. Overlain by chert locally as much as 50 feet thick; in some areas, rests directly on Chattanooga shale.

V. J. Hurst, 1953, Georgia Geol. Survey Bull. 60, p. 218. Lavender shale not readily separable from dark-colored siliceous argillaceous limestone which occurs with and above it. Much of what Butts called shale is actually limestone; hence, the dark-colored siliceous, argillaceous limestone in lower two-thirds of the Fort Payne together with the associated calcareous shale is referred to in this report as Lavender member. Thickness of Lavender member appears to be reciprocally related to thickness of bedded chert, as 1 mile south of West Rome, 30 to 50 feet of bedded chert is overlain by 80 to 100 feet of Lavender member, whereas 15 miles north, near Gore, about 150 feet of chert is exposed and Lavender member is missing.

Type locality: On railroad one-third mile west of Lavender Station, and in quarry in shale at underpass of U.S. Highway 27, beneath Southern Railway, about 1 mile north of Rome.

La Ventana Tongue (of Cliff House Sandstone)

La Ventana Sandstone Member (of Mesaverde Formation)[1]

Upper Cretaceous: Northwestern New Mexico.

Original reference: C. H. Dane, 1937, U.S. Geol. Survey Bull. 860–C.

E. C. Beaumont, C. H. Dane,and J. D. Sears, 1956, Am. Assoc. Petroleum Geologists Bull., v. 40, no. 9, p. 2159–2160. Classified as tongue of Cliff House formation. On outcrop, does not connect with Cliff House but does connect in northern part of San Juan Basin with Mesaverde group undivided. Seems possible that somewhere in subsurface it will be found to connect essentially with main body of Cliff House to which, genetically, it is clearly related as part of upper transgressive marine-sandstone sequence of Mesaverde group.

Named from town of La Ventana, Sandoval County, on the Rio Puerco near which unit crops out, and from La Ventana Mesa east of Rio Puerco, on which top of basal unit is exposed.

Laverne Formation[1]

Pliocene, lower: Northwestern Oklahoma and southwestern Kansas.

Original reference: C. N. Gould, 1927, Oklahoma Univ. Bull., Proc. Oklahoma Acad. Sci., v. 6, pt. 2, p. 235–238.

J. C. Frye and C. W. Hibbard, 1941, Kansas Geol. Survey Bull. 38, p. 398–403. Geographically extended into southwestern Kansas where it is well exposed along both sides of Cimarron Valley in southeastern Seward County and in southwestern Meade County. Consists of shale, sandstone, and limestone; locally contains a hard conglomerate; buff, blue gray, and gray. Thickness about 60 feet. Laverne beds dip at angles as much as 15° and are overlain by horizontal beds of the Ogallala. Miocene and lower Pliocene.

C. W. Hibbard, 1949, Michigan Univ. Mus. Paleontology Contr., v. 9, no. 5, p. 91–105. Unconformably underlies Rexroad formation in Seward and Meade Counties, Kans.

A. J. Myers, 1959, Oklahoma Geol. Survey Bull. 80, p. 47–50, pl. 2. In Harper County, consists of interbedded gray to blue-gray sandy chalk, blue-gray to tan shales, gray fine-grained thin-bedded sandstone, and massive tan to pink coarse-grained sandstone; basal part is coarse conglomerate containing abundance of black iron-stained pebbles; conglomerate not continuous. Thickness as much as 35 feet. At no place is Ogallala in contact with Laverne. Lower Pliocene (p. 48). Type locality stated.

Type locality: In vicinity of Laverne, Harper County, Okla.

Lavery Till

Pleistocene (Wisconsin): Northwestern Pennsylvania.

V. C. Shepps and others, 1959, Pennsylvania Geol. Survey Bull., 4th ser., G–32, p. 10 (fig. 3), 13 (fig. 4), 38–41, pl. 1. Light-gray moderately pebbly calcareous silt till deposited during Lavery advance in approximately middle Cary time. Lavery advance followed Kent advance and preceded Hiram advance.

G. W. White, 1960, U.S. Geol. Survey Bull. 1121–A, p. 2 (table 1), 3 (fig. 1), 6–7. In northeastern Ohio Lavery till is underlain unconformably by Kent till and overlain unconformably by Hiram till except in small area where it constitutes surface material.

Type area: At and north of hamlet of Lavery, Erie County, 4½ miles west of Edinboro on U.S. Route 6N.

La Vida Member (of Puente Formation)

Miocene, upper: Southern California.

J. E. Schoellhamer and others, 1954, U.S. Geol. Survey Oil and Gas Inv. Map OM–154. Defined as basal member of formation. Consists mainly of gray to black laminated siltstone with thin interbedded feldspathic sandstone beds. Maximum exposed thickness about 3,000 feet. Underlies Soquel member (new). In some areas, base is not exposed; in other areas, La Vida rests unconformably on El Modeno volcanics (new) or on Topanga formation or on Sespe and Vaqueros formations, undivided.

Named for La Vida Mineral Springs, located in Carbon Canyon about 3 miles north of Yorba Linda, in eastern part of Puente Hills, Orange County.

Lawler Peak Granite

Precambrian: West-central Arizona.

C. A. Anderson, E. A. Scholz, and J. D. Strobell, Jr., 1955, U.S. Geol. Survey Prof. Paper 278, p. 1, 18–19, pl. 3. Typical Lawler Peak granite is essentially porphyritic biotite-muscovite granite. Orthoclase phenocrysts as much as 3 inches long embedded in medium- to coarse-grained groundmass. In northern exposures, white muscovite granite forms masses more than a mile in length; biotite is absent and muscovite is more abundant than in normal Lawler Peak granite; known as muscovite facies. Also includes a gneissic facies and an altered facies. Intruded by Cheney Gulch granite (new). Intrudes all formations of Yavapai series, and gabbro, alaskite porphyry, and granodiorite gneiss.

Exposed for about 9 square miles in hilly country in northeast corner of Bagdad area, Yavapai County, where outcrops on Lawler Peak suggested name for the granite.

Lawlor Tuff

Pliocene: Northern California.

B. L. Clark, 1943, California Div. Mines Bull. 118, pt. 2, p. 189. Shown on correlation chart as "Lawler tuff;" underlies Los Medanos formation.

C. E. Weaver, 1949, Geol. Soc. America Mem. 35, p. 110 (table 24), 121–122, pls. 12, 13. Described as pumiceous andesitic tuff. Thickness 50 to 100 feet. Tuffs dip from 15° to 30° NE. In Los Medanos Hills, underlies Wolfskill formation (new) and overlies Neroly formation. Derivation of name given.

Named for exposures in Lawler [Lawlor] ravine, in southwestern Antioch quadrangle, where it forms a bond generally less than 300 feet wide.

Lawrence Clay (in Allegheny Formation)[1]

Lawrence underclay member

Pennsylvanian: Southeastern Ohio and West Virginia.

[Original reference]: Wilber Stout and others, 1923, Ohio Geol. Survey Bull. 26, p. 269.

A. T. Cross and M. P. Schemel, 1956, West Virginia Geol. Survey, v. 22, pt. 2, p. 46. Noted in West Virginia.

M. T. Sturgeon and others, 1958, Ohio Geol. Survey Bull. 57, p. 61. Lawrence underclay member of Lawrence-Lower Kittanning cyclothem in report on Athens County. At most places, combined with Lower Kittanning underclay. Allegheny series.

Lawrence coal and clay named from Lawrence Furnace, Elizabeth Township, Lawrence County, Ohio.

Lawrence cyclothem

Pennsylvanian (Allegheny Series): Ohio.

N. K. Flint, 1951, Ohio Geol. Survey, 4th ser., Bull. 48, p. 40, 46. Includes (ascending) Kittanning shale and (or) sandstone, Lawrence clay, Lawrence coal. Occurs above Scrubgrass cyclothem and below Lower Kittanning cyclothem.

Present in Ohio column but not easily recognized in Perry County; in this report, treated as part of Lower Kittanning cyclothem.

Lawrence Shale (in Douglas Group)[1]

Lawrence Shale Member (of Douglas Formation)[1]

Pennsylvanian (Virgil Series): Eastern Kansas, southwestern Iowa, northwestern Missouri, and southeastern Nebraska.

Original reference: E. Haworth, 1894, Kansas Univ. Quart., v. 2, p. 122.

F. C. Greene and W. V. Searight, 1949, Missouri Geol. Survey and Water Resources Rept. Inv. 11, p. vii (fig. 3), 15, 16. Formation in Missouri consists of two unnamed shale members separated by Amazonia limestone member. Ireland limestone member, present in Kansas, not identified in Missouri. Because of absence of this sandstone. Robbins shale at top of Stranger formation cannot be differentiated, if present in Missouri, from shale of Lawrence formation below Amazonia member. Base of Lawrence is drawn in Missouri at top of Haskell limestone.

G. E. Condra, 1949, Nebraska Geol. Survey Bull. 16, p. 26–27. Thickness 23 feet in Platte Valley; about 42 feet in Weeping Water Valley.

R. C. Moore and others, 1951, Kansas Geol. Survey Bull. 89, p. 69–72. Extends from base of Toronto limestone member of Oread limestone to disconformity below Ireland sandstone or, in places where disconformity is undeterminable, to top of Haskell limestone member of Stranger formation. Includes Ireland sandstone member below and Amazonia limestone member above. Thickness 40 to 175 feet.

H. G. Hershey and others, 1960, Iowa Highway Research Board Bull. 15, p. 23–24, fig. 5. In Iowa it is not possible to locate accurately unconformity separating Pedee group of Missouri series from Douglas group of Virgil series. Individual units of interval poorly defined, and for this reason entire interval considered as unit and referred to as Douglas-Pedee group. Locally in subsurface it has been possible to recognize Iatan limestone, uppermost formation of Pedee group, and Stranger shale, lowermost formation of Douglas group. Because it is rarely possible to differentiate these formations in Iowa, entire interval is called Lawrence-Weston shale.

Named for exposures at Lawrence, Douglas County, Kans.

Lawrence shale and (or) sandstone member

Pennsylvanian: Eastern Ohio.

M. T. Sturgeon and others, 1958, Ohio Geol. Survey Bull. 57, p. 61. Lawrence shale and (or) sandstone member included in Lawrence cyclothem in report on Athens County. Shale and sandstone below so-called Lower Kittanning underclay is actually member of Lawrence cyclothem but is usually called (Lower) Kittanning shale and sandstone. Thickness of member about 5 feet. Allegheny series.

Lawrenceville Shale (in McLeansboro Formation)

Pennsylvanian: Southeastern Illinois and southwestern Indiana.

J. A. Culbertson, 1932, The paleontology and stratigraphy of the Pennsylvanian strata between Caseyville, Kentucky, and Vincennes, Indiana: Urbana, Ill., Univ. Illinois, Abs. Thesis, p. 3, 7–8. Calcareous shale containing a gastropod fauna. Underlies New Harmony sandstone (new); overlies Grayville limestone (new).

Named from exposures in and near Lawrenceville, Ill.

Lawson Limestone

Upper Cretaceous: Northeastern Florida (subsurface).

P. L. Applin and E. R. Applin, 1944, Am. Assoc. Petroleum Geologists Bull., v. 28, no. 12, p. 1681, 1708–1711, 1746 (fig. 31). Name applied to limestone facies of late Upper Cretaceous occurring in northeastern Florida and the peninsula. Occurs below Cedar Keys limestone and above beds of Taylor age. Divided into two members: upper, a white and cream-colored calcitic porous limestone containing gypsum in most wells—thickness ranges from 40 feet in Sholtz well No. 2, Levy County, to 300 feet in Cory well No. 1, Monroe County; lower, a hard white and cream-colored microfossiliferous chalky limestone—commonly 300 to 400 feet thick in Sholtz well No. 2, 75 feet.

R. O. Vernon, 1951, Florida Geol. Survey Bull. 33, p. 82–84. In recent oil tests, particularly, Humble-Hodges well No. 1, in Taylor County, fauna characterizing upper member occurs very high in section in interval normally considered Cedar Keys formation of Paleocene age. This indicates that upper Lawson is transitional bed including fossils characterizing both Paleocene and Cretaceous; since characteristic Cretaceous fossils are present, it is considered to represent top of Cretaceous in peninsular Florida by most workers.

Name derived from J. S. Cosden's Lawson well No. 1, sec. 25, T. 13 S., R. 20 E., Marion County.

Lawson Shale Member (of Carbondale Formation)

Pennsylvanian: Western and northern Illinois.

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 35, 48 (table 1), 65, pl. 1. Proposed for shale above Brereton limestone member in western Illinois, formerly called Sheffield shale; name Sheffield preempted. Thickness about 7½ feet. Stratigraphically below Copperas Creek sandstone member. Presentation of new rock-stratigraphic classification of Pennsylvanian of Illinois. Cyclical classification is retained but is entirely independent of rock-stratigraphic classification.

Type locality: Center sec. 24, T. 16 N., R 6 E., Bureau County. Name derived from Lawson Creek, about 1 mile west of type exposure.

Laytonville Limestone

Upper Cretaceous: Northern California.

H. E. Thalmann, 1943, (abs.) Geol. Soc. America Bull., v. 54, no. 12, pt. 2, p. 1827. Reddish slightly siliceous limestone; contains foraminiferal assemblage that indicates at least a Turonian age. Laytonville limestone regarded as synchronous deposit of Calera limestones of quarries of Permanente Cement Company, Santa Clara County, and of Calera limestone at its type locality in Calera Valley, San Mateo County.

Crops out about 200 yards east of Redwood Highway, 2 miles north of Laytonville, Mendocino County.

Lazeart Sandstone Member (of Adaville Formation)[1]

Upper Cretaceous: Southwestern Wyoming.

Original reference: A. C. Veatch, 1907, U.S. Geol. Survey Prof. Paper 56.

R. H. Peterson, D. J. Gauger, and R. R. Lankford, 1953, Utah Geol. and Mineralog. Survey Bull. 47, p. 16 (fig. 4), 17–18. Basal member of Adaville formation. Consists of white sandstone 100 to 200 feet thick. Underlies Adaville-Lazeart coal.

Well exposed at Adaville mine, 2 miles south of Hodges Pass Tunnel, near Kemmerer, on Oregon Short Line.

Lazy Bend Formation (in Millsap Lake Group)

Lazy Bend Member (of Millsap Lake Formation)[1]

Pennsylvanian: North-central Texas.

Original reference: E. H. Sellards, 1933, Texas Univ. Bull. 3232, p. 106, 107, from manuscript of report by G. Scott and J. M. Armstrong, on geology of Parker County.

M. G. Cheney, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 1, p. 66 (fig. 1). Rank raised to formation in Millsap Lake group. Underlies Grindstone Creek group; overlies Dickerson group. Includes (ascending) Kickapoo Falls limestone, Dennis Bridge limestone, and Brannon Bridge limestone members.

M. G. Cheney and others, 1945, Am. Assoc. Petroleum Geologists Bull., v. 29, no. 2, p. 163. Lampasas-Strawn boundary in Brazos River outcrop section placed at base of conglomerate which rests on Dennis Bridge limestone at Dennis highway bridge in Parker County. Hence, Lazy Bend formation, Millsap Lake group, and Strawn series of Brazos River outcrop section are restricted to beds above Dennis Bridge limestone at Dennis.

Leo Hendricks, 1957, Texas Univ. Bur. Econ. Geology Pub. 5724, p. 13–18, fig. 3, pl. 1. In this report [Parker County], beds cropping out along Brazos River upstream from Dennis Bridge to beyond Lazy Bend are placed in Lazy Bend formation. Includes (ascending) Hill Creek member (with Dennis Bridge limestone bed at base), Steussy member, and Brannon Bridge member. There is no continuous type section of formation; knowledge of succession is gained by mapping key beds between separated outcrops, and type sections are established member by member. Underlies Grindstone Creek formation. Classification in this paper does not go above formation rank.

Named for Lazy Bend on Brazos River, Parker County.

Leach Formation

Mississippian or older: North-central Nevada.

S. W. Muller, H. G. Ferguson, and R. J. Roberts, 1951, Geology of the Mount Tobin quadrangle, Nevada: U.S. Geol. Survey Geol. Quad. Map [GQ–7]. Altered basic volcanics (greenstone) and pyroclastics, with much dark chert and siliceous argillite, probably largely tuffaceous. Beds of dark vitreous quartzite at top. Interbedded slate, limestone, and conglomerate near forks of Leach Canyon. May be identical with Pumpernickel formation. Thickness may exceed 6,000 feet; base not exposed. Underlies Inskip formation with gradational contact. Pennsylvanian(?).

R. J. Roberts and others, 1958, Am. Assoc. Petroleum Geologists Bull., v. 42, no. 12, p. 2847. Throughout most of outcrop area Leach and Inskip formations are in fault contact and their stratigraphic relations are not definitely known, but Leach appears to underlie Inskip. Considered to be Mississippian or older.

Named for Leach Canyon on west flank of East Range, Mount Tobin quadrangle.

Leach Canyon Tuff Member (of Quichapa Formation)

Oligocene: Southwestern Utah and eastern Nevada.

J. H. Mackin, 1960, Am. Jour. Sci., v. 258, no. 2, p. 90–91, 92 (fig. 2), 98. Single depositional unit, uniform in lithology through thickness of 450 to 500 feet. Except at base and near top, rock consists of matrix with texture of unglazed porcelain, gray to flesh in color, enclosing fragments of dark-red felsite, light-gray pumice, and other rocks, and crystals of quartz, feldspar, biotite, and other pyrogenic minerals, mostly broken. Basal member of formation; at type locality, underlies Swett tuff member (new); overlies Hole-in-the-Wall member of Isom formation (both new); elsewhere, lava flows or other volcanic rocks, local in origin and extent, present at contacts. Has zircon age of 28 million years; this suggests that Quichapa formation is Oligocene. Discussion of ignimbrites of area.

E. F. Cook, 1960, Intermountain Assoc. Petroleum Geologists Guidebook 11th Ann. Field Conf., p. 138 (fig. 3). Geographically extended into eastern Nevada.

Type locality: South side Leach Canyon, Desert Mound quadrangle, Utah.

Lead System[1]

Precambrian: Southwestern South Dakota.

Original reference: J. J. Runner, 1934, Am. Jour. Sci., 5th, v. 28, p. 354–372.

J. R. Berg, 1946, South Dakota Geol. Survey Rept. Inv. 52, p. 4, 6–7, map (on page following title page). Shown on map legend as composed of (ascending) Poorman formation, amphibolite formation, Homestake formation, Ellison formation, Northwestern formation, Garfield formation, and Roubaix group (new). Text states that youngest rocks of Roubaix group in Galena-Roubaix district are younger than and overlie rocks of Lead system.

In the Black Hills.

Lead Creek Limestone[1] (in Tradewater Formation)

Pennsylvanian: Western Kentucky.

Original reference: A. F. Crider, 1913, Kentucky Geol. Survey, 4th ser., v. 1, pt. 1, p. 279.

H. R. Wanless, 1939, Geol. Soc. America Spec. Paper 17, p. 89, Marine limestone above Lead Creek coal, Tradewater formation. Equivalent to Minshall limestone (Indiana), Seville limestone (Illinois), and Curlew limestone (western Kentucky).

Named for Lead Creek, Hancock County.

Lead Point Argillite[1]

Paleozoic(?): Northeastern Washington.

Original reference: C. E. Weaver, 1920, Washington Geol. Survey Bull. 20, p. 79, map.

Derivation of name not stated but probably named for Lead Point, Stevens County.

Leadville Limestone[1] or Dolomite

Lower and Upper Mississippian: Colorado.

Original reference: G. H. Eldridge, 1894, U.S. Geol. Survey Geol. Atlas, Folio 9.

W. S. Burbank, 1941, U.S. Geol. Survey Bull. 906–E, p. 194, 196 (chart). Name Leadville limestone introduced into Uncompahgre district for beds containing Mississippian fossils that lie just above Ouray limestone which is restricted to dolomitic limestone beds of Upper Devonian age. Lower part of unit consists of predominantly dark blue-gray or brownish-gray limestone with sandy layers near base; upper part mostly coarser textured clastic limestone with interbeds of reddish shale; locally, thin-bedded cherty and ferruginous limestone at top. Thickness 180 to 230 feet.

K. G. Brill, Jr., 1942, Am. Assoc. Petroleum Geologists Bull., v. 26, no. 8, p. 1386. In Gore area, unconformably underlies Belden shale member (new) of Battle Mountain formation.

Ogden Tweto and T. S. Lovering, 1947, Colorado Mining Resources Board [Bull.], p. 380 (chart). In Gilman district, subdivided to include Gilman sandstone member (new) at base. Overlies Dyer dolomite member of Chaffee formation; underlies Maroon formation.

H. F. Donner, 1949, Geol. Soc. America Bull., v. 60, no. 8, p. 1220 (fig. 2), 1221–1222. Described in McCoy area where it is about 150 feet thick and consists of massive- to thin-bedded fine-grained bluish-gray limestone that is locally lithographic. Disconformable contact with overlying McCoy formation and underlying Sawatch formation. Early Mississippian.

Ogden Tweto, 1949, Colorado Sci. Soc. Proc., v. 15, no. 4, p. 152 (table 1), 177–186. In Pando area, Mississippian Leadville dolomite comprises basal sandy member, Gilman sandstone, about 20 feet thick, unconformably overlain by dolomite member with average thickness of about 80 feet. Unconformably overlies Dyer dolomite member of Chaffee formation; unconformably underlies Belden shale.

I. H. Mackay, 1953, Colorado School Mines Quart., v. 48, no. 4, p. 29–33. In Thomasville-Woods Lake area, Leadville limestone is 68 to 180 feet thick and consists of arenaceous, gray dolomitic limestone at base rapidly becoming nearly pure, bluish-gray limestones. Unconformably overlies Chaffee limestone; unconformably underlies Weber(?) formation.

J. C. Cooper, 1955, Four Corners Geol. Soc. Guidebook [1st] Field Conf., p. 63, 65. Many names have been used for rocks of Mississippian age in Four Corners area. Proposed here that Mississippian rocks in area be called Leadville limestone for upper limestone unit and Madison formation for underlying dolomite. Leadville is unconformably overlain by Molas shale and underlain by transitional conformable contact with Madison formation.

W. M. Merrill and R. M. Winar, 1958, Am. Assoc. Petroleum Geologists Bull., v. 42, no. 9, p. 2109 (table 1), 2111 (fig. 2), 2115 (fig. 4). In San Juan-Needles Mountain area, disconformably underlies Coalbank Hill member (new) of Molas formation

Named for occurrence in Leadville district.

†Leadville Porphyry[1]

Eocene: Colorado.

Original references: S. F. Emmons, 1882, U.S. Geol. Survey 2d Ann. Rept., p. 215–230; U.S. Geol. Survey Leadville Atlas; 1886, U.S. Geol. Survey Mon. 12, p. 76; 1927, U.S. Geol. Survey Prof. Paper 148.

In Leadville district.

†Leander Beds[1]

Lower Cretaceous: Texas.

Original reference: R. T. Hill, 1890, Texas Geol. Survey 1st Ann. Rept., p. 105, 126.

Exposed between Florence and Leander, Williamson County.

Leaning Tower Quartz Monzonite[1]

Cretaceous: California.

Original reference: F. C. Calkins, 1930, U.S. Geol. Survey Prof. Paper 160, p. 123, map.

U.S. Geological Survey currently designates the age of the Leaning Tower Quartz Monzonite as Cretaceous on basis of a study now in progress.

Named for fact that it forms considerable part of slopes of Leaning Tower, Yosemite National Park.

Leatham Formation

Lower Mississippian: Northeastern Utah and southeastern Idaho.

F. D. Holland, Jr., 1952, Am. Assoc. Petroleum Geologists Bull., v. 36, no. 9, p. 1719–1720, figs. 1, 17. Name proposed for shales, sandy shales, and nodular limestones which unconformably overlie Devonian Jefferson formation and conformably underlie basal brownish-black shale of Mississippian Madison. Base of formation marked by 3-inch medium-dark-gray arenaceous limonitic conglomeratic limestone. Uppermost 2 feet composed of dark-gray to brownish-gray hard dense thinly bedded silty limestone. Thickness 76 feet at type locality where beds dip 18° N. 77° W.

Type locality: North wall of Leatham Hollow, three-fourths mile west of Left Fork of Blacksmith Fork at NW cor. sec. 34, T. 11 N., R. 2 E., Salt Lake base and meridian, Utah.

Leatherwood Granite[1]

Precambrian: Central southern Virginia.

Original reference: A. I. Jonas, 1928, Geol. map of Virginia, prelim. ed.: Virginia Geol. Survey.

W. R. Griffitts, R. H. Jahns, and R. W. Lemke, 1953, U.S. Geol. Survey Prof. Paper 248–C, p. 144.

Mapped at and around Leatherwood, Henry County.

Leatherwood Quartz Diorite

Post-Cretaceous: Southeastern Arizona.

F. L. Peirce, 1958, Dissert. Abs., v. 19, no. 2, p. 300. Orogeny which apparently took place during Laramide time was accompanied by emplacement of Leatherwood quartz diorite which was followed by emplacement of Catalina granite (new).

R. L. DuBois, 1959, Arizona Geol. Soc. Guidebook 2, p. 113–114. Ranges from massive to gneissic in texture and generally composed of biotite, quartz, oligoclase, and epidote. Comprises stock that intrudes Cretaceous rocks.

On northeastern slope of Santa Catalina Mountains.

L'Eau Frais Shale[1]

Eocene: Southwestern Arkansas.

Original reference: R. T. Hill, 1888, Arkansas Geol. Survey Ann. Rept. 1888, v. 2, p. 52, 188.

At mouth of L'Eau Frais, Clark County.

Leavenworth Glacial Stage

Pleistocene: Central Washington.

B. M. Page, 1939, Jour. Geology, v. 47, no. 8, p. 785, 795–805. Named as second of three successive stages of valley glaciation in Leavenworth area. Characterized by deposition of Leavenworth till and outwash. Preceded by Peshastin stage (new) and followed by Stuart stage (new).

Leavenworth Limestone Member (of Oread Limestone)[1]

Pennsylvanian (Virgil Series): Eastern Kansas, southwestern Iowa, northwestern Missouri, and southeastern Nebraska.

Original reference: G. E. Condra, 1927, Nebraska Geol. Survey Bull. 1, 2d ser., p. 32, 33, 38.

R. C. Moore, 1948, Am. Assoc. Petroleum Geologists Bull., v. 32, no. 11, p. 2035 (fig. 5); 1949, Kansas Geol. Survey Bull. 83, p. 148. Leavenworth limestone member of Oread formation; underlies Heebner shale member; overlies Snyderville shale member. This is classification agreed upon by State Geological Surveys of Iowa, Kansas, Missouri, Nebraska, and Oklahoma, May 1947.

T. L. Welp, L. A. Thomas, and H. R. Dixon, 1957, Iowa Acad. Sci. Proc., v. 64, p. 418 (fig. 1), 419. In section measured near Winterset, is blue-gray massive limestone about 1 foot thick.

H. G. O'Connor, 1960, Kansas Geol. Survey Bull. 148, p. 40, pl. 1. Thickness 0.8 to 2 feet thick in Douglas County, except south of Worden fault where it is 3.4 feet. Composed of single massive bed of hard gray-blue fine-grained limestone.

H. G. Hershey and others, 1960, Iowa Highway Research Board Bull. 15, p. 22–23, fig. 5. Single massive limestone bed. Thickness 1.1 to 1.3 feet. Overlies Snyderville shale member; underlies Heebner shale member.

Type locality: Highway cut in divide northwest of Federal Penitentiary, Leavenworth, Kans.

†Lebanon Beds[1]

Upper Ordovician: Southwestern Ohio and northern Kentucky.

Original reference: J. S. Newberry, 1873, Ohio Geol. Survey, v. 1, p. 103, 119, table opposite p. 89.

Named for Lebanon, Warren County, Ohio.

Lebanon Gabbro

Pre-Triassic: Eastern Connecticut.

J. M. Aitken, 1951, Connecticut Geol. Nat. History Survey Bull. 78, p. 10 (table 1). Incidental mention in chart. Name credited to W. G. Foye (unpub. ms.).

John Rodgers and others, 1956, Preliminary geological map of Connecticut (1:253,440): Connecticut Geol. Nat. History Survey. Dark speckled medium- to coarse-grained gabbro. Many shear zones and local areas of schistose and pencilled gabbro; otherwise fairly massive.

Named for town of Lebanon, New London County.

Lebanon Granite[1] (in Oliverian Plutonic Series)

Lebanon Group

Middle or Upper Devonian (?): West-central New Hampshire.

Original reference: C. H. Hitchcock, 1908, Vermont State Geologist 6th Rept., p. 155–156.

C. A. Chapman, 1939, Geol. Soc. America Bull., v. 50, no. 1, p. 145–146, pl. 6. Group includes Lebanon granite and border gneiss. Term granite is restricted to granitic core-rock. Two types are somewhat gradational near their contacts. Upper Devonian (?).

M. P. Billings, 1955, Geologic map of New Hampshire (1:250,000): U.S. Geol. Survey. Lebanon granite of Oliverian plutonic series consists of two mappable units: the granite proper, a subporphyritic granulated biotite granite, and the border gneiss, granulated gneiss varying in composition from amphibolite to quartz monzonite. Middle or Upper Devonian (?).

Named for village of Lebanon in southwestern Grafton County.

†Lebanon Group[1]

Lower Ordovician (Chazy): Tennessee.

Original reference: J. M. Safford, 1869, Geology Tennessee, p. 151, 159, 258–268.

Named for Lebanon, Wilson County.

Lebanon Limestone (in Stones River Group)[1]

Middle Ordovician: Central and western Tennessee and northwestern Georgia.

Original reference: J. M. Safford, 1851, Am. Jour. Sci., 2d, v. 12, p. 353, 354–356.

Charles Butts and Benjamin Gildersleeve, 1948, Georgia Geol. Survey Bull. 54, p. 22, 26–27, geol. map. Geographically extended into northwestern Georgia where it crops out along both sides of McLemore Cove along outside margin of Stones River belt north to Tennessee. Composed largely of very thin bedded limestone intercalated in gray shelly limestone all more or less argillaceous. Thickness about 200 feet.

C. W. Wilson, Jr., 1949, Tennessee Div. Geology Bull. 56, p. 39–44, fig. 11. Consists of dense fine-grained blue to gray and dove-colored limestone with many interbedded layers of medium-grained and coarsely crystalline texture. Limestone beds commonly range from 1 to 6 inches, average 2 to 3 inches in thickness, and are separated by thin partings of gray and grayish-blue calcareous shale. At average interval of 57 feet from base and 33 feet from top of formation is a massive-bedded member that averages 5 feet in thickness. Thickness 74 to 118 feet; average 92 feet. Conformably overlies Ridley limestone; unconformably underlies Carters limestone. Safford did not designate type section; his measured section near Readyville, Rutherford County, is here considered type section. Alternate type section given.

Type section: In Cannon County, Tenn., on western slope of prominent hill behind mill at Readyville, a short distance northeast of where Murfreesboro-Woodbury Highway crosses East Fork of Stones River. Alternate type section: On eastern outskirts of Lebanon, Wilson County; section begins 1 block south of highway to Carthage on eastern city limits of Lebanon and continues northeastward to a massively bedded member near top of hill north of highway.

Lebanon Junction Siltstone Member (of Brodhead Formation)

Lower Mississippian: Central Kentucky.

P. B. Stockdale, 1939, Geol. Soc. America Spec. Paper 22, p. 76, 147. A 40-foot gritty siltstone unit in lower part of Pilot Knob facies (new), Brodhead formation (new). Overlies Culver Springs shale member (new).

Measured section on south slope of knob, 1 mile northwest of Lebanon Junction, southern Bullitt County.

Lebeau Member (of Le Moyen Formation)

Recent: Southwestern Louisiana (subsurface and surface)

P. H. Jones *in* P. H. Jones, A. N. Turcan, Jr., and H. E. Skibitzke, 1954, Louisiana Dept. Conserv. Geol. Bull. 30, p. 89–90, 91. Basal part is coarse-grained channel-fill deposit of fluviatile origin, upper part is fine-grained silts and clays derived from floodwaters; deposition of member continues to present time. Lies in a pre-Recent channel cut into Pleistocene terrane to depths as great as 300 feet and commonly greater than 200 feet. Essentially contemporaneous with and merges into marine, beach, and marsh deposits of Mermentau member.

Typically represented beneath town of Lebeau in T. 4 S., R. 5 E., in St. Landry Parish, on U.S. Highway 71 about 6 miles southeast of Le Moyen. Underlies all modern floodplain of Mississippi River.

Lebec Quartz Monzonite

Jurassic(?): Southern California.

J. C. Crowell, 1952, California Div. Mines Special Rept. 24, p. 8–9, pls. 1, 2. Typical quartz monzonite; contains two facies, one, gray and medium grained making up about 80 percent of rock, and the other, buff and more coarse grained. Since Tejon Lookout granite (new) intrudes similar rocks the Lebec and Tejon Lookout are probably related although now separated by Garlock fault.

Exposed over about 14 square miles of Lebec quadrangle northwest of Garlock fault near Lebec, Kern County. Confined to hanging wall block of Pastoria thrust zone and not recognized north of Pastoria thrust or south of Garlock and San Andreas faults.

Lebo Andesitic or **Shale Member** (of Fort Union Formation)[1]

Lebo Formation (in Fort Union Group)

Paleocene: Central northern, southern, and eastern Montana.

Original reference: R. W. Stone and W. R. Calvert, 1910, Econ. Geology, v. 5, p. 746.

G. G. Simpson, 1937, U.S. Natl. Mus. Bull. 169, p. 15 (table), 21–29. Basal formation in Fort Union group as used in this report [Crazy Mountain field]. Thickness 1,350 feet. Underlies Melville formation (new); overlies Bear formation (new). Paleocene.

A. J. Collier and M. M. Knechtel, 1939, U.S. Geol. Survey Bull. 905, p. 11–13, pl. 3. In McCone County, Mont., Lebo shale member is about 400 feet thick and consists of thick beds of dark shale alternating with thick beds of white sandy clay and sandstone and coal beds. Underlies Tongue River member; overlies Tullock member of Lance formation. Eocene.

H. E. Wood 2d and others, 1941, Geol. Soc. America Bull., v. 52, no. 1, pl. 1. Paleocene (Dragonian-Torrejonian).

W. J. McMannis, 1955, Geol. Soc. America Bull., v. 66, no. 11, pl. 7. Plate 7 shows Livingston formation intertongues with Claggett, Judith River, Bearpaw, Lennep, Hell Creek, Tullock, and Lebo formations.

W. J. Mapel, 1958, Wyoming Geol. Assoc. Guidebook 13th Ann. Field Conf., p. 218 (fig. 1), 220–221. As used in this report Fort Union formation comprises three members (ascending): Tullock, Lebo shale, and Tongue River.

Named for exposures on Lebo Creek, northeast of Crazy Mountains.

Le Boeuf Conglomerate[1] Member (of Cattaraugus Formation)

Upper Devonian or Mississippian: Northwestern Pennsylvania.

Original reference: I. C. White, 1881, Pennsylvania 2d Geol. Survey Rept. Q_4, p. 101, 103, 104, 112, 239.

I. H. Tesmer, 1958, (abs.) Geol. Soc. America Bull., v. 69, no. 12, pt. 2, p. 1651. Listed as member of Cattaraugus formation in proposed sequence of Upper Devonian or Mississippian conglomerates in southwestern New York and northwestern Pennsylvania.

Exposed in Le Boeuf Township, Erie County, along French Creek.

Leclaire Dolomite[1]

Silurian (Niagaran): Central eastern Iowa.

Original reference: J. Hall, 1858, Iowa Geol. Survey, v. 1, pt. 1, p. 46, 73–75.

Type locality: Leclaire, Scott County.

†Lecompton Beds[1]

Pennsylvanian: Eastern Kansas.

Original reference: L. C. Wooster, 1905, The Carboniferous rocks system of Kansas.

Named for Lecompton, Douglas County.

Lecompton Limestone (in Shawnee Group)[1]

Lecompton Limestone Member (of Pawhuska Formation)

Lecompton Limestone Member (of Shawnee Formation)[1]

Pennsylvanian (Virgil Series): Eastern Kansas, southwestern Iowa, northwestern Missouri, southeastern Nebraska, and central northern Oklahoma.

Original references: E. Haworth, 1895, Kansas Univ. Quart., v. 3, p. 278, pl. opp. p. 290; Am. Jour. Sci., 3d, v. 50, pl. opp. p. 466.

R. C. Moore, J. C. Frye, and J. M. Jewett, 1944, Kansas Geol. Survey Bull. 52, p. 179–180. Includes (ascending) Spring Branch limestone, Doniphan shale, Big Springs limestone, Queen Hill shale, Beil limestone, King Hill shale, and Avoca limestone members. Thickness 30 to 50 feet. Underlies Tecumseh shale; overlies Kanwaka shale. Shawnee group.

F. C. Greene and W. V. Searight, 1949, Missouri Geol. Survey and Water Resources Rept. Inv. 11, p. 16, 17. Included in Shawnee group in Missouri.

H. D. Miser and others, 1954, Geologic map of Oklahoma (1:500,000): U.S. Geol. Survey. Lecompton limestone mapped in northern Oklahoma.

M. C. Oakes, 1959, Oklahoma Geol. Survey Bull. 81, p. 49, 50, 51, measured sections. Basal member of Pawhuska formation in Oklahoma; underlies Plummer member. In Creek County, consists of gray fossiliferous sandy limestone, generally thin bedded to platy, and 10 to 30 feet thick.

P. B. Greig, 1959, Oklahoma Geol. Survey Bull. 83, p. 25–26, 38–41, pls. Described in Pawnee County where it is classified as member of Pawhuska formation. Consists of several thin beds of fossiliferous limestone, flaggy in upper part, and interbedded shale. Commonly 10 feet thick. Separated from overlying Turkey Run limestone member by unnamed shale interval as much as 77 feet thick.

H. G. Hershey and others, 1960, Iowa Highway Research Board Bull. 15, p. 19–20, fig. 5. Formation comprises (ascending) Spring Branch limestone, Doniphan shale, Big Springs limestone, Queen Hill shale, Beil limestone, King Hill shale, and Avoca limestone members. Thickness 34 feet north of Thurman; 30 feet at Stennett; 11 feet north and east of Greenfield. Underlies Tecumseh shale; overlies Kanwaka shale. Shawnee group.

Named for exposures at Lecompton, Douglas County, Kans.

†Lecompton Shale[1]

Pennsylvanian: Eastern Kansas and northwestern Missouri.

Original reference: E. Haworth, 1898, Kansas Univ. Geol. Survey, v. 3, p. 64, 94.

Named for exposures at Lecompton, Douglas County, Kans.

Le Conte Flows

Recent: Southwestern Oregon.

Howel Williams, 1944, California Univ. Pub., Dept. Geol. Sci. Bull. 27, no. 3, p. 53, 62. Discussion of volcanoes of Three Sisters region. Name applied to flows from Le Conte Crater.

Le Conte Crater is south and west of South Sister Mountain.

Ledbetter Slate

Ordovician: Northeastern Washington.

C. F. Park, Jr., 1938, Econ. Geology, v. 33, p. 713 (chart), 714 (fig. 2). Named on map and stratigraphic chart. Thickness 2,500 feet. Underlies Devonian(?) limestone; overlies Metaline limestone (new).

C. F. Park, Jr., and R. S. Cannon, Jr., 1943, U.S. Geol. Survey Prof. Paper 202, p. 6 (table), 19–22, pl. 1. Black fine-grained carbonaceous slate with black limestone near top. Overlies Metaline limestone, base sharply defined; upper contacts poorly exposed. Derivation of name given.

R. G. Yates and J. F. Robertson, 1958, U.S. Geol. Survey Mineral Inv. Field Studies Map MF–137. Described in Leadpoint quadrangle where it is about 1,000 feet thick; complete section not exposed. Overlies Metaline limestone. Poorly preserved graptolites indicate Ordovician age.

Named for Ledbetter Lake, Pend Oreille County.

Ledger Dolomite[1]

Lower Cambrian: Southeastern Pennsylvania, and northern Virginia.

Original reference: G. W. Stose and A. I. Jonas, 1922, Washington Acad. Sci. Jour., v. 12, p. 359, 363.

G. W. Stose and A. I. Jonas, 1938, Virginia Geol. Survey Bull. 51–A, p. 21. Proposed to extend names Vintage dolomite, Kinzers formation, and Ledger dolomite to comparable Lower Cambrian formations in area southeast of Austinville, Va.

Named for Ledger, Lancaster County, Pa.

Ledyard Formation

Ledyard Member (of Ludlowville Shale)[1]

Middle Devonian: Central and western New York.

Original reference: G. A. Cooper, 1930, Am. Jour. Sci., 5th, v. 19, p. 218, 224.

R. G. Sutton, 1951, Rochester Acad. Sci. Proc., v. 9, nos. 5–6, p. 364–369, pl. 1. In Batavia quadrangle, about 75 miles west of type locality of Lenyard, Wanakah and Ledyard shale members of the Ludlowville were not separated as defined by Cooper (1930); Ledyard-Wanakah member overlies Centerfield limestone member and underlies Tichenor limestone member.

T. B. Coley, 1954, Jour. Paleontology, v. 28, no. 4, p. 453, 454, 455 (fig. 2). Referred to as formation. Thickness 26 feet at Jacox Run near Geneseo. Overlies Centerfield formation; underlies Wanakah formation. Ostracodes discussed.

R. S. Boardman, 1960, U.S. Geol. Survey Prof. Paper 340, p. 4–5. Term Ledyard in this report [trepostomatous Bryozoa] follows usage of Cooper (1930). Thickness 60 to 100 feet at type locality; 30 feet at Lake Erie.

Type locality: On Paines Creek, Ledyard Twp., Cayuga Lake area.

Lee Formation[1] or Group

Lower Pennsylvanian: Southwestern Virginia, eastern Kentucky, and Tennessee.

Original reference: M. R. Campbell, 1893, U.S. Geol. Survey Bull. 111, p. 28, 36.

W. A. Nelson, 1925, Tennessee Div. Geology Bull. 33–A, p. 38–53. Rank raised to group and subdivided into (ascending) Gizzard formation (including Warren Point sandstone), Sewanee conglomerate, Whitwell shale, Herbert conglomerate, Eastland shale lentil, Newton sandstone, Vandever shale, Rockcastle conglomerate, and Duskin formation. Thickness 200 to 1,400 feet. Deposited on top of irregular eroded Pennington formation. Lower Pottsville.

L. C. Glenn, 1925, Tennessee Div. Geology Bull. 33–B, p. 276. Formation, in Fentress County, comprises Rockcastle sandstone above and shale interval below, either simple or complex, for which name Fentress is suggested.

Charles Butts and W. A. Nelson, 1925, Tennessee Div. Geology Bull. 33–D, p. 5–17. In Crossville quadrangle, Lee group comprises (ascending) Gizzard formation, Sewanee conglomerate, Whitwell shale, Bonair sandstone with Eastland shale lentil, Vandever shale, and Rockcastle sandstone. Underlies Briceville shale; overlies Pennington shale.

H. R. Wanless, 1946, Geol. Soc. America Mem. 13, p. 9–54. Discussion of strata of Lee age in Tennessee and lists following subdivisions (ascending): Gizzard formation, Sewanee conglomerate, Whitwell formation, Herbert sandstone, Eastland shale, Newton sandstone, Vandever shale, Rockcastle sandstone, Duskin Creek formation, Corbin conglomerate or sandstone, and Naese sandstone.

Andrew Brown and others, 1952, U.S. Geol. Survey Circ. 171, p. 9. Formation described in côal field of southwest Virginia where outcrops are confined to northwest and southeast sides of field. Thickness about 900 feet in northwestern exposures; 1,530 to 1,800 feet in southeastern area. Underlies Norton formation; overlies Bluestone formation. Pottsville group.

C. W. Wilson, Jr., J. W. Jewell, and E. T. Luther, 1956, Pennsylvanian geology of the Cumberland Plateau: Tennessee Div. Geology [Folio]. Lee group as used by Wanless (1946) discontinued, and units included in newly defined Gizzard, Crab Orchard Mountains, and Crooked Fork groups.

K. J. Englund, 1957, U.S. Geol. Survey Coal Inv. Map C–39. In Scott and Campbell Counties, Tenn., formation is about 850 feet thick and consists of massive beds of crossbedded partly conglomeratic medium- to coarse-grained sandstone and thin beds of shale, siltstone, and coal. Overlies Pennington formation; underlies Briceville shale.

K. J. Englund, 1957, U.S. Geol. Survey Coal Inv. Map C–40. Term Lee formation extended into Tennessee by Keith (1896, U.S. Geol. Survey Geol. Atlas, Folio 25). In area of present report [Ivydell quadrangle, Tennessee], formation composed of massive conglomeratic sandstone, interbedded with siltstone, shale, and a few thin beds of coal and underclay. Various sandstone beds have been designated as top of Lee, but, because these beds are gradational and lenticular in this area, upper contact of Lee is drawn at base of persistent Red coal of Ashley and Glenn (1906, U.S. Geol. Survey Prof. Paper 49). Thickness 900 to 1,400 feet. Overlies Pennington formation; underlies Briceville shale.

R. P. Briggs, 1957, U.S. Geol. Survey Coal Inv. Map C–42. Eyl (1927, Structural geologic map of Lee County, Kentucky: Kentucky Geol. Survey, ser. 6) defined Lee formation as all of lower Pennsylvanian rocks from Mississippian-Pennsylvanian contact to top of Zachariah coal bed. In present report, top of Lee formation is lowered to base of Zachariah coal bed. Locally the Zachariah has a rider coal bed; hence, base of coal bed is more persistent horizon than top. Placing of top of formation at base of Zachariah coal follows Campbell (1898, U.S. Geol. Survey Geol. Atlas, Folio 47) who placed contact between Lee formation and Breathitt formation at base of Pittsburg (Kentucky) coal bed, which is probably equivalent of the Zachariah. Exposed thickness about 275 feet in Campton quadrangle, Kentucky. Underlies Breathitt formation.

K. J. Englund and H. L. Smith, 1960, (abs.) Geol. Soc. America Bull., v. 71, no. 12, pt. 2, p. 2015. Upper part of Pennington formation and lower part of Lee formation intertongue in their type area of outcrop, Lee County, Va., and in adjacent parts of Kentucky and Tennessee. Contact between these formations, which has been interpreted as an unconformity between Mississippian and Pennsylvanian systems, is transitional as result of intertonguing and lateral gradation between marine and nonmarine facies. Lateral gradation is most evident in sandstone beds, which in Lee formation are characteristically thickly crossbedded fine- to coarse-grained quartzose, conglomeratic sandstones as much as 300 feet thick. These sandstone tongues of the Lee grade laterally to thin wavy-bedded, very fine- to fine-grained sandstones, 20 to 30 feet thick that are typical of, and are included in, the Pennington. Conversely, tongues of light-olive-gray slightly calcareous shale in upper part of Pennington wedgeout between sandstone tongues of Lee formation. Pennington-Lee contact rises stratigraphically northward in this intertonguing sequence. Marine invertebrate fossils indicate Late Mississippian age of Pennington. Plant fossils have been reported to show that Lee formation is of Early Pennsylvanian age. Intertonguing of Lee and Pennington suggests that they are partly contemporaneous.

Type locality: Lee County, Va.

Lee Quartz Diorite[1]

Precambrian: Western Massachusetts and Connecticut.

Original reference: B. K. Emerson, 1898, U.S. Geol. Survey Mon. 29, p. 18.

Named for exposure in East Lee, Berkshire County, Mass.

Leecher Metamorphics

Age uncertain (pre-Chelan batholith): Northwestern Washington.

J. D. Barksdale, 1948, Northwest Sci., v. 22, no. 4, p. 165, 166. Series consisting of distinctly banded hornblende schist, quartz-oligoclase-hornblende gneiss, biotite-quartz-oligoclase gneiss, and calc-silicate rocks. Pronounced banding and rapid alternation of rocks of diverse mineral and chemical compositions. Predominant easterly dip that varies from 25° to vertical. In fault contact on the west with Newby formation (new). Invaded from the east by granitic rocks of Okanogan complex, and in contact on the south with Methow gneiss (new).

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Type locality: Curving belt from 1 to 3 miles wide east of Methow River in Leecher Creek drainage and in vicinity of town of Carlton, Methow quadrangle.

Leech River Group[1] or Formation

Pennsylvanian-Cretaceous: British Columbia, Canada, and northwestern Washington.

Original reference: C. H. Capp, 1910, Canada Geol. Survey Summ. Rept. 1909, p. 87.

R. A. Anderson, 1941, Washington State Coll. Research Studies, v. 8, no. 3, p. 201. Suggested that Leech River series may be correlated with Granite Falls limestone on basis of fusilinids.

J. A. Jeletzky, 1954, (abs.) Geol. Soc. America Bull., v. 65, no. 12, pt. 2, p. 1270. Suggested that age of Leech River series is more probably Triassic or lower Jurassic than Paleozoic.

W. R. Danner, 1960, (abs.) Geol. Soc. America Bull., v. 71, no. 12, pt. 2, p. 2056. Recent studies of geology of San Juan Islands have necessitated revision of at least four major units established by McLellan (1927, Washington [State] Univ. Pubs. in Geology, v. 2). Leech River group, originally designated as Pennsylvanian-Permian was found to include rocks of Early and Middle Pennsylvanian and Cretaceous age.

Occurs on San Juan Islands and Vancouver Island.

Leeds facies (of Schoharie Formation)

Middle Devonian: Eastern New York.

Winifred Goldring and R. H. Flower, 1942, Am. Jour. Sci., v. 240, no. 10, p. 683, 686, 691–693. As traced southward, Schoharie grit changes rapidly to a shaly and cherty facies, here termed Leeds facies. Name Saugerties formation—suggested by Chadwick (1940) as possible name for new formation, if such it proved to be —is considered inadvisable.

J. H. Johnson, 1957, Dissert. Abs., v. 17, no. 10, p. 2247. Rickard facies (new) passes eastward into sparingly fossiliferous Leeds facies in Albany County. Within New York, the Leeds is divisible into Aquetuck lithofacies below and Saugerties lithofacies above.

Named for exposures in falls of the Catskill in Leeds Gorge, Greene County.

Leeds Sandstone (in Silver Reef Sandstone Member of Chinle Formation)

Upper Triassic: Southwestern Utah.

P. D. Proctor, 1953, Utah Geol. and Mineralog. Survey Bull. 44, p. 25, 28, pl. 2. Mainly white to buff fine- to medium-grained sandstone. Sandstone weathers mainly white and buff to brown and stands out as prominent ledge maker. Stream crossbedding prominent in many places. Ripple marks rare; current type noted. Sandstone beds range from massive 15-foot beds to thin platy sandstones. Lenticular interbedded dark-gray to green or locally maroon shales may be present. Sandstones contain clay galls and balls which may be sufficiently abundant locally to form clay ball conglomerates. Clay balls range from ¼ inch to more than 4 feet in diameter. Total thickness as much as 60 feet. Underlies Tecumseh sandstone (new); overlies Trail Hill sandstone (new) with local unconformity.

Named for exposures near Leeds mine, Silver Reef (Harrisburg) Mining District, Washington County.

Lee Flat Limestone

Upper Mississippian and Pennsylvanian (?) : Southern California.

W. E. Hall, E. M. MacKevett, 1958, California Div. Mines Special Rept. 51, p. 7 (table 1), 8–9, pl. 2. Predominantly thin-bedded medium- to dark-gray limestone. Locally limestone is broken by thin sandy iron-stained partings or by thin beds and lenses of chert. Estimated to be more than covered by basalt and alluvium, and faulting in exposed section vitiates estimate. At least 520 feet thick at type locality where it conformably overlies Perdido formation. Underlies Keeler Canyon formation of Pennsylvanian and Permian age. Nonfossiliferous; age derived from stratigraphic position; occupies same stratigraphic position that upper part of Perdido formation and Rest Spring shale occupy in Quartz Spring area and Ubehebe Peak quadrangle; the Lee Flat, then, represents facies change from clastic section of siltstone, shale, and minor limestone in the latter areas to fine-grained limestone in Darwin quadrangle.

Type section: Trends south from top of prominent hill nine-tenths mile S. 36° E. of main shaft of Lee mine, Darwin quadrangle, central Inyo County. Named for exposures near Lee Flat, alluviated area east of Santa Rosa Hills.

Leeic period

Paleozoic: Iowa and upper Mississippi Valley.

C. R. Keyes, 1941, Pan-Am. Geologist, v. 75, no. 2, p. 98 (chart), 149–150. Term proposed for time span of so-called Early Carbonic limestone section. Lies between the Carbonic above and the Yorkic below. Includes Mississippian, Chartresan, and Oshawanan.

Name derived from Lee County, Iowa, where rocks are fully exposed.

Lee Ranch Tongue (of Abo Sandstone)

Lower Permian (Leonard Series) : Central southern New Mexico.

G. O. Bachman and P. T. Hayes, 1958, Geol. Soc. America Bull., v. 69, no. 6, p. 690 (fig. 1), 694, 695–697, 698 (fig. 5). At type locality, 106 feet thick and consists predominantly of salmon-red shale and siltstone, but some thin-bedded fine-grained soft-weathering sandstone beds are present. In northern part of area, consists predominantly of reddish-brown very thin bedded cross-laminated very fine-grained sandstone and siltstone. Conformably overlies Hueco limestone and intertongues with it near south end of mapped area. Conformably underlies siltstone and sandstone beds, and locally, white gypsum beds of Yeso formation; contact is gradational and therefore arbitrary, though transition zone does not exceed a few feet.

Type locality: SE¼ sec. 11, T. 20 S., R. 11 E., about 7 miles southwest of O. M. Lee Ranch headquarters, Otero County. Generally poorly exposed in narrow slope-forming outcrop on backslope of topographic shelf formed by Hueco limestone.

Leesport Limestone[1]

Middle Ordovician: Southeastern Pennsylvania.

Original reference: G. W. Stose and A. I. Jonas, 1927, Geol. Soc. America Bull., v. 38, p. 505–536.

R. L. Miller, 1937, Geol. Soc. America Bull., v. 48, no. 11, p. 1687–1718. Discussion of relations of Jacksonburg and Leesport formations. Leesport formation was designated by Stose and Jonas (1927) to include argillaceous limestones ("cement rock") which underlie Martinsburg shales and overlie Beekmantown or Stones River limestones in area between Lehigh and Susquehanna Rivers. Relations of these beds to Chambersburg limestone of south-central Pennsylvania and to Jacksonburg limestone of eastern Pennsylvania are confused, and paleontological evidence is lacking. Hence, Stose and Jonas deemed it inadvisable to imply any correlation by applying either of these names and designated these beds as new formation. They chose exposure in cut of Reading Railroad at West Leesport on Schuylkill River as type section. Results of present study have led to conclusion that argillaceous limestones east of Schuylkill should all be referred to Jacksonburg rather than Leesport. Reasons for this decision are discussed under following headings: (1) Leesport type section; (2) lithology of Leesport "cement rock"; (3) continuity of "cement rock"; (4) structure of Egypt region; and (5) relation to overlying and underlying beds. Choice of type section was unfortunate in that the section is one of complex structure and lithology is quite unlike typical "cement rock" elsewhere in Leesport belt. Figure 5 [of present report] is structure section traced from panoramic photograph; blank areas in illustration represent covered areas in railroad cut. One hundred and thirty-four feet of beds is exposed, but interrelationship of different parts of exposure is obscure. Contact of limestones with Martinsburg shale is a fault. Lithologically, rocks in this section are strikingly different from "cement rock" which has been called Leesport in areas to east. Platy limestones at north end of section closely resemble limestones interbedded with Martinsburg. Massive calcareous sandstones have their counterpart in limestones which have been provisionally interpreted as within Martinsburg formation. The 70 feet of thin-bedded limestones at south end of railroad cut are only rocks exposed which are lithologically similar to "cement rock". Stratigraphic position of units in this section is uncertain. If name Leesport is used for these enigmatic rocks, the "cement rock" to east should be given another designation. "Leesport cement rock" in areas between Lehigh and Schuylkill Rivers is identical with cement rock facies of the Jacksonburg. One of the reasons why it has not seemed feasible in past to apply name Jacksonburg to western "cement rock" areas is because of discontinuity of belt of outcrop west of Lehigh River. This discontinuity is much more striking on earlier geologic maps than is shown on Figure 4 of present report. According to present interpretation, the Jacksonburg belt is interrupted in Egypt region because of faulting and continues half a mile farther west in its normal position at base of Martinsburg shale hills. Evidence indicates that the "cement rock" disconformably overlies Beekmantown in this area.

Carlyle Gray, 1951, Pennsylvania Geol. Survey, 4th ser., Prog. Rept. 136, p. 15. Name Jacksonburg applied in this report to all impure limestones in part formerly called Leesport lying between Annville limestone or Beekmantown formation and Martinsburg formation in Berks County. Name Leesport, defined by Stose and Jonas (1927), not used because much of the lithology at type section not similar to that of beds under discussion. Name Jacksonburg used until Leesport is redefined.

C. E. Prouty, 1959, Pennsylvania Geol. Survey, 4th ser., Bull. G–31, p. 5, table 1. Stose and Jonas (1927) mapped argillaceous limestones in Pennsylvania between Susquehanna and Lehigh Rivers that have same stratigraphic position as Jacksonburg below the Martinsburg and above the Beekmantown. Because of uncertain relationship of these limestones to the stratigraphically similar Jacksonburg to northeast and Chambersburg to southwest of Susquehanna River, they assigned name Leesport formation to these rocks. "Leesport" has not been mapped consistently and has been variously assigned to different units. Type section is highly complex and so problematical that comparative studies cannot be made. It appears that Leesport as defined and mapped should not be considered a valid formation and should either be redefined or renamed. Interval between Beekmantown group and Martinsburg formation, embodying essentially the Leesport in east-central Pennsylvania and in restricted sense the Jacksonburg of eastern Pennsylvania and western New Jersey, is divided into (ascending) Annville, Myerstown, and Hershey limestones.

Type section (Miller, 1937): Cut of Reading Railroad at West Leesport, Berks County.

Leesville Limestone Member (of Harrodsburg Limestone)[1]

Mississippian: Southern Indiana.

Original reference: P. B. Stockdale, 1929, Indiana Acad. Sci. Proc., v. 38, p. 233–242.

J. M. Weller and A. H. Sutton, 1940, Am. Assoc. Petroleum Geologists Bull. 24, no. 5, p. 805. In Indiana, the Warsaw limestone is divisible into two parts. Lower part has been divided into three members (ascending): Ramp Creek, Leesville, and Guthrie Creek. The Leesville is a massive crinoidal limestone layer 1½ to 8 feet thick.

Named for exposures at Leesville, eastern Lawrence County.

Leesville Member (of Little Valley Formation)

Upper Jurassic[?] or Cretaceous[?]: Northern California.

J. E. Lawton, 1956, Dissert. Abs., v. 16, no. 10, p. 1885. Lower member of formation. Underlies Round Mountain member (new); overlies Grizzly Creek member of Crack Canyon formation (both new). Upper Jurassic and Cretaceous section, about 40,000 feet thick, consists of sequence of shale and silty shale which alternate with sequences of sandstone.

Occurs in Morgan-Wilbur area in Lake, Yolo, and Colusa Counties.

Le Fever Limestone

Upper Silurian: Southeastern New York.

G. H. Chadwick, 1944, New York State Mus. Bull. 336, p. 47, 51, 52 [1946]. Name applied to massive "coralline" limestone that underlies Rondout waterlime and overlies Rosendale waterlime as defined by Hartnagel (1905). Previously termed Cobleskill but is later than Cobleskill. Name credited to R. M. Logie (unpub. ms.).

Occurs in area from Kingston, Ulster County, southward.

Leffler Gravels

Pleistocene: Northwestern Oregon.

I. S. Allison, 1953, Oregon Dept. Geology and Mineral Industries Bull. 37, p. 9–10. Proposed for alluvial deposit composing terrace on south rim of North Santiam River valley in Stayton quadrangle; also proposed to apply name to similar deposits of equivalent age elsewhere in Willamette Valley and to refer all such deposits to Leffler stage of alluviation. Older than Linn gravels (new).

Type locality: Gravel terrace on south rim of North Santiam River valley, near Leffler, Stayton quadrangle. Name derived from Southern Pacific Railway Station near foot of terrace.

Lefulufulua Trachyte

Pliocene and lower Pleistocene (?) : Samoa Islands (Tutuila)

H. T. Stearns, 1944, Geol. Soc. America Bull., v. 55, no. 11, p. 1285 (table 1). Named in list of eight trachytes that are described as dense jointed cream-colored trachytic dikes, plugs, and crater fills later than most of Pliocene volcanics. Thickness of series 2,141 feet or more. Lefulufulua plug associated with Olomoana volcanics.

Legion Shale Member[1] (of Grenola Limestone)

Permian : Eastern Kansas, southeastern Nebraska, and northern Oklahoma.

Original reference: G. E. Condra and C. E. Busby, 1933, Nebraska Geol. Survey Paper 1.

R. C. Moore and others, 1951, Kansas Geol. Survey Bull. 89, p. 48. Consists of shale, mostly gray but locally zones of black; in central Kansas upper part commonly fossiliferous. Thickness 4 to 12 feet. Underlies Burr limestone member; overlies Sallyards limestone member. Permian. Wolfcamp series.

Type locality: Cuts on U.S. Highway 40, just southwest of American Legion Golf Club grounds, about 1¾ miles southwest of Manhattan. Riley County, Kans.

Legion Creek Granite

Precambrian : Central Texas.

V. E. Barnes, 1940, *in* Geol. Soc. America [Guidebook] 53d Ann. Mtg., p. 51, 53 (geol. map). Coarse-grained granite.

Map is of Cut Off Gap area, Gillespie County.

Lego Limestone Member (of Wayne Formation)[1]

Lego Limestone (in Wayne Group)

Middle Silurian : West-central Tennessee.

Original reference: A. F. Foerste, 1903, Jour. Geology, v. 11, p. 565, 578–582, 694.

C. W. Wilson, Jr., 1949, Tennessee Div. Geology Bull. 56, p. 244, 251–252, figs. 2, 75, 80, 81, 82. Rank raised to formation in Wayne group. Conformably overlies Waldron shale; conformably underlies Dixon formation; locally unconformably underlies Chattanooga shale or Pegram formation. Thickness 25 to 35 feet; average between 27 and 30 feet.

Named for Lego, Decatur County.

†Le Gore Limestone[1]

Lower Ordovician (Beekmantown) : Western Maryland.

Original reference: G. W. Stose and A. I. Jonas, 1935, Washington Acad. Sci. Jour., v. 25, no. 12, p. 564–565.

East of Le Gore quarry, at northern edge of Frederick limestone valley, Frederick County.

Le Grand beds[1]

Mississippian : Central northern Iowa.

Original reference: C. R. Keyes, 1893, Iowa Geol. Survey, v. 1, p. 57.

Named for Le Grand, Marshall County.

Lehigh Limestone[1]

Middle Ordovician : Northeastern Pennsylvania.

Original reference: E. C. Eckel, 1904, U.S. Geol. Survey Bull. 225, p. 449, 450.

Lehigh and Northampton Counties.

Lehighton Member (of Tully Formation)

Upper Devonian : East-central Pennsylvania.

R. E. Stevenson and W. S. Skinner, 1949, Pennsylvania Acad. Sci. Proc., v. 23, p. 31, 32. Upper member of formation. Consists of abundantly fossiliferous thin-bedded sandy shale. Thickness about 20 feet. Overlies Brodhead Creek member; underlies Brallier [shale]. Lenses out east of Weissport.

Type section: On Pennsylvania Highway 412, one-half mile south of Lehighton, along Mahoning Creek, Carbon County.

Lehigh Valley cement rock[1]

Middle Ordovician : Northeastern Pennsylvania.

Original reference: E. O. Ulrich, 1911, Geol. Soc. America Bull., v. 22, p. 563.

Lehigh and Northampton Counties.

Lehman Formation (in Pogonip Group)

Lower Ordovician (Chazyan) : Eastern Nevada and western Utah.

L. F. Hintze, 1951, Utah Geol. and Mineralog. Survey Bull. 39, p. 2, 19–20, 63, 67, 75. Thin- to thick-bedded fossiliferous blue-gray calcilutite with a few beds of sandstone and quartzite. Thickness at type locality about 200 feet; eastward from Ibex, Utah, thins to disappearance; westward, more than doubles in thickness by overlying Swan Peak(?) quartzite grading into Lehman lithology. Overlies Kanosh shale (new); in Ibex area, base is lowest interbedded sandstone ledge; upper limit is top of highest calcilutite beneath Swan Peak(?) quartzite.

Type locality: Bluff on north side of Smooth Canyon and in SE¼ sec. 24, T. 22 S., R. 15 W., near Ibex, Millard County, Utah. Named for exposures in Snake Range near Lehman Caves, Nev.

Lehmer Limestone Member (of Admire Shale)[1]

Pennsylvanian : Southeastern Nebraska.

Original reference: G. E. Condra, 1935, Nebraska Geol. Survey Paper 8, p. 5, 9.

At old Lehmer quarry, 4 miles southwest of Falls City, Richardson County.

Leicester Marcasite Member (of Moscow Formation)

Middle Devonian : Western New York.

R. G. Sutton, 1951, Rochester Acad. Sci. Proc., v. 9, nos. 5–6, p. 356, 379–380. Name proposed for top member of formation. Consists of lenses of yellowish-brown very fossiliferous sometimes nodular pyrite and marcasite; weathers to reddish-brown limonitic powder. Maximum thickness 6 inches. Overlies Windom member; underlies Genesee group, possibly unconformably. Previously termed Tully pyrite; not equivalent in age to Tully limestone.

Wallace de Witt, Jr., and G. W. Colton, 1959, Am. Assoc. Petroleum Geologists Bull., v. 43, no. 12, p. 2816–2817, 2827. Sutton's Leicester marcasite is lenticular layer of pyrite and marcasite in base of Geneseo shale member of Genesee formation.

Type locality: Along banks of Beards Creek one-fourth mile northwest of Leicester, Livingston County. Extends from west shore of Canandaigua Lake to Lake Erie.

Leigh Dolomite Member (of Bighorn Dolomite)[1]

Leigh Formation

Upper Ordovician: Western Wyoming.

Original reference: C. W. Tomlinson, 1917, Jour. Geology, v. 25, p. 118, 225–257.

H. R. Wanless, R. L. Belknap, and Helen Foster, 1955, Geol. Soc. America Mem. 63, p. 15–16. Rank raised to formation. Underlies Darby formation.

R. B. Boeckerman and A. J. Eardley, 1956, Wyoming Geol. Assoc. Guidebook 11th Ann. Field Conf., p. 181. In Jackson quadrangle, Lincoln County, formation consists of slabby gray dolomite with smooth white to yellowish weathered zones. Thickness 30 feet. Unconformably underlies Darby formation; unconformably overlies Bighorn dolomite. Silurian or Devonian.

Named for typical development on Leigh Creek, Teton Range.

Leighton Gray Shale Member (of Pembroke Formation)[1]

Silurian: Southeastern Maine.

Original reference: E. S. Bastin and H. S. Williams, 1914, U.S. Geol. Survey Geol. Atlas, Folio 192, p. 6–7.

Named for exposures on Leighton Neck, Penbroke Township, Washington County.

†Leightons Cove Series[1]

Silurian: Southeastern Maine.

Original reference: N. S. Shaler, 1886, Am. Jour. Sci., 3d, v. 32, p. 53, 56.

Named for exposures at Leighton's Cove, Cobscook Bay district, eastern coast of Washington County.

Leila Trachyte

Pliocene and lower Pleistocene(?): Samoa Islands (Tutuila).

H. T. Stearns, 1944, Geol. Soc. America Bull., v. 55, no. 11, p. 1285 (table 1). Named in list of eight trachytes that are described as dense jointed cream-colored trachytic dikes, plugs, and crater fills later than most of Pliocene volcanics. Thickness of sequence 2,141 feet or more. Leila plug associated with Alofau volcanics (new).

Leipers Limestone[1]

Leipers Formation (in Maysville Group)

Upper Ordovician: Western Tennessee and northwestern Alabama.

Original reference: C. W. Hayes and E. O. Ulrich. 1903, U.S. Geol. Survey Geol. Atlas, Folio 95.

C. W. Wilson, Jr., 1949, Tennessee Div. Geology Bull. 56, p. 179–193. Leipers formation as now defined includes all strata of Maysville group in central basin because it is only formation that has been proposed. Widely diverse facies are included but all carry Maysville fossils. Separated from underlying Catheys formation of Nashville group and overlying beds, regardless of age, by unconformities; locally underlain with apparent unconformity by Inman formation (new) of Eden group: unconformably underlies Arnheim formation. Thickness throughout most of out-crop belt less than 75 feet; thickens northward in Summer, Macon, Jackson, and Clay Counties to maximum of 175 feet. Hayes and Ulrich proposed no type section other than along Leipers Creek. Section suggested by Bassler (1932, Tennessee Div. Geology Bull. 38) as representing type area is here accepted as type section. It contains only two facies, but no section, anywhere, would contain adequate representations of all facies of Leipers.

G. B. Martin, 1960, Gulf Coast Assoc. Geol. Soc. Trans., v. 10, p. 202–205. Recommended that in northwestern Alabama upper part of "Chickamauga" limestone be replaced by Leipers and Fernvale formations. Leipers consists of thin-bedded gray coarsely crystalline argillaceous limestone. Exposed thickness 12 feet. Maysville group.

Type section: Along Leipers Creek 2 miles north of Water Valley, Maury County, Tenn.

†Leipers Creek Limestone (in Richmond Group)[1]

Upper Ordovician: Western Tennessee.

Original reference: A. F. Foerste, 1901, Geol. Soc. America Bull., v. 12, p. 432–433.

Named for exposures on Leipers Creek, Maury County.

Leitchfield Formation

Leitchfield Formation (in Chester Group)[1]

Upper Mississippian: Western Kentucky.

Original reference: L. C. Glenn, 1922, Kentucky Geol. Survey, ser. 6, v. 5, p. 60.

J. M. Weller and A. H. Sutton, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 5, p. 766 (fig. 1). 840. Thick shale which constitues Elvira group in Logan and Butler Counties, and farther east, is known as Leitchfield formation. Derivation of name given.

Preston McGrain and F. H. Walker, 1954, Kentucky Geol. Soc. Field Trip, Apr. 1954, p. 286. Differs from Buffalo Wallow formation (Butts, 1917) in that it includes the Tar Springs as basal member.

Named from town of Leitchfield, Grayson County.

Leitchfield Marl (in Chester Group)[1]

Mississippian: Western central Kentucky.

Original reference: C. J. Norwood, 1876, Kentucky Geol. Survey, v. 1, new ser., pt. 6, p. 12, 13.

Named for exposures at Leitchfield, Grayson County.

Leithsville Formation[1]

Leithsville Limestone

Middle(?) Cambrian: Eastern Pennsylvania.

Original reference: E. T. Wherry, 1909, Science, new ser., v. 30, p. 416.

B. L. Miller, D. M. Fraser, and R. L. Miller, 1939, Pennsylvania Geol. Survey, 4th ser., Bull. C–48, p. 227. Name abandoned and Tomstown formation extended to area as substitute.

B. F. Howell, Henry Roberts, and Bradford Willard, 1950, Geol. Soc. America Bull., v. 61, no. 12, pt. 1, p. 1357, 1361, 1362–1363, 1365, 1366. Revived since use of name Tomstown implies unwarranted correlation with Tomstown type area. Also used in place of Elbrook limestone in Buckingham Valley. Termed limestone and described as mostly dark gray-blue to black dolomitic rock with yellowish to buff beds. Variable bedding and lithologic characteristics. Includes thin-bedded impure high magnesium limestone; argillaceous sericitic shaly limestone to sericitic shale lacking carbonate; and massive dense dolomite limestone in beds up to 10 feet thick. Also contains masses of dark or light chert. Underlies newly named Limeport limestone; overlies Chickies quartzite in Buckingham Valley and disconformably overlies Hardyston quartzite in Lehigh Valley. Lower, Middle and (or) Upper Cambrian.

Bradford Willard, 1955, Geol. Soc. America Bull., v. 66, no. 7, p. 819, 821, 822, 824–825, 827. Interfingers with overlying Limeport. Conformable with underlying Hardyston at all but one contact where there is local disconformity. Middle(?) Cambrian.

Probably named for Leithsville, Northampton County.

Lemhi Formation

Mississippian to Permian (Meramecian through Wolfcampian): Central eastern Idaho.

M. R. Thomasson, 1959, Dissert. Abs., v. 20, no. 3, p. 999. Contains abundant algal, coral, and bryozoan bioherms and biostromes. Cross-stratification, edgewise limestone conglomerates, bottom scouring, cyclic sedimentation, oolite beds and calcarenites indicate shallow-water deposition. Thickness at type section 6,950 feet. Replaces "Brazer." Time equivalent of Muldoon (new) and Wood River formations.

Type section: In southern Lemhi Range.

Lemhi Quartzite

Precambrian (Belt Series): Southern central Idaho.

C. P. Ross, 1947, Geol. Soc. America Bull., v. 58, no. 12, pt. 1, p. 1096–1097, pl. 1. Principally grayish-green impure quartzite with subordinate argillaceous beds. Latter are darker than the quartzite; some are purple and maroon. Nearly pure white to pinkish quartzite lenses present locally. Thickness 3,000 feet or more; basement exposed. Underlies Swauger quartzite (new) with gradational contact.

A. L. Anderson, 1959, Idaho Bur. Mines and Geology Pamp. 118, p. 16–18. Thickness about 8,000 feet in Lemhi quadrangle. Underlies Swauger quartzite.

Named after Lemhi Range in which it is extensively exposed, Borah Peak quadrange.

Lemon Cove Schist (in Kaweah Series)

Triassic(?): Southern California.

Cordell Durrell, 1940, California Univ. Dept. Geol. Sci, Bull., v. 25, no. 1, p. 14, 116, fig. 29, geol. map. Second in sequence (ascending) of four units included in series. Considered younger than, or in part equivalent to, Yokohl amphibolite, and older than Homer quartzite (both new). Principal rock type is mica schist. Thickness in Dry Creek area 8,000 feet; base not exposed.

Named for its occurrence near town of Lemon Cove, in southern Sierra Nevada, north-central Tulare County. Also occurs along Sheep Creek in core of large anticline, and at Yucca Creek, where it appears beneath Three Rivers schist.

Lemons Bluff Member (of Big Saline Formation)

Lemons Bluff Member (of Marble Falls Formation)

Lower Pennsylvanian: Central Texas.

F. B. Plummer, 1944, Texas Univ. Bur. Econ. Geology Mineral Resources Circ. 33, p. 3, 5, 8. Member of Marble Falls formation; incidental mention in connection with study of limestones suitable for manufacture of rock wool.

F. B. Plummer, 1945, Texas Univ. Bur. Econ. Geology Pub. 4401, p. 67–69. Black subcrystalline uniformly bedded siliceous chert-bearing limestone weathering to yellowish and grayish-brown tints; locally contains quantities of minute sponge spicules. Layers are 2 to 12 inches thick and characterized by flat smooth surfaces and commonly separated by thin partings of shaly limestone. Member changes to shale beds eastward and crops out at McAnelly's Bend along Colorado River west of Bend as black fissile shale containing thin layers of dense black limestone. This shale has long been considered typical Smithwick; it ranges in thickness from a few feet to 125 feet and unconformably overlies Big Saline beds. Underlies Smithwick formation.

F. B. Plummer, 1947, Jour. Geology, v. 55, no. 3, pt. 2, p. 196 (table 2), 197–198; 1947, Jour. Paleontology, v. 21, no. 2, p. 142, 143, 144. Reallocated to member status in Big Saline formation. Thickness 20 to 60 feet. East of Cavern Ridge (Llano region) underlies Brister member (new) and overlies Aylor member (new); west of Cavern Ridge underlies Soldiers Hole member (new) and overlies Brook Ranch member (new); absent southwest of Brook Ranch in McCulloch County.

Lemons Bluff is on San Saba River, San Saba County.

Lemont Argillaceous Limestone Member (of Carlim Limestone)[1]

Middle Ordovician: Central Pennsylvania.

Original reference: C. Butts, 1918, Am. Jour. Sci., 4th v. 46, p. 526, 533, 537.

Charles Butts and E. S. Moore, 1936, U.S. Geol. Survey Bull. 855, p. 33–35, pls. 1, 2. Described in Bellefonte quadrangle. Upper part of formation. Thickness 10 to 40 feet. Associated with the Lemont are thin layers of bentonite both above and below it at Bellefonte and at least one layer below it at quarry near Oak Hall. Significant fossil for correlation is *Maclurea magna* (Lesueur) found at Lemont and near Oak Hall and elsewhere in central Pennsylvania. Underlies Lowville limestone. Lower Ordovician.

G. M. Kay, 1941, (abs.) Geol. Soc. America Bull., v. 52, no. 12, pt. 2, p. 1969. Nealmont (new) includes type Rodman, Lemont, and Center Hall (Hull and Rockland).

G. M. Kay, 1943, Econ. Geology, v. 38, no. 3, p. 195. Terms Carlim, Lemont, and "Lowville" have been applied to different units at various localities. "Lemont member of the Carlim" in Tyrone district is Hostler member (new) of Hatter formation; it is the part of the Valley View limestone [member (new) of Curtin limestone (new)] between metabentonites E and D at Bellefonte, and part of Nealmont limestone at type locality at Lemont.

G. M. Kay, 1944, Jour. Geology, v. 52, no. 1, p. 20. Type Lemont limestone is equivalent to most Nealmont limestone that overlies Valentine limestone.

G. M. Kay, 1944, Jour. Geology, v. 52, no. 2, p. 101–102. Name "Lemont" has ben applied to units older than beds at type section; Lemont limestone was originally defined as "well exposed in railroad cut a short distance south of the town," west of Oak hall. Species misidentified as *Maclurites "magnus"* Lesueur led to classification as Chazyan and belief that is was older than Curtin and Benner limestones or "Lowville" in Tyrone area.

G. A. Cooper, 1956, Smithsonian Misc. Colln., v. 127, pt. 1, p. 71–72. Member named by Butts (1918) for limestone exposed in railroad cut south of Lemont. At this place, a species of *Maclurites* is fairly common as was confused by Butts with *M. "magnus"* Lesueur of Chazy group. Butts thus regarded his Lemont as a part of the Chazy and identified his member elsewhere in Pennsylvania where rock was shaly and had *M. "magnus."* Type section of Lemont is actually top of limestone sequence now called Nealmont (Kay, 1944). Butts' use of name Lemont was generally for brownish shaly rock left as "rib" in quarrying operations to which Kay applied name "Hostler member of Hatter formation." Butts' Lemont of type section is thus part of the Nealmont, and Lemont outside type section is generally Hostler.

Named for Lemont, near State College, Centre County.

Lemont Drift

Pleistocene (Illinoian) : Northern Illinois.

J. H. Bretz, 1939, Illinois Geol. Survey Bull. 65, pt. 1, p. 53. Name applied to glacial and aqueo-glacial deposit underlying Valparaiso till. Strikingly free from clay, the finest material being a silt or very fine sand; contains large percentage of stratified material. Term till is used advisedly.

J. H. Bretz, 1955, Illinois Geol. Survey Bull. 65, pt. 2, p. 57–69. Thickness about 60 feet. Commonly tan to buff. At type locality, highly variable both vertically and horizontally; some of the sand is sufficiently cemented to yield boulder-sized fragments of sandstone and conglomerate. Overlies thick unit termed sub-Lemont drift.

Leland Horberg and P. E. Potter, 1955, Illinois Geol. Survey Rept. 185, p. 9–10, 18. In some areas, underlies buried soil and Tinley till (new). Illinoian.

Well exposed in abandoned quarries about 1 mile west of Lemont, just outside Chicago area. Also exposed along and near Sag Channel and Des Plaines Valley west of Argo, San Bridge and Palos Park quadrangles.

Le Moyen Formation

Recent: Southwestern Louisiana (subsurface and surface).

P. H. Jones, *in* P. H. Jones, A. N. Turcan, Jr., and H. E. Skibitzke, 1954, Lousiana Dept. Conserv. Geol. Bull. 30, p. 88–89. Partly channel-fill and apartly deltaic deposit beneath Mississippi River flood plain consisting of two essentially equivalent members: the Lebeau (new) containing large amounts of sand and gravel, and the Mermentau (new) containing silty clay or clay. Thickens gulfward. Maximum thickness 300 feet; at type locality about 260 feet; at Le Moyen, the basal sand and gravel is about 115 feet thick and is overlain by dark organic clay. Upper surface is land surface; base lies on rocks ranging in age from Eocene to late Pleistocene.

Penetrated by water wells near town of Le Moyen in T. 3 S., R. 4 E., and in T. 3 S., R. 4 E., in St. Landry Parish, on U.S. Highway 71 about 43 miles southeast of Alexandria.

Lena Member (of Fleming Formation)

Miocene: Central Lousiana.

H. N. Fisk, 1940, Louisiana Dept. Conserv. Geol. Bull. 18, p. 118 (fig. 26), 151–154, geol. map. Brackish-water calcareous clays with siliceous silts and local pyroclastic lentils. Dominant lithologic unit is the gray silty clay that occurs near base of typical section; this unit incorporates varying thicknesses of more calcareous clays which in places make up almost all of the section; calcareous beds contain foraminifera, whereas the gray silty clays contain carbonaceous particles and grass. Thickness 75 to 125 feet. Underlies Carnahan Bayou member (new); overlies Catahoula formation.

Typically exposed for 2½ miles north along Highway 71W from near Lena, Rapides Parish, in sec. 34, T. 6 N., R. 4 W., to a point in Natchitoches Parish.

Lenapah Limestone[1] (in Marmaton Group)

Pennsylvanian (Des Moines Series): Northeastern Oklahoma, southwestern Iowa, southern Kansas, and western Missouri.

Original reference: C. N. Gould, D. W. Ohern, and L. L. Hutchinson, 1910, Oklahoma State Univ. Research Bull. 3, p. 6, 10, 11, 12.

J. M. Jewett, 1941, Kansas Geol. Survey Bull. 38, pt. 11, p. 300, 336–340. Subdivided into (ascending) Norfleet limestone, Perry Farm shale, and Idenbro limestone members (all new). Thickness at type exposure about 22 feet. Overlies Nowata shale; underlies Memorial shale. Marmaton group, Des Moines series.

F. C. Greene and W. V. Searight, 1949, Missouri Geol. Survey and Water Resources Rept. Inv. 11, p. v. (fig. 1), 9. In western Missouri, formation comprises (ascending) Norfleet limestone, Perry Farm shale, and Sni Mills limestone members. Overlies Nowata formation; underlies Memorial shale.

M. C. Oakes, 1952, Oklahoma Geol. Survey Bull. 69, p. 36–41, pl. 1. Described in Tulsa County. Thickness a few feet to as much as 20 feet. Conformably overlies Nowata formation; conformably underlies Holdenville (Memorial) shale. Where Lenapah has been exposed by pre-Seminole erosion, it is unconformably overlain by Seminole formation. Uppermost beds of Wewoka formation are continuous with Lenapah limestone. Marmaton group.

H. G. Hershey and others, 1960, Iowa Highway Research Board Bull. 15, p. 30, fig. 5. Formation represented in Iowa by Cooper limestone (Sni Mills of Missouri). Characteristically white to light gray; has brecciated appearance with dense limestone fragments in light grayish-green argillaceous matrix. Overlies Nowata formation; underlies Pleasanton group. In Marmaton group.

Type exposure in quarry in NW¼NE¼ sec. 30, T. 28, N., R. 16 E., Nowata County, Okla., at Bell Spur, north of Lenapah.

Lennep Sandstone (in Montana Group)[1]

Upper Cretaceous: South-central Montana.

Original reference: R. W. Stone and W. R. Calvert, 1910, Econ. Geology, v. 5, p. 746.

J. G. Bartram, 1937, Am. Assoc. Petroleum Gologists Bull., v. 21, no. 7, p. 910. Suggests name Fox Hills could be extended and such names as Lennep, Horsethief, Milliken, and Trinidad be dropped.

M. H. Stow, 1953, U.S. Atomic Energy Comm. [Pub.] RME-3069, p. 12. In list of sedimentary formations exposed in Yellowstone-Beartooth-Big Horn region. Lennep occurs above Bearpaw and below Lance (Hell Creek).

W. J. McMannis, 1955, Geol. Soc. America Bull., v. 66, no. 11, pl. 7. Plate 7 shows Livingston formation intertongues with Claggett, Judith River, Bearpaw, Lennep, Hell Creek, Tullock, and Lebo formations.

Named for Lennep Station, on Chicago, Milwaukee, St. Paul, and Pacific Railroad, at northern end of Crazy Mountains.

Lenoir Limestone (in Stones River Group)[1]

Middle Ordovician: Eastern Tennessee, northern Alabama, and western Virginia.

Original reference: J. M. Safford and J. M. Killebrew, 1876, Elements of geology of Tennessee, p. 108, 123, 130–131, 137.

Charles Butts, 1940, Virginia Geol. Survey Bull. 52, pt. 1, p. 139–147. Lenoir succeeds Mosheim limestone or Murfreesboro limestone, or Beekmantown dolomite where Mosheim is absent, as in Knobs area south of Abingdon, Washington County. With exception of vicinity off Draper, Pulaski County, the Lenoir, so far as known, is universally present throughout Appalachian Valley. Well exposed at top of St. Clair facies (new) of Murfreesboro limestone in following areas: Yellow Branch, southeast of Rose Hill, Lee County; southeast of St. Clair Station west of Bluefield; northeast of Bolar, Bath County; and west edge of Crabbottom, Highland County. Where Blackford facies (new) of Murfreesboro is present, the Lenoir is not obviously recognizable but is probably present above the Mosheim. Thickness 5 feet or less at places in area of Blackford facies northwest of Clinch Mountain; 30 feet in Knobs area near Abingdon; commonly 50 feet throughout most of Appalachian Valley; possible maximum thickness 200 feet northwest of Newport, Giles County. In Stones River group. Underlies Holston limestone of Blount group.

B. N. Cooper and C. E. Prouty, 1943, Geol. Soc. America Bull., v. 54, no. 6, p. 819–886. Lower Middle Ordovician succession of Tazewell County, southwestern Virginia, is subdivided into 29 distinctive zones which are grouped into eight formations. Study led to recognition of inconsistencies in use of names Stones River, Murfreesboro, Mosheim, Lenoir, Blunt, Holston, Ottosee, Lowville, and Moccasin. Lenoir limestone of Butts has been identified largely on basis of its superposition with respect to beds supposed to be Mosheim, resulting in identification of two different zones as Lenoir. In proposed revised stratigraphic nomenclature, Cliffield formation (new) includes beds which Butts has called Murfreesboro, Mosheim, Lenoir, Holston, and Ottosee.

B. N. Cooper and G. A. Cooper, 1946, Geol. Soc. America Bull., v. 57, no. 1, p. 35–114. In classifying lower Middle Ordovician of Shenandoah Valley, formation names Stones River, Mosheim, Lenoir, Holston, Whitesburg, and Athens have been used without adequate evidence. The Lenoir and Mosheim have been misidentified in much of Appalachian Valley of Virginia, and confusion regarding these formations has resulted in misidentification of many of succeeding formations. Therefore, relationship of type Lenoir to type Mosheim has been restudied. In limestone belt which passes through Lenoir City and Philadelphia, Tenn., type Lenoir directly overlies Knox dolomite and exhibits three-fold development. Lower 15 to 25 feet composed chiefly of mealy-weathering dolomitic mudrocks with intercalated beds of dove-gray calcilutite; middle division, 25 to 45 feet thick, is impure limestone containing *Mimella nuclea* (Butts), distinctive but undescribed species of *Valcourea* and *Hesperorthis*, and characteristic coral *Billingsaria parva;* upper 100 to 125 feet is dark-gray medium-grained sparsely cherty limestone with *Maclurites "magnus"* the only common fossil. Southwest of Philadelphia, limestones of lower division of Lenoir grade vertically and laterally into dolomitic mudrock. In type exposures of Lenoir, 4 to 9 feet of dove-gray limestone, not unlike beds elsewhere called Mosheim, occur at base of Lenoir and are overlain by 7½ feet of dolomitic mudrock. Basal Lenoir calcilutite and these mud rocks are separated by 2 to 18 inches of shaly limestone containing abundant *Rostricellula pristina* (Raymond). Lithologic similarity, stratigraphic position, and occurrence of this fossil correlate lower dolomitic division of typical Lenoir with lower Blackford of Virginia. If calcilutite at base of type Lenoir were to be called Mosheim, the identification would have to be based wholly on lithologic resemblance which is not very pronounced. Near Friendsville, Tenn., where Lenoir is prominently displayed, Mosheim-type limestone occurs at several horizons. Northeast of Friendsville, where lower "Mosheim" zone is developed, the lower dolomitic division of typical Lenoir is absent, and basal calcilutite is overlain by middle fossiliferous division of the Lenoir. These "Mosheim" beds may be a dove limestone facies of lower Lenoir. Since real Lenoir contains more than one intercalation of dove-gray calcilutite and since substantial part of lower Lenoir seems to be supplanted by this type of limestone, it is believed that beds with "Mosheim" lithology are a facies of the typical Lenoir. Probably type Mosheim is a calcilutite facies representing substantial part of typical Lenoir. Use of name Mosheim for a pre-Lenoir stratigraphic division should not be extended hundreds of miles away from type locality when evidence that the Mosheim underlies the Lenoir is lacking in critical localities. Butts' Lenoir in northern Virginia is apparently not represented in Lenoir of type locality. In proposed reclassification, the lower Middle Ordovician is divided into six time-stratigraphic units (ascending): New Market limestone, Whistle Creek limestone, Lincolnshire limestone, Edinburg formation, Oranda formation, and Collierstown limestone. At least part of New Market limestone is linked with part of New York Chazy and type Lenoir.

C. E. Prouty, 1946, Am. Assoc. Petroleum Geologists Bull., v. 30, no. 7, p. 1181–1182. Discussion of lower Middle Ordovician of southwest Virginia and northeast Tennessee. Measured sections compared with revised classification in Tazewell County, Va. Lenoir limestone was named by Safford and Killebrew for nodular argillaceous *Maclurites*-bearing limestone at Lenoir City, Tenn. They considered it to be same as *Maclurea* limestone. Since this was defined as occurring above Knox dolomite (Beekmantown) and below the Marble ("Holston" marble), it is likely that this is definition intended at Lenoir City. This would here include "Mosheim" (Five Oaks) limestone at base. Since the naming of "Mosheim" in 1911, the Lenoir has been generally considered of post-"Mosheim", pre-"Holston" age. Though upper Lenoir in type section is covered, outcrops nearby show typical Lenoir lithology to continue to base of

"Holston." Under strict analysis of original designation, the boundaries are not sufficiently definite to preserve validity of name. In view of its wide use, name should be retained but should be redefined. Lenoir may be defined as the argillaceous nodular limestones occurring between "Mosheim" (Five Oaks limestone) and the "Holston" (Farragut limestone, new). Northwest of Clinch Mountain, the Lenoir would occur chronologically between the Five Oaks and Thompson Valley (new) limestones. The Five Oaks is commonly absent in both areas, and, where Blackford formation is absent, the Lenoir rests directly on the Beekmantown.

R. L. Miller and J. O. Fuller 1947, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 76; 1954, Virginia Geol. Survey Bull. 71, p. 84–90. In Rose Hill oil field, Lee County, Va, Lenoir overlies Mosheim limestone and underlies Lowville limestone. Lenoir of Rose Hill area is about same as Lenoir of Butts in southwest Virginia and probably correlates with Lincolnshire of Cooper and Prouty in Tazewell County.

Charles Butts and Benjamin Gildersleeve, 1948, Georgia Geol. Survey Bull. 54, p. 22, 25–26, geol. map. Lenoir (Ridley) limestone included in Stones River group in northwestern Georgia. Thickness about 100 feet. Overlies Mosheim limestone; underlies Lebanon limestone.

R. L. Miller and W. P. Brosgé, 1950, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 104; 1954, U.S. Geol. Survey Bull. 990, p. 43–47. Martin Creek limestone (new) replaces Lenoir limestone as used by Miller and Fuller (1947, 1954).

John Rodgers, 1952, Geologic map of the Athens quadrangle, Tennessee (1:24,000): U.S. Geol. Survey Geol. Quad. Map [GQ–19]. Lenoir limestone, in Athens quadrangle, consists chiefly of dark bluish-weathering argillaceous nodular limestone; basal beds, which rest unconformably on Mascot dolomite, vary from place to place. Massive aphanitic limestone, comparable to Mosheim limestone near Knoxville, is present locally in Sweetwater Valley and in extreme southeastern part of area. It is as much as 15 feet thick just south of southeast corner of quadrangle. In other places, basal beds are greenish silty dolomitic limestone containing angular chert fragments. Both rock types appear to be lateral facies of typical Lenoir limestone. Lenoir in Athens area was mapped as Chickamauga by Hayes (1895, Folio 20); however, name Lenoir has priority as applied to these rocks, and typical Chickamauga includes beds equivalent to Ottosee shale and higher formations. Thickness about 250 feet in Sweetwater Valley; 40 feet elsewhere. Contact with overlying Athens shale gradational.

John Rodgers, 1953, Tennessee Div. Geology Bull. 58, pt. 2, p. 68–78, pls. In this report, the Mosheim is considered a member of the Lenoir that locally replaces the lower part of the formation. The Lenoir underlies the Holston and overlies Knox group. Lenoir limestone and Athens shale grade into each other in vague belt near Monroe-McMinn County line.

Josiah Bridge, 1955, Geol. Soc. America Bull., v. 66, no. 6, p. 727–729. In Douglas Lake area, includes Douglas Lake member (new) in lower part. Overlies Mascot dolomite Underlies unnamed shaly limestone.

J. M. Cattermole, 1955, U.S. Geol. Survey Geol. Quad. Map GQ–76. Lenoir, in Shooks Gap quadrangle, Tennessee, divided into Mosheim member at base and main body of Lenoir. Thickness 380 to 500 feet. Underlies Holston formation; unconformably overlies Newala formation.

R. B. Neuman, 1955, U.S. Geol. Survey Prof. Paper 274–F, p. 145 (chart), 147–148, pl. 28. Term Lenoir limestone is applied in this report [Tellico-Sevier belt, eastern Tennessee] to limestones of several distinctive types that comprise basal part of Middle Ordovician section. Main part of formation consists of gray cobbly argillaceous limestone with which name Lenoir is associated by many geologists from Virginia to Alabama, regardless of exact stratigraphic position or fossil content. Also included is dove-gray aphanitic limestone termed Mosheim member, and a discontinuous basal unit characterized by several kinds of detrital limestone to which term Douglas Lake member is applied. Wherever there are exposures, the Lenoir, 26 to 95 feet thick, intervenes between basal beds of Blockhouse shale (new) and highest beds of Knox group. This fact is emphasized because Keith (1895, folio 16; 1896, folio 25) showed Athens shale resting on Knox in most places.

G. A. Cooper, 1956, Smithsonian Misc. Colln., v. 127, pt. 1, p. 72. Name Lenoir restricted to sequence exhibited at type locality on east side of Lenoir City. So restricted, the sequence containing *Christiania*, originally referred to the Lenoir by many geologists, is excluded. *Christiania* beds are herein named Arline formation. At type locality, the Lenoir contains three zones (ascending): *Rostricellula*, *Valcourea-Mimella*, and *Maclurites*. Best development of Lenoir is at Friendsville, Blount County, Tenn., where each zone is fairly thick. To the west of Friendsville area, across strike of various belts, the Lenoir changes lithology and is ultimately cut out. In its changed lithology, the Lenoir appears as a calcarenite well exhibited near Tumbez in Virginia with basal conglomerate containing *Rostricellula*, and massive limestones above it contain *Valcourea* and *Mimella*. Hence, it has been called Tumbez formation (Cooper, 1945). Blackford formation of dolomites, red beds, and conglomerates is equivalent to Tumbez and Lenoir. In belt along Cumberland Front, the Lenoir is missing; Blackford facies (Dot formation) there is equivalent to Hogskin member of Lincolnshire formation.

Named for exposures at Lenoir City, Loudon County, Tenn.

Lenox Limestone Member (of Bingham Quartzite)[1]

Pennsylvanian: Central northern Utah.

Original reference: A. Keith, 1905, U.S. Geol. Survey Prof. Paper 38, p. 37, map, sections.

In Lenox mine, Bingham district.

Lenoxhills Formation

Permian (Wolfcamp Series): Western Texas.

C. A. Ross, 1959, Washington Acad. Sci. Jour., v. 46, no. 9, p. 299–300; 1960, Cushman Foundation for Foraminiferal Research Contr., v. 11, no. 4, p. 120. At type section, composed of 130 feet of conglomerate at base succeeded by 160 feet of sandstone, clastic limestone, and shale. To the southwest, entire formation changes facies into conglomerate; further southwest at Dugout Mountain, conglomerate changes facies into sandstone and shale (150 feet thick) and finally into limestone and shale. Northeast of Lenox Hills, formation changes into shale facies and is thin (120 feet) just west of Iron Mountain. At Leonard Mountain, shale units intertongue eastward into biohermal limestones; in vicinity of Wolf Camp Hills, these biohermal strata intertongue into silty thin-bedded limestones, 200 to 300 feet thick. Eastward from Wolf Camp Hills the thin-bedded limestones of formation intertongue with red and varicolored shales and green crossbedded sandstone of marginal marine facies. Througout much of eastern area, basal conglomerate of formation fills valleys cut in Gaptank formation. Unconformably overlies Nealranch formation (new) ; unconformably underlies Leonard formation. Lenoxhills is upper formation of Wolfcamp series in Glass Mountains. It was included in Wolfcamp formation by King (1931, Texas Univ. Bull. 3038) and is lower 200 to 300 feet of Hess formation of Udden (1917). [Name also spelled Lenox Hills.].

Type section: Lenox Hills, one-fourth mile north of Slick-Urschel No. 1 Mary Decie well site 7 miles northwest of Marathon, Brewster County.

Leola Volcanics

Precambrian; Northeastern Washington and western Idaho.

C. F. Park, Jr., and R. S. Cannon, Jr., 1943, U.S. Geol. Survey Prof. Paper 202, p. 6 (table), 9–11, pl. 1. Name applied to succession of greenstone and green schist about 5,000 feet thick. Underlies Monk formation; overlies and is gradational into Shedroof conglomerate (new).

Named from section at Leola Peak, Pend Oreille County, Wash. Volcanics crop out from international boundary southwestward and pinch out about Pass Creek.

Leon Series[1]

Upper Cambrian and Lower Ordovician(?) : Central Texas.

Original reference: T. B. Comstock and E. T. Dumble, 1890, Texas Geol. Survey 1st Ann. Rept., p. lxii, 295–301, pl. 3.

Named for Leon Creek, Mason County.

Leona Formation[1]

Pleistocene: Southern Texas.

Original reference: R. T. Hill and T. W. Vaughan, 1898, U.S. Geol. Survey 18th Ann. Rept. , pt. 2, p. 253–254, 275–276.

W. O. George, 1952, U.S. Geol. Survey Water-Supply Paper 1138, p. 14 (table 7), 28, pl. 2. Described in Comal County where it occurs as terraces mainly in valleys of Guadalupe River and Cibolo Creek and has probable maximum thickness of 65 feet.

Named for Leona River, Uvalde and Zavala Counties.

Leona Rhyolite[1]

Pleistocene, lower or middle: Western California.

Original reference: A. C. Lawson, 1914, U.S. Geol. Survey Geol. Atlas, Folio 193.

G. D. Robinson, 1956, U.S. Geol. Survey Geol. Quad. Map GQ–88. Described in Hayward quadrangle. Lower or middle Pleistocene. Pyritic soda rhyolite flows, domes, and dikes. Thickness varies irregularly and abruptly from a few feet to more than 400 feet. Lies mostly, but not invariably, on a fault contact between shale in upper part of Knoxville in eastern part of area and a variety of Franciscan rocks and basic plutonic rocks on west; in some areas, overlies Claremont shale. No younger rocks overlie the rhyolite in area.

C. A. Hall, Jr., 1958, California Univ. Pubs. Geol. Sci., v. 34, no. 1, p. 33–34, fig. 2, geol. map. Unconformably overlies Orinda and Briones formations in Pleasanton area. Thickness about 400 feet. Questionably assigned to Pliocene.

Occurs in San Francisco Bay region. In Hayward quadrangle, crops out discontinuously throughout the front hills in a northwest-trending belt.

Leonard Formation[1] **or Series**

Lower Permian: Western Texas, Kansas, New Mexico, and Oklahoma.

Original reference: J. A. Udden, C. L. Baker, and E. Böse, 1916, Texas Univ. Bur. Econ. Geology and Tech. Bull. 44, p. 51.

J. E. Adams and others, 1939, Am. Assoc. Petroleum Geologists Bull., v. 23, no. 11, p. 1675, 1677–1678. Second division of the Permian, the Leonard series, comprises beds heretofore assigned to Leonard formation, which is thus raised to series rank. At type locality, the Leonard is more than 1,800 feet thick and consists of limestones and dark siliceous shales. Rests disconformably on Wolfcamp series and underlies Word formation of Lower Guadalupe age. Leonard equivalents include Bone Spring formation of Sierra Diablo, Delaware, and Guadalupe Mountains, the Yeso and possibly San Andres formations of New Mexico, and, in terms of older nomenclature, part of the Wichita-Albany group plus all the Clear Fork group plus part of the Double Mountain group in central Texas. In Oklahoma and Kansas, the series extends from horizon near top of Herington limestone up to top of Dog Creek shale, that is, to base of Whitehorse group. Hence, formations of Big Blue and Cimarron series of Kansas and Nebraska should be reclassified according to assignments in Wolfcamp, Leonard, and Guadalupe series. Also recommended that term Minco in Oklahoma be dropped in favor of Leonard series.

P. B. King, 1942, Am. Assoc. Petroleum Geologists Bull., v. 26, no. 4, p. 650–651. According to usage herein adopted, Leonard series in Glass Mountains is represented by one formation, also termed Leonard. The Leonard, as now defined, comprises about 2,000 feet of beds, limited below by an unconformity at top of Wolfcamp formation and above by persistent limestone bed that forms base of Word formation.

R. C. Moore and others, 1951, Kansas Geol. Survey Bull. 89, p. 38–41. Leonardian series in Kansas represented by about 1,900 feet of rocks that are chiefly unfossiliferous clastics and evaporites. Red silty shale, siltstone, and sandstone predominate in upper part. Gray silty shale is most common rock type in lower part. Comprises formations included in Nippewalla and Sumner groups.

J. M. Jewett, 1959, Graphic column and classification of rocks in Kansas: Kansas Geol. Survey. As shown on correlation chart, Leonardian stage is Middle Permian. Comprises Sumner group and lower part of Nippewalla group.

G. V. Cohee, 1960, Am. Assoc. Petroleum Geologists Bull., v. 44, no. 9, p. 1578–1579. U.S. Geological Survey has adopted a two-fold subdivision of the Permian (Lower and Upper series and Early and Late epochs). These subdivisions coincide as nearly as possible with those recognized in type Permian and are drawn according to existing concepts of biotic correlation with type sequence. Reference sequence for United States is Permian outcrops of northwestern Trans-Pecos Texas where approximate faunal boundary is taken as that between Cherry Canyon and Bell Canyon formations which are encompassed by Guadalupe series. Boundary also falls between Word and Capitan formations as recognized in Glass Mountains area. Leonard series is Lower Permian.

C. C. Branson, 1960, Oklahoma Geology Notes, v. 20, no. 9, p. 233 (table 1). As recognized in Oklahoma, series comprises Wellington formation, Garber sandstone, and Hennessey shale.

Type locality: On south face of Glass Mountains. Forms greater part of south face of Leonard Mountains. Hess Canyon quadrangle, Brewster County, Tex.

Leonardian Series or Stage

See **Leonard Series.**

Leone Lava

Recent(?): Samoa Islands (Tutuila).

R. A. Daly, 1924, Carnegie Inst. Washington Pub. 340, p. 110–111. Pahoehoe flow of limburgitic basalt, 10 to possibly 70 meters thick. Overlies Leone tuff.

H. T. Stearns, 1944, Geol. Soc. America Bull., v. 55, no. 11, p. 1306. Included in Leone volcanics.

Covers about 20 square kilometers near coast 4 miles southwest of Pago Pago Bay.

Leone Tuff

Recent(?): Samoa Islands (Tutuila).

R. A. Daly, 1924, Carnegie Inst. Washington Pub. 340, p. 111–113. Tuff comprising two breached cones at Steps Point. Overlies Leone basalt.

H. T. Stearns, 1944, Geol. Soc. America Bull., v. 55, no. 11, p. 1306. Included in Leone volcanics.

Covers area of about 7 square miles along coast 6 miles southwest of Pago Pago Bay.

Leone Volcanics

Recent(?): Samoa Islands (Tutuila).

H. T. Stearns, 1944, Geol. Soc. America Bull., v. 55, no. 11, p. 1285 (table 1), 1306–1308. Olivine (picritic) pahoehoe basalt spread from fissure reaching from Olotele Peak to Fagamaa Crater. Lava veneered with tuff over large area. Cinder member forms cones about 250 feet high at source of Tafuna flow. Stony ash member forms cone about 200 feet high composed chiefly of nodular stony essential ejecta and small amount of accessory basaltic ejecta in matrix of black volcanic sand and lapilli. Ash overlain by tuff member. Thin-bedded lithic-vitric tuff member ejected from three craters near Steps Point. Tuff from Fagatele Crater separated by erosional unconformity from overlying Fagamaa tuff, but tuffs cannot be separated along coast near Steps Point. Thickness about 200 feet. Includes Leone tuff and Leone lava (Daly, 1924).

G. A. Macdonald *in* Jacques Avias and others, 1956, Lexique Strat. Internat., v. 6, Océanie, fasc. 2, p. 171. Rests unconformably on Taputapu volcanics and Pago volcanic series. Recent(?).

Covers about 12 square miles, 3½ to 9 miles southwest of Pago Bay. Named for occurrences near Leone and Leone Point.

†Leopard Sandstone[1]

Precambrian (Keweenawan): Northern Michigan.

Original reference: A. C. Lane, 1911, Michigan Geol. and Biol. Survey Pub. 6, p. 456.

In old Hancock quarry.

Leprocomio Limestone Member (of Frailes Formation)

Upper Cretaceous: Puerto Rico.

C. A. Kaye, 1959, U.S. Geol. Survey Prof. Paper 317–A, p. 7 (chart), 9 (fig. 3), 10 (fig. 4), 19, pl. 2. Designates the more or less limey well-bedded cuesta-forming sediments in upper part of Frailes. Characteristically light-to medium-gray impure limestone and fine-grained calcareous tuff; some interbedded graywacke, and proportion of limestone to graywacke varies rapidly along strike. Thickness of limey bed variable and apparently reaches maximum development in Trujillo Alto area where it is approximately 1,120 feet thick. Typical weathered impure limestone is generally well-stratified somewhat punky tuffaceous (or argillaceous) rock without much or any carbonate. The Leprocomio is apparently the limestone referred to by Meyerhoff and Smith (1931) when they applied term Trujillò Alto limestone. Their description of a tuffaceous limestone cropping out north of Trujillo Alto agrees with characteristics of Leprocomio as herein defined. Their geologic map, however, shows this limestone in approximately the position of a higher limestone, the Trujillo Alto as used in this report.

Rocks crop out north of bend in Río Grande de Loiza at Trujillo Alto and are well exposed in several quarries east and west off Highway 181. Outcrops are near Leprocomio (Insular leper hospital) after which member is named.

Lequire Sandstone Member (of McAlester Formation)[1]

Pennsylvanian (Des Moines Series): Eastern Oklahoma.

Original reference: C. W. Wilson, Jr., 1935, Am. Assoc. Petroleum Geologists Bull., v. 19, no. 4, p. 503–520.

M. C. Oakes and M. M. Knechtel, 1948, Oklahoma Geol. Survey Bull. 67, p. 37–38, pl. 1. Further described in Haskell County where it is made up largely of thin slabby beds of fine-grained sandstone, commonly showing ripple marks. At type locality, total computed thickness about 150 feet. In some areas, rests on Warner sandstone member but, in other areas, is separated from it by an unnamed member of variable thickness; separated from overlying Keota sandstone member by an unnamed shale member. Type locality mentioned by Wilson (1935) is inapplicable because it is in reality occupied by outcrops of the Warner; new type locality designated.

Type locality: Sec. 31, T. 8 N., R. 21 E., 1½ miles northwest of Lequire, Haskell County.

Leray Limestone Member (of Lowville Formation)[1]

Leray Formation (in Black River Group)

Leray Member (of Chaumont Formation)

Middle Ordovician: Central to eastern New York.

Original reference: R. Ruedemann, 1910, New York State Mus. Bull. 138, p. 72; 1910, New York State Mus. Bull. 145, p. 79–90, 97.

G. M. Kay, 1929, Jour. Geology, v 37, no. 7, p. 664. Chaumont formation (new) comprises (ascending) Leray, Glenburnie (new), and Watertown members.

G. M. Kay, 1937, Geol. Soc. America Bull., v. 48, no. 2, p. 251. "Leray beds" of Ottawa district carry fauna in which *Doleroides ottawanus* Wilson is abundant; a similar fauna directly overlies Watertown limestone, at top of Black River group, at Watertown, N. Y. Believed that "Leray beds" at Rockland, Ontario, are post-Watertown, rather than pre-Watertown Leray limestone of New York. Rockland formation in its type section is revised to include these "Leray beds."

G. M. Kay, 1942, Geol. Soc. America Bull., v. 53, no. 4, p. 599. Chaumont is separable into two members, Leray and Watertown limestones, only in limited area near Watertown.

Named for exposures in town of Leray [now Le Raysville], Jefferson County.

†Leroux Formation[1]

Leroux limestones

Upper Triassic: Northern Arizona.

Original reference: L. F. Ward, 1901, Am. Jour. Sci., 4th v. 12, p. 401–413.

Charles Keyes, 1936, Pan-Am. Geologist, v. 65, no. 1, p. 63 (table). Limestones underline Vantana [Ventana] sandstone; overlie Nazlini shales. In Deloresian series. Thickness 200 feet.

Named for Le Roux Wash, Navajo County.

Leroy Drift

Pleistocene (Wisconsin); North-central Illinois.

Leland Horberg, 1950, Illinois Geol. Survey Bull. 75, p. 29. In Peoria area, Leroy drift is listed below Bloomington drift and above Shelbyville drift.

Derivation of name not given. Town of Leroy is in McLean County.

†Le Roy Shale[1]

Pennsylvanian: Eastern Kansas.

Original reference: E. Haworth and M. Z. Kirk, 1894, Kansas Univ. Quart., v. 2, p. 110.

Named for development in vicinity of Leroy, Coffey County.

Lester Limestone (in Dornick Hills Group)

Lester Limestone Bed (in Frensley Member of Lake Murray Formation)

Lester Limestone Member (of Dornick Hills Formation)[1]

Pennsylvanian: Central southern Oklahoma.

Original reference: C. W. Tomlinson, 1928, Oklahoma Geol. Survey Bull. 40Z, p. 14.

R. C. Moore and others, 1944, Geol. Soc. America Bull., v. 55, no. 6, chart 6 (column 37). Shown on correlation chart as formation in Dornick Hills group.

B. H. Harlton, 1956, *in* Ardmore Geol. Soc., Petroleum geology of southern Oklahoma—a symposium, v. 1: Tulsa, Okla., Am. Assoc. Petroleum Geologists, p. 140–142. Rank reduced to bed in Frensley member of Lake Murray formation.

Named from exposure on D. G. Lester Farm about 800 feet south of NE cor. sec. 13, T. 4 S., R. 1 E., Carter County.

Lester River Group[1]

Precambrian (Keweenawan): Northeastern Minnesota.

Original reference: R. D. Irving, 1883, U.S. Geol. Survey 3d Ann. Rept., pl. 14, p. 143–146.

Named for exposures on Lester River.

†Lesueur Dolomite[1]

Upper Cambrian or Lower Ordovician: Southeastern Missouri.

Original reference: C. R. Keyes, 1895, Missouri Geol. Survey Sheet Rept. 4, v. 9, p. 18, 52–53.

Named for Lesueur Hill, St. Francois County.

Letchworth Shale[1]

Upper Devonian: Western New York.

Original reference: G. H. Chadwick, 1933, Pan-Am. Geologist, v. 60, no. 2, p. 96–99, 193.

R. G. Sutton, 1951, Rochester Acad. Sci. Proc., v. 9, no. 5–6, p. 393. Locally abandoned. Although Chadwick (1933) restricted the term Gardeau and called overlying beds Table Rock sandstone and Letchworth shale, measured sections in Batavia quadrangle showed no division of Gardeau possible.

Name derived from Letchworth Park (State reservation), southwest of Mount Morris, Livingston County.

Letham Formation

See **Leatham Formation.**

Levanna Shale (in Hamilton Formation)[1]

Levanna Shale Member (of Skaneateles Formation)

Middle Devonian: Western and central New York.

Original reference: G. A. Cooper, 1930, Am. Jour. Sci., 5th, v. 19, p. 217.

R. G. Sutton, 1951, Rochester Acad. Sci. Proc., v. 9, nos. 5–6, p. 359–361, pl. 1. Described in Batavia quadrangle as shale member of Skaneateles formation. Underlies Stafford limestone member; overlies Centerfield limestone member of Ludlowville formation. Thickness ranges from 43 to 225 feet. Thinning is toward the west but is not uniform.

Type section: In Skaneateles Lake region. Probably named for Levanna, Cayuga County.

Leverett Breccia[1]

Triassic: Central Massachusetts.

Original reference: D. D. Reynolds and D. H. Leavitt, 1927, Am. Jour. Sci., 5th ser., v. 13, p. 167–171.

M. E. Willard, 1951, Bedrock geology of the Mount Toby quadrangle, Massachusetts: U.S. Geol. Survey Geol. Quad. Map [GQ–8]. Included in Mount Toby conglomerate and not mapped by name.

Named for town of Leverett, Franklin County.

Levias Limestone Member (of Ste. Genevieve Limestone)[1]

Levias Member (of Ste. Genevieve Limestone)

Upper Mississippian: Western Kentucky, southern Illinois, and Indiana.

Original reference: A. H. Sutton and J. M. Weller, 1932, Jour. Geology, v. 40, no. 5, p. 430, 439.

J. M. Weller *in* Stuart Weller and F. F. Krey, 1939, Illinois Geol. Survey Rept. Inv. 60, p. 7, 8. In Union County, Ill., underlies Hoffner member (new) of Ste. Genevieve.

C. A. Malott, 1946, Jour. Geology, v. 54, p. 323, 324 (fig. 1). Geographically extended into southwestern Indiana where it is about 22 feet thick in Owen County. Underlies Aux Vases sandstone.

T. G. Perry and N. M. Smith, 1958, Indiana Geol. Survey Bull. 12, p. 21–22, pl. 1. Termed Levias member by Indiana Geological Survey. Overlies Rosiclare member; unconformably underlies Aux Vases formation or Paoli limestone. Field separation of Levias from Paoli is dependent upon recognition of Aux Vases formation, if present, or of Bryantsville breccia (included in top of Levias). Thickness 25 to 60 feet.

Type locality: East of town of Levias, Crittenden County, Ky.

Levinson Limestone Member (of Boracho Limestone)

Cretaceous (Comanche Series): Southwestern Texas.

J. P. Brand and R. K. DeFord, 1958, Am. Assoc. Petroleum Geologists Bull., v. 42, no. 2, p. 374 (fig. 2), 379–382. Name proposed for lower member of Boracho limestone. Lower part of member dominantly shaly. Measured thickness at type locality 149 feet; base not exposed; approximate thickness 169 feet. Underlies San Martine limestone member (new); overlies Finlay limestone with disconformable contact.

Type locality: Area south of Kent, which is part of the Boracho outcrop south of U.S. Highway 80 that extends from vicinity of Levinson Lake westward to Boracho Point, Levinson quadrangle [Culberson County]. Name derived from Levinson Lake.

†Levyville Formation[1]

Eocene, upper: Northern Florida.

Original reference: L. C. Johnson, 1888, Am. Jour. Sci., 3d, v. 36, p. 230–236.

Well exposed at old iron works near Levyville, Levy County.

Lewis Shale[1]

Upper Cretaceous: Western Colorado, northwestern New Mexico, and southern and central Wyoming.

Original reference: W. Cross and A. C. Spencer, 1899, U.S. Geol. Survey Geol. Atlas, Folio 60.

E. T. Hancock, 1925, U.S. Geol. Survey Bull. 757, p. 6 (table), 20–21. Crops out in northern part of Axial and Monument Butte quadrangles, Colorado. Thickness about 1,600 feet. Overlies Williams Fork formation of Mesaverde group; underlies "Laramie" formation.

C. E. Dobbin, C. F. Bowen, and H. W. Hoots, 1929, U.S. Geol. Survey Bull. 804, p. 21–22. Lewis shale as defined in Hanna and Carbon basins, Carbon County, Wyo., includes all typical dark-gray marine shale lying above white sandstone at top of Mesaverde formation and below brown sandstones arbitrarily selected as base of Medicine Bow formation. Thickness about 3,000 feet. In some areas, overlapped by North Park formation.

Erling Dorf, 1938, (abs.) Geol. Soc. America Proc. 1937, p. 275. Medicine Bow formation of southern Wyoming and so-called Laramie formation of northwestern Colorado occupy similar stratigraphic positions above a marine sandstone which carries distinctive Fox Hills fauna, including diagnostic *Sphenodiscus lenticularis*. This marine sandstone, hitherto included in Medicine Bow formation or underlying Lewis shale, is separated as a distinct formation and referred to Fox Hills formation.

R. H. Beckwith, 1941, Geol. Soc. America Bull., v. 52, no. 9, p. 1452 (table 1). Thickness 3.000 feet in Elk Mountain district, Wyoming. Overlies Mesaverde formation; underlies Medicine Bow formation.

Erling Dorf, 1942, Carnegie Inst. Washington Pub. 508, p. 4, 5 (fig. 2), 7, 8 (fig. 3), 9 (fig. 4), 36 (fig. 8) [preprint 1938]. Discussion of stratigraphy and floras of Fox Hills and Medicine Bow formations. Figure 2 shows Lewis formation, 3,000 feet thick; underlies Fox Hills formation and overlies Mesaverde formation in Hanna basin, Wyoming. Figure 3 shows Lewis formation, 1,600 feet thick; overlies Williams Fork formation and underlies Fox Hills formation in northwestern Colorado. Recognition of the Fox Hills between the Lewis and Medicine Bow is based upon occurrence of *Sphenodiscus* zone, which is of restricted Fox Hills age. Correlation chart shows Lewis formation above Almond formation in southwestern Wyoming.

C. H. Dane, 1948, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 78. In Rio Arriba County, N. Mex., dominantly gray well-bedded calcareous shale containing throughout some beds that are sandy to greater or less degree. Thickness about 2,000 feet. Underlies Pictured Cliffs sandstone; overlies La Ventana sandstone member of Mesaverde formation.

P. T. Hayes and A. D. Zapp, 1955, U.S. Geol. Survey Oil and Gas Inv. Map OM–144. Overlies and interfingers with Cliff House sandstone and underlies and interfingers with Pictured Cliffs sandstone in Barker dome-Fruitland area, San Juan County, N. Mex.

E. I. Rich, 1958, Am. Assoc. Petroleum Geologists Bull., v. 42, no. 10, p. 2433 (fig. 5), 2436–2439. Lewis and Meeteetse formations throughout central and north-central Wyoming considered stratigraphic equivalents with name Lewis being applied generally in areas where marine strata are present and Meeteetse in areas where rocks are nonmarine in character. These designations are used in this report for interval between Mesaverde and Lance formations. The Lewis is a sequence of dark-gray marine shale and thinly bedded olive-gray sandstone. Thickness about 1,150 feet along southwestern edge of Powder River Basin. Westward from basin intertongues with Meeteetse formation and total thickness of marine strata decreases abruptly. A lower tongue of the Lewis, about 250 to 300 feet thick, overlies Teapot sandstone member of Mesaverde and underlies eastward projection of the Meeteetse. Tentative electric-log correlations from Sand Creek oil field into Elk basin field suggest that lower tongue of the Lewis may be equivalent, in part, to Bearpaw shale of Montana. In Powder River Basin, underlies Fox Hills sandstone.

Named for occurrence at Fort Lewis, in La Plata Valley, sec. 3, T. 34 N., R. 11 W., La Plata County, Colo.

†Lewisburg Group[1]

Upper Triassic: Central southern Pennsylvania.

Original reference: G. H. Ashley, 1931, Pennsylvania Topog. and Geol. Survey Bull. G_1, p. 77.

Occurs in Dauphin and York Counties.

†Lewisburg Limestone[1]

Mississippian: West Virginia and Virginia.

Original reference: W. M. Fontaine, 1876, Am. Jour. Sci., 3d, v. 11, p. 276–284, 374–384.

Probably named for Lewisburg, Greenbrier County, W. Va.

Lewisport Limestone[1]

Pennsylvanian: Western Kentucky.

Original reference: D. B. Chisholm, 1931, Kentucky Geol. Survey, ser. 6, v. 41, p. 221, 225.

Probably named for Lewisport, Hancock County.

Lewis Run Sandstone Member (of Amity Shale)

Upper Devonian: Northwestern Pennsylvania.

R. H. Flower and K. E. Caster, 1935, Bulls. Am. Paleontology, v. 22, no. 75, p. 6–7. Typically deep-reddish-purple coarse quartz-grained sandstone which carries scattering of flat pebbles of vein quartz and rarely of jasper; matrix material is vividly reddish purple; except for red color at type occurrence, member is similar to other conglomerate lenses in Venango stage; contains marine fauna. Horizon is 30 feet below Salamanca conglomerate horizon and at same distance above Wolf Creek conglomerate horizon which is apparently beneath surface at Lewis Run. Beneath the Lewis Run is a red shale member or zone, presumably of Amity age, which is unfossiliferous.

Exposed in ceramic quarries at Lewis Run, McKean County.

†Lewiston Shale[1]

Upper Ordovician (Richmond): Western New York, and Ontario, Canada.

Original reference: G. H. Chadwick, 1908, Science, new ser., v. 28, p. 346–348.

Named for exposures at Lewiston, Niagara County, N.Y.

Lewistonian Stage

Lower Silurian (Niagaran): North America.

D. W. Fisher, 1959, New York State Mus. Sci. Service Geol. Survey Map and Chart Ser., no. 1. Niagaran series divided into four stages (ascending): Lewiston(ian), Ontario(an), Tonawanda(n), and Lockport(ian). Lewiston stage includes Medina group. At type locality, complete sequence (about 100 feet) is displayed. Does not seem desirable to apply name Albion to this stage because poor exposures exist at and near Albion, N.Y.; also use of name might cause confusion for it has beeen used in series, group, and formational senses.

Type locality: In Niagara Gorge at Lewiston, Niagara County, N.Y.

Lewiston Peak Member (of Oquirrh Formation)

Pennsylvanian (Missourian): Northwestern Utah.

H. J. Bissell, 1959, Utah, Geol. Soc. Guidebook 14, p. 115–120, pls. 1, 2. Sequence of cherty limestones and silty-argillaceous limestones with minor sandstone beds. Characterized by black, dark-sooty-gray, and dark black-brown case-hardened siliceous limestone and impure calcareous chert disposed in 1 inch to 4 inch bands, discontinuous lenses, nodules, and blebs and stringers; these alternate with crystalline dark-gray and dark-blue-gray to fine-textured bioclastic limestones, which weather medium dull gray to medium light blue gray, and some limestones that are argillaceous to almost shaly. Thickness 1,409 feet. Overlies Cedar Fort member and underlies Pole Canyon member (both new).

Type locality: Secs. 28 and 29, T. 5 S., R. 3 W., along Utah-Tooele County line. Named for exposures on Lewiston Peak.

†Lewistown Chert Lentil[1] (in Lewistown Limestone)

Lower Devonian: Northeastern West Virginia.

Original reference: N. H. Darton and J. A. Taff, 1896, U.S. Geol. Survey Geol. Atlas, Folio 28.

Lewistown Limestone[1]

Silurian and Devonian: Central Pennsylvania and west-central Virginia.

Original reference: Franklin Platt, 1875, 2d Pennsylvania Geol. Survey, Rept. H., p. 1–9.

R. J. Holden, 1920, (abs.) Geol. Soc. America Bull., v. 31, p. 137. Subdivided in west-central Virginia to include two members: Longdale limestone above and Craigsville limestone below.

Occurs at Lewistown, Mifflin County, Pa.

Lewistown Limestone Shale[1]

Lower Devonian: Central Pennsylvania.

Original reference: J. P. Lesley, 1878, Pennsylvania 2d Geol. Survey Rept. F., p. xvii–xxxii.

At McVeytown, Mount Union, Huntingdon County, and Lewiston, Mifflin County.

Lewisville Formation or **Member** (of Woodbine Formation)

Lewisville Formation (in Woodbine Group)

Lewisville Marine Member (of Woodbine Sand)[1]

Upper Cretaceous (Gulf Series): Northeastern Texas.

Original reference: R. T. Hill, 1901, U.S. Geol. Survey 21st Ann. Rept., pt. 7, p. 114–115, 297.

R. T. Hazzard, B. W. Blanpied, and W. C. Spooner, [1947], Shreveport Geol. Soc. 1945 Ref. Rept., v. 2, p. 475, 476, 477, 480–481 (correlation chart.) Rank raised to formation in Woodbine group. Includes Pine Bluff tuffaceous gravelly member at base. Unconformable above Euless formation; unconformably underlies Eagle Ford formation.

W. H. Monroe, 1946, U.S. Geol. Survey Oil and Gas Inv. Prelim. Chart 23. Correlation chart of outcropping Upper Cretaceous formations in Texas shows Lewisville formation (undifferentiated) in upper part of Woodbine group above Dexter sand.

H. R. Bergquist, 1949, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 98. Member includes beds from top of tuffaceous sandstone and carbonaceous shale of Red Branch member (new) and uppermost glauconitic reef sandstone with abundant *Ostrea soleniscus* shells; underlies Templeton member (new). Thickness 75 to 95 feet.

L. W. Stephenson, 1952, U.S. Geol. Survey Prof. Paper 242, p. 4, 5 (table), 7 (fig. 2), 11–15, pls. Lewisville has greatest geographic extent of any of members of Woodbine. As used in this report member includes so-called Pine Bluff member of Hazzard, Blanpied, and Spooner. In Tarrant and Denton Counties, overlies Euless member; in Grayson and Fannin Counties, overlies Red Branch member; in other areas, lower part of Woodbine is either absent or undifferentiated. In Denton, Grayson, Fannin, and Lamar Counties, underlies Templeton member. Fauna described. Notes on type area.

Type area: Timber Creek from point about 2 miles south of center of Lewisville, Denton County, upstream to point about 3 miles southwest of center of Lewisville and about 1 mile above crossing of road to Shiloh Church.

Lexington Glacial Substage

Pleistocene (Wisconsin): Northeastern Massachusetts.

S. S. Judson, Jr., 1949, Peabody Foundation for Archeology Papers, v. 4, no. 1, p. 23–34. Name proposed for substage which includes till, sand, and gravel deposits. Younger than Boston glacial substage.

Well exposed in vicinity of town of Lexington. No specific exposures are designated as type localities.

†Lexington Group[1] or formation

Pennsylvanian: Western Missouri and southern Iowa.

Original reference: G. C. Broadhead, 1873, Missouri Geol. Survey Prelim. Rept. on Ores, pt. 2, p. 169, 187.

C. R. Keyes, 1937, Pan-Am. Geologist, v. 67, no. 3, p. 237–240. Lexington formation geographically extended into Iowa. In Appanoose County, merges with so-called Appanoose beds, so that Lexington becomes valid title of Iowa section.

Probably named for exposures at Lexington, Lafayette County, Mo.

Lexington Limestone[1]

Middle Ordovician: Central western Virginia.

Original reference: J. L. Campbell, 1879, Am. Jour. Sci., 3d, v. 18, p. 29.

Great Valley of Virginia.

Lexington Limestone,[1] Formation, or Group

Middle Ordovician: Central Kentucky.

Original reference: M. R. Campbell, 1898, U.S. Geol. Survey Geol. Atlas, Folio 46, p. 2.

A. C. McFarlan, 1938, Geol. Soc. America Bull., v. 49, no. 6, p. 989–996. Lexington limestone restricted to pre-Perryville rocks of Jessamine dome. Thus, Lexington comprises (ascending) Curdsville, Hermitage, Jessamine, Benson, Brannon, and Woodburn. Sequence completely developed only in central Bluegrass counties. To the north and south, there is progressive elimination of upper beds. As a result, post-Lexington beds rest on mid-Benson where they dip under cover in southern Bluegrass and on Jessamine formation in northern Kentucky. Divisions are in part faunal units and in part lithologic.

D. K. Hamilton, 1948, Econ. Geology, v. 43, no. 1, p. 41–42. Rank raised to group. Comprises (ascending) Curdsville limestone, Hermitage formation, Jessamine limestone, and Benson limestone. Overlies Highbridge group; underlies Brannon limestone.

A. C. McFarlan and W. H. White, 1948, Am. Assoc. Petroleum Geologists Bull., v. 32, no. 8, p. 1632–1640. Lexington limestone, as defined by Campbell, included beds between the High Bridge and Flanagan chert. There is confusion in Campbell's definition of High Bridge-Lexington boundary, though, as it is used now, it is sharpest stratigraphic boundary in section. Divisions of Lexington are in part faunal zones and in part lithologic units. In present report, the Lexington is discussed under three divisions: lower, middle, and upper. Lower Lexington comprises

Curdsville limestone, Logana formation, Jessamine limestone, and Benson limestone; the Perryville is shown to be facies of upper Benson. Middle Lexington consists of Brannon limestone with Woodburn phosphatic member. The so-called Perryville of Franklin and Woodford Counties, renamed Devils Hollow division of upper Lexington, is regarded as facies of upper Woodburn and probably also the lowermost Cynthiana. On the north in Bourbon, Harrison, Franklin, and Fayette Counties, the Brannon fades in a short distance as a useful lithologic unit; the Woodburn also thins. Recognition of these beds becomes more difficult as the Brannon wedges out (lithologic change), but the horizon is well marked wherever *Stromatocerium* and its associates of upper Benson are present. The problem to be solved is the relationship between the thinning upper Lexington and a corresponding thickening "Cynthiana".

Named for development at and around Lexington, Fayette County.

Leyden Argillite[1]

Silurian(?): Central Massachusetts and southeastern Vermont.

Original reference: B. K. Emerson, 1898, U.S. Geol. Survey Geol. Atlas, Folio 50; 1898, U.S. Geol. Survey Mon. 29, p. 196–208.

Robert Balk, 1956, U.S. Geol. Survey Geol. Quad. Map GQ–90. Lower part is sequence of black fine-grained argillite layers and glossy phyllitic slate layers, interbedded with many gray-fine-grained quartzite layers. Argillite of upper part lacks abundant quartzite interbeds. East of the valley of Falls River, upper argillite is more highly metamorphosed, containing crystalloblasts of biotite, garnet, and staurolite. Weathered leucoxene grains are characteristic of this upper argillite in northeastern corner of quadrangle. Upper part also contains a few lenses of impure limestone and interbeds of light-gray to white aphanitic to finely granular metatuff. Underlies Bernardston formation or Sugarloaf formation; conformably overlies Conway formation.

Named for occurrence in Leyden Township, Franklin County, Mass.

Libby Formation (in Missoula Group)

Precambrian (Belt Series): Northwestern Montana.

Russell Gibson, 1948, U.S. Geol. Survey Bull. 956, p. 9, 17–19, pl. 1. Predominantly light-gray, dark-gray, and greenish-gray argillite; some sandstone and impure limestone present. Thickness at least 6,000 feet; 2,250 feet in generalized section on south side of Kootenai River southeast of Flagstaff Mountain. Overlies Striped Peak formation.

C. P. Ross, D. A. Andrews, and I. J. Witkind, 1955, Geologic map of Montana (1:500,000): U.S. Geol. Survey. Included in Missoula group.

Typical section southeast of Flagstaff Mountain on south side of Kootenai River, Libby qnadrangle. Named for town of Libby, Lincoln County, where unit crops out in ridges that overlook town.

Liberty facies (of Brodhead Formation)

Lower Mississippian: Central Kentucky.

P. B. Stockdale, 1939, Geol. Soc. America Spec. Paper 22, p. 76, 136–137, 154–166. Constitutes middle zone of Broadhead formation. Consists mainly of siltstone and shale. Thickness commonly 135 to 150 feet; 175 feet where it merges with Athertonville and Pilot Knob facies (both new) in western and northwestern Marion County. Comprises Caney Creek, McKinney Knob siltstone, and Clementsville limestone members (all new) of Brodhead formation. Underlies Floyds Knob formation; overlies New Providence formation, Junction City facies (new).

Type section: (Same as Brodhead formation) starting at sandstone quarry just east of bridge over Dicks River, at Louisville and Nashville Railroad Station, Brodhead, and along road up hill east-southeast, Rockcastle County. No single exposure gives complete display of the varied characteristics of the facies. Named for town of Liberty, central Casey County.

Liberty Formation or **Limestone** (in Richmond Group)[1]

Upper Ordovician: Southeastern Indiana, north-central Kentucky, and southwestern Ohio.

Original reference: J. M. Nickles, 1903, Am. Geologist, v. 32, p. 207.

James Conkin, 1950, Kentucky Nat. History Annals, v. 1, art. 6, p. 45, 48 (fig. 6). In Oldham County, Ky., Liberty formation restricted to 51 feet of alternating shales and thin fossiliferous limestones; the upper part (mollusk horizon), the mudstone of other writers, is believed to be Whitewater. Contact with underlying Waynesville formation is marked by "Bardstown reef" characterized by *Beatricea undulata*, and *Columnaria vacua.*

W. S. Sweet and others, 1959, Jour. Paleontology, v. 33, no. 6, p. 1030. Arnheim, Waynesville, Liberty, Whitewater, and Elkhorn formations define the Richmond stage of Cincinnatian series.

Named for Liberty, Union County, Ind.

†Liberty Hall Limestone[1]

Liberty Hall facies (of Edinburg Formation)

Middle Ordovician: Central western Virginia.

Original reference: H. D. Campbell, 1905, Am. Jour. Sci., 4th, v. 20, p. 445–447.

B. N. Cooper and G. A. Cooper, 1946, Geol. Soc. America Bull., v. 57, no. 1, p. 55, 78, 79 (fig. 4), 80 (fig. 5), 81, 82. Liberty Hall facies proposed for black limestone and black shale of the Edinburg. So used, Liberty Hall refers to same succession of black strata originally included in "Liberty Hall limestone" by Campbell (1905). Designation as a facies name signifies that beds exhibiting this lithology do not everywhere fall within same precise stratigraphic limits. Interfingers with Lantz Mills facies, proposed for contrastingly cobbly to nodular buff-weathering limestone. Thickness at type section of Edinburg about 275 feet; south of Harrisonburg about 1,200 feet.

Well exposed on east side of Massanutten syncline and in vicinity of Lexington and Natural Bridge. Named for old historic ruin constructed on and of this rock.

Liberty Memorial Shale Member (of Chanute Shale)

Pennsylvanian (Missouri Series): Northwestern Missouri.

J. R. Clair, 1943, Missouri Geol. Survey and Water Resources, 2d ser., v. 27, pl. 1. Gray to blue shale, argillaceous to sandy, weathers brownish to buff; heavy channel sand in southwest Jackson County. Thickness 7 to 25 feet in Jackson County; 14 to 61 feet in Cass County. Overlies Raytown limestone member; underlies Frisbie limestone member of Iola limestone.

R. C. Moore, 1948, Am. Assoc. Petroleum Geologists Bull., v. 32, no. 11, p. 2031 (fig. 4), 2032–2033; 1949, Kansas Geol. Survey Bull. 83, p. 103. Settlement of "Iola problem" has led to number of changes in Missouri Survey's classification of middle and upper Kansas City beds so as to bring interstate agreement in nomenclature. Liberty Memorial shale, overlying Raytown limestone, no longer considered as uppermost member of Chanute shale. Name suppressed as junior synonym of Lane shale.

Occurs in Cass and Jackson Counties.

Libertytown Metarhyolite

Precambrian: Western Maryland.

A. J. Stose and G. W. Stose, 1946, Maryland Dept. of Geology, Mines and Water Resources [Rept. 12], Carroll and Frederick Counties, p. 58, 65–66. Dense cryptocrystalline rock, purple, bluish-black, or red, with macrophenocrysts of pink or white feldspar and glassy quartz in dense groundmass; interbedded with blue and purple metaandesite containing amygdules commonly filled with white, pink, or green calcite having an outer film of sericite or chlorite. Overlies Wakefield marble and interfingers with Sams Creek metabasalt (new) and Ijamsville phyllite. This unit was mapped as metarhyolite and meta-andesite in Glenarm series on geologic map of Frederick County [Maryland Geol. Survey, 1938]. Precambrian(?).

H. E. Vokes, 1957, Maryland Dept. Geology, Mines and Water Resources Bull. 19, p. 43 (table 7), 65. Volcanic series in eastern part of Piedmont province includes Sams Creek metabasalt, Libertytown metarhyolite, Ijamsville phyllite, and Urbana phyllite. Quartzites occur in all members; some quartzites pass directly from the Ijamsville into the Urbana and into the Libertytown, and from the Urbana into the Sams Creek, indicating relative contemporaneity of these formations, all of which are apparently equivalent to Harpers formation. Late Precambrian.

Named from Libertytown, Frederick County. Occurs in belt that lies south and southwest of Union Bridge and north of U.S. Highway 40; eastern part of belt extends into Carroll County to vicinity of McKinstry's Mill.

Lick Creek Sandstone Member (of Caseyville Formation)

Lick Creek Sandstone Member (of Pottsville Formation)[1]

Pennsylvanian: Southern Illinois.

Original reference: J. E. Lamar, 1925, Illinois Geol. Survey Bull. 48, p. 23, 85–91, map.

Stuart Weller and F. F. Krey, 1939, Illinois Geol. Survey Rept. Inv. 60, p. 11. Referred to as member of Caseyville formation. Thick massive ridge and cliff-forming sandstone overlying basal Wayside member.

H. R. Wanless, 1944, Geol. Soc. America Mem. 13, p. 136. Now considered to be Battery Rock sandstone.

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 55 (table 3). Replaced by Battery Rock sandstone member of Caseyville formation (redefined).

Named for village of Lick Creek, Union County.

Lick Creek Sandstone Member (of Pottsville Formation)[1]

Lower Pennsylvanian: Central Alabama.

Original reference: C. Butts, 1910, U.S. Geol. Survey Geol. Atlas, Folio 179, p. 9.

Named for exposures along Lick Creek in vicinity of Kimberly, Jefferson County.

Licking Shale[1]

Mississippian: Central Ohio.

Original reference: L. E. Hicks, 1878, Am. Jour. Sci., 3d v. 16, p. 216.

Named for Licking River, from Newark to Black Hand, Licking County.

Licking Creek Limestone (in Helderberg Group)

Lower Devonian: South-central Pennsylvania, western Maryland, western Virginia, and northeastern West Virginia.

F. M. Swartz, 1938, (abs.) Geol. Soc. America Bull., v. 49, no. 12, pt. 2, p. 1923. Name applied to a late Helderbergian limestone in south-central Pennsylvania which had been considered Becraft in age. Not continuous with type Becraft and largely younger than that formation.

F. M. Swartz, 1939, Pennsylvania Geol. Survey, ser. 4, Bull. G–19, p. 69–71, 85–86. At base is medium-bedded black chert in irregular layers interbedded with limestone. Above is thick-bedded light-gray crystalline limestone with a few nodules and layers of chert; this is overlain by light-gray limestone with numerous layers of black chert. At top of unit is thick-bedded light-gray chert-free crystalline limestone. Thickness 87 feet in type section where unit underlies Ridgeley formation and overlies beds tentatively considered Mandata shale (new). Extends southward in narrow belt through Maryland, West Virginia, and Virginia. In Virginia it had been called Becraft by Swartz (1930, U.S. Geol. Survey Prof. Paper 158–C).

H. P. Woodward, 1943, West Virginia Geological Survey, v. 15, p. 110, 125, 126 (footnote). Abandoned. Throughout most of outcrop belt from Franklin County, Pa., southward across Maryland and into West Virginia, name is replaced by geographically extended Port Jervis limestone and chert since Licking Creek apparently includes exact equivalent of the Port Jervis. Cites dissenting opinion of F. M. Swartz (written commun.) who favors use of separate name, Licking Creek, in Warren Point Monterey-Clifton Forge area because of 200-mile gap between nearest known occurrence of Port Jervis in New Jersey and Licking Creek near Warren Point at Pennsylvania-Maryland line.

F. G. Lesure, 1957, Virginia Polytech. Inst. Bull. Eng. Expt. Sta. Ser. 118, p. 20 (table 2), 48–51, pls. Names New Scotland and Becraft as used by Butts (1940) do not seem justified, and, in this report [Clifton Forge iron district], term Licking Creek sandstone used to include all limestone beds above Healing Springs sandstone and below Ridgeley sandstone. Composed of two distinct lithologies separated to form upper member of light- to medium-gray arenaceous coarse-grained limestone and lower member of medium- to dark-gray cherty fine-grained limestone. Thickness as much as 117 feet. Unconformably overlies Keyser formation where Healing Springs sandstone and Coeymans limestone are absent.

Type locality: Bluff on south side of Licking Creek several hundred feet west of bridge crossing creek about 1 mile east of Warren Point, Franklin County, Pa.

Licklog Formation (in Walden Creek Group)

Precambrian (Ocoee Series): Southeastern Tennessee.

P. B. King and others, 1958, Geol. Soc. America Bull., v. 69, no. 8, p. 955 (table 1), 962. Chiefly siltstone and shale, dark gray, laminated to crudely layered, and micaceous. These rocks are interbedded in places with sandstone and quartz-pebble conglomerate resembling those of overlying Shields formation (new). Exposed only in northwest part of outcrop belt of Walden Creek group, where it lies on Great Smoky fault so that its basal relations are unknown; a variable thickness, nowhere more than a few hundred feet, is preserved above fault.

Named for Licklog Hollow where it is typically exposed, near edge of foothills southwest of East Fork of Little Pigeon River [Sevier County].

Lick Run Conglomerate

Lower Mississippian (Oil Lake): Southwestern Pennsylvania.

W. M. Laird, 1941, Pennsylvania Topog. and Geol. Survey Progress Rept. 126, p. 16. Name will probably be used, following more definitive study of area, for unit here termed Conglomerate I and described as massive conglomerate composed chiefly of rounded or oval white quartz pebbles imbedded in a matrix of coarse gray sandstone. Where sandstone predominates, pebbles usually occur as lenses in coarse sandstone. Thickness averages about 20 feet. Disconformably underlies Sandstone J (Chestnut Ridge sandstone); disconformably overlies Sandstone H.

Type locality: Along Rock Spring Run north of Victoria, Fayette County. Also well exposed on south bank of Youghiogheny River opposit Victoria above Western Maryland Railroad tracks.

Liebre Quartz Monzonite

Jurassic(?): Southern California.

J. C. Crowell, 1952, California Div. Mines Spec. Rept. 24, p. 10–11, pls. 1, 2. Typical quartz monzonite, gray and medium-grained; characterized by closely spaced joints and shears.

Crops out at western tip of Liebre Mountain in southeastern corner of Lebec quadrangle [Los Angeles County], in anticline beneath Hungry Valley and Peace Valley beds at southern border of area, and in slivers within San Andreas fault zone.

Lighthouse Conglomerate (in Lower Marshall Sandstone)

Mississippian (Kinderhook): Southern Michigan.

H. M. Martin, 1936, The centennial geologic map of the southern peninsula of Michigan (1:500,000): Michigan Dept. Conserv., Geol. Div. Pub. 39, (Geol. Ser. 33). Shown on map legend.

Light House Granite[1] or Granitic Gneiss

Lighthouse quartz monzonite facies (of Branford Quartz Monzonite)

Pre-Triassic: South-central Connecticut.

Original reference: F. Ward, 1909, Am. Jour. Sci., 4th ser., v. 28, p. 131, map.

John Rodgers and others, 1956, Preliminary geological map of Connecticut (1:253,440): Connecticut Geol. Nat. History Survey. Redescribed as Lighthouse granitic gneiss. Medium-grained generally well-foliated pink or red gneiss. Part of the East Haven granitic body ,a structural unit. Pre-Triassic.

H. M. Mikami and R. E. Digman, 1957, Connecticut Geol. Nat. History Survey Bull. 89, p. 7, 13. Quartz monzonite facies of Branford quartz monzonite.

Named for Light House Point near East Haven, New Haven County.

Lightning Formation

Recent: Eastern Wyoming.

L. B. Leopold and J. P. Miller, 1954, U.S. Geol. Survey Water-Supply Paper 1261, p. 11. Alluvial fill consisting of light-brown to tan silty fine or medium sand containing occasional lenses of fine gravel or coarse sand but generally devoid of bedding.

Type locality: The reach of Lance Creek in immediate vicinity of town of Lance Creek.

Lightning Creek Diorite[1]

Miocene(?): Washington, and British Columbia, Canada.

Original reference: R. A. Daly, 1913, Canada Dept. Int., Rept. Chief Asst. 1910, v. 2, p. 490.

†Ligonier Sandstone[1]

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

Original reference: F. Platt, 1876, Pennsylvania 2d Geol. Survey Rept. L.

Caps highest hill in Ligonier Valley, and town of Connellsville, Fayette County, Pa., is built on it.

Lilac Argillite[1]

Lower Jurassic: Northern California.

Original reference: C. H. Crickmay, 1933, Geol. Soc. America Bull., v. 44, no. 1, p. 81.

Occurs at various localities along western base of Mount Jura and elsewhere. [Derivation of name not given. Does not say whether geographic or nongeographic.]

Lilley Formation[1]

Middle Silurian: Southwestern Ohio.

Original reference: A. F. Foerste, 1917, Ohio Jour, Sci., v. 17, p. 189, 190.

C. K. Swartz and others, 1942, Geol. Soc. America Bull., v. 53, no. 4, chart 3. Shown on correlation chart as Middle Silurian. Occurs below Euphemia dolomite and above Bisher formation.

Exposed at various localities on Lilley Hill, Hillsboro area, Highland County.

Lillibridge Sandstone Member[1] (of Chadakoin Formation or Stage)

Upper Devonian: Southwestern New York.

Original reference: K. E. Caster, 1934, Bulls. Am. Paleontology, v. 21, no. 71, table opp. p. 62, p. 59, 63.

G. A. Cooper and others, 1942, Geol. Soc. America Bull., v. 53, no. 12, pt. 1, chart 4. Shown as lowermost unit in Chadakoin formation. Underlies Dexterville shale [member]; overlies Volusia (Girard) shale.

I. H. Tesmer, 1955, New York State Sci. Service Circ. 42, p. 14, 16. Abandoned since not a distinct lithologic unit. Beds assigned to Hinsdale member of Chadakoin formation.

Named for outcrops along Lillibridge Creek, which flows south to Allegany River 1 mile northeast of Portville, and in quarries adjacent to creek.

Lillis Formation[1]

Oligocene(?): Southern California.

Original reference: J. H. Ruckman, as reported by J. C. Merriam, 1915, Am. Philos. Soc. Trans., new ser., v. 22, pt. 3, p. 194.

North Coalinga region, Fresno County.

Lillydale Shale (in Bluefield Formation[1] or Group)

Mississippian: Southeastern West Virginia and southwestern Virginia.

Original reference: D. B. Reger, 1926, West Virginia Geol. Survey Rept. Mercer, Monroe, and Summers Counties, p. 301, 437.

P. H. Price and E. T. Heck, 1939, West Virginia Geol. Survey [Rept.] Greenbrier County, p. 255, 265. Lillydale shale of Reger (1926) is represented in Greenbrier County by a dark- to greenish-gray concretionary micaceous shale that is commonly somewhat carbonaceous. Sometimes carries lenticular sandstone (Edray) that may occur at top, base, or within the shale. Thickness 75 to 130 feet. Below Glenray limestone. Base of Bluefield group. Mauch Chunk series.

Type locality: About 4 miles southwest of Union in vicinity of Lillydale, Monroe County, W. Va.

Lima Granite

Age unknown: Southeastern Pennsylvania.

W. H. Tomlinson, 1954, Pennsylvania Acad. Sci. Proc., v. 28, p. 189–192. Gneissic, partly mylonitized rock. Slight banding between mafic and felsic minerals observed. Contains inclusions of several basic rock types; enstatite xenoliths common.

Exposed in Lima quarry on north side of Baltimore Pike (Route 1) about 2.3 miles southwest of intersection with Olive Street, Media, Delaware County.

Lime Creek Glacial Stage

Pleistocene (Illinoian?): West-central Colorado.

R. L. Nelson, 1954, Jour. Geology, v. 62, no. 4, p. 327–328, fig. 2, table 4. Time of pre-Wisconsin glaciation in Frying Pan Valley. Marked by moraine and outwash deposits.

Some evidence suggests that terminal position was near junction of Lime Creek and Frying Pan River, hence, the name. In Frying Pan River drainage just west of Continental Divide in Sawatch Range.

Lime Creek Shale[1]

Lime Creek Formation

Upper Devonian: Central northern Iowa.

Original reference: H. S. Williams, 1883, Am. Jour. Sci., 3d, v. 25, p. 97–104.

M. A. Stainbrook, 1944, Illinois Geol. Survey Bull. 68, p. 187. Formation includes (ascending) Juniper Hill, Cerro Gordo, and Owen members. Unconformably overlies Shellrock formation. Stratigraphically below Sheffield formation considered by some authors to be Mississippian.

M. A. Stainbrook, 1946, Jour. Paleontology, v. 20, no. 5, p. 402–403. Amana beds are apparently basal member of Lime Creek although they do not crop out in area where Lime Creek is best known.

Named for exposures on Lime Creek, in Cerro Gordo and Floyd Counties.

Lime Hill Formation (in Wilcox Group)

Lime Hill Member (of Logansport Formation)

Paleocene (Midway): Northwestern Louisiana and northeastern Texas.

D. P. Meagher and L. C. Aycock, 1942, Louisiana Dept. Conserv. Geol. Pamph. 3, p. 13, 14. Named in stratigraphic summary of Louisiana lignite district. Name credited to G. Murray, Jr.

G. E. Murray, Jr., and E. P. Thomas, 1945, Am. Assoc. Petroleum Geologists Bull., v. 29, p. 48 (fig. 2), 57–58; G. E. Murray, 1948, Louisiana Dept. Conserv. Geol. Bull. 25, p. 117–122, pl. 10. Consists of calcareous silt and shale of a cyclic pattern; heterogeneous; sudden lithologic changes, both vertically and horizontally, into more sandy phases not uncommon; clay-ball conglomerates common in northern part of outcrop where member is much less calcareous; and around Shreveport, consists of 50 to 75 feet of silty shale, silts, and sands with numerous concretionary boulders; thin seam of lignite near top. Attains its maximum thickness of 225 feet on southern flank of Sabine uplift. Overlies Cow Bayou member; underlies Loggy Bayou member of Summit Hill formation; all contacts gradational. Paleocene. Type locality designated. Mapped in Texas.

H. V. Andersen, 1960, Louisiana Dept. Conserv. Geol. Bull. 34, p. 58 (fig. 8), 59–62. Rank raised to formation in report on Sabine Parish. At reference locality, herein designated, overlies Converse formation (new) and underlies "Hall Summit" formation. Thickness about 55 feet.

Type locality: Along Louisiana Highway 180 in SW¼ sec. 23, T. 10 N., R. 11 W., and about 2½ miles northeast of Pleasant Hill, Sabine Parish, La. Reference sections: SW¼ sec. 31, T. 10 N., R. 11 W., and SE¼ sec. 36, T. 10 N., R. 12 W., Sabine Parish. Named for exposures on and near Lime Hill. Outcrop area extends into Shelby County, Tex.

Lime Island Dolomite (in Burnt Bluff Group)

Middle Silurian (Niagaran): Northern Michigan.

G. M. Ehlers and R. V. Kesling, 1957, Michigan Geol. Soc. [Guidebook] Ann. Geol. Excursion, p. 2 (table), 3, 9, pl. 1 (fig. 4). Proposed for cream-colored to buff coarsely crystalline dolomite that rests on either Moss Lake formation (new) or Cabot Head shale and is overlain by Byron dolomite. Thickness 6 feet. Name Mayville not used in this classification; highest *Virgiana decussata*-bearing strata of Mayville are placed in the Lime Island.

Type section: Along western shore of Lime Island in St. Marys River. Best exposed on shore adjacent to old lime kiln in NE¼SE¼ sec. 26, T. 43 N., R 3 E., about 1,300 feet north-northeast of powerhouse of North Western-Hanna Fuel Co.

Lime Mountain Dolomite

Silurian: West-central Utah.

P. J. Barosh, 1960, Utah Geol. and Mineralog. Survey Bull. 68, p. 14, 23–24, 49. Consists of two members: lower one of light-gray dolomite 750 feet thick and an upper, about 250 feet, of light-gray dolomite with interbedded shales. No complete measurable section of the Lime Mountain present because base and top of formation occur in different fault blocks; correlation between blocks is not possible, and it is not known whether there is overlapping or missing section; if no faulting is assumed, minimum thickness of 1,000 feet can be assigned. Conformably overlies

Beaver Lake dolomite (new) ; upper contact poorly exposed, but attitudes across contact suggest conformable relationship with Devonian rocks referred to as Simonson dolomite-Guilmette formation(?).

Forms top of Lime Mountain and ridge to east, at top of ridge containing Galena mine, and a slope east of Galena mine, Beaver Lake Mountains, Beaver County.

Limeport Limestone

Upper Cambrian (Dresbachian): Southeastern Pennsylvania and west-central New Jersey.

B. F. Howell, Henry Roberts, and Bradford Willard, 1950, Geol. Soc. America Bull., v. 61, no. 12, pt. 1, p. 1360–1361, 1362, 1363, 1364–1366. Name proposed for dolomitic limestones formerly included at base of Allentown limestone. Characterized by thick sandy dolomitic limestone interbedded with shaly limestone and lenses of crossbedded sandstones. Algal biostromes a conspicuous feature throughout; more closely spaced toward top. Differs from Allentown, which it disconformably underlies, by being more sandy and shaly, less uniformly bedded, and having greater abundance of intraformational conglomerates, disconformities, mudcracks, and ripple marks. Thickness 400 to 500 feet in type area. In most of Buckingham Valley where Allentown is absent, the Limeport underlies Beekmantown(?). Conformably overlies Leithsville limestone.

Type locality: Section in southernmost of two abandoned quarries at Limeport at eastern tip of Buckingham Valley, Bucks County, Pa. Locality is 0.3 mile due west of Pennsylvania State Highway 32, 2.1 miles northwest of bridge across Delaware River at New Hope, Pa.

Limerick Keratophyre[1]

Middle(?) Triassic: Northwestern Nevada.

Original reference: C. P. Jenney, 1935, Nevada Univ. Bull., v. 29, no. 6, p. 18–23, map.

H. E. Wheeler, 1939, Jour. Paleontology, v. 13, no. 1, p. 106 (table 1). Limerick keratophyre, more than 5,000 feet thick, underlies Rochester trachyte in which species of *Helicoprion* has been found. Units referred to Anthracolithic time, which includes all late Paleozoic from base of Diantian stage (Mississippian) upward.

Well exposed on Lone Mountain, on north side of Limerick Canyon in upper Sacramento Canyon, and in Spring Valley, Humboldt Range.

Lime Ridge Formation (in Hermosa Group)

Pennsylvanian: Subsurface in southeastern Utah, northeastern Arizona, southwestern Colorado, and northwestern New Mexico.

J. R. Clair, 1958, Rocky Mountain Assoc. Geologists, Symposium, p. 31, 34, 46, figs. 6. 7. Varies from clean, in part oolitic, dense fossiliferous limestone to interbedded shale and limestone. Beds cherty in part. Cherts generally red, tan, or brown and vitreous. Interbedded shales are red to gray green and contain thin lentils of nodular limestone and nodules of chert. Overlies Molas formation with gradational contact and unconformably underlies Pinkerton Trail formation throughout area of occurrence.

Type section: In the Al Hill et al. No. 1 State [well], sec. 32, T. 40 S., R. 20 E., San Juan County, Utah, on Lime Ridge anticline. Confined in narrow band on shelf rim of the salt basin.

Limestone Creek Beds[1]

Oligocene: Southeastern Mississippi.

Original reference: M. A. Hanna and D. Gravell, 1934, Shreveport Geol. Soc. 11th Ann. Field Trip, p. 17, 41, table opposite p. 30.

Limestone Creek, Wayne County.

Limestone Creek Group[1]

Miocene: Southeastern Mississippi.

Original reference: M. A. Hanna and D. Gravell, 1934, Shreveport Geol. Soc. 11th Ann. Field Trip, table facing p. 30.

B. W. Blanpied and R. T. Hazzard, 1938, (abs.) Am. Assoc. Petroleum Geologists 23d Ann. Mtg., Program. p. 11. Includes Chickasawhay formation above and Bucatunna formation. Miocene. Occurrences noted.

Crops out in Wayne County.

Limestone Gap Member (of Golf Course Formation)

Limestone Gap Shale

Pennsylvanian (Morrow Series) : Southeastern Oklahoma.

B. H. Harlton, 1938, Am. Assoc. Petroleum Geologists Bull., v. 22, no. 7, p. 854 (fig. 1), 858, 901–902. Proposed for the gray-greenish, dark-gray, and black bituminous shale, containing profusion of siderite layers and concretions, that overlies Primrose formation and underlies Wapanucka formation (restricted). Has been considered part of Wapanucka. South of Arbuckles, occurs in interval between the Primrose and the Jolliff. Thickness at type locality 44 feet; 1,250 feet in Ardmore basin, 5 miles west of Springer. Morrow series here included above Pushmataha series (new) in upper part of Bendian period.

M. K. Elias, 1956, *in* Ardmore Geol. Soc., Petroleum geology of southern Oklahoma—a symposium, v. 1, Tulsa, Okla., Am. Assoc. Petroleum Geologists, p. 101–102. Harlton's name Limestone Gap shale, if understood as it appears in column for "south of Arbuckles" in his correlation chart, approximately corresponds to Gene Autry shale (new), because he applies it to interval between the Primrose and the Jolliff in Ardmore basin. When introducing name Limestone Gap formally in text, Harlton defines it as a shale in "frontal belt of the Ouachitas," resting upon the siliceous limestones and shales and to which Ardmore basin term Primrose is applied. By further definition, it is overlain by the Wapanucka in a restricted sense. Hence, the Limestone Gap is, by defintion, a shale unit between the main massive body of the Wapanucka, and the siliceous limestone and shale unit correlated with the Primrose, as these units are exposed at and around Limestone Gap, a town in the frontal belt of the Ouachitas.

B. H. Harlton, 1956, *in* Petroleum geology of southern Oklahoma v. 1: Tulsa, Okla., Am. Assoc. Petroleum Geologists, p. 137 (fig. 2), 139. Rank reduced to member in Golf Course formation (new). Overlies Rowland member (new) ; underlies Otterville member. Pennsylvanian, Morrow series.

Type locality: Limestone Gap, sec. 31, T. 2 N., R. 13 E., Atoka County.

Limones Shale

Miocene(?) : Panamá and Costa Rica.

H. N. Coryell and R. W. Mossman, 1942, Jour. Paleontology, v. 16, no. 2, p. 233. Underlies Charco Azul formation. Upper Miocene.

W. P. Woodring *in* R. Hoffstetter and others, 1960, Lexique Strat. Internat., v. 5, Amérique Latine, fasc. 2a, p. 338. An undefined name. Miocene(?).

Present in Burica Peninsula, Chriqúi Province.

Lincoln Formation[1]

Oligocene, middle: Western Washington.

Original reference: C. E. Weaver, 1912, Washington Geol. Survey Bull. 15, p. 10–22.

C. E. Weaver, 1937, Washington [State] Univ. Pubs. in Geology, v. 4, p. 110–111. Suggests abandoning name Porter shale and retaining name Lincoln formation for entire middle Oligocene of Washington.

C. E. Weaver and others, 1944, Geol. Soc. America Bull., v. 55, no. 5, p. 592. In southwest Washington, overlies Keasey formation and unconformably underlies Astoria formation. Thickness 6,000 feet.

P. D. Snavely, Jr., and others, 1958, U.S. Geol. Survey Bull. 1053, p. 35–53. Formation, in Centralia-Chehalis area, consists of about 2,000 feet of tuffaceous and basaltic marine sandstone and siltstone with associated continental deposits composed predominantly of sediments derived from volcanic rocks and pyroclastic material. Overlies Skookumchuck formation; underlies Astoria(?) formation. Oligocene.

Best exposed on Lincoln Creek near boundary between Lewis and Thurston Counties.

Lincoln Granite

Age not stated: Eastern Maine.

L. S. Wing, 1958, Maine Geol. Survey GP. and G. Survey 3, sheet 1. Incidental mention. Most of discussion deals with Linçoln granite area.

Report deals with parts of Penobscot, Hancock, and Washington Counties.

Lincoln Limestone Member (of Greenhorn Limestone)[1]

Upper Cretaceous: Western Kansas and southeastern Colorado.

Original reference: W. N. Logan, 1897, Kansas Univ. Geol. Survey, v. 2, p. 216.

R. C. Moore and others, 1951, Kansas Geol. Survey Bull. 89, p. 25. Chalky shale and chalky limestone, interbedded, light gray; beds of dark-gray petroliferous hard crystalline limestone at base and top; shale contains thin beds of bentonitic clay; member weathers to yellow gray or yellow tan. Thickness 20 feet (Ellis County) to 35 feet. Underlies Hartland shale member; overlies Graneros shale.

T. G. McLaughlin, 1954, U.S. Geol. Survey Water-Supply Paper 1256, p. 115. In Baca County, Colo., consists mainly of limy shale with thin platy limestone at top and base; shale dark gray to black and generally fissile. Thickness about 25 feet; thins westward to 19 feet in Model anticline in Las Animas County. Underlies Hartland shale member; overlies Graneros shale.

Named for Lincoln, Lincoln County, Kans.

Lincoln Porphyry[1] (in Gray Porphyry Group)

Early Tertiary: Central Colorado.

Original references: S. F. Emmons, 1882, U.S. Geol. Survey 2d Ann. Rept., p. 215–230; 1886, U.S. Geol. Survey Mon. 12, p. 78.

C. H. Behre, Jr., 1953, U.S. Geol. Survey Prof. Paper 235, p. 48–50, 57. Typical Lincoln porphyry is light-gray rock with deep pink or very pale lavender cast, brownish where weathering has been intense, and locally bleached to white or very light gray; characterized by larger phenocrysts of orthoclase. In igneous sequence, intrusion of quartz diorite porphyry was followed by intrusions of Evans Gulch and Sacramento porphyries and typical Lincoln porphyry; relative ages of these porphyries not determinable. Older than Iowa Gulch porphyry. Igneous rocks that are younger than Precambrian in area of this report [west slope of Mosquito Range] are either wholly or mainly Tertiary and only possibly in part late Cretaceous or early Pleistocene in age.

Ogden Tweto, 1953, U.S. Geol. Survey Mineral Inv. Field Studies Map MF-12. Mapped as early Tertiary in Pando area.

Named for fact it forms summit of Mount Lincoln, north of Alma, Park County.

Lincoln Sandstone

Middle Cambrian: Kentucky (subsurface).

W. R. Jillson, 1948, New horizons in Kentucky: Frankfort, Ky., Roberts Printing Co., p. 27–29. Massive silica sand 610 feet thick. In type well, occurs between depths of 5,110 and 5,720 feet. Overlies, probably unconformably, 41 feet of dolomite and limestone.

Type well: California Oil Co. A. R. Spears No. 1, Lincoln County.

Lincoln Slate[1]

Precambrian: Eastern Massachusetts.

Original reference: W. A. Hobbs, 1899, Am. Geologist, v. 23, p. 109–115.

Named for occurrence near South Lincoln, Middlesex County.

Lincoln Creek Formation[1]

Oligocene: Southwestern Washington.

Original reference: R. Arnold and H. Hannibal, 1913, Am. Philos. Soc. Proc., v. 52, p. 605.

Well exposed on Lincoln Creek near boundary between Lewis and Thurston Counties.

Lincoln Peak Formation

Middle and Upper Cambrian: East-central Nevada.

Harald Drewes and A. R. Palmer, 1957, Am. Assoc. Petroleum Geologists Bull., v. 41, no. 1, p. 106 (fig. 2), 108 (fig. 3), 113-114, 118; Harald Drewes, 1958, Geol. Soc. America Bull., v. 69, no. 2, p. 224 (fig. 2), 226, pl. 1. Defined to include more than 1,000 feet of shale and thin commonly fossiliferous limestone beds of late Middle Cambrian and early Late Cambrian age that lie below Johns Wash limestone (new) and overlie Pole Canyon limestone (new). In most of mapped area, separated from underlying Pole Canyon by thrust fault and in many places similarly separated from overlying formations, but in vicinity of type section, upper contact is undisturbed.

Type section: On south slope of south fork of Lincoln Canyon directly below head of Johns Wash, Mount Washington-Lincoln Peak area, Snake Range.

Lincolnshire Limestone

Lincolnshire Limestone (in Cliffield Group)

Lincolnshire Limestone Member (of Cliffield Formation)

Middle Ordovician: Southwestern Virginia and northeastern Tennessee.

B. N. Cooper and C. E. Prouty, 1943, Geol. Soc. America Bull., v. 54, no. 6, p. 827, 868, 884 (fig. 3). In Tazewell County, the strata embraced by Chazyan and Black River groups of Butts (1940) are subdivided into (ascending) 29 zones. Lincolnshire limestone member of Cliffield formation (which includes zones 1–9) is proposed for zone 5, which consists of brownish-gray to black medium-grained irregularly bedded limestone averaging 60 feet thick; thickness at type locality 102 feet. Overlies Five Oaks limestone member (new) and underlies Ward Cove limestone member (new).

B. N. Cooper, 1944, Virginia Geol. Survey Bull. 60, p. 58–59. In valley between Brushy and Walker Mountains, the Lincolnshire is considered a formation in Cliffield group. The Lincolnshire is the Lenoir of Butts in belts southwest of Clinch Mountain but not the same as the Lenoir identified by Butts in some areas north of Clinch Mountain.

B. N. Cooper, 1945, Virginia Geol. Survey Bull. 66, p. 17, 46, 136, 138 (fig. 12). In Russell County, overlies Elway formation (new) and underlies Rockdell formation (new). Used in this area where Ward Cove and Peery limestones cannot be differentiated.

B. N. Cooper and G. A. Cooper, 1946, Geol. Soc. America Bull., v. 57, no. 1, p. 75–77, 80 (fig. 5). As used in this report [stratigraphy of Shenandoah Valley], the Lincolnshire is a time-stratigraphic name for beds above the New Market or Whistle Creek limestone (new) and below either brownish-weathering "trilobite beds" identified by Butts as Whitesburg, or below base of the lower *Echinosphaerites* zone as developed where the "Whitesburg" is not separately recognized. Includes Murat calcarenite facies. Underlies Botetourt member of Edinburg formation (both new). Name Strasburg was introduced without definition by Ulrich (1939) for part of succession herein identified as Lincolnshire. Since the name had received no precise definition or description at time Lincolnshire was introduced, Strasburg is considered invalid. Geographically extended into northeastern Tennesssee.

G. A. Cooper, 1956, Smithsonian Misc. Colln., v. 127, pt. 1, p. 61–62, 66–67. In Virginia, overlies Marcem formation (new). In Tennessee, includes Eidson cherty limestone member and Hogskin member (both new).

Type section: In abandoned quarry along County Road 645 about 1 mile north of intersection of U.S. Route 19 and State Highway 61. Named derived from a branch tributary to Clinch River, which parallels County Road 645 about 1 mile west of Five Oaks, Tazewell County, Va.

Lincolnshirian Stage

Middle Ordovician (Chazyan): Virginia and West Virginia.

Marshall Kay, 1948, Am. Assoc. Petroleum Geologists Bull., v. 32, no. 8, p. 1401–1402. Middle Ordovician is divided into Chazyan, Bolarian, and Trentonian series. Term Lincolnshirian is used as stage-formation unit in upper Chazyan. In sequence, follows "Blackford-Five Oaks" and is succeeded by Hatterian stage of Bolarian series.

Lincolnville Chert (in Boone Limestone)[1]

Mississippian: Northeastern Oklahoma.

Original reference: S. Weidman, 1932, Oklahoma Geol. Survey Bull. 56, p. 17.

C. C. Branson, 1957, Oklahoma Geology Notes, v. 17, no. 11, p. 101. Abandoned by Oklahoma Geological Survey.

Exposed along Spring River, 10 miles below Baxter Springs, Ottawa County.

Linden Group[1]

Lower Devonian: Western and central Tennessee.

Original reference: J. M. Safford and J. B. Killebrew, 1876, Elements of geology of Tennessee, p. 108, 142, 146–148.

G. A. Cooper and others, 1942, Geol. Soc. America Bull., v. 53, no. 12, pt. 1, chart 4. Shown on correlation chart as including (ascending) Rockhouse shale, Olive Hill formation, Flat Gap limestone, Birdsong shale, and Decaturville chert; occurs below Quall limestone. Rockhouse shale is shown as Silurian; hence, age of group is Silurian and Lower Devonian.

Named for occurrence at Linden, Perry County.

Linderman Sandstone

Lower Mississippian (Oil Lake): Southwestern Pennsylvania.

W. M. Laird, 1941, Pennsylvania Topog. and Geol. Survey Progress Rept. 126, p. 12–14. Name will probably be used, following more definitive study of area, for unit here termed Sandstone E and defined as basal member of Mississippian system in Fayette County inliers. Consists of sandstone principally cemented with calcite; usual appearance is as friable limonitic sandstone. Thickness 2½ to 5 feet. Conformably underlies Sandstone J (Chestnut Ridge sandstone); unconformably overlies Sandstone D (Jumonville sandstone).

Type locality: On Linderman Farm in the Youghiogheny Gorge through Laurel Hill near Victoria, Fayette County.

Lindley Conglomerate

Eocene, lower: Southwestern Montana.

W. T. Thom, Jr., 1957, Billings Geol. Soc. Guidebook 8th Ann. Field Conf., p. 11 (table 1). Name appears on generalized stratigraphic section. Equivalent to Wasatch formation(?). Fanglomerate material 0 to 500 feet thick. Occurs below Absaroka volcanics and above Fort Union.

Area of section is Crazy Mountain Basin and vicinity.

Lindsey Bridge Member (of Moorefield Formation)

Mississippian (Chesterian): Northeastern Oklahoma.

G. G. Huffman and others, 1958, Oklahoma Geol. Survey Bull. 77, p. 55–57, pls. 1–5. Gray medium-crystalline locally oolitic crossbedded calcarenite; characterized by abundance of angular white, tan, and blue chert fragments ranging in size from pebbles to microscopic specks; in some areas, consists of heavy, 4-foot bed of limestone separated from overlying 2-foot ledge by approximately one foot of blue-yellow silty shale. Maximum thickness 24¼ feet. Conformably overlies Bayou Manard member (new) and, where exposed, contact is sharp; locally overlaps the Bayou Manard and rests upon Keokuk chert; believed to be conformable with overlying Ordnance Plant member (new), and in some areas, contact is sharp and in others gradational.

Type locality: Along north bank of Grand River in cliff east of Lindsey Bridge, sec. 6, T. 20 N., R. 20 E., southern Mayes County.

Lindside Sandstone (in Pocono Sandstone[1] or Series)

Lower Mississippian: Southwestern Virginia and southeastern West Virginia.

Original reference: D. B. Reger, 1926, West Virginia Geol. Survey Rept. Mercer, Monroe, and Summers Counties, p. 505, 518.

J. M. Weller and others, 1948, Geol. Soc. American Bull., v. 59, no. 2, chart 5 (column 98). Shown on correlation chart in Pocono series below Logan sandstone and above Broad Ford sandstone.

Type locality: On Dry Creek about one-half mile southeast of Lindside and just south of Ernest Fleshman coal prospect, Monroe County, W. Va.

Lindwurm Member[1] (of Milwaukee Formation)

Middle Devonian: Southeastern Wisconsin.

Original reference: G. O. Raasch, 1935, Kansas Geol. Soc. 9th Ann. Field Conf., p. 262, 265.

G. A. Cooper and others, 1942, Geol. Soc. America Bull., v. 53, no. 12, pt. 1, chart 4. Lindwurm member shown on correlation chart above Berthelet member and below North Point member.

Type locality: Milwaukee Cement Quarry, Milwaukee County. Probably named for village of Lindwurm.

Lingle Limestone[1]

Middle Devonian: Southwestern Illinois and eastern Missouri.

Original reference: T. E. Savage, 1920, Am. Jour. Sci., 4th, v. 49, p. 171, 176.

J. M. Weller and G. E. Ekblaw, 1940, Illinois Geol. Survey Rept. Inv. 70, p. 15–16; J. M. Weller, 1940, Illinois Geol. Survey Rept. Inv. 71, p. 24–25, 26. Strata intervening between Grand Tower limestone (or Dutch Creek sandstone where Grand Tower is absent) and Mountain Glen shale (or Springville shale where Mountain Glen is absent) have been referred by Savage to Misenheimer shale and Lingle and Alto limestones. Restudy of area suggests that recognition of these three formations may be neither stratigraphically logical nor practically feasible.

G. A. Cooper and A. S. Warthin, Jr., 1942, Geol. Soc. America Bull., v. 53, no. 6, p. 883. Restricted to limestone exposed above Misenheimer shale on branch of Lingle Creek in SW¼ sec. 26, T. 13 S., R. 2 W., about 3 miles west-northwest of Mill Creek, Ill., where 31 feet of limestone is exposed in slope above the dark shale. Lingle limestone as exposed here is not to be confused nor correlated with Hamilton limestone above Grand Tower limestone at the Devils Backbone and Bake-Oven north of Grand Tower, Ill.

A. S. Warthin, Jr., and G. A. Cooper, 1944, Am. Assoc. Petroleum Geologists Bull. v. 28, no. 10, p. 1523. Term "Lingle" is used to include only those limestones present at type locality, with their correlatives. It rests on St. Laurent limestone and is overlain by the Alto, which is considered to be younger than Hamilton. The Lingle seems to be the most widely distributed part of the Hamilton in Illinois, being present where any beds of that age are found. Toward the east, the Lingle becomes the Beechwood limestone of the Sellersburg of southern Indiana, and, toward northeast, the Logansport is its equivalent.

Type locality: Along branch of Lingle Creek, in SW¼ sec. 26, T. 13 S., R. 2 W., Union County, Ill.

Linietta Clay[1]

Mississippian: Central northern Kentucky.

Original reference: A. F. Foerste, 1905, Kentucky Geol. Survey Bull. 6, p. 145, 156.

Named from exposures in immediate vicinity of Linietta Springs, near Junction City, Boyle County.

Linley Conglomerate[1]

Post-Eocene(?): Central southern Montana.

Original reference: W. R. Calvert, 1916, U.S. Geol. Survey Bull. 641, p. 203.

W. C. Alden, 1953, U.S. Geol. Survey Prof. Paper 231, p. 7. Mentioned in report on physiography and glacial geology of western Montana and adjacent areas. Unconformably overlies Fort Union formation.

Named for development in vicinity of Linley. Occupies about 5 square miles between Linley, Carbon County, and Beartooth Mountains.

Linn Gravels

Pleistocene: Northwestern Oregon.

I. S. Allison, 1953, Oregon Dept. Geology and Mineral Industries Bull. 37, p. 11–12, geol. map. Term used to designate gravels of stage of alluviation next younger than Leffler gravels (new); also proposed to use term Linn gravels for all deposits of equivalent age throughout Willamette Valley. Older than Willamette silts.

Type section: Cliff about 30 feet high on left bank of North Santiam River in sec. 30, T. 9 S., R. 1 W., Stayton quadrangle. Named for Linn County where they are well exposed.

Linn Subgroup (of Kansas City Group)

Pennsylvanian (Missouri Series): Eastern Kansas, southwestern Iowa, western Missouri, southeastern Nebraska, and northeastern Oklahoma.

R. C. Moore, 1948, Am. Assoc. Petroleum Geologists Bull., v. 32, no. 11, p. 2029–2031. Name applied to middle part of Kansas City group. As defined, includes strata from base of Cherryvale formation to top of Iola formation. Comprises (ascending) Cherryvale formation, Drum limestone, Chanute formation, and Iola formation. Occurs above Bronson subgroup and below Zarah subgroup (new).

G. E. Condra, 1949, Nesbraska Geol. Survey Bull. 16, p. 35–38. In Nebraska, includes (ascending) Sarpy, Quivira, Drum, Chanute, and Iola formations.

R. C. Moore and others, 1951, Kansas Geol. Survey Bull. 89, p. 82, 84. Thickness in Kansas about 110 feet.

Named from Linn County, Kans., which contains excellent exposures of all constituent units.

Linnian series

Paleozoic [Devonic]: Iowa, Arizona, Missouri, and region northwest.

C. R. Keyes, 1939, Pan-Am. Geologist, v. 72, no. 1, p. 64. Proposed to cover entire Devonic deposition of Iowa-Missouri region and northwestward.

Series is complete cyclic sedimentation and full depositional filling of normal geosyncline. Embraces original Cedar Valley limestones, the Wapsipinicon section below, and the Rockford shales above. Cedarian series as first proposed referred only to median limestone section.

C. R. Keyes, 1942, Pan-Am. Geologist, v. 77, no. 3, p. 228 (table). In Arizona, Linnian series embraces (ascending) Silver shale, Bella shale, and Berenda limestone. Table shows Linnian series below Rockfordian series.

Name derived from Linn County, Iowa, through which Cedar River flows.

Linton Formation

Middle Pennsylvanian: Southwestern Indiana.

C. E. Wier, 1950, U.S. Geol. Survey Coal Inv. Map C-1; 1952, Indiana Geol. Survey Bull. 6, p. 12–14. Consists of (ascending) 10 to 20 feet of sandstone and shale, Coal IIIa 8 inches thick, 2 to 5 feet of black fissile shale, 1½ feet limestone, 20 to 30 feet of sandstone and shale, and Coal IV averaging 4 feet in thickness. Rests on Coal III or on 1 to 6 feet of gray shale overlying Coal III; lies above erosional unconformity cut into topmost beds of underlying Staunton formation; overlain by shale or sandstone of Petersburg formation.

S. A. Friedman, 1960, Indiana Geol. Survey Prog. Rept. 23, p. 7, 23–28. Includes Coxville sandstone member at or near base.

Named for exposures along tributaries of Latta Creek in secs. 26 and 27, T. 8 N., R. 7 W., approximately 4 miles north of Linton, Greene County.

Linville Metadiabase[1]

Precambrian: Western North Carolina and eastern Tennessee.

Original reference: A. Keith, 1903, U.S. Geol. Survey Geol. Atlas, Folio 90, p. 3.

J. L. Stuckey and S. G. Conrad, 1958, North Carolina Div. Mineral Resources Bull. 71, p. 29; J. L. Stuckey, 1958, Geologic map of North Carolina (1:500,000): North Carolina Div. Mineral Resources. Occurs as irregular outcrops associated with Montezuma schist, Flattop schist, Cambrian quartzite, and as narrow bands in Cranberry gneiss.

Named for Linville, Mitchell County, N.C.

†Linville Slates[1]

Precambrian and Cambrian: Western North Carolina.

Original reference: W. C. Kerr, 1869, North Carolina Geol. Survey Rept. 2, p. 13–36.

Named for exposures on Linville Mountain on boundary between McDowell and Burke Counties.

Linwood Member (of Cedar Valley Limestone)[1]

Upper Devonian: Eastern Iowa.

Original reference: A. C. Trowbridge, M. L. Thompson, and E. H. Scobey, 1935, Kansas Geol. Soc. 9th Ann. Field Conf. Rept., fig. 1, p. 36, 434.

G. A. Cooper and others, 1942, Geol. Soc. America Bull., v. 53, no. 12, pt. 1, p. 1751. Cooper and Cloud suggested correlation of the Solon member (sometimes called Linwood) with the Rogers City limestone.

Type locality: Quarry at Linwood, Scott County.

Linwood Shale[1]

Pennsylvanian: Eastern Kansas.

Original reference: R. C. Moore, 1932, Kansas Geol. Soc. Guidebook 6th Ann. Field Conf., p. 87, 97.

Probably named for occurrence near Linwood, Leavenworth County.

Linwood shales

Pennsylvanian: Northeastern Kansas.

C. R. Keyes, 1937, Pan-Am. Geologist, v. 67, no. 5, p. 366. Proposed for shale from the Bethany to the Plattsburg or Stanton limestone.

Type locality and derivation of name not stated.

Lion Sandstone[1]

Miocene, lower: Southern California.

Original reference: F. E. Vaughan, 1922, California Univ. Pub., Dept. Geol. Sci. Bull., v. 13, no. 9, p. 344, 375–376, 378, map.

Named for Lion Canyon, Riverside County.

†Lion Canyon coal group (in Williams Fork Formation)[1]

Upper Cretaceous: Northwestern Colorado.

Original reference: E. T. Hancock and J. B. Eby, 1930, U.S. Geol. Survey Bull. 812, p. 197, 206.

Meeker quadrangle.

Lion Canyon Sandstone Member (of Williams Fork Formation)[1]

Upper Cretaceous: Northwestern Colorado.

Original reference: E. T. Hancock and J. B. Eby, 1930, U.S. Geol. Survey Bull. 812, p. 197, 206.

Occurs in Lion Canyon, 3 miles west of Meeker, Rio Blanco County.

Lion Hill Formation[1]

Upper Mississippian: Central northern Utah.

Original reference: S. G. Olmstead, 1921, Econ. Geology, v. 16, p. 452.

Exposed over a large area on Lion Hill, Ophir district.

Lion Mountain Sandstone Member (of Riley Formation)

†Lion Mountain Sandstone Member (of Cap Mountain Formation)[1]

Upper Cambrian: Central Texas.

Original reference: Josiah Bridge, 1937, U.S. Geol. Survey Prof. Paper 186–L.

P. E. Cloud, Jr., V. E. Barnes and Josiah Bridge, 1946, Texas Univ. Bur. Econ. Geology Pub. 4301, p. 154–155. Reallocated to member status in newly defined Riley formation. Overlies Cap Mountain (here reduced to member status in Riley); underlies Welge sandstone member of Wilberns formation. Highly glauconitic sandstone, lower part of which contains numerous lenses or tangential beds of coquina-like limestone made up chiefly of trilobites. Thickness 24 feet.

Named for Lion Mountain in northwestern part of Burnet quadrangle. [Burnet County].

†Lipan Beds[1]

Eocene: Southern Texas.

Original reference: E. T. Dumble, 1924, Am. Assoc. Petroleum Geologists Bull., v. 8, p. 424–436.

Exposed in Lipan Hills, east of Campbellton, Atascosa County.

Lippincott Member (of Lost Burro Formation)

Middle and Upper Devonian: Southern California.

J. F. McAllister, 1955, California Div. Mines Spec. Rept. 42, p. 9 (fig. 3), 12, pl. 2. Siliceous zone, sporadically cherty and consistently sandy or quartzitic, at base of Lost Burro formation. Thickness 155 to 250 feet. Overlies Hidden Valley dolomite.

Exposures northeast of all workings of Lippincott mine, Ubehebe Peak quadrangle, Inyo County. Best exposures of Lippincott where not metamorphosed is in Andy Hills east of Hidden Valley about 7 miles northeast of Lippincott mine.

Lirio Limestone

Pliocene or Pleistocene: Puerto Rico.

C. A. Kaye, 1959, U.S. Geol. Survey Prof. Paper 317–C, p. 147–148, pl. 12. A limestone that unconformably overlies Isla Mona limestone (new). On plateau, the two formations cannot be distinguished, but in sea cliff at Punta Este they are distinguished by the unconformity and darker weathered surface of the Lirio. Maximum thickness 50 feet at Punta Este; where identified in sea cliff commonly 10 to 15 feet. On basis of meager fossil evidence, age is taken to be Pliocene or Pleistocene.

Named for Cueva del Lirio, at Punta Este, which lies entirely in it. Occurs on Isla Mona and probably on Monito.

Lisbon Formation[1]

Cambrian or Ordovician: Northwestern New Hampshire.

Original reference: C. H. Hitchcock, 1874, Am. Jour. Sci., 3d, v. 7, p. 468–476.

Named for Lisbon, Grafton County.

Lisbon Formation (in Claiborne Group)[1]

Eocene, middle: Southwestern Alabama, Georgia, and Mississippi.

Original reference: T. H. Aldrich, 1886, Alabama Geol. Survey Bull. 1, p. 44–60.

R. E. Grim, 1936, Mississippi Geol. Survey Bull. 20, p. 122. Lisbon formation in Mississippi includes Kosciusko and Chickasawhay (new) members. (Chickasawhay as used here includes Wautubbee marl).

U. B. Hughes and others, 1940, Mississippi Geol. Soc. [Guidebook] Field Trip, Feb. 10, 11, columnar section. Lisbon formation includes (ascending) Winona sand, Zilpha (new), Kosciusko sand, and Wautubbee members. Overlies Tallahatta formation; underlies Yegua formation.

E. P. Thomas, 1942, Mississippi Geol. Survey Bull. 48, p. 29, 40, 48. Winona greensand, Kosciusko, and Wautubbee are treated as formations and not part of Lisbon formation.

F. S. MacNeil, 1946, Southeastern Geol. Soc. [Guidebook] 4th Field Trip, p. 22. Lisbon formation in Alabama is equivalent of Winona sand, Zilpha clay, Sparta sand (Kosciusko), and Cook Mountain formation (Wautubbee) combined.

F. S. MacNeil, 1947, U.S. Geol. Survey Oil and Gas Inv. Prelim. Chart 29. Chart of outcropping Tertiary formations of eastern Gulf region shows Lisbon formation present in Georgia.

Named for exposures in Lisbon Bluff, on Alabama River, in Clarke County, Ala.

†Lisbon Group[1]

Upper Triassic: Central southern Pennsylvania.

Original reference: G. H. Ashley, 1931, Pennsylvania Topog. and Geol. Survey Bull. G1, p. 77.

Occurs in Dauphin and York Counties.

†Lisbon Quartzite[1]

Upper Ordovician(?): Northwestern New Hampshire.

Original reference: M. Billings, 1933, Am. Jour. Sci., 5th, v. 25, no. 146, p. 149.

Type locality: Lisbon Township, Grafton County.

†Lisbon Shale[1]

Upper Cretaceous: Northwestern Kansas and eastern Colorado.

Original reference: F. W. Cragin, 1896, Colorado Coll. Studies, v. 6, p. 52.

Named for Lisbon, Logan County, Kans.

Lisburne Group

Lisburne Limestone[1]

Lower and Upper Mississippian, Pennsylvanian(?), and Permian: Northern Alaska.

Original reference: F. C. Schrader, 1902, Geol. Soc. America Bull. v. 13, p. 241.

A. L. Bowsher and T. J. Dutro, Jr., 1957, U.S. Geol. Survey Prof. Paper 303–A, p. 3, figs. 2–4. Group consists of two formations in Shainin Lake area, central Brooks Range: the Wachsmuth and the Alapah limestones (new) in ascending order.

W. P. Brosgé, 1960, U.S. Geol. Survey Prof. Paper 400–B, p. B351, B352. In south-central Brooks Range, group includes Kayak shale, Kanayut conglomerate, and unnamed sandstone. Devonian and Mississippian(?).

U.S. Geological Survey currently designates age of Lisburne Group as Lower and Upper Mississippian, Pennsylvanian(?), and Permian on basis of study now in progress.

Named for Cape Lisburne in northwestern Alaska. Extends from Cape Lisburne, on Arctic Ocean, east almost if not quite continuously for 600 miles to international boundary.

Lisco Member (of Broadwater Formation)

Pleistocene, lower: Western Nebraska.

C. B. Schultz and T. M. Stout, 1945, Am. Jour. Sci., v. 243, no. 5, p. 232–236. Defined as including all sediments between basal and upper gravel members of formation; at some localities, consists of diatomaceous marl and peat with sand and silt lenses; at other localities, loess-like silt facies is present; alluvial and colluvial silts and sands also are present locally within member. Thickness as much as 8 feet.

Type locality: At Broadwater Locality A of University of Nebraska State Museum, near Broadwater, Morrill County. Name derived from town of Lisco, Garden County.

Lisman Formation[1] (in McLeansboro Group)

Upper Pennsylvanian: Western Kentucky.

Original reference: L. C. Glenn, 1912, Kentucky Geol. Survey Rept. Prog. 1910 and 1911, p. 26.

E. J. Harvey, 1956, U.S. Geol. Survey Water-Supply Paper 1356, p. 47, 55 (fig. 9), 64–70. In Henderson area, formation consists of (ascending) Providence limestone member, No. 12 coal, Anvil Rock sandstone member, and Madisonville limestone member; these are normally separated by shales and sandy shales. Base of formation is here designated as top of No. 11 coal underlying Providence limestone—it had been placed by Glenn at base of Anvil Rock sandstone member. Thickness in eastern part of quadrangle about 255 feet; in western part where Madisonville is exposed, thickness about 300 feet. Overlies Carbondale formation; almost entirely covered by alluvium and loess.

Apparently named for Lisman, Webster County.

Lissie Formation[1]

Pleistocene. Eastern Texas and northwestern Louisiana.

Original reference: A. Deussen, 1914, U.S. Geol. Survey Water-Supply Paper 335, p. 27, 78–80.

A. W. Weeks, 1945, Am. Assoc. Petroleum Geologists Bull., v. 29, no. 12, p. 1708. Traced coastward along Colorado River, the surface of Capitol terrace appears to coincide with surface of sand and sandy clay formation near Lissie, to which Deussen gave name Lissie. On basis of priority, name Capitol (Hill and Vaughan, 1898) has preference over name Lissie.

J. A. Doering, 1956, Am. Assoc. Petroleum Geologists Bull., v. 40, no. 8, p. 1860 (table 7). Gulf Coast Pleistocene correlation chart shows Lissie younger than Citronelle and older than Oberlin; also older than Capitol of Colorado River section.

Named for Lissie, Wharton County, Tex.

Liston Creek Formation[1]

Middle Silurian: Northeastern Indiana.

Original reference: E. R. Cumings and R. R. Shrock, 1928, Indiana Cons. Comm., Div. Geology Pub. 75, p. 53, 71–94.

J. B. Sangree, Jr., 1960, Dissert, Abs., v. 21, no. 6, p. 1528. Revision of Silurian stratigraphy of northern Indiana proposed. Liston Creek formation and New Corydon formation tentatively considered cherty facies of Mississinewa formation.

Well exposed at mouth of Liston Creek, Wabash County.

Liston Creek Limestone Member (of Liston Creek Formation)[1]

Silurian (Niagaran): Northeastern Indiana.

Original reference: E. R. Cumings and R. R. Shrock, 1927, Indiana Acad. Sci. Proc., v. 36, p. 75–76.

Occurs along Liston Creek, Wabash County.

Litchfield Coal Member (of Spoon Formation)

Pennsylvanian: Southwestern Illinois.

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 33, 45 (table 1), pl. 1. Assigned member status in Spoon formation (new). Present in lower part of formation. Coal named by Kay (1915, Illinois Geol. Survey Min. Inv. 11). Presentation of new rock-stratigraphic classification of Pennsylvanian strata in Illinois.

Type locality: Mine, SE¼NE¼NE¼ sec. 32, T. 9 N., R. 5 W., Montgomery County. Recognized only in vicinity of mine near Litchfield.

Litchfield mafic intrusives

Litchfield Norite[1]

Pre-Triassic: Western Connecticut.

Original reference: H. E. Gregory, 1906, Connecticut Geol. Nat. History Survey Bull. 6, p. 74, 111.

John Rodgers and others, 1956, Preliminary geological map of Connecticut (1:253,440): Connecticut Geol. Nat. History Survey. Mapped as mafic intrusives. Redescribed to include medium- to coarse-grained mostly massive olivine norite, quartz, norite, and hypersthene pyroxenite. Cut by dikes of several rock types from pyroxenite to granodiorite. Pre-Triassic. Derviation of name stated.

Named for town of Litchfield, Litchfield County.

†Lithodendron Formation[1]

†Lithodendron Member[1] (of Shinarump Formation)

Upper Triassic: Northern Arizona.

Original reference: L. F. Ward, 1905, U.S. Geol. Survey Mon. 48.

Occurs on Lithodendron Creek, a short distance from Petrified Forest.

Lithonia Gneiss or Granite

Lithonia Granite-Gneiss

Precambrian or upper Cambrian(?): Northwestern Georgia.

T. L. Watson, 1902, Georgia Geol. Survey Bull. 9–A, p. 54, 125–127. Name applied to contorted granite-gneiss in vicinity of Lithonia.

G. W. Crickmay, 1952, Georgia Geol. Survey Bull. 58, p. 42. Toccoa Falls quartzite (Galpin 1915) is a fine-grained phase of Lithonia granite.

L. A. Herrmann, 1954, (abs.) Geol. Soc. America Bull., v. 65, no. 12, pt. 2, p. 1362; 1954, Georgia Geol. Survey Bull. 61, p. 8–15, 34–41, 68–73, 78–79. Metamorphic rocks of area considered Precambrian. Lithonia gneiss was apparently migmatized during or shortly after final deformation of the metamorphic rocks. This deformation may have taken place in early stages of Appalachian Revolution. Intruded by Stone Mountain granite.

Marc Grunenfelder and L. T. Silver, 1958, (abs.) Geol. Soc. America Bull., v. 69, no. 12, pt. 2, p. 1574. Age determinations by isotope-dilution methods on zircon concentrations gave age of Lithonia granite as 425 to 485 million years. These data are in contrast with K/A and Rb/Sr ages of 250–290 million years reported by previous workers. These older ages indicate a late Cambrian(?) plutonic episode.

Named for occurrence near Lithonia, De Kalb County.

Lithopolis Member (of Cuyahoga Formation)[1]

Lithopolis Siltstone Member (of Cuyahoga Formation)

Mississippian (Kinderhook): South-central Ohio.

Original reference: J. E. Hyde, 1915, Jour. Geology, v. 23, p. 656, 657, 670.

F. T. Holden, 1942, Jour. Geology, v. 50, no. 1, p. 43, 45. Included in Hocking Valley conglomerate facies of formation and name emended to

Lithopolis siltstone member [on p. 45 unit is referred to as sandstone member]. Estimated thickness 180 to 200 feet. Underlies Fairfield sandstone member, contact concealed.

Named for Lithopolis, Fairfield County. Exposures limited to northwestern Fairfield, southeastern Franklin and southwestern Licking Counties.

Littig Glauconitic Member (of Kincaid Formation)[1]

Paleocene: Eastern Texas.

Original reference: F. B. Plummer, 1933, Texas Univ. Bull. 3232, p. 530, 535, 536, 550, 554.

Mackenzie Gordon, Jr., J. I. Tracey, Jr., and M. W. Ellis, 1958, U.S. Geol. Survey Prof. Paper 299, p. 13. Basal member of Kincaid. Underlies Pisgah member.

G. R. Kellough, 1959, Gulf Coast Assoc. Geol. Soc. Trans., v. 9, p. 150–152. Consists of dark-green sandy shale with streaks of sandstone containing much coarse elongate to free-form dark-green glauconite, shell fragments, fish teeth, phosphate, pebbles, coprolites, and Foraminifera. Thickness 7 feet. Underlies Pisgah member; unconformably overlies Upper Cretaceous Navarro formation.

Type exposure: In road 1½ miles by road southwest of Littig, Travis County, on south side of Wilbarger Creek.

Little Alvord Creek Rhyolite[1]

Tertiary, upper: Southeastern Oregon.

Original reference: R. E. Fuller, 1931, Washington Univ Pub. Geol., v. 3, no. 1, p. 66.

Exposed in Little Alvord Creek, Steens Mountain, Harney County.

Little Bear Formation or residuum

Lower Cretaceous: Mississippi, Alabama, Kentucky, and Tennessee.

F. F. Mellen, 1937, Mississippi Geol. Survey Bull. 34, p. 8–20, 27–29. Name applied to material that originated in situ from decomposition of Paleozoic strata. Outcrops are subjacent to Tuscaloosa formation and extend from Kentucky to west-central Alabama, and perhaps extend to central and eastern Alabama, and western Georgia, if not farther. Deposits vary in character from place to place depending upon nature of original material. Formative process probably began in early Mesozoic, or even late Paleozoic and continued into Cretaceous; formation is for most part Comanchean.

Named for development in drainage area of Little Bear Creek heading 1 mile northeast of Iuka, Tishomingo County, Miss.

Little Belknap Lava, Flows

Recent: Southwestern Oregon.

Howel Williams, 1944, California Univ. Pub., Dept. Geol. Sci. Bull. 27, no. 3, p. 57. Discussion of volcanoes of Three Sisters region. Name is applied to lava and flows from Little Belknap Crater.

Little Belknap Crater is south of Mount Washington and east of Belknap Crater.

Little Black Mountain Quartz Monzonite Porphyry

Tertiary: Central Colorado.

J. T. Stark and others, 1949, Geol. Soc. America Mem. 33, p. 81, 92, pl. 1. Mapped on Little Black Mountain as Little Black porphyry. Cited in text as Little Black Mountain quartz monzonite porphyry. Intrusive relation to Upper Cretaceous formations.

Most conspicuous mass forms Little Black Mountain and centers in sec. 8, T. 11 S., R. 77 W. Outcrop about 1½ miles long and 1 mile wide. Other smaller masses also mapped in western part of South Park.

Little Brazos Limestone Lentil (in Claiborne Group)[1]

Eocene, middle: Eastern central Texas.

Original reference: B. C. Renick and H. B. Stenzel, 1931, Texas Univ. Bull. 3101, p. 78, 92.

Well exposed along Little Brazos River about 1.4 miles northeast of Bryan Junction, Brazos County.

Little Butte Volcanic Series

Oligocene(?): Southwestern Oregon.

F. G. Wells, 1956, U.S. Geol. Survey Geol. Quad. Map GQ–89. Name applied to a volcanic series, about 3,000 feet thick, that overlies Coleston formation (new) and is capped by Heppsie andesites (new) of Miocene(?) age. Comprises two sequences: lower, Wasson formation, and upper, Roxy formation (both new).

Well exposed in valley of Little Butte Creek, Jackson County.

†Little Cabin Sandstone Member (of Cherokee Formation)[1]

Pennsylvanian: Southern Kansas and northwestern Oklahoma.

Original reference: C. L. Cooper, 1928, Oklahoma Univ. Bull., Proc. Oklahoma Acad. Sci., v. 7, p. 160–164.

W. B. Howe, 1956, Kansas Geol. Survey Bull. 123, p. 33. Replaced by term Warner sandstone.

Named for exposures along west bank of Little Cabin Creek, Craig County, Okla.

Little Chain Limestone (in McLeansboro Formation)

Pennsylvanian: Southeastern Illinois.

J. A. Culbertson, 1932, The paleontology and stratigraphy of the Pennsylvanian strata between Caseyville, Kentucky, and Vincennes, Indiana: Urbana, Ill., Univ. Illinois, Abs. Thesis, p. 3, 8. Thin ferruginous limestone. Occurs 35 feet above New Haven limestone.

Named from its outcrop at north end of Little Chain Hills, 6 miles northeast of New Haven.

Little Chief Porphyry[1]

Mesozoic: Southeastern California.

Original references: F. M. Murphy, 1930, Econ. Geology, v. 25, p. 311; 1933, California Div. Mines Rept. 28 of State Mineralogist July-Oct., 1932, p. 351, map.

C. W. Jennings, 1958, Geologic map of California (1:250,000) Death Valley Sheet: California Div. Mines. Mapped with Mesozoic granite rocks.

Inyo County, Death Valley region.

Little Chief Canyon Member (of Lodgepole Limestone)

Lower Mississippian: Central Montana.

M. M. Knechtel, J. E. Smedley, and R. J. Ross, Jr., 1954, Am. Assoc. Petroleum Geologists Bull., v. 38, no. 11, p. 2395–2399. Thin conodont-bearing fissile black shale at base of Lodgepole limestone. Thickness about 1½ feet. In sharp contact with overlying thinly bedded limestone, and rests with equally sharp contact on light-gray blocky clay.

Type locality: Little Chief Canyon of Lodgepole Creek, N½ sec. 27, T. 26 N., R 25 E., Blaine County, about 3½ south-southwest of Lodgepole Subagency of the Fort Belknap Indian Reservation.

Little Clarksburg cyclothem

Pennsylvanian (Conemaugh series): Southeastern Ohio.

M. T. Sturgeon and others, 1958, Ohio Geol. Survey Bull. 57, p. 94 (table 11), 114 (map 18), 151–153. Embraces interval between Elk Lick cyclothem (new) below and Lower Little Pittsburgh cyclothem (new) above. Normal succession includes six members (ascending): Morgantown redbed, Morgantown shale and sandstone, Clarksburg redbed, Clarksburg limestone, Clarksburg underclay, and Little Clarksburg coal. Average thickness about 60 feet. In area of this report, Conemaugh series is discussed on cyclothemic basis; 15 cyclothems are named. [For sequence see Mahoning cyclothem.]

Members of cyclothem occur in discontinuous distribution in Alexander, Ames, Canaan, Dover, and Lodi Townships, Athens County.

Little Clarksburg Limestone (in Conemaugh Formation)[1]

Pennsylvanian: Western Pennsylvania.

Original reference: B. L. Miller, 1925, Pennsylvania Geol. Survey, 4th ser., Bull. M–7, p. 250.

Little Compton Shales[1]

Precambrian: Southeastern Rhode Island.

Original reference: A. F. Foerste, 1899, U.S. Geol. Survey Mon. 33, p. 281–283, 383.

Extends from Browns Point to south side of Pachet Brook southward within one-half mile of road running north from Little Compton, Newport County, thence westward.

Little Cottonwood Granite[1]

Little Cottonwood Quartz Monzonite

Upper Cretaceous or lower Tertiary: Central northern Utah.

Original references: S. F. Emmons, 1903. Am. Jour. Sci., 4th, v. 16, p. 141–147; F. F. Hintze, Jr., 1913, New York Acad. Sci. Annals, v. 23, p. 85–143.

F. C. Calkins and B. S. Butler, 1943, U.S. Geol. Survey Prof. Paper 201, p. 38–43. Little Cottonwood quartz monzonite incidentally mentioned. Most of discussion is quartz monzonite of Little Cottonwood stock.

Exposed in Little Cottonwood Canyon.

Little Creek Breccia Member (of Quichapa Formation)

Tertiary: Southwestern Utah.

E. F. Cook, 1960, Utah Geol. and Mineralog. Survey Bull. 70, p. 18 (fig. 1), 40. Andesitic flows and breccia. Massive flow rock is dark red to dark purple and black; in addition to these colors, the brecciated rock is gray, olive green, and brown. Maximum thickness 1,200 feet. Overlies Bauers tuff member; underlies Harmony Hills tuff member. Name credited to H. R. Blank, unpublished thesis.

Area of report is Washington County.

Little Dry Glaciation

Little Dry Glacial Stage[1]

Pleistocene: Northwestern Utah and southwestern Wyoming.

Original reference: W. H. Bradley, 1936, U.S. Geol. Survey Prof. Paper 185–I, p. 194–195.

Ernst Antevs, 1945. Am. Jour. Sci., v. 243–A, p. 24, table 2. Nebraskan.

Named for Little Dry Creek, northeastern Utah.

Little Elk Gneissoid Granite

Little Elk Creek Gneissoid Granite

Precambrian: Western South Dakota.

G. L. Taylor, 1935, Am. Jour. Sci., 5th ser., v. 29, no. 171, p. 283–284. Light-gray medium-grained gneissoid granite. Intruded Precambrian sediments. Field evidence did not indicate relative ages of Little Elk, Game Lodge granite (new), Harney Peak granite, or igneous amphibolites.

J. R. Berg, 1946, South Dakota Geol. Survey Rept. Inv. 52, p. 5. Referred to as Little Elk Creek gneissoid granite.

Occurs in valley of Little Elk Creek in Galena-Roubaix district, northern Black Hills.

Little Falls Dolomite[1]

Upper Cambrian: East-central and eastern New York.

Original reference: J. M. Clarke, 1903, New York State Mus. Hdb. 19, p. 16, chart.

John Rodgers, 1937, Geol. Soc. America Bull., v. 48, no. 11, p. 1576. Discussion of upper Champlain Valley. Name Little Falls proposed by Clarke (1903) for pre-Tribes Hill Calciferous of Mohawk Valley. Ulrich and Cushing (1911, New York State Mus. Bull. 140) extended name into Champlain Valley to include all of Division A and part of Division B, of Brainerd and Seely (1890, Am. Mus. Nat. History Bull., v. 3). There is a significant unconformity 35 feet below base of Division B, and this break seems to correspond with break above the Little Falls in Mohawk Valley. Beds of Division B together with upper 35 feet of Division A are here named Whitehall formation.

R. H. Wheeler, 1941, (abs.) Geol. Soc. America Bull., 52, no. 12, pt. 2, p. 1938–1939. Cambro-Ordovician correlations revised in Champlain, Hudson, Mohawk, and St. Lawrence Valleys. Revisions involve definitions and successions of previously accepted Cambro-Ordovician formations (Upper Cambrian Potsdam, Theresa, Hoyt, and Little Falls and Lower Ordovician Whitehall, Tribes Hill, and Beekmantown). "Typical" Theresa is physically and faunally differentiated from "Upper Theresa" (now Heuvelton member of Tribes Hill formation); Hoyt fauna occurs in lower half of emended Whitehall formation above Little Falls dolomite; a new upper (Skene) member of Whitehall formation represents late Cambrian offlap; two marine cycles, represented by Tribes Hill formation (containing the Norton-Heuvelton, Fort Ann-Bucks Bridge, Benson-Ogdensburg members) and the Cassin formation, constitute the Beekmantown series. Oneota, Stonehenge, Van Buren, and Gasconade faunas occur in Tribes Hill formation, not in Little Falls as generally believed. Each revised unit is tied in with Divisions A through E of original "Calciferous" formation (Brainerd and Seely, 1890).

R. H. Wheeler, 1942, Am. Jour. Sci., v. 240, no. 7, p. 522–523. Base of Whitehall formation is raised to coincide with contact of Little Falls dolomite and Hoyt limestone, and latter is redefined as a lower member of Whitehall formation. At corrected Skene Mountain section, Little Falls formation, about 210 feet thick, overlies Theresa formation.

D. W. Fisher and G. F. Hanson, 1951, Am. Jour. Sci., v. 249, no. 11, p. 795–813. Evidence presented to substantiate radical change in interpretation of Paleozoic stratigraphy of Saratoga Springs, region, New York. Previously accepted sequence of beds (Potsdam sandstone, Theresa formation, Hoyt limestone, Little Falls dolomite, Amsterdam limestone, Trenton limestone, Canajoharie shale) is revised to read Potsdam sandstone, Galway formation, Hoyt limestone, Ritchie limestone (new) Mosherville sandstone (new), Gailor dolomite (new), Lowville limestone, Amsterdam limestone, Trenton limestone (Rockland(?), Hull, Sherman Fall representatives) and Canajoharie shale. Term "Theresa" is not applicable in this area; hence, name Galway is reintroduced for strata younger than Potsdam and older than Hoyt. Lower Ordovician beds have been traced into Saratoga region from Mohawk Valley and constitute most of dolomite which has heretofore been regarded as Little Falls dolomite (Upper Cambrian). Wheeler was first to suggest that long-accepted stratigraphy of region was not true one. He stated that Hoyt limestone overlay Little Falls dolomite in Saratoga region and that the dolomite which overlay the Hoyt was a younger formation to which he applied name Skene. He classified Hoyt limestone as basal member of the Whitehall and Skene as upper member, the latter being a very late Upper Cambrian offlapping unit. He mistook Ordovician Gailor dolomite for the older Little Falls dolomite, for the Hoyt and his supposed "Little Falls" are in fault contact in his "unfaulted" area 4 miles west of Saratoga Springs. Tracing of Little Falls dolomite from its type locality at Little Falls, eastward into Saratoga region shows that it is absent there as such, but that its correlatives are facies equivalents, namely, Potsdam sandstone, Galway formation, and perhaps even a part of Hoyt limestone. Little Falls dolomite (restricted) thus represents an offshore, more carbonate phase of the aforementioned formations. Absence of these formations within Mohawk Valley further corroborates this interpretation; wherever exposed, the Little Falls rests directly on the Precambrian.

Named for exposures at pass in Mohawk Valley at Little Falls, Herkimer County.

Little Genesee Conglomerate[1]

Upper Devonian: Southwestern New York.

Original reference: C. S. Prosser, 1892, Rochester Acad. Sci. Proc., v. 2, p. 55, 57, 93, 94, 96.

Exposed north of Little Genesee, Allegany County.

†Little Grizzly Creek Beds[1]

Pennsylvanian: Northern California.

Original reference: H. W. Turner, 1894, Am. Geologist, v. 13, p. 230–231.

Occur by road to Cascade gravel mine and to east of Little Grizzly Creek at southwestern base of Mount Ingalls, Plumas County.

Little Hominy Limestone Member (of Pawhuska Limestone)[1]

Pennsylvanian (Virgil Series) : Northeastern Oklahoma.

Original reference: K. C. Heald and K. F. Mather, 1919, U.S. Geol. Survey Bull. 686–M, p. 150, 152.

M. C. Oakes, 1959, Oklahoma Geol. Survey Bull. 81, p. 49, 50. Pawhuska formation, in Osage County, comprises (ascending) Lecompton, Plummer, Deer Creek, Little Hominy, Pearsonia, and Turkey Run members. Only Lecompton and Turkey Run continue across Pawnee County and into Creek County [this report].

Named for outcrops on Little Hominy Creek in southwestern part of T. 25 N., R. 8 E., Osage County.

†Littlehorn Limestone[1]

Lower Mississippian: Northern Wyoming.

Original reference: N. H. Darton, 1904, Geol. Soc. America Bull., v. 15, p. 394–401.

Named for exposures in Little Horn Canyon on east side of Bighorn Mountains.

Little Kaw Limestone Member[1] (of Stanton Formation)

Pennsylvanian (Missouri Series) : Northeastern Kansas.

Original references: R. C. Moore, M. K. Elias, and N. D. Newell, 1934, Stratigraphic sections of Pennsylvanian and "Permian" rocks of Kansas River valley: Kansas Geol. Survey, issued Dec.; R. C. Moore, 1935, Rock formations of Kansas *in* Kansas Geol. Soc.: Wichita, Kans., [Am. Assoc. Petroleum Geologists 20th Ann. Mtg., Mar. 21–23]; N. D. Newell, 1935, Kansas Geol. Survey Bull. 21, pt. 1, p. 76–79.

H. S. McQueen and F. C. Greene, 1938, Missouri Geol. Survey and Water Resources, 2d ser., v. 25, pl. 5. Shown on chart of Pennsylvanian formations in Missouri as South Bend or Little Kaw limestone.

Named for Little Kaw Creek, north of Lorgin, Leavenworth County.

Little Medicine Member (of Goose Egg Formation)

Little Medicine Tongue (of Dinwoody Formation)[1]

Lower Triassic: South-central Wyoming.

Original reference: H. D. Thomas, 1934, Am. Assoc. Petroleum Geologists Bull., v. 18, no. 12, p. 1664, 1669.

H. A. Tourtelot, 1953, U.S. Geol. Survey Oil and Gas Inv. Map OM–124. In southeastern Big Horn Mountains, about 25 feet thick and consists of thin beds of gypsum and dolomite resting on red siltstone of a westward-extending tongue of Chugwater.

U.S. Geological Survey currently classifies the Little Medicine as a member of Goose Egg Formation on basis of a study now in progress.

Type locality: Along north bank of Little Medicine Bow River (locally known as Little Medicine) in Flat Top anticline 8 miles north of town of Medicine Bow on road from Medicine Bow to Casper.

Little Missouri Lens (in Newcastle Formation)

Upper Cretaceous: Northeastern Wyoming.

R. M. Grace, 1952, Wyoming Geol. Survey Bull. 44, p. 14, 15. Predominantly siltstone and shale. Maximum thickness 80 feet. Lies north and east of New Haven lens (new).

Occurs on north bank of Little Missouri River, Crook County. Outcrop extends almost to Wyoming-Montana State line and has lateral extent of 15 miles.

Little Missouri Lignites or Ligneous Shales[1]

Eocene: Southwestern Arkansas.

Original reference: R. T. Hill, 1888, Arkansas Geol. Survey Ann. Rept. 1888, v. 2, p. 50, 188.

Occurs at mouth of Little Missouri.

Little Natches Member (of Cook Mountain Formation)

Eocene (Claiborne): Northwestern Louisiana.

J. Huner, Jr., 1939, Louisiana Dept. Conserv. Geol. Bull. 15, p. 87, 101-109, pls. 3, 8 (fig. 2). Consists of a series of sands and shales with weathered zones of greensand and calcareous shale in lower part; sands and lignitic chocolate-brown shales in upper part differ little from overlying Cockfield except that sands contain casts of macrofossils and the shale contains agglutinated types of foraminifers. Thickness in southern part of Winn Parish 60 to 70 feet; in northern part, thickness approximately 50 feet, and here shales with irregular zones of fossiliferous ironstone replace the fossiliferous sands that are present farther south. Overlies Saline Bayou member.

Type section: Southwest corner of NE¼NE¼ sec. 15, T. 9 N., R. 6 W., Winn Parish, along U.S. Highway 71, about a quarter mile southeast of Little Natches Bayou.

Little Oak Limestone[1]

Middle Ordovician: North-central Alabama.

Original reference: Charles Butts, 1926, Alabama Geol. Survey Spec. Rept. 14, p. 112, map.

G. A. Cooper, 1956, Smithsonian Misc. Colln., v. 127, pt. 1, p. 74–75. Consists of thick-bedded dark nodular limestone with nodular chert; in St. Clair County, contains two layers of metabentonite. Maximum thickness 500 feet. Near Siluria, thinned edge of formation rests on black shale of Columbiana formation; along Cahaba Valley, thickens enormously and rests on Lenoir formation.

Named for exposures on west front of Little Oak Ridge, south of Leeds, Jefferson County.

Little Osage Member (of Fort Scott Formation)

Pennsylvanian (Des Moines Series): Eastern Kansas, southwestern Iowa, northwestern Missouri, and northeastern Oklahoma.

J. M. Jewett, 1941, Kansas Geol. Survey Bull. 38, pt. 11, p. 306–309, pl. 1. Name applied to the shale, coal bed, and limestone bed that lie between Blackjack Creek limestone member below and Higginsville limestone member above. Thickness in Kansas about 5 to 11 feet. Includes Houx limestone bed near top.

F. C. Greene and W. B. Howe, 1952, Missouri Geol. Survey and Water Resources Inf. Circ. 8, p. 19. Columnar section shows the Little Osage as containing (ascending) Summit coal, Houx limestone, Blackwater Creek shale, and Flint Hills sandstone.

M. C. Oakes, 1952, Oklahoma Geol. Survey Bull. 69, p. 22, 24 (fig. 2). Geographically extended into northeastern Oklahoma.

Type exposure: In northeast part of SE sec. 2, T. 24 S., R. 25 E., Bourbon County, Kans., on south valley wall of Little Osage River.

Little Pavlof Agglomerate

Quaternary: Southwestern Alaska.

G. C. Kennedy and H. H. Waldron, 1947, U.S. Geol. Survey Alaskan Volcano Inv. Rept. 2, pt. 2, pl. 2. Includes many interbedded lava flows. Name appears only on geologic map legend.

Mapped on western slope of Little Pavlof Volcano, Alaska Peninsula.

Little Pawnee Shale Member (of Cass Formation)

Pennsylvanian (Virgil Series): Southeastern Nebraska.

G. E. Condra, 1949, Nebraska Geol. Survey Bull. 16, p. 29. Name applied to middle member of formation. Upper part of member is bluish gray; middle part is dark and somewhat fissile; lower part dark gray and fossiliferous; combined thickness 1½ to 1¾ feet. Underlies Haskell limestone member; overlies Shoemaker limestone member.

Type locality: Little Pawnee Creek valley in SE sec. 9, T. 12 N., R. 10 E., Saunders County.

†Little Pine Ridge Sandstone[1]

Upper Cretaceous: Central Wyoming.

Original reference: C. E. Jamison, 1912, Wyoming State Geologist, ser. B., Bull. 4.

Forms Little Pine Ridge, east of Salt Creek oil field, Natrona County.

†Little Pittsburgh Limestone (in Conemaugh Formation)[1]

Pennsylvanian: Western Pennsylvania, Maryland, and northern West Virginia.

Original reference: F. Platt, 1877, Pennsylvania Geol. Survey Rept. H_5, p. 55–104.

Northwestern part of Allegheny County, Pa.

Little Pittsburgh Member (of Conemaugh Formation)[1]

Pennsylvanian: Western Pennsylvania.

Original reference: M. E. Johnson, 1929, Pennsylvania Geol. Survey Topog. and Geol. Atlas 27, p. 31.

Pittsburgh quadrangle.

Little Pittsburgh Underclay

Pennsylvanian: West Virginia.

W. A. Tallon and R. G. Hunter, 1959, West Virginia Geol. Survey Rept. Inv. 17, p. 13. Little Pittsburgh underclay immediately underlies Little Pittsburgh coal. Average thickness 3 feet.

Little River Gneiss

Precambrian: Southwestern Virginia.

R. V. Dietrich, 1959, Virginia Polytech. Inst. Bull., Engineering Expt. Sta. Ser. 134, p. 58–69, pl. 1. Chiefly highly sheared blue quartz augen gneiss plus or minus feldspar augen. Appears to be mixed with rocks of Blue Ridge complex and to grade upward into rocks mapped as Lynchburg formation (may not be correlative with type locality Lynchburg). Contact with complex poorly defined. Contact with Lynchburg consists of intercalated layers or rock essentially identical with those of either side of zone plus a few layers of rock intermediate in composition. May be same age as Willis phyllite (new); locally grades into Alum phyllite (new). Absolute, relative, and geologic age data suggest that Little River gneiss and rocks mapped as belonging to Lynchburg formation once belonged to same sedimentary sequence and are of pre-late Precambrian.

Well exposed along eastern side of Route 102, just south of County Road 619 W and in quarry on east side of Route 8, approximately 1.1 miles south of Little River bridge at Floyd-Montgomery county line.

Little River Series

Paleozoic(?): Northeastern Georgia.

A. L. Peyton and H. E. Cofer, Jr., 1950, U.S. Bur. Mines Rept. Inv. 4664, p. 4–5. Undifferentiated metamorphic series considered to be of volcanic and sedimentary origin. Consists of sericitic, chloritic, and amphibole-pyroxene rocks, all of which have been considerably silicified and otherwise altered; subdivided into three general types: mica schist, garnet-mica schist, and weakly to nonschistose amphibole-pyroxene rocks.

G. W. Crickmay, 1952, Georgia Geol. Survey Bull. 58, p. 31–33. Little River series is a complex group of sedimentary, extrusive, and intrusive rocks of distinctly younger age than the surrounding more highly metamorphosed schists and gneisses of Carolina series. Of the metamorphic rocks of the State, this series alone may be Paleozoic, but its relationships to known Paleozoic slates further north (Quantico and Arvonia) are unknown. Biotite phyllite occurs in northern Wilkes County where series is intruded by Elberton granite.

Exposed along Little River in Wilkes, Lincoln, and McDuffie Counties. Occupies three separate belts that unite in South Carolina to form the so-called Carolina shale belt.

Little Rock Creek Limestone

Devonian: Northwestern Indiana.

G. A. Cooper, 1941, Washington Acad. Sci. Jour., v. 31, no. 5, p. 181. Proposed for the gray brittle conchoidally fracturing limestone above the Logansport; contains fauna including a large *Chonetes*. Thickness 7 feet.

Exposed on Little Rock Creek above road crossing 1 mile above Lockport, Carroll County.

Little Saline Limestone[1]

Lower Devonian: Eastern Missouri and southwestern Illinois.

Original reference: C. L. Dake, 1918, Missouri Bur. Geology and Mines, v. 15, 2d ser., p. 88, 174.

E. B. Branson, 1944, Missouri Univ. Studies, v. 19, no. 3, p. 118–120. Thick-bedded pure crystalline limestone nearly white in color or with slightly pinkish tinge. Crinoidal bed near top. Two bryozoan beds present in upper half. Thickness about 100 feet. Overlies Bailey limestone; underlies Grand Tower formation.

Named for exposures at quarries of Ozora Marble Company, in east bank of Little Saline Creek, just south of bend in stream from northerly to easterly direction, a little less than 1½ miles west of road crossing south of Ozora, Ste. Genevieve County, Mo.

Littles Corner Limestone Member[1] (of Hayfield Shale)

Devonian or Carboniferous: Northwestern Pennsylvania.

Original reference: K. E. Caster, 1933, Geol. Soc. America Bull., v. 44, pt. 1, p. 202.

Wallace de Witt, Jr., 1946, U.S. Geol. Survey Oil and Gas Inv. Prelim. Chart 21. Cussewago limestone of White (1881), renamed Hayfield by Chadwick (1925) and redefined as Littles Corner(s) by Caster, is described as occurring in this shale [Bedford] in outcrop at Bartholomew quarry (outcrop 15 of this report). Examination of exposure shows two siliceous limestones, one in lower part of the Berea and the other in middle of the Cussewago. Either of these limestones may have been called Littles Corners, but no limestone occurs in Bedford shale. Validity of Littles Corners limestone is questioned. Term Hayfield is invalid because unit has been found to be Bedford shale in present investigation.

Named for village of Littles Corner in Cussewago Valley, Crawford County.

Little Shades Sandstone Member (of Parkwood Formation)

Mississippian (Chester): Alabama.

R. B. Morton, 1949, Mississippi Geol. Soc. Guidebook 7th Field Trip, p. 37, 38, 40. Shown on stratigraphic section as sandstone in basal part of Parkwood formation. Occurs above Floyd shale.

Present in Birmingham Valley.

Little Sheep Mudstone Member (of Cloverly Formation)

Lower Cretaceous: Northwestern Wyoming.

R. M. Moberly, Jr., 1958, Dissert. Abs., v. 18, no. 1, p. 198. Proposed for lowest of three members of redefined Cloverly. Consists chiefly of bentonitic (montmorillonitic) mudstones in variegated shades of neutral gray, purple, dusky and pale red, and olive. Other typical lithologies include bentonites, cherts, coaly beds, calcareous nodules, and chert-pebble conglomeratic sandstones. Underlies Lovell member (new); conformably overlies Morrison formation.

Ralph Moberly, Jr., 1960, Geol. Soc. America Bull., v. 71, no. 8, p. 1139 (fig. 1), 1143 (fig. 2), 1145–1147, 1151 (fig. 5), pl. 1. Series of bentonitic mudstones, commonly containing some chert-pebble sandstone lenses and beds of a few other lithologies. Thickness 250 feet at type locality. Underlies Himes member (new) and locally overlies Pryor conglomerate member; overlies Morrison formation. In this report [northern Bighorn Basin], Cloverly formation is redefined on lithogentic basis.

Type locality: Sec. 36, T. 56 N., R. 95 W., on northeast flank of Little Sheep Mountains, about 4 miles south-southwest of Kane, Big Horn County.

Little Sitkin Dacite

Quaternary: Southwestern Alaska.

G. L. Snyder, 1959, U.S. Geol. Survey Bull. 1028–H, p. 181–183, pl. 23. Lavas ranging in composition from andesite to rhyodacite, but 90 percent by volume estimated to be low-silica dacite. Most rocks are black glassy to crypto-crystalline dacite. A few massive light-gray nonporphyritic andesites interbedded with other lava. At least 300 feet of dacite exposed in cliffs on Pratt Point and near crater of Little Sitkin volcano. Estimated maximum thickness 1,000 feet. Two members, Pratt Point (new) and West Cove (new), mapped separately from bulk of Little Sitkin dacite. Except for surficial deposits, Little Sitkin dacite overlies all other rocks on island.

Type section: Exposure in crater rim of Little Sitkin volcano at lat 50°57'2'' N., long 178°32'57'' E., Little Sitkin Island, in Rat Islands group of Aleutian Islands. Widespread on east and south sides of volcano.

Littleton Formation[1]

Lower Devonian: Central and southern New Hampshire, north-central Massachusetts, and southeastern Vermont.

Original reference: C. P. Ross, 1923, Am. Jour. Sci., 5th ser., v. 5, p. 267–302.

C. R. Williams and M. P. Billings, 1938, Geol. Soc. America Bull., v. 49, no. 7, p. 1015–1019. Extended to include Talford schist in Franconia quadrangle, New Hampshire.

M. P. Billings and others, 1946, Geol. Soc. America Bull., v. 57, no. 3, p. 263–266, pl. 1. Subdivided. Contains three mappable units in Mount Washington quadrangle, New Hampshire; middle one which lies about 1,400 feet above base of formation named Boott member.

J. B. Hadley, 1949, Bedrock geology of the Mount Grace quadrangle, Massachusetts: U.S. Geol. Survey Geol. Quad. Map [GQ–3]. Geographically extended to Massachusetts.

G. E. Moore, Jr., 1949, Geol. Soc. America Bull., v. 60, no. 10, p. 1629–1633, 1635, pl. 1. Geographically extended to Vermont. Occurs in limited area west of Connecticut River.

Jacob Freedman, 1950, Geol. Soc. America Bull., v. 61, no. 5, p. 453 (fig. 2), 459–464, pl. 1. Contains Gove member (new) near base in Mount Pawtuckaway quadrangle, New Hampshire.

M. T. Heald, 1950, Geol. Soc. America Bull., v. 61, no. 1, p. 45–55, pl. 1. Subdivided in Lovewell Mountain quadrangle, New Hampshire. Consists of three members (ascending): Hubbard Hill, May Pond, and Dakin Hill.

M. T. Heald, 1955, Geology of the Gilmanton quadrangle, New Hampshire: Concord, New Hampshire State Plan. Devel. Comm., p. 8–9, 10, 11, map. Subdivided in Gilmanton quadrangle, New Hampshire. Includes Pittsfield member near middle, Jenness Pond member near top, and Durgin Brook member at top.

M. P. Billings, 1955, Geologic map of New Hampshire (1:250:000): U.S. Geol. Survey. Stratigraphically restricted. Gove member reallocated to Berwick formation.

M. P. Billings, 1956, Geology of New Hampshire, pt. 2, Bedrock geology: Concord, New Hampshire State Plan. Devel. Comm., p. 27–35, 42, 93–94. Complex lithologic variations in metamorphic zones discussed. Maximum thickness about 10,000 feet.

Type locality: Around Slate Ledge, Walker Mountain and district, 1 mile to southwest in Littleton Township, Grafton County, N.H.

Littleton Member (of Cedar Valley Limestone)[1]

Upper Devonian: Eastern Iowa.

Original reference: C. L. Fenton and M. A. Fenton, 1930, Am. Mid. Nat., v. 12, no. 1, p. 12–13.

M. A. Stainbrook, 1944, Illinois Geol. Survey Bull. 68, p. 182, 185. Middle member of Cedar Valley. Overlies Linwood member; underlies Coralville member.

Named for occurrence near Littleton, Buchanan County.

†Little Traverse Group[1]

Middle Devonian: Michigan.

Original reference: A. Winchell, 1871, Michigan Geol. Survey Rept. Prog., p. 26–33.

Crops out at Little Traverse Bay and Grand Traverse, Lower Peninsula.

Little Traverse Bay Limestone[1]

Middle Devonian: Michigan.

Original reference: C. C. Douglass, 1839, Michigan Leg. H. Doc. 27, p. 97–111.

Occurs on shores of Little Traverse Bay, northwestern part of Lower Peninsula.

Little Union Quartz Latite

Tertiary, upper, or lower Pleistocene(?): Colorado.

C. H. Behre, Jr., E. N., Goddard, and E. A. Sandberg, 1939, Preliminary geologic map of west slope of Mosquito Range in vicinity of Leadville, Colorado (1:12,000): U.S. Geol. Survey; C. H. Behre, Jr.. 1939, Colorado Sci. Soc. Proc., v. 14, no. 2, p. 66–67. Rhyolite and quartz latite group of west slope of Mosquito Range includes two members, Little Union quartz latite and a rhyolite that occurs mainly as agglomerate.

C. H. Behre, Jr., 1953, U.S. Geol. Survey Prof. Paper 235, p. 58–59, pls. Occurs as two bodies, one near head of Little Union Gulch and the other 1½ miles west of Empire Gulch. Where fresh, light grayish brown; weathers to darker color with rusty spots. Tertiary or perhaps very early Pleistocene.

Named for occurrence in Little Union Gulch, one-half mile south of ranch-house on Hatch Ranch, west slope of Mosquito Range, near Leadville, Lake County.

Little Valley Formation

Upper Jurassic[?] or Cretaceous[?]: Northern California.

J. E. Lawton, 1956, Dissert. Abs., v. 16 no. 10, p. 1885. Listed as underlying Davis Creek formation and overlying Crack Canyon formation (both new). Comprises Round Mountain member above and Leesville member (both new). Upper Jurassic and Cretaceous section, 40,000 feet thick, consists of sequence of shale and silty shale which alternate with sequences of sandstone.

Occurs in Morgan-Wilbur area in Lake, Yolo, and Colusa Counties.

†Little Valley Limestone or Formation

Upper Mississippian: Southwestern Virginia.

Paul Averitt, 1941, Virginia Geol. Survey Bull. 56, p. 17–21. Name applied to limestone of Warsaw age that occurs below St. Louis limestone and above Maccrady shale (restricted). Consists of an upper dark-colored unit 100 to 150 feet thick that is generally divided into two parts by beds of argillaceous limestone, and a lower argillaceous and fossiliferous limestone unit approximately 500 feet thick that contains two distinct zones of sandstone.

B. N. Cooper, 1945, Virginia Geol. Survey Bull. 66, p. 69–70. In Tazewell County, Little Valley formation underlies Hillsdale limestone. Thickness about 75 feet. Approximately 2,500 feet stratigraphically above Tonoloway and 4,200 feet above Moccasin formation.

R. H. Wilpolt and D. W. Marden, 1949, U.S. Geol. Survey Oil and Gas Inv. Prelim. Chart 38, sheet 1. Abandoned by U.S. Geological Survey. Considered equivalent to the part of the Greenbrier limestone underlying the Hillsdale member.

Named for typical exposure in Little Valley, Scott County.

Littel Vermilion cyclothem (in Mattoon Formation)

Little Vermilion cyclothem (in McLeansboro Group)

Pennsylvanian: Northern Illinois.

J. M. Weller *in* C. L. Cooper, 1946, Illinois Geol. Survey Bull. 70, p. 14, 16 (fig. 2). A cyclothem overlying LaSalle cyclothem. Includes Litttle Vermilion limestone.

H. R. Wanless and Raymond Siever, 1956, Illinois Geol. Survey Circ. 217, p. 12, pl. 1. Type locality stated.

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 53 (table 2), pl. 1. In Mattoon formation (new). Presentation of new rock-stratigraphic classification of Pennsylvanian strata in Illinois; cyclical classification independent of rock-stratigraphic classification.

Type locality: SW¼SW¼ sec. 11, T. 33 N., R. 1 E., La Salle County.

Little Vermilion Limestone Member (of Mattoon Formation)

Little Vermilion Limestone (in McLeansboro Group)

Pennsylvanian: Northern Illinois.

J. M. Weller *in* C. L. Cooper, 1946, Illinois Geol. Survey Bull. 70, p. 14. Included in Little Vermilion cyclothem in McLeansboro group.

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 41, 51 (table 1), pl. 1. Reallocated to member status in Mattoon formation (new). Only named member of formation in area. Presentation of new rock-stratigraphic classification of Pennsylvanian strata in Illinois; cyclical classification independent of rock-stratigraphic classification.

Type locality: SW¼SW¼ sec. 11, T. 33 N., R. 1 E., La Salle County.

Little Wabash Sandstone (in McLeansboro Formation)

Pennsylvanian: Southeastern Illinois and southwestern Indiana.

J. A. Culbertson, 1932, The paleontology and stratigraphy of the Pennsylvanian strata between Caseyville, Kentucky, and Vincennes, Indiana: Urbana, Ill., Univ. Illinois, Abs. Thesis, p. 3, 7–8. Coarse, massive sandstone. Overlies a coal about 140 feet above New Haven limestone.

Named because of its prominence along bluffs of Little Wabash River between Concord and New Haven, Ill.

Little Washington cyclothem

Permian (Washington Series): Southeastern Ohio.

M. T. Sturgeon and others, 1958, Ohio Geol. Survey Bull. 57, p. 203 (table 14), 210–213. Embraces interval between Waynesburg "A" cyclothem (new) below and Washington cyclothem above. Thickness about 52½ feet. Includes (ascending) Mannington shale and sandstone, redbed, fresh-water limestone, underclay, Little Washington coal, and Little Washington roof shale members. In some areas, poorly defined and hard to demonstrate owing to coalescing of Mannington and Waynesburg sandstones. In area of this report, Washington series is discussed on cyclothemic basis; four cyclothems are named. [For sequence see Elm Grove cyclothem.]

Present in Athens County.

Little Washington roof shale member

See Little Washington cyclothem.

Little Waynesburg cyclothem

Pennsylvanian (Monongahela Series): Southeastern Ohio.

M. T. Sturgeon and others, 1958, Ohio Geol. Survey Bull. 57, p. 158 (table 13), 185–186, 187 (table 25). Embraces interval between Uniontown cyclothem (new) below and Waynesburg cyclothem (new) above. Succession includes six members (ascending): Uniontown sandstone, redbed, Waynesburg limestone, Little Waynesburg underclay, Little Waynesburg coal, and Little Waynesburg roof shale. Consists almost entirely of Uniontown sandstone and the redbed members which grade laterally into each other. Thickness 26 to 45 feet. In area of this report, Monongahela series is discussed on a cyclothemic basis; 12 cyclothems are named. [For sequence see Pittsburgh cyclothem.]

Extensive in Bern, Rome, and Carthage Townships, in hilltops in eastern part of Lodi Township, and along valley of Hocking River and its tributaries in Troy Township, Athens County.

Little Waynesburg rider cyclothem

Pennsylvanian (Monongahela Series): Southeastern Ohio.

M. T. Sturgeon and others, 1958, Ohio Geol. Survey Bull. 57, p. 188. A thin cyclothem, complete to sandstone and redbed members, lying between Little Waynesburg and Waynesburg coal beds.

Discussed in report on Athens County.

Little Waynesburg roof shale member

See Little Waynesburg cyclothem.

Little Waynesburg underclay member

See Little Waynesburg cyclothem.

Little White River Beds[1]

Little White River Formation

Pliocene (Clarendonian): Central southern South Dakota.

Original reference: C. C. O'Harra, 1920, South Dakota Geol. Survey Bull. 13, p. 36.

H. E. Wood, 2d, and others, 1941, Geol. Soc. America Bull., v. 52, no. 1, pl. 1. Shown on correlation chart as Little White River formation; unconformable above Miocene Rosebud beds.

Occurs in Little White River valley and valley of the Niobrara.

Little Willow Series

Precambrian: Central northern Utah.

A. E. Granger and others, 1952, Utah Geol. Soc. Guidebook 8, p. 3, pl. 1. Sequence of strongly folded gneissic quartzites, quartz-mica schists and stretched-pebble schists, intruded by basic igneous rocks now altered to amphibolites and chlorite-amphibole schists. Oldest rocks exposed in core of Uinta arch structure. Unconformably underlies Big Cottonwood series.

R. E. Cohenour, 1959, Intermountain Assoc. Petroleum Geologists Guidebook 10th Ann. Field Conf., p. 34, 36, 37 (fig. 2). Precambrian rocks of western Uinta Mountains and central and northern Wasatch Mountains are divisible into two main groups. Older group is subdivided into two sequences: the older, Farmington Canyon complex, and the younger, Little Willow series. The Little Willow differs from Farmington Canyon in that it contains abundant basic rocks and no potash pegmatites. Underlies Big Cottonwood series.

In Little Willow Creek, just north of Little Cottonwood Canyon, in Wasatch Mountains, east of Salt Lake City.

Livengood Chert[1]

Mississippian: East-central Alaska.

Original reference: J. B. Mertie, Jr., 1926, Washington Acad. Sci. Jour., v. 16, no. 3, p. 79.

J. T. Dutro, Jr., and T. G. Payne, 1957, Geologic map of Alaska (1:2,500,000): U.S. Geol. Survey. Appears on map legend.

Exposed in vicinity of Livengood, on Livengood Creek and at Livengood dome, Yukon-Tanana region.

Liveoak Member (of Tejon Formation)

Eocene, middle(?): Southern California.

J. G. Marks, 1941, (abs.) Geol. Soc. America Bull., v. 52, no. 12, pt. 2, p. 1922. Listed as member of Tejon formation in type area of Tejon. Thickness 1,970 feet. Underlies Metralla sandstone member (new); overlies Uvas conglomerate member (new).

J. G. Marks, 1943, California Div. Mines Bull. 118, pt. 3, p. 535, 536 (fig. 232), 537 (fig. 233). Consists of coarse-grained sediments in lower half and of alternating fine-grained sandstone, silts, and shales in upper half. Conformably overlies Uvas conglomerate member in Grapevine Canyon; rests upon granitic terrane in all other parts of area by either unconformable or fault contact. In its type locality, the Liveoak is only representative of Tejon strata and lies unconformably beneath Tecuya formation. Assigned tentatively to late middle Eocene.

Type locality: Liveoak Canyon, Tehachapi Mountains, Kern County.

Live Oak Bar Formation

Pleistocene: Southern Texas.

A. W. Weeks, 1945, Am. Assoc. Petroleum Geologists Bull., v. 29, no. 12, p. 1695 (fig. 1), 1697 (fig. 2), 1714–1715. Quaternary section of Texas Coastal Plain between Brazos River and Rio Grande is divided into 11 terraces and terrace deposits. Inland from a recent offshore bar is line of sand ridges extending through parts of Kleberg, Nueces, San Patricio, Aransas, Refugio, and Calhoun Counties. They have been referred to as Live Oak mature offshore bar (Price, 1933, Am. Assoc. Petroleum Geologists Bull., v. 17, p. 907–962). For formation composing this bar, which is correlative with one or more of the Quaternary units, name Live Oak Bar is proposed. Approximately Beaumont age.

Name derived from Live Oak ridge shown on Aransas Pass topographic sheet.

Livermore Gravel[1]

Pliocene, upper, and Pleistocene: Northern California.

Original reference: B. L. Clark, 1930, Geol. Soc. America Bull., v. 41, p. 774, 779, pls. 15. 20.

A. S. Huey, 1948, California Div. Mines Bull. 140, p. 16 (fig. 2), 47–48, pls. 1, 2, 3. Described in Tesla quadrangle as continental deposits of gravels, sands, and clays 4,000 feet thick. Formation dips at angles of 10° to 30° northward toward Livermore Valley; at different places, rests unconformably on following formations: Neroly, Cierbo, Oursan(?), Panoche, and Franciscan: underlies Tulare formation. Name credited to F. P. Vickery (1925, unpub. ms.)

Crops out from La Costa Valley north to town of Livermore, and eastward from Old Hearst Ranch into Tesla quadrangle.

Livermore Shale Member (of Lykins Formation)

Permo-Triassic: Northern Colorado.

T. L. Broin, 1958, Dissert. Abs., v. 19, no. 1, p. 114. Underlies Poudre limestone member (new); overlies Forelle limestone member.

Liverpool cyclothem (in Carbondale Group)[1]

Liverpool cyclothem (in Spoon-Carbondale Formations)

Pennsylvanian: Western Illinois.

Original reference: H. R. Wanless, 1931, Illinois Geol. Survey Bull. 60, p. 188, 192.

J. M. Weller and others, 1942, Am. Assoc. Petroleum Geologists Bull., v. 26, no. 10, p. 1589. Restricted below; unit formerly referred to as Lower Liverpool is herein named Abingdon cyclothem.

H. R. Wanless, 1957, Illinois Geol. Survey Bull. 82, p. 50 (fig. 22), 62–63, 85–94, pl. 5. Liverpool is one of most widely exposed cyclothems in area and includes prominent key beds (ascending): Browning sandstone, Colchester (No. 2) coal, Francis Creek shale, Jake Creek sandstone (new), Oak Grove beds, and Purington shale. Maximum thickness nearly 100 feet; minimum about 5 feet; range in thickness due mostly to truncation by Pleasantview sandstone, locally as much as 70 feet. Separated from adjacent cyclothems, Abingdon below and Summum above by major erosional unconformities, the most prominent in Pennsylvanian strata of western Illinois. Gives type exposure.

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 41, 42, 52 (table 2), pl. 1. In Spoon (new) and Carbondale (redefined) formations. Name discontinued in southern Illinois because it included strata not in cyclothem in type area. Name Tonica proposed for strata in northern Illinois previously referred to Liverpool cyclothem. Presentation of new rock-stratigraphic classification of Pennsylvanian strata in Illinois: cyclical classification independent of rock-stratigraphic classification.

Type exposure: In secs. 17 and 20, T. 5 N., R. 4 E., Liverpool Township, Havana quadrangle, Fulton County.

Livingston Conglomerate (in Lee Formation)

Livingston Conglomerate (in Pottsville Group)[1]

Pennsylvanian: Southeastern Kentucky.

Original reference: A. M. Miller, 1908, Kentucky Geol. Survey Rept. Prog. 1906, 1907, p. 28.

H. R. Wanless, 1939, Geol. Soc. America Spec. Paper 17, p. 90. A channel of conglomerate sandstone at base Pennsylvanian; in Lee formation, below Rockcastle conglomerate.

Occurs on Roundstone Creek, north of Livingston, Rockcastle County.

Livingston Group

Livingston Formation[1]

Upper Cretaceous: Southwestern Montana.

Original references: W. H. Weed, 1893, U.S. Geol. Survey Bull. 105; J. P. Iddings and W. H. Weed, 1894, U.S. Geol. Survey Geol. Atlas, Folio 1; A. C. Peale, 1896, U.S. Geol. Survey Geol. Atlas, Folio 24; R. W. Stone and W. R. Calvert, 1910, Econ. Geology, v. 5, p. 551–557, 652–669, 741–764.

J. S. Vhay, 1939, Am. Geophys. Union Trans., v. 20, pt. 3, p. 433–437. Formation is series of pyroclastic rocks several thousand feet thick cropping out on north side of Beartooth Mountains. These pyroclastic rocks grade laterally into Claggett, Judith River, Bearpaw, and Lennep formations of Montana group. They are of Upper Cretaceous age and antedate Laramide orogeny. Present report describes formation where it is exposed in Nye No. 2 quadrangle along southeast edge of its outcrop. At several places, transition contact with Eagle formation is exposed, and the sandstones contain more and more volcanic material until somewhere in Claggett(?) formation true volcanic conglomerates come in and these give way above to typical pyroclastic rocks. At least 1,000 feet of Livingston is exposed here; upper limit lies outside area. Consists of fine to coarse tuffs, lapilli-tuffs, tuff breccias, and breccias, and some intercalated tuffaceous sandstones. Term agglomerate and tuff-agglomerate might be preferable for many of these rocks. Concluded that much of formation was formed by mudflows and that certain chloritized beds were deposited by hot mudflows.

W. H. Parsons, 1942, Geol. Soc. America Bull., v. 53, no. 8, p. 1175–1186. Name Livingston formation first applied by Weed (1893) to about 7,000 feet of sandstones, shales, and conglomerates north and east of Livingston. Later studies by Stone and Calvert (1910) and others have shown that this formation grades laterally into Claggett, Judith River, Bearpaw, Lennep, Lance, and Fort Union formations and has resulted in considerable remapping of Livingston formation areas. Present-day use of term Livingston formation (Vhay, 1939) often refers only to Weed's (1893) agglomerate member of Livingston—a member mapped as basic andesitic breccia in Livingston Folio (Iddings and Weed, 1894) and including all pyroclastic rocks discussed in present report. In view of changes in use of name Livingston, these pyroclastics are herein called Livingston igneous series. Comprises breccias, tuff-breccias, lapilli-tuffs, tuffs, vent agglomerates, tuffaceous sandstones, and volcanic conglomerates. Thickness at least 2,000 feet in Deer Creek headwaters region; thins to north and west to about 50 feet at Yellowstone River near Springdale, and wedges out southeast of Stillwater River, east of Nye, Mont. Overlies with slight angular unconformity the Eagle, Claggett, and Judith River formations as exposed along Main Boulder and East Boulder River valleys. Northward and northeastward, the gently dipping volcanic series is overlain conformably by Lance sediments; immediately overlying bed has been identified as Hell Creek member of Lance in some areas.

P. W. Richards and G. F. Prichard, 1950, Billings Geol. Soc. [Guidebook] 1st Ann. Field Conf., p. 49–55. Review of literature dealing with Livingston formation and data based on recent field work in Livingston Peak

15-minute quadrangle. Following conclusions presented: (1) Livingston composed largely of volcanic material, most of which was transported only short distance before being deposited in standing water; a wedge-like intercalation of coarse pyroclastics is in part conformable upon older beds in southern part of Crazy Mountain syncline and has very limited extent. (2) Thickness varies from area to area; maximum probably several thousand feet. (3) Equivalent in age to formations from lower part of Fort Union down to Eagle sandstone and, in some areas west of Crazy Mountain syncline, to "Dakota" of early geologists; Livingston is westward and southwestward facies of those formations. (4) Conglomerate wedge which contains water-worn pebbles of many types of sedimentary and volcanic rocks occurs along western edge of Crazy Mountain syncline; was included in upper part of Livingston by Weed and seemingly by Stone and Calvert (1910). This conglomerate may be Piedmont alluvial deposit in Fort Union similar in origin to Kingsbury conglomerate member of Eocene Wasatch along eastern flank of Bighorn Mountains, Wyo. (5) Formation overlain, probably conformably, in much of area by Fort Union formation, and separation of Cretaceous beds from Paleocene beds may be difficult at many places. (6) Member names, leaf beds, volcanic agglomerates, and Livingston conglomerates, given by Weed are not satisfactory in much of area.

W. J. McMannis, 1955, Geol. Soc. America Bull., v. 66, no. 11, p. 1388 (table 1), 1407–1413, pls. 1, 7. Formation described in Bridger Range, where it is well exposed in eastern quarter of map area. Thickness up to 14,500 feet. Divided into five parts: lower 4,500-foot unit of tuffaceous or andesitic sandstone; finer grained valley-forming unit, about 3,500 feet thick, of siltstone, shale, some andesitic sandstones and fresh-water limestones; conglomerate and andesitic sandstone about 3,500 feet thick; andesitic sandstone about 2,000 feet thick; and upper conglomerate about 1,000 feet thick. Overlies Eagle sandstone (formation) with gradational contact; underlies Tertiary ash, sand, silt, and fanglomerate. In Maudlow basin, directly north of Bridger Range, contains Maudlow conglomerate lentil (new). Lower two units are Cretaceous. Exact position of Cretaceous-Paleocene boundary not known but taken to be boundary between shaly unit and overlying conglomeratic beds. Weed (1893) subdivided formation near Livingston into a lower dominantly andesitic sandstone, called leaf beds, and an upper purple shale and sandstone which graded upward into andesitic sandstone and conglomerate. Locally, in Boulder River area, southeast of Livingston, two major units are separated by series of agglomerates. Weed believed what is now called Eagle sandstone to be Laramie (uppermost Cretaceous) and that overlying beds were Coloradan and Montanan. He mentioned possibility that upper part of Livingston might be equivalent to Fort Union and assigned formation to Cretaceous(?). Units described by Weed correspond to lower three units of Livingston as delimited for area east of Bridger Range. The 2,000-foot sandstone unit and the 1,000-foot conglomerate unit of latter area are not present in vicinity of type locality. Plate 7 shows Livingston interfingers with Claggett, Judith River, Bearpaw, Lennep, Hell Creek, Tullock, and Lebo formations.

P. W. Richards, 1957, U.S. Geol. Survey Bull. 1021–L, p. 419–422, pls. 34, 35, 36. Formation, in area east and southeast of Livingston, is about 7,000 feet thick and is divisible into five units although there are no sharp contacts between them. Top of section. Overlies Virgelle sandstone and undivided younger rocks. Upper Cretaceous and Paleocene.

M. R. Klepper, R. A. Weeks, and E. T. Ruppel, 1957, U.S. Geol. Survey Prof. Paper 292, p. 38–40. Peale (1896) mapped volcanic rocks in Three Forks area and referred them to Livingston formation; he showed them unconformable on the Kootenai (Dakota formation of Peale). Alexander (1951, unpub. thesis) extended name Livingston into Whitehall area and included in formation more than 9,600 feet of andesitic flows and tuffs that are continuous with Elkhorn Mountains volcanics (new) of this report [southern Elkhorn Mountains, Jefferson and Broadwater Counties]. These, he says, are unconformable on folded and truncated Madison. Volcanic rocks in Whitehall area are herein assigned to Elkhorn Mountains volcanics. Although volcanic rocks of Elkhorn Mountains volcanics are partial age equivalents of and compositionally similar to Livingston formation of type area, their modes of origin are distinctly different, and separate formation names are needed. Rocks in the Elkhorn Mountains are largely volcanic outpourings; those of Livingston formation largely sediments composed of volcanic material, of which some—and perhaps most—was derived from erosion of Elkhorn Mountains volcanics.

U.S. Geological Survey currently classifies the Livingston as a group and designates the age as Late Cretaceous on basis of a study now in progress.

Typically developed in vicinity of Livingston, Park County.

Livingston Limestone Member (of Bond Formation)

Livingston Limestone (in McLeansboro Formation[1] or Group)

Livingston Limestone (in Wabash Formation)

Pennsylvanian: Southeastern Illinois and western Indiana.

Original reference: A. H. Worthen, 1895, Illinois Geol. Survey, v. 6, p. 11–19.

J. M. Weller, L. G. Henbest, and C. O. Dunbar, 1942, Illinois Geol. Survey Bull. 67, p. 19 (fig. 4), 27. In east-central Illinois, consists of two hard fine-grained light-gray limestones, massive or unevenly bedded, separated by a few feet of shale or clay; total thickness 20 feet or more. Southward shale or clay increases in thickness, coal and underclay appear; two cyclothems are represented which are provisionally termed Lower and Upper Livingston. McLeansboro group.

R. C. Moore and others, 1944, Geol. Soc. America Bull., v. 55, no. 6, chart 6 (column 25). Shown on correlation chart as limestone in Wabash formation in Indiana.

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 39, 50 (table 1), 83. Member of Bond formation (new).

Type locality: SE¼NW¼ sec. 6, T. 11 N., R. 11 W., Clark County, Ill. Named for Livingston.

Llajas Formation[1]

Eocene, lower and middle: Southern California.

Original references: H. G. Schenck, 1931, California Univ. Pubs. Geol. Sci., v. 19, no. 19, p. 455, footnote 50; J. H. McMasters, 1933, (abs.) Geol. Soc. America Bull., v. 44, no. 1, p. 217–218.

J. A. Cushman and J. H. McMasters, 1936, Jour. Paleontology, v. 10, no. 6, p. 74–77. Name Llajas was originally used informally to designate the series of conglomerate, fine sand, and sandy siltstone underlying Sespe formation and outcropping at and in vicinity of mouth of Las Llajas Canyon. It first appeared in literature in paper by Schenck (1931). McMasters (1933) designated typical exposures. Thickness at type locality, herein described for first time, 1,720 feet. Consists of conglomerate grading upward into oily silty sands which are overlain by 1,600 feet of sandy shales and siltstone. Overlies Santa Susana formation; underlies Sespe formation. Foraminifers described.

A. M. Keen and Herdis Bentson, 1944, Geol. Soc. America Spec. Paper 56, p. 21 (fig. 4). Lower and middle Eocene.

Type locality: Several short amphitheaters eroded in northwest side of north branch of Las Llajas Canyon, immediately northwest of mouth of latter, Ventura County. This north branch is locally known as Oil Canyon from presence in it of several small oil seeps.

Llanada Sandstone Member (of Marlife Shale)

Upper Cretaceous: Central California.

M. B. Payne, 1960, Soc. Econ. Paleontologists and Mineralogists, Pacific Sec., Guidebook Spring Field Trip, p. 5 (fig. 3), 6 (fig. 4), 7 (fig. 5), 13 (fig. 6). Concretionary sandstone 840 feet thick. In upper half of formation. Name credited to D. W. Sutton (unpub. thesis).

Type locality: Moreno Gulch, Fresno County. Name derived from Llanada townsite, east center sec. 19, T. 15 S., R. 10 E.

Llanfair Sandstone Member (of Allegheny Formation)[1]

Middle Pennsylvanian: Southern central Pennsylvania.

Original reference: C. Butts, 1905, U.S. Geol. Survey Geol. Atlas, Folio 133.

Crops out in gorge opposite Henriette shaft No. 1, and exposed along tract near Llanfair shaft No. 2, about 2 miles south of Llanfair, Cambria County.

Llano Series[1]

Precambrian: Central Texas.

Original reference: C. D. Walcott, 1884, Am. Jour. Sci., 3d v. 28, p. 431–432.

Llano de Oro Formation[1]

Pleistocene (Wisconsin): Southwestern Oregon.

Original reference: P. J. Shenon, 1933, U.S. Geol. Survey Bull. 846–B.

F. G. Wells, P. E. Hotz, and F. W. Cater, Jr., 1949, Oregon Dept. Geology and Mineral Industries Bull. 40, p. 17. Described in Kerby quadrangle which includes area mapped by Shenon (1933). Consists of poorly sorted clay and sand with scattered pebbles and cobbles or thin lenses of gravel in sandy silt; commonly rusty red to buff. Maximum thickness 100 feet; commonly less than 50 feet. In some areas, formation has been tilted.

Named for exposures at Llano de Oro mine, Takilma-Waldo district. Well exposed in roadcuts along U.S. Highway 199, south of East Fork of Illinois River, Josephine County.

Llano Estacadan series[1]

Tertiary: New Mexico.

Original reference: C. R. Keyes, 1906, Am. Jour. Sci., 4th, v. 21, p. 298.

†Llano Estacado Formation[1]

Pliocene: Southeastern New Mexico and western Texas.

Original reference: R. T. Hill, 1892, Geol. Soc. America Bull., v. 3, p. 87–100.

H. E. Wood 2d and others, 1941, Geol. Soc. America Bull., v. 52, no. 1, p. 27. Panhandle formation [Panhandle beds] proposed by Gidley (1903) for pre-Clarendonian beds of Texas Panhandle, but commonly treated as Texas equivalent of Ogallala, is not in regular current use in either sense. If an unambiguous term, in the latter sense, is desired, Llano Estacado formation is available.

Plains on Panhandle of Texas and New Mexico.

Llao Rock Dacite Flow, Lava

Pleistocene to Recent: Southwestern Oregon.

J. S. Diller and H. B. Patton, 1902, U.S. Geol. Survey Prof. Paper 3, p. 34, 36–37. Name applied to dacite flow on Llao Rock. Fills valley in rim of Crater Lake. Flow is more than a mile wide along crest and over 1,200 feet thick in middle, tapering to edges on both sides. On the northeast, tapers rapidly to an edge and ends in mass of pumice nearly 100 feet thick. Llao Rock eruption is younger than Grouse Hill flow (new). [See Sun Creek Dacite Flow].

J. E. Allen, 1936, Jour. Geology, v. 44, no. 6, p. 739–740. Llao flow filled glacial valley cut in northwest side of Mount Mazama and overflowed this valley on both sides. It is 1,200 feet thick at center (as exposed in crater walls) and 400 feet thick at south rim of valley. Extends south from rim of valley for three-quarters mile, thinning as it goes. Northward, steep side of filled glacial valley rises until flow is only 100 feet thick, but lava spreads out laterally for one-quarter mile beyond this point before it pinches out.

Howel Williams, 1942, Carnegie Inst. Washington Pub. 540, p. 30, 34, 35, 44, 47–49, 137, pl. 12. Thickest lava sheet on walls of Crater Lake. Llao lava escaped from vertical-sided vent on bottom of glacial valley, several thousand feet below former summit of Mount Mazama. Eruption of Llao dacite was preceded by explosions of dacite pumice. Beyond caldera rim, the lava is almost entirely concealed by blanket of pumice. Diller supposed that lava of Grouse Hill was older than Llao Rock flow because it seemed to have suffered more erosion and because it seemed to be partly overlain by same sheet of pumice that underlies dacite cliffs of Llao. First of these arguments is questionable, and second is invalid because pumice on top of Grouse Hill is part of same sheet that lies above Llao flow. There is no way of deciding which of the two flows is older. Probably, they are about same age. Probably erupted about same time as Llao flow.

Llao Rock forms high cliffs on north rim of Crater Lake.

Lloyd Sand Member (of Raritan Formation)

Lloyd Sand[1]

Upper Cretaceous: Southeastern New York and northern New Jersey.

Original reference: A. C. Veatch, 1906, U.S. Geol. Survey Prof. Paper 44, p. 21.

Wallace deLaguna, 1948, New York State Water Power and Control Comm. Bull. GW–17, p. 8 (table 1), 11–12, pl. 2. Raritan formation overlies the bedrock over most of Long Island and much of Kings County; here consists of two members, an upper clay (unnamed) and lower known as Lloyd sand. The Lloyd consists of beds of coarse white quartz sand and gravel, separated by one, two, or in some places three thin clay partings. Thickness commonly 100 feet; as much as 250 feet on eastern part of island. Name "Lloyd sand", which is in common use, is misleading because it implies that the unit is either a formation or the equivalent of one; proper term is Lloyd sand member.

Named for occurrence in deep well at Lloyd Point, Lloyd Neck, Long Island.

Lobato Basaltic Lavas

Quaternary: North-central New Mexico.

H. T. U. Smith, 1938, Jour. Geology, v. 46, no. 7, p. 959. Named in a list of Quaternary formations in the area. Younger than Canones andesite and older than Puye gravel.

Occurs in Abiquiu quadrangle, Rio Arriba County.

Lobelville Shaly Limestone Member (of Brownsport Formation)[1]

Lobelville Formation (in Brownsport Group)

Middle Silurian: Western and central Tennessee.

Original reference: W. F. Pate and R. S. Bassler, 1908, U.S. Natl. Mus. Proc., v. 34, p. 410–432.

C. K. Swartz and others, 1942, Geol. Soc. America Bull., v. 53, no. 4, chart 3. Shown on correlation chart as formation in Brownsport group.

T. W. Amsden, 1949, Yale Univ., Peabody Mus. Nat. History Bull. 5, p. 25. In area of this report [western Tennessee], there does not appear to be any valid basis for subdividing Brownsport into three members or formations. Proposed that terms "Beech River", "Bob", and "Lobelville" be abandoned.

C. W. Wilson, Jr., 1949, Tennessee Div. Geology Bull. 56, p. 264–266, figs. 2, 78. Lobelville formation included in Brownsport group. Conformably overlies Bob limestone; where Bob limestone is not typically developed, Lobelville and Beech River, locally in contact, cannot be separated lithologically; unconformably underlies Decatur limestone, a Devonian formation, or Chattanooga shale. In deeper part of structural saddle between Nashville dome and southeastern extension of Ozark dome, thickness averages 35 feet, locally being 40 or 50 feet. Distribution restricted to parts of Hardin, Wayne, Decatur, Perry, and Hickman Counties.

Named for exposures near Lobelville, Perry County. Only complete section is about 1 mile northeast of Lobelville.

Lobitos Mudstone Member (of Purisima Formation)

Pliocene: Northern California.

R. M. Touring, 1959, Dissert. Abs., v. 20, no. 4, p. 1326. Thickness 450 feet. Overlies San Gregorio sandstone member (new); underlies Tunitas sandstone member (new).

Area of report is in Santa Cruz Mountains, 30 to 40 miles south of San Francisco.

Lobo Formation[1]

Lower Cretaceous(?) or Tertiary(?): Southwestern New Mexico.

Original reference: N. H. Darton, 1916, U.S. Geol. Survey Bull. 618, p. 19, 39.

V. C. Kelley and Caswell Silver, 1952, New Mexico Univ. Pubs. in Geology 4, p. 109. Age of Lobo uncertain. According to Darton, it may be Permian, Triassic, Jurassic, or Cretaceous. Regional considerations appear to rule out presence of Jurassic rocks. Lobo does not resemble Triassic rocks of central New Mexico and therefore is probably either Permian or Cretaceous in age.

H. L. Jicha, Jr., 1954, New Mexico Bur. Mines Mineral Resources Bull. 37, p. 24–26, 34 (fig. 3). In Cooks Range, Lake Valley quadrangle, formation is 80 to 150 feet thick and consists of reddish-brown sandstones and shales, and chert conglomerates with limestone matrix. Overlies Magdelena group undifferentiated; underlies Sarten formation. No definite proof of actual age. Herein classed as Permian(?).

Christina Lochman-Balk, 1958, Roswell Geol. Soc. Guidebook 11th Ann. Field Conf., p. 46 (fig. 1), 50 (fig. 4), 51–52. Lobo formation overlies Paleozoic section (top of which is Aleman formation) in Capitol Dome section, Florida Mountains. Formation known only in northern part of Florida Mountains where exposures start on northwest side of range, then cross range in southeasterly direction south of Arco del Diablo (Florida Peak) to Lobo Draw, the type locality. Formation overlaps bounding faults of Paleozoic fault block and rests with angular unconformity upon both Ordovician and Precambrian. Its areal distribution in range is same as overlying Tertiary volcanics. Thickness 250 to 350 feet. Age not known. No fossils have been found.

Probably named for occurrence at Lobo Draw on eastern slope of Florida Mountains, Deming region.

Lobster Lake Series[1]

Silurian: Western Maine.

Original reference: F. W. Toppan, 1932, Geology of Maine, Contr. Dept. Geol. Union Coll., Schenectady, p. 70–72.

Well exposed on shores of Lobster Lake [Lobster Pond?], Piscataquis County.

Locatelli Formation

Paleocene: Western California.

E. E. Brabb, 1960, Dissert, Abs., v. 21, no. 5, p. 1163. Oldest sedimentary rocks in area. Underlies Butano sandstone. Rests nonconformably on quartz diorite.

Report discusses Big Basin area, Santa Cruz Mountains.

Lockatong Formation (in Newark Group)[1]

Lockatong lithofacies (of Newark Group)

Upper Triassic: New Jersey and southeastern Pennsylvania.

Original references: H. B. Kummel, 1897, New Jersey Geol. Survey Ann. Rept. State Geologist 1896, p. 40–47; 1897, Jour. Geology, v. 5, p. 544–547.

D. B. McLaughlin and Bradford Willard, 1949, Pennsylvania Acad. Sci. Proc., v. 23, p. 43. Interpretation of Newark group implies: (1) Brunswick and Lockatong were largely formed contemporaneously as red, torrential and nonred, paludal facies respectively; (2) Stockton and early Brunswick sedimentations were also to a degree contemporaneous; and (3) Newark is not a group of three distinct formations successively deposited, but a series of interfingering, in part contemporaneously formed, continental facies.

M. E. Johnson and D. B. McLaughlin, 1957, Geol. Soc. America Guidebook for Field Trips Atlantic City Mtg., p. 41–44, 51–52, pl. 1. Main body of formation is dark-gray argillite about 2,500 feet thick, with a few red argillite beds. Above this is alternating series of thick gray argillites separated by lesser thicknesses of red. Calculated thickness of southern belt 2,150 feet (plus faulted-out section of possibly 700 feet) as against more than 3,800 feet in northern belt. Distribution noted.

D. B. McLaughlin, 1959, Pennsylvania Topog. and Geol. Survey Bull. C–9, p. 77–91, pls. Lockatong lithofacies described in detail in Bucks County, Pa.

Named for Lockatong Creek, Hunterton. N.J. Crops out in three belts in New Jersey, but only two at Delaware River, owing to dying out of Hopewell fault. South belt less than 2 miles wide between Yardley and Washington Crossing; marginal fault with throw of several hundred feet has eliminated outcrop of lower part at West Trenton. Eastward formation passes under coastal plain sediments. Continues in Pennsylvania, widening in western Bucks County, then narrowing westward and disappearing by fingering out into red shale and sandstone of the Brunswick in Chester County. Northern belt 3 miles wide at the Delaware. East of there, strike curves northward, and full thickness passes through sandstone border facies into coarse fanglomerate at north border several miles northwest of Flemington, N.J. Cut off by east-west Chalfont fault near Bucks-Montgomery County line.

†Lockhart Formation (in Chester Group)[1]

Mississippian: Western Kentucky.

Original reference: F. J. Fohs, 1907, Kentucky Geol. Survey Bull. 9, p. 67.

Probably named for Lockhart, Livingston County.

Lockport Dolomite

Lockport Dolomite (in Niagara Group)[1]

Lockport Formation or Group

Middle Silurian (Niagara Series); New York and Michigan, and Ontario, Canada.

Original reference: J. Hall, 1839, New York Geol. Survey 3d Rept., p. 289, 327.

Charles Butts, 1939, Geologie der Erde, North America, v. 1, p. 372–375. Discussion of Niagaran formations in Michigan, Wisconsin, and Illinois. Upper Niagaran prevails here as in New York; extension of name Lockport to this region to include post-Mayville Niagaran seems justified.

E. R. Cumings, 1939, Geologie der Erde, North America, v. 1, p. 596 (fig. 7), 597. Lockport dolomite at Niagara Gorge divided into (ascending) Gasport dolomite, Suspension Bridge dolomite (new), and Eramosa dolomite members. Thickness 77 feet. Underlies Guelph dolomite; overlies Decew waterlime.

B. F. Howell and J. T. Sanford, 1947, Wagner Free Inst. Sci. Bull., v. 22, no. 4, p. 34. Lockport formation in western New York comprises (ascending) DeCew waterlime, Gasport limestone, Goat Island (replaces preoccupied Suspension Bridge), Eramosa, and Oak Orchard (new) members.

D. W. Fisher, 1959, New York State Mus. Sci. Service Geol. Survey Map and Chart Ser. 1. Group comprises (ascending) Gasport limestone, Goat Island limestone, Eramosa dolomite, Devils Hole dolomite (new), Oakfield limestone (new), and Oak Orchard dolomite. Lockport(ian) stage (new) and Lockport group have same stratigraphical limits—from base of Gasport to top of Guelph—in type section where about 210 feet of limestones and dolomites occur. East of Syracuse, Lockport group grades into dominantly shale for which name Illion is proposed. There is difference of opinion as to whether time break exists between Lockport group and underlying Rochester shale. Some claim that the Brownsport, Waldron, and Laurel fill this "gap." Evidence is not altogether conclusive inasmuch as apparent faunal differences may be due to ecological control. There seems to be physical break between Decew and Gasport in western New York, but no physical break can be seen from Rochester eastward. Decew is transferred to underlying Tonawanda stage (new). Underlies Salina group. Niagaran series. Middle Silurian.

Named for exposures at Lockport, Niagara County, N.Y.

Lockportian Stage

Middle Silurian: North America.

D. W. Fisher, 1959, New York State Mus. Sci. Service Geol. Survey Map and Chart Ser. 1. Niagaran series divided into four stages (ascending): Lewiston(ian), Ontario(an), Tonawanda(n), and Lockport(ian). Lockport stage and Lockport group have same stratigraphical limits—from base of Gasport to top of Guelph. Thickness 120 feet in type section.

Type section: Lockport Township, Niagara County, N.Y.

Loco Diorite[1]

Eocene: Central Montana.

Original reference: W. H. Weed, 1899, U.S. Geol. Survey Geol. Atlas, Folio 56.

At north end of Loco Mountain, Little Belt Mountains.

Locomotive Fanglomerate

Tertiary, middle(?): Southwestern Arizona.

James Gilluly, 1937, Arizona Bur. Mines Bull. 141, Geol. Ser. 9, p. 15 (table 1), 40–43, pl. 1; 1946, U.S. Geol. Survey Prof. Paper 209, p. 35–39, pl. 3 [1947]. Chiefly coarse alluvial-fan deposits, poorly sorted, with interbeds of tuff and breccia. Some sandstone and shale toward top and in southeasterly exposures. Maximum thickness between 6,000 and 12,000 feet. Interfingers with Ajo volcanics (new). Unconformably overlies Cardigan gneiss (new), Concentrator volcanics (new), and Cornelia quartz monzonite (new): unconformably underlies Sneed andesite (new).

Named from its characteristic exposure at Locomotive Rock, Ajo quadrangle, Pima County. Exposed widely in pediments and lower slopes south and southeast of main mass of Little Ajo Mountains. Small outlier occurs west of Chico Shunie fault.

Locust Grove Diorite[1]

Precambrian: Northeastern Virginia.

Original reference: J. T. Lonsdale, 1927, Virginia Geol. Survey Bull. 30.

Near Locust Grove, Orange County.

Locust Grove Granite[1]

Precambrian: Northeastern Virginia.

Original reference: J. T. Lonsdale, 1927, Virginia Geol. Survey Bull. 30.

Well exposed near Locust Grove, Orange County.

Locust Point Formation (in Borden Group)[1]

Lower Mississippian: Southeastern Indiana.

Original reference: P. B. Stockdale, 1931, Geol. Soc. America Bull., v. 42. no. 3, p. 708–716.

P. B. Stockdale, 1931, Indiana Div. Geology Pub. 98, p. 77, 126–147. Includes following facies: Spickert Knob, Schooner Hill, Belmont, and Nelson Hill.

J. M. Weller and others, 1948, Geol. Soc. America Bull., v. 59, no. 2, chart 5 (column 76). Shown on correlation chart in Borden group, Osage series; underlies Carwood formation; overlies New Providence shale.

Named from topographic prominence on Ohio River bluff, about 1 mile south of Floyd-Harrison County line south center sec. 12, T. 4 S., R. 5 E., and from nearby Locust Point post office, center SE¼ same section.

Lodgepole facies

See **Tongue River Member** (of Fort Union Formation).

Lodgepole Granite

Jurassic-Cretaceous: Central California.

D. C. Ross, 1958, California Div. Mines Spec. Rept. 53, p. 13, pl 1. Distinguishing features are coarse grain size, seriate texture, and distinct color difference of the two feldspars—potash feldspar is pinkish gray to salmon colored and sodic oligoclase is gray to white. Contact with Giant Forest pluton sharp, but, near south end of Lodgepole mass, scattered outcrops contain gradational types between the two varieties. In some respects, resembles Pear Lake quartz monzonite (new).

Named from exposures near Lodgepole Campground, Sequoia National Park. Granite crops out over about 7 square miles in an elongate body extending from Little Lake to south of Panther Peak.

Lodgepole Limestone (in Madison Group)[1]

Lower Mississippian: Southwestern Montana, northeastern Utah, and western Wyoming.

Original reference: A. J. Collier and S. H. Cathcart, 1922, U.S. Geol. Survey Bull. 736–F, p. 173.

L. L. Sloss and R. H. Hamblin, 1942, Am. Assoc. Petroleum Geologists Bull., v. 26, no. 3, p. 315–318, measured sections. Includes Paine member below and Woodhurst member above. Overlies Three Forks formation; underlies Mission Canyon limestone. Proposed that term Lodgepole be applied throughout Montana and Wyoming.

M. M. Knechtel, J. E. Smedley, and R. J. Ross, Jr., 1954, Am. Assoc. Petroleum Geologists Bull., v. 38, no. 11, p. 2395–2411. Subdivided to include Little Chief Canyon member (new) at base. Overlies Sappington sandstone member of Three Forks shale.

F. D. Holland, Jr., 1952, Am. Assoc. Petroleum Geologists Bull., v. 36, no. 9, p. 1710–1715, 1716 (fig. 8). Lower formation of Madison group. Thickness 584½ feet at Madison type section. Conformably underlies Mission Canyon limestone at type section of Madison; contact arbitrarily drawn, principally on basis of color change. Unconformably overlies Sappington sandstone at Sappington type section.

J. W. Strickland, 1956, Wyoming Geol. Assoc. Guidebook 11th Ann. Field Conf., p. 51–57. Basal formation of Madison group. Underlies Mission Canyon formation; overlies Sappington formation. Average thickness about 800 feet in western Wyoming; 200 feet in central and eastern Wyoming. Correlates with "Laminated limestones" of Peale (1893), the lower thin-bedded part of the Woodhurst of Weed (1899), lower unit of Madison group of Andrichuk (1955) and the "Madison" as used in most publications concerning the Mississippian of eastern Idaho, northern Utah, and western Wyoming.

W. J. Sando, J. T. Dutro, Jr., and W. C. Gere, 1959, Am. Assoc. Petroleum Geologists Bull., v. 43, no. 12, p. 2745 (fig. 2), 2746–2747. Limestones underlying Brazer dolomite, mapped as Madison limestone by Richardson (1913, Am. Jour. Sci., 4th, v. 36, p. 406–416) here assigned to Lodgepole limestone of Madison group. Divided into three mappable members in Crawford Mountains. Thickness 773 feet in Brazer Canyon; 884 feet in Emma Canyon. Overlies "Three Forks" formation.

W. J. Sando and J. T. Dutro, Jr., 1960, Wyoming Geol. Assoc. Guidebook 15th Ann. Field Conf., p. 117–126. Corresponds roughly with Peale's (1893) "Laminated limestones" of Madison limestone. Lower formation of Madison group. Thickness as much as 733 feet. Underlies Mission Canyon limestone. Underlies Brazer dolomite at type section of Brazer; overlies Three Forks formation at Baldy Mountain and Brazer Canyon and Darby formation at Darby Canyon and Haystack Peak. Includes both the "Laminated limestones" and "Massive limestones" of Peale (1893). Coral zonation discussed.

Named for exposure in Lodgepole Canyon, Little Rocky Mountain region, Montana.

Lodgepole Rhyolite and Obsidian (in Gardiner River Rhyolite-Basalt Complex)

Tertiary: Northwestern Wyoming.

R. E. Wilcox, 1944, Geol. Soc. America Bull., v. 55, no. 9, p. 1050, 1054–1055, pls. 1, 2. Term assigned to rhyolite flow that contributed to formation of Gardiner River rhyolite-basalt complex (new). Flow may have been extensive but no large masses uncontaminated by basaltic material have been found. Lithologically, least contaminated Lodgepole is normal gray to buff rock of lithoidal texture carrying abundant phenocrysts of orthoclase and quartz, grading at extreme east and west ends of complex into glassy and spherulitic rock. Relationships indicate that Lodgepole rhyolite, obsidian, and Cataract basalt (new) are younger than Meadow rhyolitic tuff (new).

Present on Gardiner River near Sevenmile Bridge, Yellowstone Park. Narrow zone of outcrops of contaminated rhyolite and obsidian extends southeasterly up river for about two-thirds mile.

Lodi Member (of Trempealeau Formation)

Lodi Shale Member (of St. Lawrence Formation)[1]

Upper Cambrian: Southern Wisconsin, Iowa, Michigan, and eastern Minnesota.

Original reference: F. T. Thwaites, 1923, Jour. Geology, v. 31, p. 547.

Josiah Bridge, 1937, U.S. Geol. Survey Prof. Paper 186–L, p. 236 (table 2). Table 2 shows various classifications of late Upper Cambrian strata in upper Mississippi Valley. According to Ulrich (1935, personal commun.) Lodi shale is member of Trempealeau formation; overlies St. Lawrence dolomite member and underlies Norwalk sandstone member. U.S. Geological Survey classification shows Lodi shale as uppermost member of St. Lawrence formation; overlies Mendota dolomite member; underlies Norwalk sandstone member of Jordan sandstone.

C. R. Stauffer, G. M. Schwartz, 1939, Geol. Soc. America Bull., v. 50, no. 8, p. 1228 (table 1), 1238 (table 2); C. R. Stauffer and G. A. Thiel, 1941, Minnesota Geol. Survey Bull. 29, p. 28 (table 4), 30, 46. In proposed classification of St. Croixian of Minnesota, Lodi is upper member of St. Lawrence; overlies Nicollet Creek member (new); underlies Norwalk member of Jordan formation.

G. O. Raasch, 1939, Geol. Soc. America Spec. Paper 19, p. 96 (fig. 5), 97–113, 114 (fig. 14). Member of Trempealeau formation. Overlies St. Lawrence member; underlies Jordan member.

G. V. Cohee, 1945, U.S. Geol. Survey Oil and Gas Inv. Prelim. chart 9. Member of Trempealeau formation in Michigan. Commonly white to buff dolomite which may be slightly sandy in part; purple dolomite may be present in basal part. Underlies Jordan sandstone member; overlies St. Lawrence member. Thickness 350 feet in Voss well, Washtenaw County.

C. A. Nelson, 1956, Geol. Soc. America Bull., v. 67, no. 2, p. 169 (fig. 2), 170 (fig. 3), 171, 173–176, 178, 179, 180, 181, 182. Term Lodi retained for dolomitic siltstone and sandstone member of St. Lawrence formation in upper Mississippi Valley. Occurs above Franconia formation and beneath Jordan formation. Vertically succeeds Black Earth member in basinward exposures; elsewhere, occurs beneath dolomite beds of Black Earth member as well as above it. At Arcadia, Wis., strata beneath the dolomite are regarded by Raasch (1952) as type Arcadia member of Trempealeau; except for presence of *Osceolia* fauna, on which basis they were designated Arcadia member, these beds do not differ from beds above the dolomite; these upper beds Raasch (1939) called Lodi, presumably because they contain the upper *Dikelocephalus* zone fauna. North of Arcadia, as at Ridgeland, the Lodi is continuous from the Franconia to the Jordan. Lodi shows facies change from basinward exposures to shoreward areas to the north. At Victory, Lodi is terminated by 6 feet of sandy dolomite, included in basal Jordan by Twenhofel, Raasch, and Thwaites (1935, Geol. Soc. America Bull., v. 46, no. 11, p. 1734), but here included in Lodi. Measured sections show thickness ranges from 2 to 43½ feet.

Presumably named for exposures at or near Lodi, Columbia County, Wis.

Lodo Formation

Paleocene and Eocene: Central California.

R. T. White. 1938, (abs.) Geol. Soc. America Proc. 1937, p. 256–257. Defined as disconformably overlying Moreno shale and conformably underlying Domengine formation. Includes Martinez(?) formation of Anderson and Pack (1915, U.S. Geol. Survey Bull. 603), plus a new member, Cerros shale, between Cantua sandstone member and Moreno shale. At type locality, Lodo formation is composed of 1,150 feet of claystone. Four miles south, the Cantua appears as lens in middle of unit. At this point and southward, the Lodo is divisible into (ascending) Cerros member, Cantua sandstone member, and Arroyo Hondo member. Eocene.

R. T. White, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 10, p. 1735–1745. Formation described in Coalinga district. Underlies Yokut sandstone (new). Thickness varies from zero, at north and south ends of its exposures, where it is overlapped by the Domengine, to more than 5,000 feet east of San Carlos Creek.

I. F. Wilson, 1943, California Jour. Mines and Geology, v. 39, no. 2, p. 208. Described in San Benito quadrangle as represented by about 300 feet bluish-gray foraminiferal clay-shale occurring in narrow belt along southwest side of Butts Ranch syncline. Overlies Big Oak Flat shale and sandstone member (new) of Panoche group. Underlies Yokut sandstone. Middle Eocene.

M. B. Payne, 1951, California Div. Mines Spec. Rept. 9, p. 15. Described in Fresno County in area of type Moreno. About 428 feet thick. Overlapped by Domengine.

J. E. Schoellhamer and D. M. Kinney, 1953, U.S. Geol. Survey Oil and Gas Inv. Map OM–128. Described in Tumey and Panoche Hills, Fresno County, where it is 1,197 feet thick and includes (ascending) Cerros shale, Cantua sandstone, and Arroyo Hondo shale members. Overlies Moreno formation; underlies Yokut sandstone. Paleocene and Eocene.

Tulsa, Okla., Am. Assoc. Petroleum Geologists, p. 10, 45, 46, 281–282.

V. S. Mallory, 1959, Lower Tertiary biostratigraphy of the California Coast Ranges: Tulsa, Okla., Am. Assoc. Petroleum Geologists, p. 10, 45, 46, 281–282. Term Lodo extended to include Mabury and Gredal formations of Van Couvering and Allen (1943) plus an unnamed unit beneath them. [Mallory states he proposed this change in 1953 and cites Am. Assoc. Petroleum Geologists Bull., v. 37, no. 12, p. 2781. This is an abstract in which Paleocene and Eocene stage names were proposed. No rock-stratigraphic terms were mentioned in this abstract.] Term Lodo further extended to south of Devils Den area to region of Temblor Hills and Media Agua Creek to be used for an unnamed lower Tertiary unit mapped by English (1921, U.S. Geol. Survey Bull. 721) as Cretaceous below Tejon formation. Lodo formation is included in Ulatisian stage. Acebedo member of Lodo mentioned on page 46.

Type locality: Lodo Gulch, about one-half mile south of junction of Panoche and Silver Creeks, in NE¼ sec. 29, T. 15 S., R. 12 E., in Tumey Hills, on west side of San Joaquin Valley, Fresno County.

Lodore Formation[1] or Shale[1]

Upper Cambrian: Northwestern Colorado, northeastern Utah, and south-central Wyoming.

Original reference: J. W. Powell, 1876, Geology of eastern portion of Uinta Mountains: U.S. Geol. and Geog. Survey of Terr., 2d div., p. 41, 56, 58, 144–147.

G. E. Untermann and B. R. Untermann, 1949, Am. Assoc. Petroleum Geologists Bull., v. 33, no. 5, p. 689 (table 1). Formation described in Green and Yampa River Canyons. White to red coarse poorly sorted quartzitic and in part arkosic sandstones at top, middle, and base; middle part glauconitic; sandstone members separated by two layers of silty shale containing thin sandstone beds which are frequently somewhat glauconitic and fossiliferous. Thickness 350 to 400 feet. Unconformable below Madison formation and above Uinta Mountain group. Upper Cambrian.

Christina Lochman-Balk, 1955, Wyoming Geol. Assoc. Guidebook 10th Ann. Field Conf., p. 29. Proposed that term Lodore be adopted for all thin wedge-edge sandstones of Upper Cambrian age in south-central Wyoming.

D. M. Kinney, 1955, U.S. Geol. Survey Bull. 1007, p. 22–24, pls. 1, 6. At type section in Dunn's Cliff (now known as Limestone Ridge), formation is 460 feet thick and consists of soft sandstone and shale with conglomerate at base. At section, 1 mile north of Hells Half Mile on Green River and 2 miles west of type locality, formation is about 440 feet thick. At this locality, lower 290 feet of tan to reddish sandstone is very feldspathic at base and grades upward into green micaceous sandy shale and sandstone 150 feet thick. In area of present report [Uinta River-Brush Creek area, Utah], formation consists of light-gray to pink coarse-grained massive to thick-bedded and cross-laminated, arkosic sandstone as much as 155 feet thick. Unconformably overlies Uinta Mountain group; underlies unnamed Mississippian limestone unit.

W. E. Hallgarth, 1959, U.S. Geol. Survey Oil and Gas Inv. Chart OC–59. At Cross Mountain, Colo., formation is exposed in canyon walls of Yampa River. Lower 150 feet consists of red and gray irregularly bedded crossbedded conglomerate and interbedded sandstone. Upper 100 feet consists of interbedded red and green, partly glauconitic shaly sandstone and sandy shale. Angular unconformities present at both base and top of formation.

Type locality: Dunn's Cliff (now known as Limestone Ridge). Named for Lodore Canyon, Moffat County, Colo.

Logan Fire Clay (in Pottsville Formation)[1]

Pennsylvanian: Southeastern Ohio.

Original reference: E. Orton, 1878, Ohio Geol. Survey, v. 3, p. 713, 901.

Named for Logan, Hocking County.

Logan Formation[1]

Mississippian: Ohio and northeastern Kentucky.

Original reference: E. B. Andrews, 1870, Ohio Geol. Survey Rept. Prog. 1869, p. 62, 76, 79, 80, 87.

F. T. Holden, 1942, Jour. Geology, v. 50, no. 1, p. 41 (table 2), 53–64. Three lithologic facies distinguished in formation: Vanceburg siltstone, Scioto Valley shale, and Pretty Run sandstone (new). In area of Vanceburg, facies includes (ascending) Buena Vista sandstone, Rarden shale, Vanceburg siltstone, Churn Creek siltstone and shale, and Vinton sandstone members; in Scioto Valley, facies includes (ascending) Buena Vista sandstone, Portsmouth shale, and Vinton sandstone members; in Pretty Run, facies includes (ascending) Berne conglomerate, Byer sandstone, Allensville conglomerate, Vinton sandstone, and Rushville shale members. Overlies Cuyahoga formation; underlies basal Pennsylvanian Pottsville except in south-central part of State where, at a few places at easternmost outcrops of Mississippian, Maxville limestone lies between the Logan and Pottsville.

J. E. Hyde, 1953, Ohio Geol. Survey Bull. 51, p. 3 (table 1), 25, 26–28. In Toboso, Granville, and Hocking Valley provinces, comprises (ascending) Byer, Allensville, and Vinton members; elsewhere not subdivided. Possibly a fourth member should be recognized; Andrews (1878) proposed Rushville for member at top of Logan. Included in Waverly series. [Facies as used by Holden not recognized in this report.] Editor's note stages that Hyde (1921, Ohio Geol. Survey Bull. 23) correlated Buena Vista sandstone, with Berne and lower part of Byer in discussing geology of Camp Sherman quadrangle; such a correlation would necessitate placing the Rarden, Vanceburg, Churn Creek, and most of Portsmouth shale in Logan formation.

J. M. Weller and others, 1948, Geol. Soc. America Bull., v. 59, no. 2, chart 5 (column 84). Shown on correlation chart as Osagean series.

Named for Logan, Hocking County, Ohio.

†Logan Group[1]

Mississippian: Ohio.

Original reference: E. Orton, 1880, Review Strat. Geology Eastern Ohio, p. 14.

Probably named for Logan, Hocking County.

Logan Limestone[1]

Silurian: Central Pennsylvania.

Original reference: J. P. Lesley, 1892, Pennsylvania 2d Geol. Survey Summ. Final Rept., v. 2, p. 787, 790, 805.

Crops out near Logan Furnace, Mifflin County.

†Logan Limestone or Flint (in Logan Formation)[1]

Mississippian: Southeastern Ohio.

Original reference: E. Orton, 1878, Ohio Geol. Survey, v. 3, p. 900–901, pls. opposite p. 889, 900, 921, 933.

Probably named for occurrence in Logan formation, at Logan, Hocking County.

†Logan Sandstone (in Kanawha Formation)[1]

Pennsylvanian: Southern West Virginia.

Original reference: R. V. Hennen and D. B. Reger, 1914, West Virginia Geol. Survey Rept. Logan and Mingo Counties, p. 178.

Named for Logan, Logan County.

Logan Shale[1]

Silurian: Central Pennsylvania.

Original reference: J. P. Lesley, 1892, Pennsylvania 2d Geol. Survey Summ. Final Rept., v. 2, p. 787.

Mifflin County.

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Logana Member (of Lexington Limestone)

Logana Bed[1]

Logana Formation (in Lexington Group)

Middle Ordovician: Central Kentucky.

Original reference: A. M. Miller, 1905, Kentucky Geol. Survey Bull. 2, p. 9, 19.

G. G. Huffman, 1945, Jour. Geology, v. 53, no. 3, p. 169. Inasmuch as the Hermitage has its type locality in Tennessee and since the Hermitage of central Tennessee may contain strata of Curdsville age, retention of name Logana for strata immediately above the Curdsville of Kentucky is urged.

D. K. Hamilton, 1950, Kentucky Geol. Survey, ser. 9, Bull. 5, p. 12. A formation in Lexington group. Consists of thin-bedded fine-grained blue-gray argillaceous limestone with large amount of interbedded shale. Thickness about 35 feet. Overlies Curdsville limestone; underlies Jessamine limestone.

Named for Logana, Jessamine County.

Logan Branch Member (of Stonehenge Limestone)

Lower Ordovician (Canadian): Central Pennsylvania.

A. C. Donaldson, 1960, Dissert. Abs., v. 20, no. 9, p. 3693. Uppermost member; overlies Baileyville member (new). Characterized by oolitic fossiliferous calcarenites and calcirudites.

Type locality and derivation of name not stated.

Logan Hill Formation

Pleistocene, lower: Southwestern Washington.

P. D. Snavely, Jr., and others, 1951, U.S. Geol. Survey Coal Inv. Map C-8, sheet 1. Partly consolidated fluvial deposits of gravel and sand with minor amounts of silt and clay. More than 150 feet thick. Near Bucoda, formation rests on erosion surface that truncates Smith coal bed.

P. D. Snavely, Jr., and others, 1958, U.S. Geol. Survey Bull. 1053, p. 67-72, chart 1, pls. 1, 4. Described in Centralia-Chehalis district. Deposited on old land surface of mature relief. Average thickness 75 to 100 feet; may exceed 200 feet in areas where old channels have been filled.

A. E. Roberts, 1958, U.S. Geol. Survey Bull. 1062, p. 12 (chart), 37-38, pl. 1. Described in Toledo-Rock Castle coal district where it is about 250 feet thick. Unconformably overlies Wilkes formation. Underlies alpine drift.

Type area: Roadcuts and canyons on Logan Hill, Thurston and Lewis Counties. Caps hills between Skookumchuck River and Hanaford Creek and flat-topped upland surface that forms Logan Hill.

Logansport Formation (in Midway Group)

Paleocene: Northwestern Louisiana and northeastern Texas.

Grover Murray, Jr., 1941, (abs.) Am. Assoc. Petroleum Geologists Bull., v. 25, no. 5, p. 941-942. Consists of basal sand member, middle lignitic shale member, and upper calcareous member. Underlies Hall Summit formation (new); overlies Naborton formation (new).

D. P. Meagher and L. C. Aycock, 1942, Louisiana Dept., Conserv. Geol. Pamph. 3, p. 13. Includes (ascending) Dolet Hills, Cow Bayou, and Lime Hill members (all new).

G. E. Murray. Jr., and E. P. Thomas, 1945, Am. Assoc. Petroleum Geologists Bull., v. 29, no. 1, p. 48 (fig. 2), 57–58. Includes all strata overlying Naborton beds and underlying Hall Summit formation; both contacts gradational. Type locality designated. Mapped in Texas. Paleocene.

G. E. Murray, 1948, Louisiana Dept. Conserv. Geol. Bull. 25, p. 101–127. Described in De Soto and Red River Parishes. Includes (ascending) Dolet Hills, Cow Bayou, and Lime Hill members. Underlies Naborton formation; underlies Hall Summit formation. Midway group.

H. V. Andersen, 1960, Louisiana Dept. Conserv. Geol. Bull. 34, p. 52. Term Logansport discontinued in Sabine Parish. Members raised to formational rank.

Type locality: Eastern side of Sabine River just above bridge at Logansport, De Soto Parish, La. Outcrop belt extends into Shelby and Panola Counties, Tex.

Logansport Limestone

Middle Devonian: North-central Indiana.

G. A. Cooper and A. S. Warthin, 1941, Washington Acad. Sci. Jour., v. 31, no. 6, p. 259–260. Consists of 12 feet of light-colored granular limestone; fossiliferous in upper half. Overlies Silurian at type section. Previously correlated with Onondaga limestone.

Type locality: Pipe Creek Falls, 2 miles above junction of Pipe Creek and Wabash River, 7 miles above Logansport, Cass County.

Loggy Bayou Member (of Hall Summit Formation)

Paleocene (Midway): Northwestern Louisiana and northeastern Texas.

D. P. Meagher and L. C. Aycock, 1942, Louisiana Dept. Conserv. Geol. Pamph. 3, p. 13, 14. Named in stratigraphic summary of Louisiana lignite district. Name credited to G. Murray, Jr.,

G. E. Murray, Jr., and E. P. Thomas, 1945, Am. Assoc. Petroleum Geologists Bull., v. 29, no. 1, p. 48 (fig. 2), 59; G. E. Murray, 1948, Louisiana Dept. Conserv. Geol. Bull. 25, p. 128, 129–130, pl. 10. Consists of massive to broken sands with subordinate amounts of sandy shale and clay-ball conglomerates; locally contains small amounts of glauconite; becomes lenticular and difficult to trace over northern half of Sabine uplift. Thickness 20 to 60 feet. Underlies Grand Bayou member; overlies Lime Hill member of Logansport formation; all contacts gradational. Type locality designated. Mapped in Texas. Paleocene.

Type locality: Exposures at and in vicinity of Yellow Bluff in NW¼ sec. 8 and SW¼ sec. 5, T. 14 N., R. 10 W., near junction of Love Lake and Loggy Bayou, Red River Parish, La. Reaches maximum development along escarpment west of Joaquin, Shelby County, Tex.

Log Springs Formation

Lower Pennsylvanian (Morrow): Northern New Mexico.

A. K. Armstrong, 1955, New Mexico Bur. Mines Mineral Resources Circ. 39, p. 5, 9–10, figs. 2, 4, 5, 6. Consists of shales, sandstones, and congolmerates. Basal shale is highly ferruginous, with numerous oolites of hematite, followed by medium-bedded series of deep-red shales, sandstones, and conglomerates. Sandstones tend to form small prominent ledges. Thickness of formation ranges from 10 to 75 feet. Unconformably overlies Mississippian strata in Sandia, Jemez, Nacimiento, and San Pedro Mountains; unconformably overlies Arroyo Penasco formation (new) at type section; underlies Sandia formation and in some areas unit referred to as Madera(?).

Type section: In Penasco Canyon, Nacimiento Mountains, NW¼SE¼ sec. 5, T. 16 N., R. 1 E. Name derived from Log Springs in Penasco Canyon.

Logtown Ridge Formation (in Amador Group)

Upper Jurassic: East-central California.

N. L. Taliaferro, 1943, California Div. Mines Bull. 125, p. 283. Upper formation of Amador group at its northern type section. Consists of flows, tuffs, and fine to coarse augite andesite agglomerates; they are 2,700 feet thick along west side of Mother Lode Highway but thin and become finer in grain toward the west where they are several times repeated by folding. Overlies Cosumnes formation (new).

J. H. Eric, A. A. Stromquist, and C. M. Swinney, 1955, California Div. Mines Spec. Rept. 41, p. 11–12, pls. 1, 2. Described in Angels Camp and Sonora quadrangles, Calaveras and Tuolumne Counties, where it consists predominantly of metamorphic rocks derived from coarse-grained generally mafic pyroclastics, mafic tuff, mafic flows felsic tuff, and a few thin beds of tuffaceous shale. Thickness 1,500 to 2,600 feet; in many parts of Sonora quadrangle, formation has been cut out by intrusive bodies and faults. Overlies Cosumnes formation; underlies Mariposa formation, and in some areas contact is depositional, in others it is unconformable. Age considered to be Middle or Upper Jurassic.

Type locality: At northern type section of Amador group on Cosumnes River, El Dorado and Amador Counties.

Lohali sandstones[1]

Jurassic: Northeastern Arizona.

Original reference: C. R. Keyes, 1922, Pan-Am. Geologist, v. 38, p. 250, 337.

Occurs near Lohali, Apache County, west of Chinle, and northwest of Fort Defiance.

Lohn Shale Member (of Thrifty Formation)[1]

Upper Pennsylvanian: Central Texas.

Original reference: N. F. Drake, 1893, Texas Geol. Survey 4th Ann. Rept., pt. 1, p. 387, 408.

C. O. Nickell, 1938, Texas Univ. Bur. Econ. Geology Pub. 3801, p. 122, 125–126. Drake gave name "Lohn bed" to coal-bearing shale overlying Speck Mountain limestone and underlying Chaffin limestone, near settlement of Lohn. Thickness of Lohn varies, partly because of unconformable relations that it bears to Parks Mountain sandstone, which in some places cuts it out, and partly because of another somewhat higher unconformable sandstone, which in places cuts into it. Thickness about 66 feet in Coleman County.

D. H. Eargle, 1960, U.S. Geol. Survey Prof. Paper 315–D, p. 72. Because Drake's descriptions apply chiefly to beds in vicinity of Colorado River and southward, his terminology may not apply perfectly to beds to the north where differences exist in the stratigraphy. He described as one unit the shale and sandstone sequences overlying the Speck Mountain limestone member which extend up to next highest persistent limestone, the Chaffin member. He named the unit the Lohn bed. This terminology applies to sequences as they crop out south of Home Creek in southern Coleman County. He concluded that the Chaffin member splits into two beds north of Home Creek; his Lohn bed from there northward extends up to his lower Chaffin limestone bed. In present study, Drake's lower Chaffin was found to be Breckenridge limestone member, which does not extend south of vicinity of Home Creek. His Lohn bed includes thicker stratigraphic interval south of Home Creek than that north of creek. For that reason, name Lohn is discarded as stratigraphic name for use in eastern Coleman and northwestern Brown Counties.

Named for Lohn, McCulloch County.

Lohrville Granite[1]

Precambrian: Wisconsin.

Original reference: C. C. Wang, 1932, Geol. Soc. China Bull., v. 11, no. 4, p. 426–428.

†Lolo Series[1]

Precambrian (Belt Series): Central western Montana and Idaho.

Original reference: W. Lindgren, 1904, U.S. Geol. Survey Prof. Paper 27, p. 16, 34.

Near Lolo Pass, northern Bitterroot Mountains.

Loma Blanca Tongue (of Yegua Formation)

Eocene (Claiborne): Southwestern Texas.

W. G. Kane and G. B. Gierhart, 1935, Am. Assoc. Petroleum Geologists Bull., v. 19, no. 9, p. 1374–1375. Referred to as Loma Blanca oyster horizon of [F. C.] Owens.

J. M. Patterson, 1942, Am. Assoc. Petroleum Geologists Bull., v. 26, no. 2, p. 259 (fig. 2), 265–266. Suggests that F. C. Owens' Loma Blanca sandstone member be enlarged to include all of an upper sandstone tongue of the Yegua which lithologically cannot be subdivided on American side of Rio Grande. Locally there are several thin lenses of shale, sandy shale, and red streaks, but these are not easily traced. East of Falcon is 400 feet thick but east of Laredo has completely lensed out, having interfingered with a predominantly nonmarine section of red and green bentonitic shales.

Basal beds well exposed on Loma Blanca (white hill), Arroyo Clareno quadrangle.

Loma Plata Limestone

Cretaceous (Comanche Series): Southwestern Texas.

D. L. Amsbury, 1957, Dissert. Abs., v. 17, no. 9, p. 1981; 1958, Texas Univ. Bur. Econ Geology, Geol. Quad. Map 22. Name applied to strata between cap rock of Benevides formation (new) and base of Grayson marl. Consists of lower nodular slope-forming limestone member, 340 feet thick, and an upper cliff-forming limestone member that is thick bedded, massive, light brownish gray, cherty and siliceous, rudistid bearing, and fine to medium crystalline. Total thickness 720 feet. Gradational into Grayson formation through an interval of 40 feet.

P. C. Twiss, 1959, Texas Univ. Bur. Econ. Geology Quad. Map 23. In area of this report (Van Horn Mountains), the Loma Plata is restricted to southern half of area. Thickness 685 feet. Divided into two unnamed members. Overlies Benevides formation; underlies Eagle Mountains sandstone.

Type section for lower part is measured section 12 and for top is measured section 13, Pinto Canyon area, Presidio County.

Lombard facies (of Big Snowy Group)

Upper Mississippian: Central Montana.

O. D. Blake, 1959, Billings Geol. Soc. [Guidebook] 10th Ann. Field Conf., p. 64 (fig. 1), 65–68. To south and west characteristic lithologies of Tyler, Heath, and Otter formations of group are blended into single unit to which term Lombard facies is applied. Thickness commonly 200 to 300 feet; more than 450 feet at Sawmill Creek in southern part of Castle Mountains. Lies above Kibbey formation and below Alaska Bench limestone or Amsden dolomite.

Named for exposures in vicinity of Lombard Station on Missouri River.

Lomita Marl Member (of San Pedro Formation)

Lomita Formation[1]

Lomita Marl

Pleistocene, lower: Southern California.

Original reference: U.S. Grant 4th and H. R. Gale, 1931, San Diego Soc. Nat. History Mem., v. 1, p. 42–43, 61.

W. P. Woodring, M. N. Bramlette, and W. S. W. Kew, 1946, U.S. Geol. Survey Prof. Paper 207, p. 42–53, pls. 1, 13, 14. Described as Lomita marl formation. Occurs at base of lower Pleistocene deposits. In San Pedro where units are superimposed, the sequence is (ascending) Lomita marl, Timms Point silt, and San Pedro sand. Maximum exposed thickness 60 to 70 feet; computed thickness in San Pedro about 100 feet. Type region designated.

J. F. Poland, A. M. Piper, and others, 1956, U.S. Geol. Survey Water-Supply Paper 1109, p. 38 (table), 61, pl. 3. Rank reduced to member of San Pedro formation.

Type region: Near Lomita quarry, in western part of Gaffey syncline, Los Angeles County.

Lonaconing Sandstone (in Conemaugh Formation[1] or Group)

Pennsylvanian: Western Maryland and southwestern Pennsylvania.

Original reference: C. K. Swartz, W. A. Price, and H. Bassler, 1919, Geol. Soc. America Bull., v. 30, p. 573.

W. O. Hickok, 4th, and F. T. Moyer, 1940, Pennsylvania Geol. Survey 4th ser., Bull. C–26, p. 98, fig. 21. Section northeast of Connellsville shows 20 feet of dark clay shale which contains plant fragments; near top of clay are several lenses of coal as much as 1 foot thick; coal lenses are inclined 10° to 15° to major bedding of the shale. Overlies Morgantown sandstone; underlies Clarksburg red shale. Included in Lonaconing subdivision of Conemaugh group.

Named for exposures along Georges Creek, south of Lonaconing, Allegany County, Md.

†Lone limestone[1]

Upper Silurian: Nevada.

Original references: C. R. Keyes, 1923, Pan-Am. Geologist, v. 40, p. 53; 1924, Pan-Am. Geologist, v. 41, p. 37.

Lone quartzite[1]

Upper Cambrian: Southwestern New Mexico.

Original references: C. R. Keyes, 1915, Iowa Acad. Sci. Proc., v. 22, p. 257–259; 1915, Conspectus of geologic formations of New Mexico: Des Moines, Robert Henderson, State Printer, p. 4, 8.

Well exposed in Lone Mountain, near Silver City, Grant County.

Lone Butte Limestone Member[1] (of Jefferson Limestone)

Upper Devonian: Northwestern Montana.

Original reference: C. F. Deiss, 1933, Montana Bur. Mines and Geology Mem. 6, p. 43.

G. A. Cooper and others, 1942, Geol. Soc. America Bull., v. 53, no. 12, pt. 1, p. 1768, chart 4 (facing p. 1788). Age shown as Upper Devonian on correlation chart.

Type locality: On southeast side of southern spur of Lone Butte, in NE¼ sec. 26, T. 23 N., R. 13 W. Known only in five sections: Lone Butte, Spotted Bear Mountain, Pentagon Mountain, Prairie Reef-White Ridge, and Dearborn.

Lone Camp Group

Pennsylvanian (Strawn Series): North-central Texas.

M. G. Cheney, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 1, p. 66 (fig. 1), 88. Beds between the Millsap Lake and Graford (restricted) groups herein divided into two groups, a lower Lone Camp group and an upper Whitt group with common boundary at disconformity between the Strawn and Canyon series. Lone Camp comprises Garner formation below and East Mountain shale above. Term Lone Camp limestone appeared in the Parker County, Tex., outcrop may in 1930, but did not come into common usage because this thin limestone had been named Dog Bend on Palo Pinto County outcrop map published in March, 1929.

M. G. Cheney and D. H. Eargle, 1951, Geologic map of Brown County, Texas (1:62,500): Texas Univ. Bur. Econ. Geology. Group includes named units (ascending) Ricker Station limestone, Ricker sandstone and Capps limestone. Underlies Whitt group.

Named from village of Lone Camp, 12 miles southwest of Mineral Wells, Palo Pinto County.

Lone Camp Limestone (in Mineral Wells Formation)[1]

Pennsylvanian: Central northern Texas.

Original reference: G. Scott and J. M. Armstrong, 1930, Geologic map of Parker County: Texas Univ. Bur. Econ. Geology.

M. G. Cheney, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 1, p. 88. Term Lone Camp limestone appeared in the Parker County outcrop map in 1930. Name did not come into common usage because this thin limestone had been named Dog Bend limestone on Palo Pinto

County outcrop map published in March, 1929. Term Lone Camp is used in present report as a group term to include Garner and East Mountain formations.

†Lone Grove Series[1]

Precambrian (Llano Series): Central Texas.

Original reference: T. B. Comstock and E. T. Dumble, 1890, Texas Geol. Survey 1st Ann. Rept., p. lv, 255–267, pl. 3.

Named for Lone Grove, Llano County.

Lone Mountain Dolomite

Lone Mountain Limestone[1] or Formation

Silurian: Eastern Nevada.

Original reference: A. Hague, 1883, U.S. Geol. Survey 3d Ann. Rept., p. 253, 262, 267.

C. W. Merriam, 1940, Geol. Soc. America Spec. Paper 25, p. 8 (table 1), 10–14. Lone Mountain limestone, as orignally defined, embraced deposits of both Ordovician and Silurian age. Unit is herein restricted, and name Lone Mountain formation retained for a discrete lithologic unit representative of the higher Silurian but possibly including in its upper 350 feet beds of Lower Devonian (Helderbergian) age. Name Hanson Creek formation applied to the Ordovician unit and Roberts Mountains formation to the fossiliferous Silurian unit. Thickness of restricted formation at type section 1,570 feet. Underlies Nevada formation (redefined).

T. B. Nolan, C. W. Merriam, and J. S. Williams, 1956, U.S. Geol. Survey Prof. Paper 276, p. 37–80. Lone Mountain dolomite described in vicinity of Eureka, where it ranges in thickness from 1,500 to 2,200 feet. Overlies Roberts Mountains formation; underlies Beacon Peak dolomite member (new) of Nevada formation.

Type locality: Lone Mountain, about 18 miles north of Eureka, Eureka County.

Lone Oak Limestone Lentil (in Kincaid Formation)[1]

Eocene: Northeastern Texas.

Original reference: F. B. Plummer, 1933. Texas Univ. Bull. 3232, p. 536, 539, 553.

Well exposed at Lone Oak quarry west of Lone Oak, Hunt County.

Lonesome Formation

Upper Jurassic(?): East-central Oregon.

R. L. Lupher, 1941, Geol. Soc. America Bull., v. 52, no. 2, p. 227 (table 1), 229, 265–266. Consists of black shale with intercalated beds of massive blue-gray sandstone and conglomerate. In South Fork Valley, lower part of section shows three conglomeratic beds, each about 100 feet thick, alternating with black shale beds of equal thickness. Thickness of formation along South Fork River about 4,000 feet. Beds dip at angles of 80° to 90° in South Fork syncline and some are overturned. Unconformably overlies Trowbridge shale (new).

Type area: Extends from Spoon Creek region on Snow Mountain northeast across South Fork Valley along axis of a syncline which adjoins the southeast side of Mowich anticline. Named for Lonesome Creek, a tributary of Lewis Creek, in South Fork Valley, Crook County.

Lone Star Formation[1]

Precambrian: Southern British Columbia, Canada, and northeastern Washington.

Original reference: R. A. Daly, 1912, Canada Geol. Survey Dept. Mines Mem. 38, map 7.

Named for exposures on east slope of Lone Star Mountain, British Columbia.

†Lone Wolf Sandstone[1]

Permian: Southwestern Oklahoma.

Original reference: L. T. Patton, 1926, Am. Jour. Sci., 5th, v. 12, p. 194–196.

Named for development near town of Lone Wolf, Kiowa County.

Longarm Quartzite (in Snowbird Group)

Precambrian (Ocoee Series): Western North Carolina.

P. B. King and others, 1958, Geol. Soc. America Bull., v. 69, no. 8, p. 954, 955 (table 1), 956 (fig. 3). Consists largely of clean feldspathic quartzite and arkose, dominantly light, medium bedded, and medium to very coarse grained; most layers current-bedded; interbedded with quartzite and arkose, especially in upper part, are many beds 1 to 3 feet thick of darker fine-grained sandstone. Thickness at type locality about 5,000 feet; thins and eventually pinches out a short distance southeast of Great Smoky Mountains. Conformably overlies Wading Branch formation (new) with contact gradational over several tens of feet; overlies and intertongues with Roaring Fork sandstone (new).

Type locality: Along Pigeon River at north base of Long Arm Mountain, which lies west of the Pigeon River about southeast of Waterville, Haywood County. Forms substantial part of group near Pigeon River and eastward, where it projects in ridges of intermediate height; appears in limited areas as far southwest as Cherokee.

Long Beards Riffs Sandstone[1]

Upper Devonian: Southwestern New York.

Original reference: D. D. Luther, 1902, New York State Mus. Bull. 52, p. 619.

Frederick Houghton, 1942, Hobbies, v. 22, no. 3, p. 48. Considered a lentil in the Wiscoy or in lower part of the Gowanda shale in which such sandstone layers are numerous.

J. F. Pepper and Wallace de Witt, Jr., 1950, U.S. Geol. Survey Oil and Gas Prelim. Chart 37. Abandoned. Field evidence indicates that sandstones at the riffle are similar in lithology to siltstones in basal part of the Dunkirk rocks on Wiscoy Creek. However, because identification of unit is open to question at any place other than the type exposure, it does not seem advisable to retain a name for such a local and indefinite unit.

Named from exposures on Genesee River in sides and bottom of river channel 1 mile south of Fillmore, Allegany County, where it forms "Long Beards riffs". Also exposed in north wall of ravine falls at Wiscoy.

†Long Beach sand[1]

Eocene: Eastern New Jersey.

Original references: S. Weller, 1905, New Jersey Geol. Survey Ann. Rept. 1904, p. 147, 157; 1905, Jour. Geology, v. 13, p. 76.

Long Canyon Member (of Las Posas Formation)[1]

Pleistocene: Southern California.

Original reference: E. D. Pressler, 1929, California Univ. Pub., Dept. Geol. Sci. Bull., v. 18, no. 13, p. 325–345.

Occurs in Long Canyon, on southern slope of South Mountain, Ventura County.

Long Canyon Sandstone (in Panoche Group or Formation)

Upper Cretaceous: Central western California.

P. P. Goudkoff, 1945, Am. Assoc. Petroleum Geologists Bull., v. 29, no. 7, p. 962 (fig. 2), 993. Panoche group (or formation) is subdivided into 10 units. Long Canyon sandstone is second in sequence (ascending). Underlies Lower Waltham shale (new); overlies Curry Mountain shale (new). Long Canyon sandstone is assigned to Delevanian stage (new). Name credited to J. Q. Anderson.

Occurs in Alcalde Hills, Coalinga-Ortigalito area, San Joaquin Valley.

Long Creek Limestone Member (of Foraker Limestone)

Long Creek Limestone[1]

Long Creek Limestone Member (of Konawa Formation)

Permian: Southeastern Nebraska, northeastern Kansas, and northern Oklahoma.

Original reference: G. E. Condra, 1927, Nebraska Geol. Survey Bull. 1, 2d ser., p. 84, 85, 88.

R. C. Moore, 1937, Kansas Geol. Soc. Guidebook 11th Ann. Field Conf., p. 103. Limestone member of Foraker limestone. Identifiable in southern Kansas and northern Oklahoma.

R. C. Moore, J. C. Frye, and J. M. Jewett, 1944, Kansas Geol. Survey Bull. 52, pt. 4, p. 168; R. C. Moore and others, 1951, Kansas Geol. Survey Bull. 89, p. 48. Alternating beds of yellow limestone and shale, or thin-bedded limestone, locally containing abundance of fusulines in northern part of outcrop area; in southern Kansas, light-gray limestone, more or less massive in upper and lower parts and sparsely fossiliferous. Thickness 5 to 8 feet. Overlies Hughes Creek shale member; underlies Johnson shale. Wolfcamp series.

P. B. Greig, 1959, Oklahoma Geol. Survey Bull. 83, p. 83–85, pls. 1, 2, 3, 4. Persists as far south as T. 16 N., in southern Lincoln County. In northern Osage County, consists of shaly limestone and shale and minor amounts of chert. Ranges in thickness from 9.8 to 12 feet. In Pawnee County, consists of interbedded dense gray limestone and gray marly shale; no chert. Thickness as much as 25.3 feet; entire sequence seldom exposed at one place. Overlies Hughes Creek shale member; underlies Johnson shale.

A. E. West, 1960, Shale Shaker, v. 11, no. 3, p. 4–6. Described in Lincoln County, Okla., where it is classified as member of Konawa formation. Thickness 55 to 60 feet. Overlies Americus(?) limestone member; underlies Red Eagle limestone member.

Named for exposures on Longs Creek, at foot of bluff west of cemetery at Auburn, Nemaha County, Nebr.

Longdale Limestone[1] Member (of Lewistown Limestone)

Lower Devonian: West-central Virginia.

Original reference: R. J. Holden, 1920, (abs.) Geol. Soc. America Bull., v. 31, p. 137.

F. M. Swartz *in* Bradford Willard, F. M. Swartz, and A. B. Cleaves, 1939, Pennsylvania Geol. Survey, 4th ser., Bull. G–19, p. 69. Name Long Dale abandoned since Holden's data was never published and occurrences in type area was never described. Licking Creek limestone extended for use in area.

Probably named for Longdale, Alleghany County.

Long Draw Glacial Substage

Pleistocene (Wisconsin): Southern Rocky Mountains.

L. L. Ray, 1939, (abs.) Geol. Soc. America Bull., v. 50, no. 12, pt. 2, p. 2007; Kirk Bryan and L. L. Ray, 1940, Smithsonian Misc. Colln., v. 99, no. 2, p. 34–35; L. L. Ray, 1940, Geol. Soc. America Bull., v. 51, no. 12, pt. 1, p. 1862. Fourth of five glacial substages in southern Rocky Mountains. Followed Corral Creek substage and preceded Sprague substage.

Named for moraine in small valley tributary to Long Draw, sec. 17, T. 6 N., R. 75 W., approximately 4 miles upstream from moraines of Corral Creek substage, Cache la Poudre Valley.

Longfellow Limestone[1]

Upper Cambrian and Lower Ordovician: Southeastern Arizona.

Original reference: W. Lindgren, 1905, U.S. Geol. Survey Prof. Paper 43.

T. F. Stipp and H. M. Beikman, 1959, U.S. Geol. Survey Oil and Gas Inv. Map OM–201. In stratigraphic section of rocks in southern Arizona.

Exposed in Longfellow incline and Longfellow mine, Morenci district.

Long Island Beds (in Ash Hollow Formation)

Pliocene, lower: Western Kansas.

M. K. Elias, 1942, Geol. Soc. America Spec. Paper 41, p. 144. Mentioned in article on Tertiary prairie grasses from high plains. Rhinoceros Hill sands may belong in channel of same late Tertiary river system as Wray beds and Long Island beds and are probably nearly or quite contemporaneous with them.

Type locality and derivation of name not given.

†Long Island division[1]

Tertiary: Southeastern New York.

Original reference: W. W. Mather, 1843, Geology New York, pt. 1, p. 246.

In Oyster Bay and Hempstead quadrangles on Long Island.

Long Lake Gneiss[1]

Precambrian: New York.

Original reference: H. P. Cushing, 1907, New York State Mus. Bull. 115, p. 463–469.

Long Lake quadrangle, Adirondack Mountains.

Long Lake Series[1] or Stage

Middle Devonian: Northeastern Michigan.

Original reference: A. W. Grabau, 1902, Michigan Geol. Survey Rept. 1901, p. 184.

A. S. Warthin, Jr., and G. A. Cooper, 1943, Am. Assoc. Petroleum Geologists Bull., v. 27, no. 5, p. 573. Long Lake series and its synonym, Presque Isle series or stage, are abandoned.

Probably named for Long Lake, in Presque Isle and Alpena Counties.

Longmeadow Sandstone[1]

Upper Triassic: Central Connecticut and central Massachusetts.

Original reference: B. K. Emerson, 1891, Geol. Soc. America Bull., v. 2, p. 451–456.

M. E. Willard, 1951, Bedrock geology of the Mount Toby quadrangle, Massachusetts: U.S. Geol. Survey Geol. Quad. Map [GQ–8]. Name replaced by Turners Falls sandstone (new) in Greenfield and nothern part of Mount Toby quadrangle. Unit can not be traced into this area from its type area.

Robert Balk, 1957, Geol. Soc. America Bull., v. 68, no. 4, p. 496–497, pl. 1. Maximum thickness in Mount Holyoke quadrangle about 2,000 feet. Earliest beds older than Granby tuff, middle and upper parts younger than Granby.

Named for occurrence at Longmeadow, Mass.

Longmire Acid Breccias

See Keechelus Andesitic Series.

Long Mountain Granite

Upper Devonian: Northern New Hampshire.

R. W. Chapman, 1946, (abs.) Geol. Soc. America Bull., v. 57, no. 12, pt. 2 p. 1187. Mentioned as a binary granite. Belongs to the New Hampshire magma series.

R. W. Chapman, 1948, Geol. Soc. America Bull., v. 59, no. 11, p. 1079–1080, pl. 1. Described as light-gray medium-grained granite of uniform grain size. Locally porphyritic. Forms stocklike intrusion. Cuts Albee formation and is cut by narrow alkaline dike of the White Mountain magma series. Also locally intruded by small pegmatite dikes.

Type locality: Northern ridge of Long Mountain in northern part of Percy quadrangle, Coos County.

†Long Mountain Series[1]

Precambrian (Llano Series): Central Texas.

Original reference: T. B. Comstock and E. T. Dumble, 1890, Texas Geol. Survey 1st Ann. Rept., p. lv, lvi, 255–267, pl. 3.

Named for Long Mountain, Llano County.

Long Savannah Formation

Middle Ordovician (Mohawkian): Southeastern Tennessee, Alabama, and northwestern Georgia.

G. A. Cooper, 1956, Smithsonian Misc. Colln., v. 127, pt. 1, p. 75–76, chart 1 facing p. 130. Red dolomitic mudstone and interbedded buff earthy limestones. Basal layers contain detrital chert and some minor quartz sand. Thickness 50 to 175 feet. Underlies Mahan formation (new); overlies Lower Ordovician limestones and dolomites.

Type section: Exposed along Mahan Gap Road, Snow Hill quadrangle. Named from Long Savannah Creek just northeast of Snow Hill, Snow Hill quadrangle, Hamilton County, Tenn. Occurs in belts northwest of White Oak Mountain fault in southern Tennessee, Georgia, and Alabama.

Longs Peak Granite[1]

Precambrian: Central northern Colorado.

Original reference: M. B. Fuller, 1924, Jour. Geology, v. 32, p. 51–63.

T. S. Lovering and E. N. Goddard, 1950, U.S. Geol. Survey Prof. Paper 223, p. 29. Included in Silver Plume granite in the Front Range area.

Named for Longs Peak, a large part of whose bulk is made of this granite.

Longs Peak-St. Vrain Granite

Precambrian: Central northern Colorado.

E. E. Wahlstrom, 1940, Econ. Geology, v. 35, no. 4, p. 480. Idaho Springs gneisses and Boulder Creek granite gneiss are cut by a younger granite batholith locally called Long's Peak-St. Vrain granite.

M. F. Boos, 1954, Geol. Soc. America Bull., v. 65, no. 2, p. 120. Chief granite of the Longs Peak-St. Vrain batholith.

At Camp Albion, Boulder County.

Long Spring Formation

Pliocene, upper, or Pleistocene: Southeastern Idaho.

Z. S. Merritt, 1956, Wyoming Geol. Assoc. Guidebook 11th Ann. Field Conf., p. 119. Poorly sorted, well-consolidated conglomerate, consisting predominantly of pebbles, cobbles, and boulders of Paleozoic limestone and dolomite. Medium gray to gray buff. Individual limestone, dolomite, and shale fragments are angular and vary in size from small pebbles to boulders more than 2 feet in diameter, average about 3 inches in diameter. Interbedded with hard limestone conglomerate are lenses of softer dark- to yellow-brown or olive-green shale-breccia. Thickness varies from a few feet in upper Long Spring Canyon to about 200 feet in type area. Overlies Teewinot formation with angular unconformity in Alpine area.

Type section: In Grand Valley, 3 miles north-northwest of Alpine in secs. 21, 22, 27, and 28, T. 2 S., R. 46 E., Bonneville County. Outcrops in distinctive flat benches in bottom of canyon from which it derives its name.

Long Trail Shale Member (of Great Blue Limestone)[1]

Upper Mississippian: Central northern Utah.

Original reference: J. Gilluly, 1932, U.S. Geol. Survey Prof. Paper 173.

J. W. Strickland, 1956, Wyoming Geol. Assoc. Guidebook 11th Ann. Field Conf., p. 53. Section of rocks of Chester age formerly included with Brazer (Williams, 1943; Williams and Yolton, 1945) are raised to group rank, consisting of (ascending) unit 3, Long Trail formation; unit 4, unnamed thin- to medium-bedded cherty limestone sequence; and unit 5, Manning Canyon formation. Units 1 and 2 are classed as members of the Brazer as defined in this paper.

R. P. Zeller, 1958, Brigham Young Univ. Research Studies, Geology Ser., v. 5, no. 8, p. 1–36. Gilluly (1932) described Long Trail as a black carbonaceous shaly unit. In present study, it has been found that black carbonaceous shales, though predominating at type area, are only minor constituent of member. Elsewhere shale-type rocks such as mudstone, siltstones, and claystones are prevalent along with thin interbedded carbonates. Intergradation, sediment size variation, and induration differences have resulted in large variety of units. Thickness 98 to 111 feet.

Named for exposures at head of Long Trail Gulch, in Ophir Canyon, Fairfield quadrangle.

Longview Limestone[1] or **Dolomite** (in Knox Group)

Lower Ordovician: Northern Alabama, eastern Tennessee, and southwestern Virginia.

Original references: E. O. Ulrich, 1924, Tennessee Dept. Ed. Div. Geology Bull. 28, p. 34; Bull. 31, p. 16.

John Rodgers, 1943, Geologic map of Copper Ridge district, Hancock and Grainger Counties, Tennessee (1:24,000): U.S. Geol. Survey Strategic Minerals Inv. Prelim Map; C. R. L. Oder and W. H. Miller, 1945, Am. Inst. Mining Metall. Engineers Tech. Pub. 1818, p. 2. Underlies Kingsport formation (new).

John Rodgers and D. F. Kent, 1948, Tennessee Div. Geology Bull. 55, p. 22–25. Longview dolomite described in Lee Valley, Hawkins County, where it is 264 feet thick; underlies Kingsport limestone and overlies Chepultepec dolomite.

R. L. Miller and W. P. Brosgé, 1954, U.S. Geol. Survey Bull. 990, p. 23–26, pl. 1. Described in Jonesville district, southwestern Virginia, where it consists chiefly of light-gray to nearly white dolomite, some of which is medium crystalline and some fine crystalline. Thickness 98 to 272 feet. Underlies Kingsport dolomite; overlies Chepultepec dolomite; base of Longview not clear cut at all localities.

J. M. Cattermole, 1955, U.S. Geol. Survey Geol. Quad. Map GQ–76. In Shooks Gap quadrangle, Tennessee, Longview dolomite is about 250 feet thick; overlies Chepultepec dolomite and underlies Newala formation.

Named for fact that town of Longview, Shelby County, Ala., is located on a wide area of formation.

Longwall Sandstone Member (of Frontier Formation)

Lower Cretaceous(?): Northeastern Utah.

L. A. Hale, 1960, Wyoming Geol. Assoc. Guidebook 15th Ann. Field Conf., p. 136 (chart 1), 139 (fig. 1), 140–141. Medium-light-gray to white sandstone. Thickness 70 feet in western part of area; 100 feet, eastern part. Underlies Spring Canyon member (new); transitional contact with Aspen(?) shale.

J. M. Boutwell (1933, 16th Internat. Geol. Cong. [United States] Guidebook 17, Excursion C–1, p. 62) listed, but did not define, Longwall Sandstone in sequence between Kelvin Conglomerate and Aspen Shale. This may or may not be same unit defined by Hale, 1960.

Present in Coalville anticline, Summit County. Unit forms conspicuous white sandstone "wall" locally called the Longwall.

Longwood Shale[1]

Upper Silurian: Northern New Jersey and southeastern New York.

Original reference: N. H. Darton, 1894, Geol. Soc. America Bull., v. 5, p. 367, 382, 383.

Named for fact the most extensive exposures are along Longwood Valley east of Milton, Morris County, N.J.

Lonsdale Limestone (in McLeansboro Group)

Lonsdale Limestone Member (of McLeansboro Formation)[1]

Lonsdale Limestone Member (of Modesto Formation)

Upper Pennsylvanian: Central and western Illinois.

Original reference: A. H. Worthen, 1882, Econ. Geology of Illinois, v. 3, p. 258.

Chalmer Cooper, 1946, Illinois Geol. Survey Bull. 70, p. 16 (fig. 2). Shown on correlation chart as limestone in McLeansboro group.

H. R. Wanless, 1957, Illinois Geol. Survey Bull. 82, p. 50 (fig. 22), 117–119, 194. Averages 6 to 8 feet; maximum 25 feet; locally only 2 or 3 feet. Where several feet thick, commonly consists of two parts: lower, dense to slightly crystalline, massive to thick bedded, fossiliferous, 3 to 7 feet thick; and upper, commonly composed of nodules of light-gray or mottled light- and medium-gray fairly pure limestone cemented with medium-gray limestone. Included in Gimlet cyclothem; where limestone cuts through underlying members of the Gimlet and Sparland cyclothems, it varies more in lithology and includes beds of limestone conglomerate. Type locality given.

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 38, 49 (table 1), pl. 1. Reallocated to member status in Modesto formation (new). Occurs above Gimlet sandstone member and below Exline limestone member. Presentation of new rock-stratigraphic classification of Pennsylvanian strata in Illinois.

Type locality: Old Lonsdale quarries in N½ sec. 6, T. 8 N., R. 7 E., Glasford quadrangle, Peoria County.

Lookout Sandstone (in Pottsville Group)[1]

Lower Pennsylvanian: Northeastern Alabama, northwestern Georgia, and southern Tennessee.

Original reference: C. W. Hayes, 1892, Alabama Geol. Survey Bull. 4, p. 49–51.

V. H. Johnson, 1946, Coal deposits on Sand and Lookout Mountains, Dade and Walker Counties, Georgia: U.S. Geol. Survey Prelim. Map. Consists of two members, Gizzard below and Sewanee above. Underlies Whitwell shale; overlies Pennington shale.

H. R. Wanless, 1946, Geol. Soc. America Mem. 13, p. 8, 10, 24, 31, 33, 45, 144. Terms Lookout and Walden were extensively applied in Tennessee for a time, but later were supplanted by term Lee, introduced from Virginia.

Named for exposures on Lookout Mountain, northeastern Alabama and northwestern Georgia.

Lookout Schist[1] (in Snowy Range Series)

Precambrian: Southeastern Wyoming.

Original reference: E. Blackwelder, 1926, Geol. Soc. America Bull., v. 37, p. 620, 623, 634.

J. J. Runner, 1928, (abs.) Geol. Soc. America Bull., v. 39, no. 1, p. 202. Included in Snowy Range series (new).

Exposed on southeast shore of Lookout Lake, Medicine Bow Mountains.

Loomis Peak Dacites[1]

Cenozoic: Northern California.

Original reference: Howel Williams, 1932, California Univ. Pub., Bull. Dept. Geol. Sci., v. 21, no. 5, p. 71 (map).

O. P. Jenkins, 1943, California Div. Mines Bull. 118, p. 679. Cenozoic.

Occur in Mount Lassen region.

Loon Lake Granite[1]

Cretaceous: Northeastern Washington.

Original reference: C. E. Weaver, 1920, Washington Geol. Survey Bull. 20, p. 87, map.

U.S. Geological Survey currently considers Loon Lake Granite to be Cretaceous in age.

Named for exposures in vicinity of Loon Lake, Stevens County.

Loon Lake Quartz-Syenite Complex

Precambrian: Northeastern New York.

A. F. Buddington, 1948, Geol. Soc. America Mem. 28, p. 25. Loon Lake, Jennings Mountain, and Stark complexes are exposed on core of domes or anticlines which are either close-folded or isoclinally overturned.

A. F. Buddington, 1953, New York State Mus. Bull. 346, p. 71, 81–84. Consists of two members, phacoidal syenite, and phacoidal quartz-syenite and granite. Also referred to as Loon Lake series. Discussion of structure and origin of the complex and its relationship to Saranac complex.

Named for occurrence in vicinity of Loon Lake, Franklin County.

Lopez Fanglomerate[1]

Pleistocene or Recent: Southern California.

Original reference: M. L. Hill, 1930, California Univ. Pub., Dept. Geol. Sci. Bull., v. 19, no. 6, p. 141, 144.

B. F. Howell, 1954, California Div. Mines Bull. 170, map sheet 10. Referred to as Lopez alluvium. Thickness as much as 400 feet. An older higher fan than others in area except possibly Beehive Mesa alluvium (new). Pleistocene or Recent.

Named for exposures in Lopez Canyon, Los Angeles County.

Lorane Shale Member (of Spencer Formation)

Eocene: Western Oregon.

H. E. Vokes, P. D. Snavely, Jr., and D. A. Myers, 1951, U.S. Geol. Survey Oil and Gas Inv. Map OM–110. Name applied to basal shale and mudstone of Spencer formation (redefined). Thickness about 600 feet; figure varies due to thinning of member toward south and to local irregularities on surface of Tyee formation on which it was deposited. Intercalated sandstones, siltstones, shales, and mudstones at top of member gradually pass into typical sandstones of the formation.

H. E. Vokes, D. A. Myers, and Linn Hoover, 1954, U.S. Geol. Survey Oil and Gas Inv. Map OM–150. Discussion of west-central border area of Willamette Valley. Uppermost exposed part of Tyee formation consists of thin-bedded siltstone and mudstone. Beds in an equivalent stratigraphic position in Eugene area were mapped as Lorane shale member of Spencer by Vokes and others (1951) who estimated thickness of sequence to be about 600 feet. Mapping in Corvallis-Monroe area indicates that Lorane shale member is more closely related to Tyee formation than to Spencer formation.

Type locality: Valley of North Fork of Siuslaw River, in the S½ sec. 36, T. 19 S., R. 6 W., and sec. 1, T. 20 S., R. 6 W., north of Lorane, Lane County.

Loray Formation

Permian (Guadalupian): East-central Nevada and northwestern Utah.

J. S. Berge, Apr. 1960, Brigham Young Univ. Research Studies, Geology Ser., v. 7, no. 5, chart (strat. section). (Footnote on chart refers to Steele's article in Intermountain Assoc. Petroleum Geologists Guidebook 11th Ann. Field Conf., 1960, p. 91, 106–107.) Named on stratigraphic section. Name credited to Grant Steele (unpub. thesis), who used term Loray for strata which writer [Berge] has included in Kaibab limestone.

Grant Steele, 1960, Intermountain Assoc. Petroleum Geologists Guidebook 11th Ann. Field Conf., p. 93 (chart 1), 105 (pl. 6, fig. 2), 106–107. (Road logs dated Sept. 8–10). Formal proposal of name. Sequence of yellow-tan, gypsiferous silts and thin bioclastic limestones. At type locality, conformable with underlying Pequop formation (new) and overlain by Kaibab formation. Thickness 2,475 feet in central Butte Monntains, White Pine County; here rests on Upper Moorman Ranch member of Pequop and underlies Plympton formation. Identified at Ferguson Springs Mountain, Gold Hill, Cherry Creek Mountains, and Pequop Mountains. Probably equivalent to upper 300 to 400 feet of Hose and Repenning's (1959) measured Arcturus formation in Confusion Range, Utah.

Named for exposures at head of Loray Wash in Southern Pacific Railroad cut on southwest side of Montello Valley, SW¼NE¼ sec. 28, T. 38 N., R. 68 E., Elko County.

Lorette Beds

Lorette Formation[1]

Middle Ordovician: Quebec, Canada, and eastern New York.

Original reference: P. E. Raymond, 1916, Harvard Coll. Mus. Comp. Zoology Bull., v. 56, p. 257.

A. E. Wilson, 1936, Canada Geol. Survey Mem. 202, p. 10. Referred to as Lorette beds. Fine-grained conglomerate at base followed by thin-bedded blue-gray limestone, which becomes thick bedded and dark grey toward top. Thickness 90 feet at type locality, where it rests on Precambrian and is succeeded by typical middle Trenton beds.

Type locality: Just west of Quebec City, Quebec, Canada. Also exposed near Montreal.

Loretto Slate[1] Member (of Vulcan Iron-Formation)

Precambrian (Animikie Series): Northern Michigan.

Original reference: R. C. Allen, 1919, Ann. Inst. Min. Met. Engrs. Bull. 153, p. 2593.

H. L. James, 1958, U.S. Geol. Survey Prof. Paper 314–C, p. 30 (table 1), 35. Rank reduced and reallocated to Vulcan iron-formation where it forms upper member of formation and overlies Curry iron-bearing member.

Best developed on property of Loretto mine, Menominee district, Dickinson County.

Lorraine Shale

Lorraine Group[1]

Upper Ordovician: New York, and Ontario, Canada.

Original reference: E. Emmons, 1842, Geology of New York, pt. 2, div. 4, geology 2d dist., p. 119–123, 401, 429.

G. M. Kay, 1937, Geol. Soc. America Bull., v. 48, no. 2, p. 286–287. Throughout New York-Ontario region, where sediments of post-Trenton age are preserved, they are of lower Cincinnatian Eden age and of clastic character. They comprise lower Lorraine sandy shales in New York and eastern Ontario, lower Dundas shales in central Ontario, and Sheguiandah shale of Manitoulin.

C. E. Decker, 1952, Am. Assoc. Petroleum Geologists Bull., v. 36, no. 1, p. 137. Incidental mention in discussion of graptolites of Athens shale. Utica and Lorraine formations are represented in the upper Viola.

W. H. Twenhofel and others, 1954, Geol. Soc. America Bull., v. 65, no. 3, chart 2 (columns 9b, 19). As shown on correlation chart, Lorraine group in northwestern New York comprises Whetstone Gulf shale below and Pulaski shale above. Occurs above Utica shale and below Oswego sandstone. Group in Montreal lowland comprises Leclercville shale below and Nicolet River shale above.

Probably named for Lorraine, Jefferson County, N.Y.

Los Angelan Epoch[1]

Pleistocene: Southern California.

Original reference: O. H. Hershey, 1902, California Univ. Pub., Dept. Geol. Bull., v. 3, p. 1–29.

Los Arrieros Shale Member (of Yegua Formation)

Eocene (Claiborne): Southern Texas.

J. M. Patterson, 1942, Am. Assoc. Petroleum Geologist Bull., v. 26, no. 2, p. 259 (fig. 2), 266. Gray-green bentonitic locally sandy shale. Thickness approximately 110 feet. Uppermost member of formation; overlies Loma Blanca tongue; underlies Salineno sandstone tongue of Fayette formation. In some areas, underlies Rio Grande silts.

Named from village of Los Arrieros, located on bank of Rio Grande at north line of Roma quadrangle.

Los Banos Creek member (of "Quinto B" reef beds)

Upper Cretaceous: Central western California.

C. T. Smith, 1945, Jour. Paleontology, v. 19, no. 1, p. 38. Name appears in a sequence of Upper Cretaceous strata indicated by evolution of *Glycymeris veatchii*.

"Quinto B" reef beds are exposed on Los Banos Creek, west of Los Banos, Merced County.

Los Cerritos Beds[1] (in San Pedro Formation)

Pleistocene: Southern California.

Original reference: J. P. Smith, 1910, Jour. Geology, v. 18, chart opposite p. 217.

See Deadman Island Beds.

Losee Gneiss

Losee Diorite Gneiss[1]

Precambrian: Northern New Jersey and western Pennsylvania.

Original reference: A. C. Spencer, 1908, U.S. Geol. Survey Geol. Atlas, Folio 161.

W. S. Bayley, 1941, U.S. Geol. Survey Bull. 920, p. 49–50, pl. 5. Consists mainly of oligoclase and quartz, smaller amounts of orthoclase, bright-green diopside, with hornblende, hypersthene, biotite, apatite, magnetite, sphene, and locally zircon. Losee, Pochuck gabbro gneiss, and Byram granite gneiss grade into each other through intermediate types. With decrease in oligoclase, Losee phases pass into the Byram phases, and, with increase in pyroxene and hornblende, into phases of the Pochuck gabbro gneiss. Younger than Pickering gneiss and Franklin limestone.

Named for development around Losee Pond, Sussex County, N.J.

†Losee Pond Granite[1]

Precambrian: Northern New Jersey.

Original reference: J. E. Wolff and A. H. Brooks, 1898, U.S. Geol. Survey 18th Ann. Rept., pt. 2, p. 439.

Named from exposures around Losee Pond, Sussex County.

Los Gatos Beds (in Panoche Group)

Los Gatos Sandstone

Los Gatos Stage

Upper Cretaceous (Chico Series): Northern California.

F. M. Anderson, 1937, (abs.) Am. Assoc. Petroleum Geologists Bull., v. 21, no. 12, p. 1612. Incidental mention as beds in Panoche group.

F. M. Anderson, 1943, California Div. Mines Bull. 118, pt. 2, p. 185 (fig. 69) [preprint 1941]. Shown as a stage, based on a faunal assemblage, in Panoche group.

P. P. Goudkoff, 1945, Am. Assoc. Petroleum Geologists Bull., v. 29, no. 7, p. 962 (fig. 2). Shown in list of subdivisions of the Panoche, as Los Gatos sandstone underlying Alcalde shale and overlying Waltham shale in Coalinga-Ortigalito area, San Joaquin Valley.

First mentioned as occurring in Diablo Range.

Losh Run Shale[1] Member (of Fort Littleton Formation)

Upper Devonian: Southern central Pennsylvania.

Original reference: Bradford Willard, 1935, Geol. Soc. America Proc. 1934, p. 123.

Bradford Willard, 1939, Pennsylvania Geol. Survey, 4th ser., Bull. G–19, p. 215–216. Conmmonly dark-gray to brown shale which weathers rusty brown. Thickness about 10 feet. Underlies Trimmers Rock member. The Losh Run is a thin band, in some places a faunal zone, occurring chiefly in lower part of the Trimmers Rock but also represented in the underlying Brallier.

Named for stream in Perry County that enters the Juniata from the west about 5 miles north of Duncannon.

Los Medanos Formation

Pliocene, lower: Northern California.

B. L. Clark, 1943, California Div. Mines Bull. 118, pt. 2, p. 189, 191 [preprint 1941]. Shown on correlation chart as overlying "Lawler tuff."

Occurs on north side of Mount Diablo.

Los Muertos Creek Formation

Eocene, middle: Northern California.

I. F. Wilson, 1943, California Jour. Mines and Geology, v. 39, no. 2, p. 205–206, 226 (fig. 5), pl. 3. A series of siltstones, fine-grained buff micaceous sandstones, clay-shales, and cherty shales. Thickness about 1,000 feet. Conformably overlain by Tres Pinos sandstone to southwest; overlapped by San Benito gravels to southeast; base is faulted out against Panoche group to northeast. Unit was assigned to Meganos formation by Kerr and Schenck (1925, Geol. Soc. America Bull., v. 36, no. 9), but that was before Capay stage had been separated in California Eocene.

Exposed 2 miles northwest of Los Muertos Creek, west of Brown Valley, in northeastern part of San Benito quadrangle. Out crop forms a narrow belt trending northwest for a distance of about 2 miles.

Losoya Creek Conglomerate (in Sabinetown Formation)[1]

Eocene, lower: Southern Texas.

Original reference: F. B. Plummer, 1933, Texas Univ. Bull. 3232, p. 575, 602.

On Losoya Creek, at bridge on South Flores Road south of San Antonio, Bexar County.

Lospe Formation

Miocene, lower(?) Southern California.

C. F. Tolman, 1927, Econ. Geology, v. 22, no. 5, p. 459. Named on stratigraphic column. Thickness, 2,700 feet. Consists of black shale, gray gypsiferous shale, gray sandstone, greenish-gray sandstone, red and green sandstone, conglomerate, and rhyolite tuffs. Underlies Monterey formation.

S. G. Wissler and F. E. Dreyer, 1943, California Div. Mines Bull. 118, pt. 2, p. 237, 238 [preprint 1941]. Described as 2,600-foot section of unfossiliferous, continental beds. Lower 650 feet consists of well-bedded maroon and greenish-gray sandstone and conglomerate; middle 1,000 feet composed of greenish-gray sandstone and sandy shale with two prominent 50-foot white and greenish tuff beds in upper 250 feet; upper 950 feet consists of gypsiferous gray and greenish-gray clay shale. Unconformably underlies Point Sal formation; unconformably overlies the Franciscan. Type area noted.

W. P. Woodring and M. N. Bramlette, 1950, U.S. Geol. Survey Prof. Paper 222, p. 11, 13–16, pls. 1, 3. Noted as resting on Franciscan or Knoxville; overlain without marked discontinuity by Point Sal formation or apparently overlapped by it. In type area, divided into two mapped but unnamed members.

Type area: Southwest slope of Mount Lospe, near western end of Casmalia Hills, approximately 2 miles south of Point Sal Landing and one-half mile north of Lions Head Beach (Guadalupe quadrangle).

Los Pinos Granite

Precambrian: Central New Mexico.

J. T. Stark and E. C. Dapples, 1941, (abs.) Geol. Soc. America Bull., v. 52, no. 12, pt. 2, p. 1936. Intrudes Sais quartzite (new), Blue Springs muscovite schist (new), White Ridge quartzite (new), and Sevilleta rhyolite (new). Granitization pronounced along its borders.

J. T. Stark and E. C. Dapples, 1946, Geol. Soc. America Bull., v. 57, no. 12, pt. 1, p. 1136–1138, pl. 1. In its least contaminated facies, medium-coarse-grained pink rock composed largely of microcline, orthoclase, albite, and quartz. Biotite most prominent dark mineral. Where biotite increases in amount to as much as 7 percent, it is intimately related to schist inclusions and adjacent formations. Comprises core of intruded granite grading outward through migmatitic facies into host rock.

Constitutes major part of Los Pinos Mountains. Forms steep western escarpment for 7 miles along central and southern parts of range.

Los Pinos Gravel

Los Pinos Formation

Los Pinos Member (of Hinsdale Formation)[1]

Miocene and Pliocene(?): Northern New Mexico and central southern Colorado,

Original reference: W. W. Atwood and K. F. Mather, 1932, U.S. Geol. Survey Prof. Paper 166.

E. S. Larsen, Jr., and Whitman Cross, 1956, U.S. Geol. Survey Prof. Paper 258, p. 13, 185–192. Age of gravel given as Miocene and Pliocene(?). Flows mostly in Conejos quadrangle, Colorado, where they make up much of thick section of Chiquita Peak and Green Ridge, and no doubt were extruded by local volcano. Local flows also in northern part of New Mexico. Most material well bedded and individual beds mostly thick, but range from fraction of a foot to 100 feet or more. Overlies Treasure Mountain rhyolite in most places in Colorado but locally overlies Sheep Mountain quartz latite. Overlies Conejos quartzite latite or older rocks in New Mexico. Underlies Hinsdale formation.

Fred Barker, 1958, New Mexico Bur. Mines Mineral Resources Bull. 45, p. 38, 43–51, pl. 1. Redefined as formation to include all rocks that overlie Treasure Mountain formation and unconformably underlie Cisneros basalt. In Tusas Valley, separated into four members (ascending): Biscara, Esquibel, Jarita basalt, and Cordito (all new). Biscara and Esquibel grouped together northwestward from point about 3 miles southeast of Tusas. Type locality designated.

Type locality: In canyon of Los Pinos Creek, near town of San Miguel, in extreme northern part of New Mexico, about 10 or 12 miles southwest of Antonito, Conejos County, Colo.

Los Puertos Limestone[1]

Los Puertos Member (of Naranjo Formation)

Oligocene or Miocene: Puerto Rico.

Original reference: B. Hubbard, 1920, Science, new ser., v. 51, p. 396.

A. D. Zapp, H. R. Bergquist, and C. R. Thomas, 1948, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 85, sheets 1, 2. Unit formerly termed Los Puertos limestone included in Aymamón limestone (new).

E. A. Pessagno, Jr., 1960, Caribbean 2d Geol. Conf. Trans., Mayagüez, Puerto Rico, p. 84. Member includes 0 to 2,300 feet of volcanic conglomerates and siltstones at base of Naranjo formation. Grades upward into Coamo Springs limestone member. Unconformably overlies Cretaceous units of Santonian age (Toa Vaca and Santa Ana formations). Naranjo formation considered early middle Eocene. Ponce-Coamo area.

First described in Lares district.

Lost Conglomerate Member (of Repetto Formation)

Pliocene, lower: Southern California.

C. J. Kundert, 1952, California Div. Mines Spec. Rept. 18, p. 9, pl. 2. A conglomerate with interbedded sandstone. Thickness 30 to 300 feet. Occurs in middle of formation.

Occurs in Whittier-La Habra area, south of Whittier fault, Los Angeles County.

Lost Brook Formation

Silurian(?): Central western Maine.

R. J. Willard, 1959, Dissert. Abs., v. 19, no. 11, p. 2918. Originally a pelitic, argillaceous quartz silty clay. Metamorphic grade of the pelitic and quartz-rich sediments restricted to chlorite and biotite zones of greenschist facies. Thickness about 7,000 feet. Underlies Johns Pond formation (new).

In Kennebago Lake quadrangle.

Lost Burro Formation

Middle and Upper Devonian: Southern California.

J. F. McAllister, 1952, California Div. Mines Spec. Rept. 25, p. 3, 14 (fig. 6), 18–20, pls. 1, 2, 3. Generally very light gray dolomite prominently striped with nearly black limestone and dolomite; lower part entirely dolomite; sandy beds that weather brownish gray mark base of formation; midway in section, conspicuous black limestone beds consist of masses of stromatoporoids, of which concentric cellular structure is sufficiently persistent to be considered a lithologic characteristic of that part of formation; spaghettilike outlines of masses of cladoporoids in several beds are another characteristic of the lithology; the combination of these two structures of organic origin occurs in none of the other formations and is excellent indicator of the formation. Thickness at type locality 1,525 feet; in Andy Hills about 2,245 feet. Underlies Mississippian Tin Mountain limestone (new); overlies Lower Devonian Hidden Valley dolomite (new).

J. F. McAllister, 1955, California Div. Mines Spec. Rept. 42, p. 9 (fig. 3), 12, pl. 2. Subdivided to include Lippincott member (new) at base.

B. L. Langenheim, Jr., and Herbert Tischler, 1960, California Univ. Pubs., Geol. Sci., v. 38, no. 2, p. 92, 94 (fig. 4), 134–135, 136. Includes Quartz Spring sandstone member (new) in Quartz Spring area. Underlies Tin Mountain limestone. Late Devonian.

Type locality: On western side of Lost Burro Gap at southern entrance; extends from Hidden Valley dolomite at base of slope to Tin Mountain limestone near top. Named for Lost Burro Gap, through which road passes from Racetrack Valley to Hidden Valley, northern Panamint Range, Inyo County. Formation also widespread in region between Death Valley and Saline Valley.

Lost Cabin Member (of Wind River Formation)

†Lost Cabin Formation[1]

Eocene, lower: Northern Wyoming.

Original reference: W. J. Sinclair and W. Granger, 1911, Am. Mus. Nat. History Bull., v. 30, p. 104–111.

H. E. Wood 2d and others, 1941, Geol. Soc. America Bull., v. 52, no. 1, p. 24, pl. 1. Referred to as member (or formation) of Wind River formation (or group). Is valid mappable lithologic unit. Overlies Lysite member. Wasatchian.

H. A. Tourtelot, 1948, Wyoming Geol. Soc. Guidebook 3d Ann. Field Conf., p. 113 (fig. 1), 114, 117–119. Although lithologic difference between rocks of Lost Cabin and Lysite units were described by Sinclair and Granger, most later workers considered the names to represent only faunal zones. Recent work has substantiated opinion of Wood and others that the units are lithologically separable as members of Wind River formation. Member typically consists of gray and grayish-green siltstone and claystone with yellowish-brown to orange sandstones deposited in sheets and channels; many sandstones conglomeratic. Thickness more than 400 feet between Badwater Creek and top of divide between Badwater and Poison Creeks, south of Lysite. Contact with Lysite member gradational; nature of distinguishing criteria for separating the two members suggests that the names should not be applied to lithologic units in places other than along southern margin of Big Horn Mountains. Report includes historical summary of usage of name.

Type area: East of Lost Cabin along Alkali Creek and on divide between Alkali and Poison Creeks, Fremont County.

Lost City Limestone Member (of Hogshooter Formation)

†Lost City Limestone[1]

Pennsylvanian (Missouri Series): Northeastern Oklahoma.

Original reference: C. N. Gould, 1911, Oklahoma Geol. Survey Bull. 5, p. 179.

M. C. Oakes, 1940, Oklahoma Geol. Survey Bull. 62, p. 44. Rank reduced to member status in Hogshooter formation. In Washington County, a 5-foot soft gray platy limestone bed is referred to Lost City member. Underlies Winterset member; overlies Stark or Canville; regarded as time equivalent of both Canville limestone and Stark shale members.

M. C. Oakes, 1952, Oklahoma Geol. Survey Bull. 69, p. 61–62. Described in Tulsa County where thickness ranges from 3 feet at northernmost exposure to 50 feet south of Arkansas River.

Named from exposures near Lost City, near Sand Springs, Tulsa County.

Lost Creek Limestone[1]

Silurian: Central Pennsylvania.

Original reference: J. P. Lesley, 1878, Pennsylvania 2d Geol. Survey Rept. F., p. xxvi.

In Lost Creek valley, Juniata County.

Lost Creek Limestone[1]

Lost Creek Limestone (in Breathitt Formation)

Pennsylvanian: Eastern Kentucky.

Original reference: W. C. Morse, 1931, Kentucky Geol. Survey, ser. 6, v. 36, p. 296, 304.

H. R. Wanless, 1939, Geol. Soc. America Spec. Paper 17, p. 91; R. C. Moore and others, 1944, Geol. Soc. America Bull., v. 55, no. 6, chart 6 (column 22). A limestone in Breathitt formation.

Exposed along crest of ridge between Lost Creek and Big Branch of North Fork of Kentucky River, Buckhorn quadrangle, Breathitt County.

Lost Creek Shale Member (of Admiral Formation)[1]

Permian (Wolfcamp Series): Central Texas.

Original reference: N. F. Drake, 1893, Texas Geol. Survey 4th Ann. Rept., pt. 1, p. 421, 422.

R. C. Moore, 1949, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 80, sheet 2. Described in Colorado River valley where it underlies Hords Creek member and overlies Coleman Junction limestone member of Putnam formation. Consists of yellowish-brown shale and thin platy sandstone. About 30 feet thick in south-central Coleman County.

Named for Lost Creek, Coleman County.

Lost Creek Trachyte

Miocene and (or) Pliocene: Southwestern Montana and northwestern Wyoming.

A. D. Howard, 1937, Geol. Soc. America Spec. Paper 6, p. 21–29, 78 (table 9), pl. 4. Silicified, tuffaceous, porphyritic trachyte with phenocrysts of orthoclase and scattered lithic fragments; light shades of brown, buff, green, gray, or white. Commonly mottled; massive in appearance. Because of resistance to weathering and erosion, and vertical jointing, most exposures are vertical cliffs. Weathers in plates that form characteristic talus.

Scattered patches of rock exposed in Yellowstone Valley, in northern part of Yellowstone National Park. Best and most accessible exposures in valley of Lost Creek, near Tower Falls Ranger Station. Derives name from this locality.

Lost Gulch Quartz Monzonite[1]

Upper Cretaceous or lower Tertiary: Central Arizona.

Original reference: F. L. Ransome, 1903, U.S. Geol. Survey Prof. Paper 12.

N. P. Peterson, 1954, Econ. Geology, v. 49, no. 4, p. 363. Lost Gulch quartz monzonite intruded probably in late Cretaceous or early Tertiary time.

N. P. Peterson, 1954, U.S. Geol. Survey Geol. Quad. Map GQ–41. Mapped in Globe quadrangle, where it comprises two textural types— porphyritic quartz monzonite and quartz monzonite porphyry.

Occupies greater part of Lost Gulch and stretches northeast toward Horrell's Ranch, on Pinal Creek, Globe quadrangle.

Lost Jim Lava Flow

Quaternary: Central western Alaska.

D. M. Hopkins, 1953, (abs.) 4th Alaskan Sci. Conf. Proc., p. 237. Pahoehoe flow of olivine basalt, youngest of a series of basaltic lava flows compromising a lava plateau surrounding Imuruk Lake. Ranges in thickness from 10 to about 150 feet. Extends 17½ miles westward from its source cone (Lost Jim cone) and covers more than 60 square miles.

Around Lost Jim cone near Imuruk Lake, Seward Peninsula.

†Lostmans River Limestone[1]

Pliocene and Pleistocene: Southern Florida.

Original reference: S. Sanford, 1909, Florida Geol. Survey 2d Ann. Rept., p. 222–225, table opposite p. 50.

Named for exposures on Lostmans River, Monroe County.

Lost Nation Group

Lost Nation Quartz Diorite

Upper Ordovician(?): Northern New Hampshire.

R. W. Chapman, 1935, Am. Jour. Sci., 5th ser., v. 30, no. 179, p. 404, 405. Mapped as quartz diorite. Intrusive into Albee formation. Tentatively assigned Upper Ordovician age.

M. P. Billings, 1937, Geol. Soc. America Bull., v. 48, no. 4, p. 499. Belongs to Highlandcroft magma series.

R. W. Chapman, 1948, Geol. Soc. America Bull., v. 59, no. 11, p. 1072–1074, pl. 1. Described as group consisting of quartz diorite with minor amount of diorite. Not possible to map these separately. Both types are dark gray, dark green, or black, medium grained and granular. Older than some intrusives of the White Mountain magma series. Pre-Silurian, probably Upper Ordovician. Derivation of name.

Named from typical occurrence at small community of Lost Nation in southwestern corner of Percy quadrangle, Coos County.

Lost Quarry Beds (in Ash Hollow Formation)

Pliocene, lower: Western Kansas.

M. K. Elias, 1942, Geol. Soc. America Spec. Paper 41, p. 145. Mentioned in article on Tertiary prairie grasses from high plains. Occur higher in *Biorbia fossilia* zone than Rhinoceros Hill beds.

Quarry is in NW¼ sec. 1, T. 1 S., R. 38 W., Wallace County.

Los Trancos Formation

Miocene: Northern California.

H. C. Langerfeldt and L. W. Vigrass, 1959, *in* U.S. Congress, Joint Committee on Atomic Energy, Subcommittee on Research and Development, and Subcommittee on Legislation, Stanford Linear Electron Accelerator, Hearings: U.S. 86th Cong., 1st sess., app. D, p. 621. Divided into four members from base upward. Member A, loose to poorly cemented sand, 75 to 100 feet thick; Member B, volcanic rock including basaltic flows and fragmental volcanic material, 65 to 600 feet; Member C, coarse fragmental sandy limestone probably less than 50 feet; Member D, soft friable sandstone with some mudstone layers, thickness unknown. Overlies Searsville formation (new) with angular discordance.

Type locality and derivation of name not given. Area described is in Santa Clara and San Mateo Counties. Board on Geographic Names states that Los Trancos Creek forms boundary between San Mateo and Santa Clara Counties.

Los Trancos Member (of Topanga Formation)

Miocene, middle: Southern California.

J. G. Vedder, R. F. Yerkes, and J. E. Schoellhamer, 1957, U.S. Geol. Survey Oil and Gas Inv. Map OM–193. Consists mainly of dark-gray siltstone interbedded with light-gray medium-grained sandstone that is locally tuffaceous. Maximum thickness about 3,100 feet. Rests conformably on Bommer member (new); overlain with apparent disconformity by Paularino member (new); contact with Paularino is marked locally by andesite flow breccia that occurs in Paularino.

Typical exposures occur in area between Los Trancos Canyon and Bonita Creek in western part of San Joaquin Hills, Orange County. Named for large canyon that originates at Signal Peak in San Joaquin Hills and empties into sea at Crystal Cove.

Lost River Chert (in Fredonia Member of Ste. Genevieve Limestone)

Lost River Chert[1]

Mississippian (Meramec Series): Southwestern Indiana.

Original reference: M. N. Elrod, 1899, Indiana Acad. Sci. Proc. 1898, p. 258–267.

T. G. Perry and N. M. Smith, 1958, Indiana Geol. Survey Bull. 12, p. 20, pl. 1. As originally defined by Elrod (1899), the Lost River chert was intraformational zone between "Paoli" and Mitchell limestones. Term Mitchell limestone abandoned, and Lost River chert included in Fredonia member of Ste. Genevieve limestone. Blue-gray chert 1 to 6 feet thick, commonly 10 to 20 feet above base of the Fredonia.

Named for occurrence on Lost River, near Orangeville, Orange County.

Lost Run Conglomerate

Upper Ordovician: Central Pennsylvania.

F. M. Swartz, 1948, Pennsylvania Geologists Guidebook 14th Ann. Field Conf., supp., p. 4–5, diagram. Traced eastward from Lewistown, the ridge-making member of Bald Eagle sandstone becomes conglomerate with pebbles of vein quartz, quartz-veined quartzites, cherts and jaspers, and, rarely, quartz-veined meta-argillites. Term Lost Run conglomerate is proposed for the conglomerate. Thickness about 350 feet in Lost Run area. Near Lewistown overlain by about 1,500 feet of Juniata red beds and underlain by about 300 feet of sandstone or graywacke, seemingly representative of lower part of Bald Eagle near Tyrone, than by sandy beds containing *Orthorhyncula stevensoni.*

F. M. Swartz, 1957, Pennsylvania Stat. Univ., Dept. Geology Contr. 3, 58 p. In vicinity of Tyrone Gap, interfingers with Spring Mount sandstone member (new) of Bald Eagle sandstone. At Lewistown and Lost Creek Gap, the Lost Run is overlain by 1,700 to 1,800 feet of red Juniata beds, including (descending) Run Gap, Plummer Hollow (new), and East Waterford (new) members. Underlain by 200 to 250 feet of greenish-gray Bald Eagle sandstone that appears to be representative, for the most part, of Centennial School sandstone and shale member (new) of Bald Eagle at Tyrone Gap.

Named for Lost Creek Gap, northeast of Lewistown, Mifflin County.

Lost Sheep Dolomite

Middle Silurian: Northwestern Utah.

F. W. Osterwald, 1953, U.S. Geol. Survey Trace Elements Inv. Rept. TEI-330, p. 105; M. H. Staatz and F. W. Osterwald, 1959, U.S. Geol. Survey Bull. 1069, p. 19 (fig. 2), 26–28, pl. 1. Made up of two members: lower two-thirds—gray member—comprises three light- to medium-gray units and one thin black bed—149 to 159 feet thick; upper one third—cherty member—66 to 92 feet thick. Overlies Harrisite dolomite and underlies Thursday dolomite (both new).

Type section: About 2,000 feet southwest of Blowout mine in sec. 28, T. 12 S., R. 12 W., Juab County. Named for occurrence at Lost Sheep mine. Widely distributed on western side of Spor Mountain.

Los Vallos Member (of Yeso Formation)

Permian: West-central New Mexico.

V. C. Kelley and G. H. Wood, 1946, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 47. Lower part consists of tan-brown friable siltstone, sandstone, and shale with several persistent thin limestone and thicker gypsum beds. In upper part, gypsum makes up about 50 percent of section. Constitutes bulk of Yeso formation. Thickness 820 to 1,020 feet. Overlies Meseta Blanca sandstone member (new); underlies San Andres formation.

W. H. Tonking, 1957, New Mexico Bur. Mines Mineral Resources Bull. 41, p. 6, 7 (fig. 2), 10, pl. 1. Conformably overlies Abo formation and gradationally underlies Glorieta sandstone in Socorro County.

Underlies west Los Vallos and forms lower slopes of east face of Sierra Lucero in a long and broad belt extending from west edge of area in T. 5 N., into head of Carrizo Arroyo. Farther north forms floor and slopes of wide inner valley of Santa Fe Arroyo and head of Garcia Arroyo. Valencia and Socorro Counties.

Lothair Till

Pleistocene: Central northern Montana.

J. F. Smith, Jr., I. J. Witkind, and D. E. Trimble, 1959, U.S. Geol. Survey Bull., 1071–E, p. 134, 137–138, pl. 10. Light-tan till that weathers to buff; tightly cemented, very hard, and breaks with difficulty into irregular fragments with conchoidal surfaces. Consists of unsorted material ranging from clay-size particles to boulders as much as 3 feet in diameter. Clay and sand-size particles predominate. Lenses of sand and gravel intercalated in the till. Material of lenses is crossbedded. In many exposures, layers of light-yellow to buff even-bedded massive silt enclosed in the till; commonly forms lenses about one-half mile long and as much at 50 feet thick. Thickness of till commonly about 50 feet, but is as much as 310 feet in buried ancestral Marias River channel. Older than Pondera till (new).

Type locality: In NW¼ sec. 29, T. 30 N., R. 7 E., Liberty County. Covers much of the mapped Marias River area, Chouteau, Hill, and Liberty Counties. Named from town of Lothair in northwest corner of mapped area.

†Lott Chalk Member (of Taylor Marl)[1]

Upper Cretaceous: Northeastern Texas.

Original reference: C. H. Dane and L. W. Stephenson, 1928, Am. Assoc. Petroleum Geologists Bull., v. 12, p. 52.

Crops out in vicinity of Lott, Falls County, and 1 to 3 miles north-northwest of Rogers, Bell County.

Lotus Formation

Cambrian: Southeastern California.

B. K. Johnson, 1957, California Univ. Pubs. Geol. Sci., v. 30, no. 5, p. 380–382, figs. 1, 3. Proposed to designate a section of limestone and dolomitic limestone that crops out south and east of Lotus mine. Thickness at mine 4,800 feet (section incomplete); north of Wingate Pass 4,000 feet thick. Within mapped area, the Lotus is conformable with algal limestone at top of underlying Wood Canyon formation; upper limit (not mapped) is determined by faults along east edge of Panamint Valley.

Named for Lotus Mine, Manly Peak quadrangle, southern Panamint Range, Inyo County.

Louann Salt

Louann Tongue (of Eagle Mills Formation)

Upper Permian to Upper Jurassic: Subsurface in Arkansas, Louisiana, and Texas.

R. W. Imlay, 1940, Arkansas Geol. Survey Inf. Circ. 12, p. 4 (table 2), 8. Name Louann tongue applied to lower redbeds of Eagle Mills formation. Jurassic. Name credited to Shreveport Geological Society.

R. T. Hazzard, W. C. Spooner, and B. W. Blanpied, [1947], Shreveport Geological Soc. 1945 Ref. Rept., v. 2, p. 483, 484, 487–488, 489 (table 4), cross sections. Term Louann tongue as formerly used is synonymous with Werner formation as used in this report. Term Louann salt proposed for formation that overlies Werner and underlies Norphlet formation (new). Thickness in type well 857 feet; as much as 3,300 feet in Webster Parish, La. Permian. By inference, an unconformity is placed at base of Norphlet formation where it rests on Louann salt, and it is concluded that this is the Mesozoic-Paleozoic contact in Tri-State area.

E. D. McKee and others, 1956, U.S. Geol. Survey Misc. Geol. Inv. Map I–175. Assigned to Jurassic (Callovian).

D. I. Andrews, 1960, Gulf Coast Assoc. Geol. Soc. Trans., v. 10, p. 215–240. Report is comprehensive discussion of Louann salt and its relationship to Gulf Coast salt domes. Age of salt cannot be proved definitely. It is known to be older than Upper Jurassic, but believed no older than Upper Permian.

Type section: Gulf Refining Co.'s No. L. Werner Saw Mill Company well, Union County, Ark.

Loudoun Formation[1] (in Chilhowee Group)

Lower Cambrian(?): Virginia, Maryland, southern Pennsylvania, and West Virginia.

Original reference: A. Keith, 1893, as reported by G. H. Williams and W. B. Clark *in* Maryland, its resources, industries, and institutions, chap. 3, p. 68.

A. I. Jonas and G. W. Stose, 1939, Am. Jour. Sci., v. 237, no. 8, p. 575. Rocks of known Precambrian age in Virginia comprise an injection complex and a volcanic series. Both series occur in Catoctin Mountain-Blue Ridge and Mount Rogers anticlinoria. Injection complex comprises metamorphosed sedimentary rocks, intrusive diorite, granite, and injection gneisses. The granitic rocks were intruded during period of Precambrian folding and metamorphism. Volcanic rocks comprise both basalt and rhyolite, and, on west side of Blue Ridge uplift, are associated with series of slates and arkoses previously believed to be infolds of Loudoun formation but which are now believed to be rocks largely of tuffaceous origin interbedded with flows and lying at base of Catoctin metabasalt.

A. J. Stose and G. W. Stose, 1946, Maryland Dept. Geology, Mines and Water Resources Carroll and Frederick Counties, p. 31–34, fig. 5. Described in Frederick County, Md., where it crops out on slopes and in places on top of Catoctin and South Mountains. Formation is largely soft arkosic quartzite with beds of purer harder quartzite, quartzose conglomerate, and phyllite or slate. Some basal beds are red and green slate with scattered unassorted grains and small pebbles of quartz and feldspar; on west slope of Catoctin Mountain, basal beds contain bluish-gray and green tuffaceous slate which is overlain by thin quartzite and coarse arkosic quartzite containing pebbles. At High Knob, these basal beds are 200 feet thick. Upper beds are white to gray thin-bedded quartzite and purple banded arkosic quartzite which shows current bedding in places. Top of formation is placed below first prominent bed of purer vitreous quartzite of Weverton. Thickness variable; at Pine Knob on South Mountain about 200 feet; at High Knob on Catoctin Mountain about 310 feet. Overlies Catoctin metabasalt; in some areas, overlaps Catoctin and Swift Run tuff and rests on gneisses of injection complex at Potomac River. Some areas of quartzite formerly mapped at Loudoun are here included. Catoctin and South Mountains are synclinal in structure and lie on either side of anticlinal Middletown Valley.

H. P. Woodward, 1949, West Virginia Geol. Survey [Rept.], v. 20, p. 67–69. Term Loudoun normally applied to oldest sediments east of Blue Ridge, but in area west of Blue Ridge, including West Virginia, similarly located rocks have been separated into Loudoun and Weverton formations. Belt containing this western outcrop extends at least as far as Cloverdale, near Roanoke, Va., and ends in sharp summit known as Fullhardt Knob. Much confusion surrounds term "Loudoun," and it is here recommended that new or different nomenclature be adopted for sediments between Harpers shale and crystalline basement on inland flanks of Blue Ridge-South Mountain. None of the terms Loudoun, Weverton, or Unicoi seem adequate. Tentatively, joint name Loudoun-Weverton is used in this report.

P. B. King, 1950, U.S. Geol. Survey Prof. Paper 230, p. 16–17, pl. 1. Included in Chilhowee group. Described in Elkton, Va., area, where it is as much as 200 feet thick. Consists of spotted purple or gray slate, probably representing altered volcanic tuffs and breccias; lava flows in some areas. Unconformably overlies Catoctin greenstone; underlies Weverton formation. Doubt exists as to whether Loudoun formation is valid unit. Original definition by Keith was ambiguous, no type locality was designated, and name was applied to beds in more than one stratigraphic unit. Some workers have interpreted the Loudoun that was supposed to overlie Weverton at type locality of latter as consisting of overturned post-Weverton beds. It is possible that terminology herein adopted may not prove satisfactory and further consideration may have to be given to a name for beds in Elkton area here termed Loudoun formation.

R. O. Bloomer, 1950, Am. Jour. Sci., v. 248, no. 11, p. 766. It appears that the Lynchburg and Loudoun in the respective type sections are approximately equivalent. According to the rule, name Lynchburg should be abandoned and replaced by older name Loudoun.

J. C. Whitaker, 1955, Geol. Soc. America Bull., v. 66, no. 4, p. 441–442. Studies of geology of Catoctin Mountain, Md. and Va., indicate that area is not syncline as previously interpreted but a tightly folded westward-dipping sequence which forms upper and eastern limb of South Mountain anticlinorium. It is here considered that original description of the Loudoun by Keith and description by Stose and Stose (1946) are invalid because they interpreted Catoctin Mountain as a syncline, overturned asymmetrically to west. As interpreted here, the Loudoun is exposed only on western slopes of Catoctin Mountain where it overlies Catoctin metabasalt in normal sequence. Strata mapped as Loudoun on eastern slopes actually form a zone including basal part of the Harpers and the uppermost beds of Weverton quartzite. As described in this report Loudoun comprises two unnamed members, a basal phyllite, and an upper conglomerate.

Named for exposures in Loudoun County, Va.

Loughridge Formation (in Ancell Group)

Middle Ordovician: Northern Illinois.

J. S. Templeton and H. B. Willman, 1952, Tri-State Geol. Soc. Guidebook 16th Ann. Field Conf., p. 21, figs. 3, 12. Argillaceous, silty sandstone about 7 feet thick. Shown on columnar section as underlying Harmony Hill formation (new) and overlying Daysville formation (new).

Occurs in Dixon-Oregon area.

Louisenhoj Formation (in Virgin Island Group)

Upper Cretaceous: Virgin Islands.

T. W. Donnelly, 1960, Dissert, Abs., v. 20, no. 7, p. 2756; 1960, Caribbean 2d Geol. Conf. Trans., Mayagüez, Puerto Rico, p. 153. Lowermost unit in group. Consists of augite andesite breccias and tuffs with intercalated conglomerates (Cabes Point conglomerate lithofacies) containing pebbles and cobbles of Water Island formation (new). Eruptive center during Louisenhoj time was probably in Pillsbury Sound; in western St. John and eastern St. Thomas, formation consists of coarse cone debris, derived largely by gravitational sliding from small sub-aerial cone; in central St. Thomas, pyroclastics commonly showing laminar slumping are present; in western St. Thomas and on Culebra unslumped pyroclastics predominate. Thickness about 13,000 feet. Underlies Outer Brass limestone (new). Group considered of Cenomanian age.

Report discusses geology of St. Thomas and St. John Islands.

Louisiana Limestone[1]

Louisiana Formation

Louisiana Limestone (in Champ Clark Group or Fabius Group)

Lower Mississippian: Eastern Missouri, southwestern Illinois, and eastern Iowa.

Original reference: C. R. Keyes, 1892, Geol. Soc. America Bull., v. 3, p. 289.

E. B. Branson, 1938, Missouri Univ. Studies, v. 13, no. 3, pt. 1, p. 5. Louisiana limestone, Glen Park limestone, and Grassy Creek shale, which have been classed as Lower Mississippian by many geologists, are referred to Devonian in this study. Saverton shale included in Grassy Creek.

J. M. Weller and others, 1948, Geol. Soc. America Bull., v. 59, no. 2, p. 101, chart 5; J. M. Weller, 1948, (abs), Am. Jour Sci., v. 246, no. 3, p. 150. Included in Fabius group (new). In standard section, overlies Saverton shale; underlies Maple Mill shale of Easley group (new). Devonian or Mississippian.

M. A. Stainbrook, 1950, Am. Jour. Sci., v. 248, no. 3, p. 208–209. Louisiana and McCraney are parts of same body of limestone. McCraney limestone not a member of Hannibal. Since name Louisiana has precedence, term McCraney may well be dropped.

L. E. Workman and Tracey [Tracy] Gillette, 1956, Illinois Geol. Survey Rept. Inv. 189, p. 8 (fig. 1), 18–20. Reallocated to Champ Clark group (new) proposed to replace Fabius group of Weller and others (1948). In this report, name Louisiana is used to designate lithographic limestone that in western Illinois normally overlies Saverton shale, or, where Saverton is absent, Grassy Creek shale. In Illinois, underlies Glen Park formation of Hannibal group. Thickness 3 to 5 feet. Mississippian or Devonian.

T. J. Laswell, 1957, Missouri Geol. Survey and Water Resources Rept. Inv. 22, p. 9 (fig. 2), 30–34, pl. 1. Formation described in Bowling Green quadrangle where it is 0 to 40 feet thick. Sublithographic thin irregularly bedded gray- to pale-orange limestone with dolomitic mudstone partings. Conformably overlies Saverton formation; unconformably underlies Hannibal formation. Devonian-Mississippian.

M. G. Mehl, 1960, Denison Univ. Jour. Sci. Lab., art. 5, p. 87–89, 98, 100 (fig. 3), 105. Unconformably underlies Cuivre shale (new) in Pike County, Mo.; elsewhere underlies Hannibal shale. In Missouri, unconformably overlies Saverton shale; in some places, rests directly on Grassy Creek shale. Age discussion. In this report, considered Upper Devonian.

Named for exposures at Louisiana, Pike County, Mo.

Louisville Limestone[1]

Silurian: North-central Kentucky and southern Indiana.

Original reference: A. F. Foerste, 1897, Indiana Dept. Geol. and Nat. resources 21st Ann. Rept., p. 217, 218, 232.

J. B. Patton, T. G. Perry, and W. J. Wayne, 1953, Indiana Geol. Survey Field Conf. Guidebook 6, pl. 1. Gray-tan finely crystalline to dense dolomitic limestone. Thickness 0 to 10 feet. Overlies Waldron shale.

Named for exposures east of Louisville, Ky.

Louisville Limestone[1]

Pennsylvanian: Eastern Kansas and southeastern Nebraska.

Original reference: G. E. Condra and N. A. Bengston, 1915, Nebraska Acad. Sci. Pub., v. 9, no. 2, p. 7, 23.

Exposed at base of slope west of South Bend and in upper slopes eastward to Louisville, Cass County, Nebr.

†Louisville-Delphi Black Slate[1]

Upper Devonian: Indiana and Kentucky.

Original reference: J. Collett, 1872, Indiana Geol. Survey 3d and 4th Ann. Repts., p. 294, 306.

Probably named for occurrence from Louisville, Ky., to Delphi, Carroll County, Ind.

†Loup Fork Beds[1]

†Loup Fork Group[1]

Miocene, Pliocene, and Pleistocene(?): Eastern Colorado, Nebraska, South Dakota, and other western states.

Original reference: F. B. Meek and F. V. Hayden, 1862, Acad. Nat. Sci. Philadelphia Proc., v. 13, p. 415–435.

A. L. Lugn, 1939, Geol. Soc. America Bull., v. 50, no. 8, p. 1269–1270. Names abandoned. Loup River is original name and Loup Fork was its synonym for many years.

Named for occurrences along Loup River, Nebr.

Loupian[1] (series)

Tertiary, middle: Nebraska.

Original reference: C. R. Keyes, 1915, Iowa Acad. Sci. Proc., v. 22, p. 255.

†Loup River Beds[1]

Tertiary: Nebraska.

Original reference: F. B. Meek and F. V. Hayden, 1862, Philadelphia Acad. Nat. Sci. Proc., v. 13, p. 415–435.

Extends from Loup Fork of Platte River north to Niobrara River and south to unknown distance beyond the Platte.

Lousetown Formation

Lousetown Series or Andesite

Pliocene, upper, or Pleistocene, lower: Western Nevada.

T. P. Thayer, 1937, Geol. Soc. America Bull., v. 48, no. 11, p. 1648–1650. Lavas of the series, in its type area, are all olivine basalts. They range from pale- or medium-gray porous lavas to fine-grained glassy dark flows. All types have a characteristic sheen on certain surfaces in hand specimen, owing to fluidal arrangement of feldspar laths. Prominent pyroxene phenocrysts rather common in coarser varieties. Related rocks in southern part of Comstock Lode district referred to as Lousetown pyroxene andesite and described as being more or less platy and in places with good columnar structure. Volcanics at the most are a few hundred feet thick. Overlies other volcanics of upper Miocene or lower Pliocene age.

G. A. Thompson, 1956, U.S. Geol. Survey Bull. 1042–C, p. 57–58, pl. 3. Formation ranges from fine-grained pyroxene andesite with basaltic habit and appearance to olivine basalt. Flows less than 50 feet thick, with vesicular tops. Commonly lies with marked angular unconformity on Truckee formation and older rocks. In Steamboat Hills, probably contemporaneous with or younger than Steamboat Hills rhyolite; elsewhere younger. Assigned late Pliocene or early Pleistocene age.

Type locality: In area east of Lousetown Creek, about 6 miles north of Virginia City, where lavas are best exposed and exhibit most variation.

Loutre Formation (in Cherokee Group)

Pennsylvanian (Des Moines Series): East-central Missouri.

H. S. McQueen, 1943, Missouri Geol. Survey and Water Resources, 2d ser., v. 28, p. 71–78, pl. 6. Green, light-gray to greenish-gray clay. Thickness at type locality 11½ feet. Underlies Tebo formation; overlies Cheltenham clay.

Type locality: Pit of the Laclede-Christy Clay Products Company, on east side of valley of Little Loutre Creek in SE¼NE¼ sec. 9, T. 49 N., R. 6 W., Montgomery County.

Louviers Alluvium

Pleistocene (early Wisconsin): Northeastern Colorado.

G. R. Scott, 1960, Geol. Soc. America Bull., v. 71, no. 10, p. 1542–1543. Consists of reddish-brown pebbly facies along major streams and yellowish-brown silty facies along minor streams. At type locality, lies 60 feet above modern stream and 40 feet below older Slocum alluvium (new). Older than Broadway alluvium (new).

Type locality: Gravel pit along northeast edge of town of Louviers in SW¼SE¼ sec. 33, T. 6 S., R. 68 W., Kassler quadrangle, Douglas County.

Lovedale Gypsum Member (of Blaine Formation)[1]

Permian: Northwestern Oklahoma.

Original reference: Noel Evans, 1931, Am. Assoc. Petroleum Geologists Bull., v. 15, no. 4, p. 405–432.

D. A. Green, 1936, Am. Assoc. Petroleum Geologists Bull., v. 20, no. 11, p. 1468. Occurs above Shimer gypsum and below Haskew gypsum. Thickness 1 to 8 feet.

Named for exposures near Lovedale, T. 26 N., R. 20 W., Harper County.

Lovejoy Formation or Basalt

Eocene, upper, or Oligocene, lower: Northeastern California.

Cordell Durrell, 1957, Pacific Petroleum Geologist, v. 11, no. 3, p. 3. Black blocky lava flows about 550 feet thick. Boulders of the basalt underlie Oligocene leaf-bearing beds at La Porte. Underlies Clover formation (new); unconformable above Eocene auriferous gravels; unconformity marked by faulting.

Cordell Durrell, 1959, California Univ. Pubs. Geol. Sci., v. 34, no. 3, p. 165 (fig. 1), 166–167. At type section, herein stated, formation consists of nine flows of olivine basalt and is 500 feet thick; base of section not exposed. Flows vary in thickness from 10 to more than 50 feet. Overlies unit referred to as Auriferous gravels; underlies Ingalls formation (new). Locally underlies Penman formation. May be upper middle Eocene or upper Eocene.

Cordell Durrell, 1959, California Univ. Pubs. Geol. Sci., v. 34, no. 4, p. 193–218. Detailed discussion of origin distribution and age of formation. Age established as upper Eocene or lower Oligocene.

Type section: On Red Clover Creek in secs. 30 and 31, T. 25 N., R. 12 E., Blairsden quadrangle, Plumas County. Named for Lovejoy Creek, a tributary to Little Grizzly Creek, near Walker mine in secs. 8 and 17, T. 22 N., R. 12 E.

Loveland Loess[1] or Formation

Loveland Formation (in Sanborn Group)

Loveland Silt Member (of Sanborn Formation)

Pleistocene: Iowa, Illinois, Kansas, Kentucky, Mississippi, Nebraska, South Dakota, and Tennessee.

Original references: B. Shimek, 1909, Geol. Soc. America Bull., v. 20, p. 405; 1910, Science, new ser., v. 31, p. 75.

J. C. Frye and O. S. Fent, 1947, Kansas Geol. Survey Bull. 70, pt. 3, p. 42–45. Loveland loess was described from exposures in western Iowa and has been traced westward across Nebraska and southward from Nebraska as far as central Kansas. In this report stratigraphic equivalents of Loveland are designated Loveland silt member of Sanborn formation. Member includes eolian silts of the uplands and stratigraphically continuous colluvial silts on some slopes and fluvial-eolian silts of lower levels. Thickness 5 to 80 feet. Underlies Peoria silt member.

G. E. Condra, E. C. Reed, and E. D. Gordon, 1947, Nebraska Geol. Bull. 15, p. 25–26. Overlies Crete formation (new). Thickness 8½ feet at type section of Crete. Underlies Peorian formation.

M. M. Leighton and H. B. Willman, 1950, Jour. Geology, v. 58, no. 6, p. 612, 616. Extended into southern Illinois and southward into Tennessee and Mississippi.

L. L. Ray, 1957, Jour. Geology, v. 65, no. 5, p. 543. Loveland loess described at Medora, Ky., near Louisville. Thickness 10 to 12 feet. Overlies gravel; underlies Farmdale loess:

C. W. Hibbard, 1958, Am. Jour. Sci., v. 256, no. 1, p. 55 (fig. 1). Included in Sanborn group. Overlies Crete formation; underlies Peoria formation.

R. B. Daniels and R. L. Handy, 1959, Jour. Geology, v. 67, no. 1, p. 114–118. Type locality of Loveland formation destroyed in 1957 when site was used as borrow pit for road construction. New cut adjacent to type locality is described; the exposure is recommended as new type section. Commonly dark brown. Thickness 18¾ feet. Overlies Kansan till; underlies Farmdale loess.

J. M. Jewett, 1959, Graphic column and classification of rocks in Kansas: Kansas Geol. Survey. Shown on correlation chart as Loveland formation. Above Crete formation and below Sangamon soil. [Kansas does not use term Sanborn group.]

H. E. Simpson, 1960, U.S. Geol. Survey Prof. Paper 328, p. 59, 77–78, pl. 1. Geographically extended into Yankton area, South Dakota. Lies upon Illinoian till; overlain by Farmdale loess. Late Illinoian.

Type locality (Shimek): Sec. 3, T. 77 N., R. 44 W., Pottawattamie County, Iowa. Type section (Daniels and Handy): NW¼ sec. 3, T. 77 N., R. 44 W., Harrison County, Iowa.

Named for Loveland, Pottawattamie County.

Lovell Member (of Cloverly Formation)

Lower Cretaceous: Central southern Montana and central northern Wyoming.

R. M. Moberly, Jr., 1958, Dissert, Abs., v. 18, no. 1, p. 198. Proposed for youngest of three members of redefined Cloverly. Composed of three principal lithologies. Commonly at base is olive-gray and reddish-brown lithic wacke. Greatest part of formation [member] is variegated reddish- and yellowish-brown and gray kaolinitic claystone and mudstone, containing veinlets and hardpans of iron oxides. Quartz arenites which filled fluvial channels are laced through claystones. Overlies Little Sheep mudstone member (new); disconformably underlies Crooked Creek formation (new).

In Bighorn Basin.

Lovell Member (of Mount Simon Formation)

Upper Cambrian: Northern Illinois (subsurface).

J. S. Templeton, Jr., 1950, Illinois Acad. Sci. Trans., v. 43, p. 153 (fig. 2), 154 (fig. 3), 155. Name applied to relatively fine-grained unit overlying Kenyon member (new). Type section extends from depths of 2,850 to 2,975 feet. Thickness 65 to 190 feet. Underlies Mayfield member (new).

Type well: Wyman No. 1 (well 7), in NE¼NE¼SE¼ sec. 35, T. 41 N., R. 5 E., De Kalb County. Name derived from Lovell School three-fourths mile south of type well.

Lovelockian series[1]

Lower Jurassic: Nevada.

Original reference: C. R. Keyes, 1923, Pan-Am. Geologist, v. 40, p. 52, 79.

Well exposed in Humboldt Range, east of Lovelock Station, Humboldt County.

Love Ranch Formation

Tertiary: Central southern New Mexico.

F. E. Kottlowski and others, 1956, New Mexico Bur. Mines Mineral Resources Mem. 1, p. 2 (fig. 1), 6 (table 2), 13 (fig. 7), 63 (fig. 14), 69–71. Intercalated boulder-conglomerates and reddish siltstones that overlie Mancos-Eagle Ford beds with pronounced erosional unconformity. Total thickness uncertain because formation is involved in thrust faulting. May be as much as 2,100 feet thick at type locality; 100 feet and less in Organ Mountains.

Named for exposures northwest of Love Ranch, San Andres Mountains, Dona Ana County.

Lovingston Granite Gneiss[1]

Lovingston Formation

Lovingston Granite Gneiss (in Virginia Blue Ridge Complex)

Lovingston Quartz Monzonite Gneiss

Precambrian: Western and northern Virginia.

Original reference: A. I. Jonas, 1928, Virginia Geol. Survey prelim, ed, of geol. map of Virginia.

A. I. Jonas and G. W. Stose, 1939, Am. Jour. Sci., v. 237, no. 8, p. 589. Rockfish conglomerate at its type locality and elsewhere contains pebbles and boulders of granite gneiss and gneiss derived from Lovingston granite gneiss.

R. O. Bloomer, 1950, Am. Jour. Sci., v. 248, no. 11, p. 758, 759, 761. Lovingston gneiss, Marshall granite, and hypersthene granodiorite (delineated on Geologic Map of Virginia, 1928) represents widespread facies of the granitized complex. Lovingston gneiss comprises about two-thirds of the complex. It forms an irregular elongate mass about 12 miles wide at Rockfish River and 150 miles long from Roanoke River on southwest to Thornton River on northeast.

W. R. Brown, 1951, (abs.) Virginia Jour. Sci., new ser., v. 2, no. 4, p. 346; 1953, Kentucky Geol. Survey, ser. 9, Spec. Pub. 1, p. 90–92. Lovingston quartz monzonite gneiss grades into Reusens migmatite (new). Dark gneisses in migmatite resemble, in places, the overlying Lynchburg gneiss; this resemblance led earlier workers (Virginia Geol Map, 1928; Furcron, 1935, Geol. Survey Bull. 53) to conclude that Lovingston was intrusive into Lynchburg.

R. O. Bloomer and H. J. Werner, 1955, Geol. Soc. America Bull., v. 66, no. 5, p. 582, pl. 1. In Blue Ridge area, central Virginia, Lovingston formation forms mappable body about 25 miles long and 8 miles wide. Across contact zone about 100 feet wide, rock grades into Marshall formation with changes in composition, granularity, and structure. To the southeast, unconformably overlain by Lynchburg gneiss. Other bodies as much as 3 miles long and 2 miles wide and elongated parallel to regional foliation are contained in Marshall formation. Gneiss and granite consist of quartz, potash feldspar, oligoclase-andesine and biotite; the gneiss is dark-gray medium grained rock with prominent biotite folia and porphyroblasts of potash feldspar as much as 4 inches in diameter. It surrounds the granite which is a granulose rock containing biotite as irregular, equidimensional aggregates a fraction of an inch in diameter and as randomly oriented grains.

W. R. Brown, 1958, Virginia Div. Mineral Resources Bull., 74, p. 9. Lovingston gneiss and granite included in Virginia Blue Ridge complex (new). Bloomer and Werner (1955) limited name Lovingston to gneisses with marked augen typical of this gneiss at type locality and to biotite granite surrounded by augen gneiss; to those rocks formerly called Lovingston but lacking prominent augen, they extend the name Marshall. Rocks of Lynchburg area, previously mapped as Lovingston gneiss, are generally without these prominent augen, so following usage of Bloomer and Werner they are called Marshall in this paper.

Named for occurrences around Lovingston, Nelson County.

Lovington Sandstone Member (of San Andres Formation)

Permian (Leonard): Subsurface in eastern New Mexico and western Texas.

J. M. Hills *in* R. L. Bates, 1942, New Mexico Bur. Mines Mineral Resources Bull. 18, p. 269–271. Name applied to 30-foot sandstone in San Andres formation. Occurs between depths of 4,705 and 4,735 feet in type well, 100 feet below top of formation.

Type section: Penetrated in Skelly No. 3–0 State, 660 feet from south line and 2,310 feet from east line of sec. 31, T. 16 S., R. 37 E., Lea County, N. Mex. Recognized in Gaines, Andrews, and Yoakum Counties, Tex.

Low Creek Beds[1]

Eocene: Eastern Texas and western Louisiana.

Original reference: A. C. Veatch, 1902, Louisiana Geol. Survey Rept. 1902, pt. 6, p. 127–128, pl. 37.

At Low's Creek, near Sabinetown, Sabine County, Tex.

Lowe Granodiorite[1]

See Mount Lowe Granodiorite.

Lowell Clay

Pennsylvanian: Northern Illinois.

H. R. Wanless, 1939, Geol. Soc. America Spec. Paper 17, p. 91. Lowell clay occurs at base of Pennsylvanian below La Salle third vein coal; a refractory clay.

Occurs at Lowell, La Salle County.

Lowell Coal Member (of Carbondale Formation)

Pennsylvanian: Western and northern Illinois.

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 35, 47 (table 1), pl. 1. Assigned member status in Carbondale formation (redefined). Occurs above Jake Creek sandstone member and below Oak Grove limestone member. Coal named by Willman and Payne (1942, Illinois Geol. Survey Bull. 66). Presentation of new rock-stratigraphic classification of Pennsylvanian strata in Illinois.

Type locality: SE¼SW¼ sec. 8, T. 32 N., R. 2 E., La Salle County.

Lowell cyclothem (in Carbondale Formation)

Lowell cyclothem (in Carbondale Group)

Pennsylvanian: Northern Illinois.

H. B. Willman and J. N. Payne, 1942, Illinois Geol. Survey Bull. 66, p. 87, 102–107. Cyclothem containing eight stratigraphic units. Occurs above

Liverpool cyclothem and below Summum cyclothem. In Carbondale group.

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 52 (table 2). Included in Carbondale formation (redefined). Presentation of new rock-stratigraphic classification of Pennsylvanian strata in Illinois; cyclical classification is independent of rock-stratigraphic classification.

Type exposure: In high bank on south side of Vermilion River, SE¼SW¼ sec. 8, T. 32 N., R. 2 E., one-half mile west of Lowell, La Salle County.

Lowell Formation (in Bisbee Group)

Lowell Limestone (in Allegheny Formation)[1]

A. A. Stoyanow, 1949, Geol. Soc. America Mem. 38, p. 8–19, pl. 27. Series of alternating sandstones, shales, and limestones. Includes following members (new) in ascending order: Pacheta, Joserita, Saavedra, Cholla, Quajote, Perilla, and Pedregosa. Total thickness 1,104 feet. Overlies Morita formation; underlies Mural limestone.

Type locality: In Ninety One Hills area, immediately north of international border in vicinity of international monument No. 91, southeast of Bisbee Junction of Southern Pacific Railway, and southwest of Schlaudt ranch, Cochise County. Standard section also in Ninety One Hills.

Lowell Limestone (in Allegheny Formation)[1]

Pennsylvanian: Northeastern Ohio.

Original reference: J. S. Newberry, 1878, Ohio Geol. Survey, v. 3, p. 797–798.

Well exposed near Lowell, Mahoning County.

Lowell Mountain Formation[1]

Paleozoic: Northeastern Vermont.

Original reference: S. B. Keith and G. W. Bain, 1932, Econ. Geology, v. 27, no. 2, p. 173, 175.

Lowell Mountain, Irasburg quadrangle, Orleans County.

Lowell Park Member (of Platteville Limestone)[1]

Middle Ordovician: Northwestern Illinois.

Original reference: R. S. Knappen, 1926, Illinois Geol. Survey Bull. 49, p. 54–61, 65.

G. A. Cooper, 1956, Smithsonian Misc. Colln., v. 127, pt. 1, p. 113. Listed with upper Mississippi Valley formations not in general use.

Named for typical development in Lowell Park and along road north of Dixon quadrangle.

Lowellville Limestone (in Pottsville Formation)[1]

Lowellville limestone member

Pennsylvanian (Pottsville Series): Northeastern Ohio.

Original reference: G. F. Lamb, 1910, Ohio Nat., v. 10, p. 129.

R. E. Lamborn, 1954, Ohio Geol. Survey Bull. 51, p. 50–52, geol. map. In Coshocton County, Lowellville limestone member of Pottsville series is thin fossiliferous limestone above Vandusen coal and about 58 feet below Lower Mercer limestone.

Well exposed near Lowellville, Mahoning County; also in Washington Township, Coshocton County; and in Madison and Hopewell Townships, Muskingum County.

Lower Brush Creek cyclothem

Pennsylvanian (Conemaugh Series): Southeastern Ohio.

M. T. Sturgeon and others, 1958, Ohio Geol. Survey Bull. 57, p. 95 (table 11), 107–111. I. C. White (1878) applied name Brush Creek to marine shale and limestone at the position of the Lower(?) Brush Creek limestone. Brush Creek is now applied to a series of different beds comprising two more or less complete cyclothems which are now designated Lower Brush Creek and Upper Brush Creek, respectively. Lower Brush Creek embraces interval between Mason cyclothem below and Upper Brush Creek cyclothem. Normal succession includes five members (ascending): Lower Brush Creek shale and (or) sandstone, Lower Brush Creek redbed, Lower Brush Creek underclay, Lower Brush Creek coal, Lower Brush Creek limestone. Thickness about 36 feet. In area of this report, Conemaugh series is discussed on a cyclothemic basis; 15 cyclothems are named. [For sequence see Mahoning cyclothem.]

Members of cyclothem are present in Alexander, Athens, Dover, Lee, Trimble, Waterloo, and York Townships, Athens County.

Lower Brush Creek Limestone

Lower Brush Creek limestone member

Pennsylvanian (Conemaugh Series): Eastern Ohio.

H. R. Wanless, 1939, Geol. Soc. America Spec. Paper 17, p. 91. Lower of two fossiliferous limestones in Ohio, at position of Brush Creek limestone which is exposed in Cranberry Township, Butler County, Pa.

M. T. Sturgeon and others, 1958, Ohio Geol. Survey Bull. 57, p. 95 (table 11), 110. Lowest exposed marine member of Lower Brush Creek cyclothem in Athens County. Consists of varied beds of marine origin limestone, shale, or flinty chert, and at many places is combination of these different lithologies. Thickness about 6 feet. In some areas coalesces with Upper Brush Creek limestone member of Upper Brush Creek cyclothem.

Lower Brush Creek redbed member

Pennsylvanian (Conemaugh Series): Eastern Ohio.

M. T. Sturgeon and others, 1958, Ohio Geol. Survey Bull. 57, p. 95 (table 11), 109. Member of Lower Brush Creek cyclothem in report on Athens County. At almost every locality where coal and underclay underlie Lower Brush Creek limestone, variegate claystone or shale underlies underlay in turn. It is possible that this claystone may belong to the claystone underlying Mason coal and underclay and, where separated from Lower Brush Creek limestone by shale or sandstone, the name Mason is generally applied, and where no shale or sandstone intervenes, the appellation is Brush Creek. Thickness of redbed member 5 to almost 16 feet.

Lower Brush Creek shale and (or) sandstone member

Pennsylvanian (Conemaugh Series): Eastern Ohio.

M. T. Sturgeon and others, 1958, Ohio Geol. Survey Bull. 57, p. 95 (table 11), 109. Member of Lower Brush Creek cyclothem in report on Athens

County. Average thickness of interval between Mason and Lower Brush Creek limestone is 18 feet. Most common type of rock occurring in this interval is stratified silty, sandy, and micaceous shale. Massive shale or clay shale occupies interval in some areas. Bedded fine to medium micaceous sandstone and interbedded sandstone occurs in some outcrops.

Lower Brush Creek underclay member

Pennsylvanian (Conemaugh Series) : Eastern Ohio.

M. T. Sturgeon and others, 1958, Ohio Geol. Survey Bull. 57, p. 95 (table 11), 109. Member of Lower Brush Creek cyclothem in report on Athens County. Thickness 4 inches to 4 feet.

Lower Freeport Clay (in Allegheny Formation)[1]

Pennsylvanian: Ohio and West Virginia.

Wilber Stout, 1918, Ohio Geol. Survey, 4th ser., Bull. 21, p. 211, table 2. Clay above Lower Freeport limestone and below Lower Freeport or No. 6a coal. Thickness about 5 feet.

J. B. McCue and others, 1948, West Virginia Geol. Survey, v. 18, p. 16. Lower Freeport underclay present in West Virginia below Lower Freeport coal. Thickness 3 to 6 feet.

N. K. Flint, 1951, Ohio Geol. Survey, 4th ser., Bull. 48, p. 51, 53, table 1. Lower Freeport clay included in Lower Freeport cyclothem. Average thickness 4 feet. Directly underlies Lower Freeport coal. Commonly gradational with underlying Lower Freeport limestone. Area of report, Perry County.

D. L. Norling, 1958, Ohio Geol. Survey Bull. 56, p. 19. Lower Freeport clay member covered in Morgan County. Member has been recognized in Perry and Muskingum Counties. About 4 feet thick in Perry County and 5½ feet thick in Muskingum County. Zone may be as much as 5 feet thick in Morgan County. Allegheny series.

M. T. Sturgeon and others, 1958, Ohio Geol. Survey Bull. 57, p. 80–82. Lower Freeport underclay present in Athens County. Thickness varies from 6 inches to 5 feet 10 inches. Included in Lower Freeport cyclothem; occurs above Lower Freeport limestone member and below Lower Freeport coal member.

Name derived from town of Freeport, Armstrong County, Pa.

Lower Freeport cyclothem

Pennsylvanian (Allegheny Series) : Southeastern Ohio.

N. K. Flint, 1949, Ohio Acad. Sci. [Guidebook] 24th Ann. Field Conf., p. 12, 14. Incidental mention in road log.

N. K. Flint, 1951, Ohio Geol. Survey, 4th ser., Bull. 48, p. 51–54, table 1, geol. map. Consists of (ascending) Lower Freeport shale and (or) sandstone, 25 feet; Lower Freeport limestone, 6 feet; unnamed shale, 4 feet; Lower Freeport clay, 4 feet; and Lower Freeport coal. Occurs below Bolivar cyclothem and above Middle Kittanning cyclothem. In area of this report, the Allegheny series is described on cyclothem basis; nine cyclothems are named. [For sequence see Brookville cyclothem.]

M. T. Sturgeon and others, 1958, Ohio Geol. Survey Bull. 57, p. 48 (table 7), 78–84. As early as 1858, Rogers used Freeport as group name for those strata between Lower Freeport and Lower Mahoning sandstones.

Strata in above interval now recognized as including three cyclothems which are (ascending) Lower Freeport, Bolivar, and Upper Freeport cyclothems. Bolivar cyclothem is minor, and most of thickness of Roger's Freeport group is occupied by the Freeport cyclothems. Lower Freeport members are (ascending) Lower Freeport shale and (or) sandstone. Lower Freeport limestone, Lower Freeport underclay, Lower Freeport coal, and Dorr Run shale. In area of this report [Athens County], the Allegheny series is described on cyclothemic basis; 13 cyclothems named. [For complete sequence see Brookville cyclothem.]

Name derived from town of Freeport, Armstrong County, Pa.

Lower Freeport Limestone Member (of Allegheny Formation)[1]

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

Original reference: F. Platt, 1877, Pennsylvania 2d Geol. Survey Rept. H_2, p. xxviii.

N. K. Flint, 1948, Ohio Geol. Survey, 4th ser., Bull. 48, p. 51, 53, table 1. Lower Freeport limestone included in Lower Freeport cyclothem. Average thickness 6 feet. Limestone lies between basal Lower Freeport sandstone and (or) shale member and Lower Freeport clay member. Area of report, Perry County.

R. E. Lamborn, 1951, Ohio Geol. Survey, 4th ser., Bull. 49, p. 27. In early reports on geology of Pennsylvania, Lower Freeport limestone was called Middle Freeport in Cambria and Somerset Counties (Platt and Platt, 1877, Pennsylvania 2d Geol. Survey Rept. H_2) and Butler limestone in Beaver County (White, 1878, Pennsylvania 2d Geol. Survey Rept. Q). Later, White (1877, Pennsylvania 2d Geol. Survey Rept. Q_2) changed name to Lower Freeport in his report on Lawrence County. This term has been generally accepted. Present report includes discussion of limestones of eastern Ohio.

M. T. Sturgeon and others, 1958, Ohio Geol. Survey Bull. 57, p. 48 (table 7), 80. Member of Lower Freeport cyclothem. Recognized at less than 10 localities in Athens County [this report]. In part, it seems to be replaced by a massive sandstone and, in part, to be absent due to lack of development—even where overlying underclay and coal are present. In many localities, the limestone and underclay between Lower Freeport and Lower Mahoning sandstones are interpreted as belonging to either Bolivar or Upper Freeport cyclothem. This is primarily because of the large thickness of Lower Freeport sandstone, possibly including Upper Freeport sandstone as well, and its general stratigraphic relationship to Lower Mahoning sandstone. Thickness of Lower Freeport limestone 8 inches to 8 feet. Underlies Lower Freeport underclay member; overlies Lower Freeport shale and (or) sandstone member. Allegheny series.

Name derived from town of Freeport, Armstrong County, Pa.

†Lower Freeport Sandstone (in Allegheny Formation)[1]

Lower Freeport sandstone and (or) shale member

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

Original reference: J. J. Stevenson, 1878, Pennsylvania 2d Geol. Survey Rept. K_3.

N. K. Flint, 1948, Ohio Geol. Survey, 4th ser., Bull. 48, p. 51, 52, table 1. Lower Freeport sandstone and (or) shale included in Lower Freeport cyclothem. Thickness 15 to 40 feet. Includes interval between Middle Kittanning coal and Lower Freeport limestone. Area of report, Perry County.

See Lower Freeport shale and (or) sandstone member.

Name derived from town of Freeport, Armstrong County, Pa.

Lower Freeport Shale

Lower Freeport shale and (or) sandstone member

Pennsylvanian: Eastern Ohio.

R. E. Lamborn, C. R. Austin, and Downs Schaaf, 1938, Ohio Geol. Survey, 4th ser., Bull. 39, p. 118 (table), 160–177. Stratigraphic position of Lower Freeport shale is between Lower Freeport clay and Middle Kittanning coal. In various parts of the state, this interval includes in addition such local members as Washingtonville shale, Upper Kittanning coal and clay, and Lower Freeport sandstone. Lower Freeport shale crops out over belt extending from Mahoning, Columbiana, and Jefferson Counties, on east, to Lawrence County, on south. Average thickness about 36 feet. Lower Freeport sandstone partly or completely replaces Lower Freeport shale.

M. T. Sturgeon and others, 1958, Ohio Geol. Survey Bull. 57, p. 48 (table 7), 79–80. Lower Freeport shale and (or) sandstone is lowermost member of Lower Freeport cyclothem. Thickness of member 39 feet. In the general absence of Washingtonville marine shale and Upper Kittanning member [of Kittanning cyclothems], the Lower Freeport shale and sandstone rest upon top of Middle Kittanning (No. 6) coal. Underlies Lower Freeport limestone member. Allegheny series. Area of report, Athens County.

Name derived from town of Freeport, Armstrong County, Pa.

Lower Kittanning Clay (in Allegheny Formation)[1]

Lower Kittanning clay or underclay member

Pennsylvanian: Western Pennsylvania, eastern Ohio, and West Virginia.

Edward Orton, 1893, Ohio Geol. Survey, v. 7, p. 65–66. Discussion of clays of Ohio. Position of the Kittanning clay is between the Ferriferous limestone and Lower Kittanning coal. Often occupies entire interval between these beds. In some sections where interval is unusually expanded, a sandstone occurs, and the clay and shale are reduced in extend. Thickness 8 to 30 feet. In some instances, the Kittanning clay proper merges with Middle Kittanning clay. Kittanning clay horizon proper is best exposed where it enters Ohio from Pennsylvania and where it leaves Ohio in its extension into Kentucky.

W. C. Phalen and Lawrence Martin, 1911, U.S. Geol. Survey Bull. 447, p. 27. Lower Kittanning clay member of Allegheny formation commonly underlies lower bench of Lower Kittanning coal from which it may be separated by a few inches of shale. In absence of lower bench of coal, the clay sometimes occurs below main coal itself, being separated from it by 3 to 4 inches of bone or shale. Overlies Kittanning sandstone member. Area of report, vicinity of Johnstown, Pa.

Wilber Stout and others, 1923, Ohio Geol. Survey, 4th ser., Bull. 26, p. 268–269. Lower Kittanning clay lies on average about 22 feet above Vanport limestone and nearly 35 feet below Middle Kittanning coal. Thickness of clay 2 to 20 feet. [Report quotes from Orton, 1893.]

C. K. Graeber and R. M. Foose, 1942, Pennsylvania Geol. Survey, 4th ser., Topog. and Geol. Atlas 54, p. 40. Lower Kittanning clay is basal unit of Kittanning formation in report on Brookville quadrangle. Thickness a few inches to 20 feet. Underlies Lower Kittanning coal; overlies Lower Kittanning sandstone of Clarion formation.

M. N. Shaffner, 1946, Pennsylvania Geol. Survey, 4th ser., Topog. and Geol. Atlas 55, p. 48. Ashley (unpub. ms.) proposed revision of Pennsylvanian system for Pennsylvania. He suggested base of Lower Kittanning clay in Kittanning member of Allegheny group as base of Allegheny group. Studies in western Pennsylvania reveal that Lower Kittaning coal is, regionally, most persistent coal in lower Allegheny group. It seems logical that this horizon should form lower limit of that group. Until final acceptance of Ashley's proposed reclassification, Brookville coal is considered a base of Allegheny group in present report [Smicksburg quadrangle].

N. K. Flint, 1951, Ohio Geol. Survey, 4th ser., Bull. 48, p. 46. Lower Kittanning clay included in Lower Kittanning cyclothem. Thickness 8 to 10 feet in Perry County. Overlies Kittanning shale and (or) sandstone member; underlies Lower Kittanning (No. 5) coal. Allegheny series.

W. A. Tallon and R. G. Hunter, 1959, West Virginia Geol. Survey Rept. Inv. 17, p. 15. Lower Kittanning underclay commonly occurs immediately below Lower Kittanning or No. 5 Block coal, but a foot or two of dark-gray or black shale locally intervenes between the coal and its underclay. Average thickness of underclay 3.7 feet.

Name derived from Kittanning, Armstrong County, Pa.

Lower Kittanning cyclothem

Pennsylvanian (Allegheny Series): Western Pennsylvania and southeastern Ohio.

N. K. Flint, 1949, Ohio Acad. Sci. [Guidebook] 24th Ann. Field Conf., p. 14. Incidental mention in road log.

N. K. Flint, 1951, Ohio Geol. Survey, 4th ser., Bull. 48, p. 46–47, table 1, geol map. Includes (ascending) Kittanning shale and (or) sandstone, 6 feet; Lower Kittanning clay, 6 inches to 12 feet; Lower Kittanning (No. 5) coal; Hamden limestone. Occurs below Strasburg cyclothem and above Scrubgrass cyclothem. For purposes of this report, units of Lawrence cyclothem are treated as part of the Lower Kittanning. In area of this report, the Allegheny series is described on cyclothemic basis; nine cyclothems are named. [For sequence see Brookville cyclothem.]

M. T. Sturgeon and others, 1958, Ohio Geol. Survey Bull. 57, p. 48 (table 7), 60–64. Type area of the three (Lower, Middle, and Upper) Kittanning cyclothems is in vicinity of Kittanning, Pa. Rogers (1858, Geology of Pennsylvania, v. 2, pt. 1) called one of the coals in his Clarion group the Kittanning coal. Later, Lesley and White (1876, Pennsylvania 2d Geol. Survey map of southern Butler County) used term Kittanning group, and White's (1878, Pennsylvania 2d Geol. Survey Rept. Q) definition included those members from top of Upper Kittanning coal downward to top of Ferriferous ironstone. Exact correlation between the several Kittanning cyclothems in Pennsylvania and the Kittanning cyclothems and the Lawrence and Strasburg cyclothems in Ohio and Athens County is still uncertain. Since Lawrence coal and Lower Kittanning shale and sandstone are seldom present, the underclays of these two cyclothems are commonly coalesced and extend along their outcrop belt in Ohio as single thick underclay known as Lower Kittanning or Number 5 clay. In present report [Athens County], shale and sandstone and underclay members of Lawrence and Lower Kittanning cyclothems are discussed as combined units rather than individually. Unnamed marine shale and limestone over Lower Kittanning coal has in recent years been described under name of Hamden, a name which should be used for nonmarine limestone and ironstone associated with Oak Hill underclay of Strasburg cyclothem.

Type area: Vicinity of Kittanning, on Allegheny River, in Armstrong County, Pa.

†Lower Kittanning Limestone (in Allegheny Formation)[1]

Pennsylvanian: Western Pennsylvania.

Original reference: J. P. Lesley, 1878, Pennsylvania 2d Geol. Survey Rept. Q, p. 303–305.

Lower Kittanning Marine Shale

See Kittanning Formation.

Lower Kittanning Sandstone (in Allegheny Formation)

Pennsylvanian: Pennsylvania and West Virginia.

C. K. Graeber and R. M. Foose, 1942, Pennsylvania Geol. Survey, 4th ser., Topog. and Geol. Atlas 54, p. 40–41. Discussion of Brookville quadrangle. Lower Kittanning sandstone is uppermost unit in Clarion formation. Lies above Vanport sandstone and below Lower Kittanning clay of Kittanning formation.

M. N. Shaffner, 1946, Pennsylvania Geol. Survey, 4th ser., Topog. and Geol. Atlas 55, p. 63. Discussion of Smicksburg quadrangle. Lower Kittanning sandstone is between Lower Kittanning coal and Vanport limestone.

R. L. Nace, and P. P. Bieber, 1958, West Virginia Geol. Survey Bull. 14, p. 22 (table 5). Lower Kittanning sandstone listed with recognized named members of Allegheny formation in Harrison County. Above Vanport limestone and below Lower Kittanning clay.

Name derived from Kittanning, Armstrong County, Pa.

Lower Kittanning Shale

Pennsylvanian: Eastern Ohio.

R. E. Lamborn, 1938, Ohio Geol. Survey, 4th ser., Bull. 39, p. 118 (table), 138–145. In previous reports of Ohio Geological Survey involving stratigraphy of Pennsylvanian rocks of Ohio, names have been used consistently for various coal, clay, limestone, iron ore, and sandstone beds, but little attention has been given to shale intervals. Shale beds in present report are given name of first prominent underlying coal, except where a prominent sandstone is found on same horizon as shale bed. In the latter case, the name of the sandstone is applied. Stratigraphic position of Lower Kittanning shale, as term is used in this report, is in interval between Clarion coal horizon below and Lawrence clay above. Massive sandstone fills part of this interval. Thickness of shale about

8 feet. Top of Lower Kittanning shale is clearly defined across Ohio as either Lawrence clay or overlying Lower Kittanning clay is invariably present on outcrop. Close above Clarion coal or clay are a limestone and an overlying iron ore, known as Vanport and Ferriferous respectively.

Name derived from Kittanning, Armstrong County, Pa.

Lower Little Pittsburgh cyclothem

Pennsylvanian (Conemaugh Series): Southeastern Ohio.

M. T. Sturgeon and others, 1958, Ohio Geol. Survey Bull. 57, p. 94 (table 11), 153–156. Embraces interval between Little Clarksburg cyclothem (new) and Upper Little Pittsburgh cyclothem (new). In normal sequence, includes five members (ascending): Connellsville shale and sandstone, Connellsville redbed, Lower Pittsburgh limestone, Lower Little Pittsburgh underclay, and Lower Little Pittsburgh coal. Thickness about 54 feet. Two Little Pittsburgh cyclothems underlie Pittsburgh (No. 8) coal in parts of northern Appalachian coal basin. In general, these two cycles are irregular and uncertain in development, and at many places most or even all members of one or both cyclothems seem to be missing. Hence, correlation of Little Pittsburgh members is often uncertain. In Athens County, only Connellsville sand and redbed members are well developed. In area of this report, Conemaugh series discussed on cyclothemic basis; 15 cyclothems are named. [For sequence see Mahoning cyclothem.]

Present in Alexander, Ames, Athens, Bern, Canaan, and Rome Townships, Athens County.

†Lower Little Pittsburgh Limestone[1]

Pennsylvanian: Western Pennsylvania, western Maryland, and northern West Virginia.

Original reference: J. P. Lesley, 1878, Pennsylvania 2d Geol. Survey Rept. Q, p. 305–308.

Lower Little Pittsburgh underclay member

Pennsylvanian: Eastern Ohio

M. T. Sturgeon and others, 1958, Ohio Geol. Survey Bull. 57, p. 94 (table 1), 156. Member of Lower Little Pittsburgh cyclothem (new) in report on Athens County. Rests directly on top of Connellsville sandstone or more frequently on Connellsville redbed. Average thickness 11 inches. Lower Pittsburgh limestone commonly not developed in County. Conemaugh series.

Lower Mahoning limestone member

Pennsylvanian (Conemaugh Series): Eastern Ohio.

M. T. Sturgeon and others, 1958, Ohio Geol. Survey Bull. 57, p. 95 (table 11), 101–102. Lower Mahoning limestone member included in Mahoning cyclothem in report on Athens County. Thickness 1½ feet. Occurs above Lower Mahoning redbed member and below Thornton clay member. Conemaugh series.

Name derived from Mahoning Creek(s) in Indiana and Jefferson Counties, Pa.

Lower Mahoning redbed member

See Mahoning Red Bed (in Conemaugh Formation) and Mahoning cyclothem.

†Lower Mahoning Sandstone[1] (in Conemaugh Formation)

Lower Mahoning Sandstone (in Conemaugh Group)

Lower Mahoning sandstone and shale member

Pennsylvanian: Western Pennsylvania, Maryland, eastern Ohio, and northern West Virginia.

Original reference: F. Platt, 1876, Pennsylvania 2d Geol. Survey Rept. L.

W. O. Hickok and F. T. Moyer, 1940, Pennsylvania Geol. Survey, 4th ser., Bull. C-26, p. 89, fig. 21. Lowest sandstone in Conemaugh group. Rests directly on Upper Freeport coal bed or is separated from it by Uffington shale. At many places between Lower and Upper Mahoning sandstones is a shale interval which may contain up to three beds of coal, several beds of impure fire clay, one or two limestone horizons, iron ore, and a bed of red clay. Thickness of Lower Mahoning sandstone 30 to 40 feet in Fayette County [this report].

D. L. Norling, 1958, Ohio Geol. Survey Bull. 56, p. 26-27. Lower Mahoning sandstone is basal member of Conemaugh series and includes shale and sandstone extending from top of Upper Freeport (No. 7) coal to base of Mahoning limestone. Where Mahoning limestone is absent, sandstone member extends upward into Thornton clay or to base of Mahoning sandstone. Area of report, Morgan County. Cyclothemic classification not used in this report.

M. T. Sturgeon and others, 1958, Ohio Geol. Survey Bull. 57, p. 95 (table 11), 98-100. Lower Mahoning sandstone included in Mahoning cyclothem in report on Athens County. Average thickness 34½ feet. Lowermost member of cyclothem; underlies Lower Mahoning redbed member. Allegheny series.

Name taken from Mahoning Creek(s) in Indiana and Jefferson Counties, Pa.

Lower Mercer cyclothem

Pennsylvanian (Pottsville Series): Southeastern Ohio.

N. K. Flint, 1949, Ohio Acad. Sci [Guidebook] 24th Ann. Field Conf., p. 4, 8. Incidental mention in road log.

N. K. Flint, 1951, Ohio Geol. Survey, 4th ser., Bull. 48, p. 29-31, table 1, geol. map. Includes (ascending) Lower Mercer shale and (or) sandstone 10 to 25 feet; Lower Mercer clay, 6 inches to 11 feet; Lower Mercer (No. 3) coal; and Boggs member, 1 inch to 4 feet. Occurs below Flint Ridge cyclothem and above Vandusen cyclothem; where entire Vanlusen cyclothem is missing, the shale and sandstone cannot be distinguished from Massillon shale of Bear Run cyclothem. In area of this report, Pottsville series is described on cyclothemic basis; 10 cyclothems are named. [For sequence see Anthony cyclothem.].

Exposed in northern and western Perry County.

Lower Mercer Fire Clay (in Pottsville Formation)[1]

Lower Mercer [fire] clay member

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

Original reference: J. P. Lesley, 1879, Pennsylvania 2d Geol. Survey Rept. Q_2.

N. F. Flint, 1951, Ohio Geol. Survey 4th ser., Bull., p. 30, table 1. Referred to as Lower Mercer clay member of Lower Mercer cyclothem in report on Perry County. Thickness 3 to 6 feet. Directly overlain by Lower Mercer coal and underlain by either sandstone or shale. Pottsville series.

Lower Mercer Iron Shales (in Pottsville Formation)[1]

Pennsylvanian: Western Pennsylvania.

Original reference: I. C. White, 1879, Pennsylvania 2d Geol. Survey Rept. Q_2.

Lower Mercer Limestone (in Pottsville Formation)[1]

Lower Mercer limestone member

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

Original reference: I. C. White, 1879, Pennsylvania 2d Geol. Survey Rept. Q_2.

N. K. Flint, 1951, Ohio Geol. Survey, 4th ser., Bull. 48, p. 33, table 1. Referred to as Lower Mercer limestone member of Middle Mercer cyclothem in report on Perry County. Youngest member of cyclothem. Thickness 1 to 12½ feet. Lies between Middle Mercer coal member and basal sandstone or shale member of Bedford cyclothem. Pottsville series.

R. E. Lamborn, 1951, Ohio Geol. Survey, 4th ser., Bull. 49, p. 23. Lower Mercer limestone formerly called Blue limestone and Zoar limestone in early reports on geology of Ohio. In early writings of Geological Survey of Pennsylvania, this bed was called Mercer limestone (Rogers, 1858). White (1878, Pennsylvania 2d Geol. Survey Rept. Q_2) considered Lower Mercer more appropriate name for this member, and as a result latter term has come into general use in both Ohio and Pennsylvania. Lower Mercer is most prominent and widely distributed limestone member of Pottsville series. Thickness a few inches to 10 feet; average thickness about 2 feet. Position of Lower Mercer in Ohio varies from about 65 feet to 90 feet below base of Brookville coal which marks top of Pottsville series; occurs 15 to 40 feet below Upper Mercer limestone.

R. E. Lamborn, 1954, Ohio Geol. Survey Bull. 53, p. 58–75. Lower Mercer limestone discussed in report on Coshocton County. Consists of dark bluish-gray to grayish-black stone containing profusion of fossils. Thickness a few inches to about 10 feet. Present about 27¼ feet below Upper Mercer limestone.

Named for Mercer, Mercer County, Pa.

Lower Mesa Formation or Gravels

Pleistocene: Southeastern Oregon and southwestern Idaho.

V. R. D. Kirkham, 1931, Jour. Geology, v. 39, no. 3, fig. 1 (p. 202), fig. 12 (p. 211), fig. 13 facing p. 212. Overlies Idaho formation. Name appears only on geologic map and on geologic cross-sections.

Mapped in Ada, Canyon, Owyhee, Payette, and Washington Counties, Idaho, and Malheur County, Oreg.

Lower Narrows Rhyolite[1]

Precambrian: South-central Wisconsin.

Original reference: J. T. Stark, 1932, Jour. Geology, v. 40, no. 2, p. 120, 121.

Occurs on north flank of syncline on both sides of Lower Narrows of Baraboo River, secs. 20, 21, 22, and 23, T. 12 N., R. 7 E., Baraboo district.

Lower Pittsburgh Limestone Member (of Conemaugh Formation)[1]

Lower Pittsburgh limestone and shale member

Upper Pennsylvanian: Western Pennsylvania, eastern Ohio, and northern West Virginia.

Original reference: F. Platt and W. G. Platt, 1877, Pennsylvania 2d Geol. Survey Rept. H_3, p. 286.

D. L. Norling, 1958, Ohio Geol. Survey Bull. 56, p. 10 (fig. 3), 61–62, geol. map. Lower Pittsburgh limestone was named Summerfield limestone by Condit (1912, Ohio Geol. Survey Bull. 17) for exposures in Noble County, Ohio, and term was widely used in geological literature of state. Condit later retracted term Summerfield in favor of older term Lower Pittsburgh limestone (1923, U.S. Geol. Survey Bull. 270). Ohio Geological Survey recently abandoned term Summerfield. Lower Pittsburgh limestone not well represented in Morgan County [this report]. Lower Pittsburgh limestone and shale member of Conemaugh series occupies interval between Connellsville sandstone and shale member and Bellaire sandstone and shale member. Where best exposed in Morgan County, consists of 10 feet of yellowish-brown finely crystalline to dense nodular limestone with interbedded calcareous shales; limestone is separated from overlying Bellaire sandstone by 7 feet 5 inches of sandy clay shales.

M. T. Sturgeon and others, 1958, Ohio Geol. Survey Bull. 57, p. 154–156. Lower Pittsburgh limestone member included in Lower Little Pittsburgh cyclothem (new) of Conemaugh series, in report on Athens County. Only representation of member in county consists of small limestone nodules and pellets in Connellsville redbed in Canaan Township.

Name for its occurrence with Pittsburgh coal in western Pennsylvania.

Lower Pittsburgh redbed member.

Pennsylvanian: Eastern Ohio.

M. T. Sturgeon and others, 1958, Ohio Geol. Survey Bull. 57, p. 159 (table 13), 161. Member of Pittsburgh cyclothem (new) in report on Athens County. Average thickness about 17 feet. Typically gray to tan limonite-stained clay shale or claystone, with mottling of maroon, yellow, and red with some purple and orange. Above Lower Pittsburgh (Bellaire) shale and (or) sandstone member and below Upper Pittsburgh limestone member. Monongahela series.

Lower Pittsburgh Sandstone (in Conemaugh Formation)

Pennsylvanian: Pennsylvania and West Virginia.

[Original reference]: I. C. White, 1903, West Virginia Geol. Survey, v. 2, p. 244.

R. R. Dutcher and others, 1959, Geol. Soc. America Guidebook for Field Trips Pittsburgh Mtg., p. 69 (fig. 4). Generalized columnar section for Pennsylvanian western Pennsylvania shows Lower Pittsburgh sandstone above Little Pittsburgh coal and below Upper Pittsburgh limestone. Conemaugh series.

Probably named for occurrence in vicinity of Pittsburgh, Pa.

Lower Pittsburgh (Bellaire) shale and (or) sandstone member

Pennsylvanian: Eastern Ohio.

M. T. Sturgeon and others, 1958, Ohio Geol. Survey Bull. 57, p. 159 (table 13), 161. Member of Pittsburgh cyclothem (new). Locally, lenses of shale and sandstone occupy part of interval of Lower Pittsburgh redbed. In Athens County [this report] these are uncommon but do occur locally and represent Lower Pittsburgh sandstone or Bellaire sandstone of Condit. Average thickness of lenses about 7 feet. Monongahela series.

Lowerre Quartzite[1]

Precambrian: Southeastern New York.

Original reference: F. J. H. Merrill, 1898, New York State Mus. 15th Ann. Rept., v. 1, p. 21–31.

J. J. Prucha, 1956, Am. Jour. Sci., v. 254, no. 11, p. 676–683. So-called Lowerre quartzite, not valid name. Examination of all reported occurrences of the Lowerre showed only two localities where quartzitic-looking rocks are present, and detailed studies showed these pseudoquartzites to be highly sheared phases of Fordham gneiss and related intrusives.

Named for exposures in southern Westchester County, near Lowerre Station in Yonkers at Hastings marble quarry and about one-half mile south of Sparta on shore of Hudson River.

Lower Sewickley cyclothem

Pennsylvanian (Monongahela Series): Southeastern Ohio.

M. T. Sturgeon and others, 1958, Ohio Geol. Survey Bull. 57, p. 158 (table 13), 172–173, 174 (map 22). Embraces interval between Fishpot cyclothem (new) below and Sewickley cyclothem (new) above. Normal succession includes six members (ascending): Lower Sewickley shale and sandstone, Lower Sewickley redbed, Lower Sewickley limestone, Lower Sewickley underclay, Lower Sewickley coal (very local), and Lower Sewickley roof shale (if present is very thin and usually considered part of coal zone). Average thickness 19 feet. Terms Lower Sewickley coal and Lower Sewickley cyclothem will be used until further fieldwork demonstrates its true relation to Sewickley coal bed. [See Sewickley cyclothem.] In area of this report, Monongahela series is discussed on cyclothemic basis; 12 cyclothems are named. [For sequence see Pittsburgh cyclothem.]

Present in Athens County.

Lower Sewickley limestone member

Pennsylvanian (Monongahela Series): Eastern Ohio.

M. T. Sturgeon and others, 1958, Ohio Geol. Survey Bull. 57, p. 158 (table 13), 172. Member of Lower Sewickley cyclothem (new) in report on Athens County. Occurs at only one locality and represents only recorded occurrence of fresh-water limestone in Fishpot to Sewickley coal bed interval. Thickness as much as 9 feet, but is interbedded with sandstone and redbeds. Occurs above Lower Sewickley redbed member and below Lower Sewickley underclay and coal members.

Name derived from Lower Sewickley cyclothem.

Lower Sewickley redbed member

Pennsylvanian (Monongahela Series): Eastern Ohio.

M. T. Sturgeon and others, 1958, Ohio Geol. Survey Bull. 57, p. 172. Member of Lower Sewickley cyclothem (new) in Athens County. Occurs in normal sequence above Lower Sewickley sandstone member. Average thickness 5 2/3 feet.

Name taken from Lower Sewickley cyclothem.

Lower Sewickley roof shale member

See Lower Sewickley cyclothem.

Lower Sewickley Sandstone

Lower Sewickley sandstone and shale member

Pennsylvanian (Monongahela Series): West Virginia and eastern Ohio.

R. V. Hennen, 1912, West Virginia Geol. Survey [Rept.] Doddridge and Harrison Counties, p. 201–202. Buff fine-grained micaceous massive and arenaceous sandstone 25 to 30 feet thick. Lies 5 to 10 feet under Sewickley coal. Stratigraphically below Upper Sewickley sandstone.

D. L. Norling, 1958, Ohio Geol. Survey Bull. 56. p. 73. Lower Sewickley sandstone and shale member, as accepted by Ohio Geological Survey, occupies interval between Fishpot coal and Meigs Creek (No. 9) coal. Stratigraphic nomenclature of unit uncertain. It is the sandstone in interval designated as Fishpot sandstone by Lamborn (1930). In Lamborn's description of his Fishpot sandstone a probable correlation with Lower Sewickley sandstone of West Virginia was recognized. Writer [Norling] has not located original source of this latter term in West Virginia literature. Term probably resulted from recognition of position of Sewickley (No. 9) coal within long sandstone section and application of terms Lower and Upper to parts of that sandstone below and above the coal, respectively. Lower Sewickley member in Morgan County is sequence of sandstones and shales, 10 to 20 feet thick, which underlies Meigs Creek (No. 9) coal. Varies from sandy shale to massive sandstone sections.

M. T. Sturgeon, 1958, Ohio Geol. Survey Bull. 57, p. 172–173. In Ohio, the sandstone between Fishpot and Sewickley coal beds has been referred to as Lower Sewickley sandstone and Fishpot sandstone. Name Lower Sewickley, suggested by Hennen (1912), antedates name Fishpot proposed by Lamborn (1930) and is accepted terminology. Lower Sewickley shale and sandstone member of Lower Sewickley cyclothem (new) is 5 to 6 feet thick in Athens County [this report]. Occurs below Lower Sewickley redbed member of Lower Sewickley cyclothem. Name Lower Sewickley shale and sandstone member is used for lowest unit of Sewickley cyclothem (new) when its lower boundary rests on Fishpot cyclothem because it is proper term for this lithology in usual Fishpot to Sewickley coal bed interval and is continuous with Lower Sewickley shale and sandstone of Lower Sewickley cyclothem.

Mentioned by Hennen in section near Gore Station, Harrison County, W. Va.

Lower Sewickley underclay member

See Lower Sewickley cyclothem.

Lower Uniontown cyclothem

Pennsylvanian (Monongahela series): Southeastern Ohio.

M. T. Sturgeon and others, 1958, Ohio Geol. Survey Bull. 57, p. 158 (table 13), 181–182, 183 (map 24). Table shows Lower Uniontown as embracing interval between Arnoldsburg cyclothem (new) below and Uniontown cyclothem (new) above; however, text states Lower Uniontown is interposed within boundaries of Uniontown cyclothem. Succession includes six members (ascending): Arnoldsburg shale and sandstone, Ritchie redbed, Lower Uniontown limestone, Lower Uniontown underclay, Lower Uniontown coal (not observed in Athens County), and Lower Uniontown roof shale (not positively identified in Athens County). [See Uniontown cyclothem.] Thickness about 27 feet. In area of this report, Monongahela series discussed on cyclothemic basis; 12 cyclothems are named. [For sequence see Pittsburgh cyclothem.]

Fairly consistent in Washington and Monroe Counties but of irregular occurrence and minor importance in Athens County.

Lower Uniontown roof shale member

See Lower Uniontown cyclothem.

Lower Uniontown shale and sandstone member

See Lower Uniontown cyclothem.

Lower Uniontown underclay member

See Lower Uniontown cyclothem.

Lower Washington Limestone Member (of Washington Formation)[1]

Lower Washington Limestone

Permian: Southwestern Pennsylvania, eastern Ohio, and West Virginia.

Original reference: J. J. Stevenson, 1876, Pennsylvania 2d Geol. Survey Rept. K, p. 44, 50.

R. E. Lamborn, 1951, Ohio Geol. Survey, 4th ser., Bull. 49, p. 39, 40. In Ohio, known distribution of Lower Washington on outcrop is confined to Belmont County, where it tends to be patchy and discontinuous. Thickness varies from a few feet to nearly 20 feet. Generally separated from underlying Washington coal by thin bed of arenaceous shale or shale and thin sandstone. Included in Washington series which, in Ohio, consists of following limestones (ascending): Elm Grove, Mount Morris, Lower Washington, Middle Washington, and Upper Washington.

R. L. Nace and P. P. Bieber, 1958, West Virginia Geol. Survey Bull. 14, p. 18 (table 2). Listed in summary of stratigraphic sections of Dunkard group in Harrison County. Thickness 0 to 8 feet.

Named for exposures near Washington, Washington County, Pa.

Lowes Grove Beds

Triassic: North-central North Carolina.

Grover Murray, Jr., 1938, Science, v. 87, no. 2261, p. 390. Fine white to brown yellow-mottled slightly metamorphosed shale containing *Estheria ovata* (Lea) and smooth-shelled ostracoda of the Cypridae family. Equivalent in age to Nelson beds (new).

Occurs in Durham Triassic basin along State Highway 54 about one-half mile west of Lowe's Grove, Durham County.

Low Gap Limestone (in Hinton Formation)[1]

Mississippian: Southeastern West Virginia.

Original reference: D. B. Reger, 1926, West Virginia Geol. Survey Rept. Mercer, Monroe, and Summers Counties, p. 296, 344.

Type locality: On Wolf Creek Mountain, Summers County, in public road slightly east of and above Low Gap School.

Low Gap Sandstone (in Cross Mountain Group)

Pennsylvanian (Pottsville Series): Eastern Tennessee.

C. W. Wilson, Jr., J. W. Jewell, and E. T. Luther, 1956, Pennsylvanian geology of the Cumberland Plateau: Tennessee Div. Geology [folio], p. 11, 19, pl. 2. Massive sandstone 45 to 70 feet thick. Overlies unnamed shale interval 35 to 140 feet thick that contains Grassy Spring coal; underlies shale interval 110 to 200 feet thick that contains the Cold Gap and Wild Cat coals and in turn underlies Tub Springs sandstone (new).

Type locality: Same as Cross Mountain group, which is on road leading to top of Cross Mountain, Lake City quadrangle, Anderson County. Named from exposures in Low Gap on crest of Redoak Mountain between Graves Gap and Cross Mountain.

Low Gap Sandstone (in Hinton Formation)[1]

Mississippian: Southeastern West Virginia and southwestern Virginia.

Original reference: D. B. Reger, 1926, West Virginia Geol. Survey Rept. Mercer, Monroe, and Summers Counties, p. 296, 334.

Type locality: On Wolf Creek Mountain, Summers County, W. Va., in public road slightly east of and above Low Gap School.

Low Gap Shale (in Hinton Formation)[1]

Mississippian: Southeastern West Virginia.

Original reference: D. B. Reger, 1926, West Virginia Geol. Survey Rept. Mercer, Monroe, and Summers Counties, p. 296, 345.

Type locality: On Wolf Creek Mountain, Summers County, in public road slightly east of and above Low Gap School.

Low Hollow Limestone Member (of Maynardville Limestone)

Upper Cambrian: Southwestern Virginia.

R. L. Miller and J. O. Fuller 1947, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 76. Gray crypto-crystalline ribbon limestone in lower part and mottled limestone in upper part; interbedded fine-grained dolomite near top. Thickness 160 to 206 feet. Underlies Chances Branch dolomite member (new); overlies Conasauga shale.

R. L. Miller and J. O. Fuller, 1954, Virginia Geol. Survey Bull. 71, p. 35–37; R. L. Miller and W. P. Brosagé, 1954, U.S. Geol. Survey Bull. 990, p. 15, 89, pl. 1. Further described. Thickness at type locality (herein given) 142 feet.

Type locality: Along Fourmile Creek at Virginia-Tennessee State line. Well exposed along road in Low Hollow 4½ miles south of Rose Hill and 1 mile south of Deans Store, Lee County.

Lowrie Sandstone Bed (in Wellington Formation)[1]

Permian: Central northern Oklahoma.

Original reference: J. M. Patterson, 1933, Am. Assoc. Petroleum Geologists Bull., v. 17, no. 3, p. 243, 251.

Exposed a few miles north of Guthrie vertical bluffs on east side of Cimarron River, in central part of T. 17 N., R. 2 W. Named from railroad station of Lowrie. in sec. 16.

Lowville Granite[1]

Precambrian: Northwestern New York.

Original reference: A. F. Buddington, 1934, New York State Mus. Bull. 296, p. 74, 78–79, 83, 104, and map of Lowville quad.

A. F. Buddington, 1939, Geol. Soc. America Mem. 7, p. 136, 137, 139. Includes finer grained modified border facies in Lake Bonaparte quadrangle.

Occurs in Lowville area.

Lowville Limestone (in Black River Group)[1]

Middle Ordovician: New York, Maryland, Pennsylvania, and western Virginia, and Ontario, Canada.

Original reference: J. M. Clarke and C. Schuchert, 1899, Science, new ser., v. 10, p. 874–878.

Charles Butts, 1940, Virginia Geol. Survey Bull. 52, pt. 1, p. 179–191. Term Lowville-Moccasin used in this report [Appalachian Valley] because equivalent of upper three-fourths of Lowville in middle belt of valley is a red argillaceous limestone or calcareous mudrock facies which has received name Moccasin limestone, a name extensively used in southwestern Virginia and northern Tennessee. Lowville is bounded below by Athens shale or Ottosee limestone, or locally by Holston limestone. Overlain in some places by Eggleston limestone; in others by Trenton limestone or Trenton division of Martinsburg shale. In parts of the valley, a hiatus exists between Lowville-Moccasin and the Trenton due to absence of Chambersburg limestone, which in Franklin County, Pa., immediately overlies the Lowville.

B. N. Cooper and C. E. Prouty, 1943, Geol. Soc. America Bull., v. 54, no. 6, p. 819–886. Lower Middle Ordovician succession of Tazewell County, Va., subdivided into 29 distinctive zones. This study has revealed inconsistencies in use of stratigraphic names Stones River, Murfreesboro, Mosheim, Lenoir, Blount, Holston, Ottosee, Lowville, and Moccasin. Revised stratigraphic nomenclature proposed. Further use of terms Lowville and Lowville-Moccasin in Tazewell County and other parts of southwestern Virginia seems inadvisable. Witten limestone of revised classification corresponds to part, and locally to all, of Lowville limestone or Lowville limestone facies of Lowville-Moccasin formation as defined by Butts.

C. W. Wilson, Jr., 1949, Tennessee Div. Geology Bull. 56, p. 46. Believed that names Tyrone and Lowville should not be used in central Tennessee as applied to definite units of limestone (name Carters has priority over New York name, Lowville, and Kentucky name, Tyrone). Name Carters should be restored to formational rank and be used as originally defined by Safford.

D. W. Fisher and G. F. Hanson, 1951, Am. Jour. Sci., v. 249, no. 11, p. 795–814. In Saratoga Springs area, New York, previously accepted sequence of beds (Potsdam sandstone, Theresa formation, Hoyt limestone, Little Falls dolomite, Amsterdam limestone, Trenton limestone, Canajoharie shale) is revised to read Potsdam sandstone, Galway formation, Hoyt limestone, Ritchie limestone (new), Mosherville sandstone (new), Gailor dolomite (new), Lowville limestone, Amsterdam limestone, Trenton limestone (Rockland?, Hull, Sherman Fall representatives), and Canajoharie shale.

R. L. Miller and J. O. Fuller, 1954, Virginia Geol. Survey Bull. 71, p. 90–103, pl. 9. In Rose Hill district, Lee County, the Lowville is restricted to the pre-Moccasin beds, whose thickness amounts to about two-thirds of Lowville-Moccasin sequence (Butts, 1940). Consists of a lower redbed member and an upper platy member. Thickness 583 feet Overlies Lenoir limestone; underlies Moccasin limestone. In Tazewell County, several new names have been proposed (Cooper and Prouty, 1943) for beds at least partly equivalent to those here described under Lowville but correlates between the two areas are not established, and Tazewell County names are not applied in Rose Hill district.

R. L. Miller and W. P. Brosgé, 1954, U.S. Geol. Survey Bull. 990, p. 47–56. Hurricane Bridge limestone, in Jonesville district, Virginia, is identical to the redbed member of Lowville limestone as mapped by Miller and Fuller. Woodway limestone is exactly equivalent to platy member of Lowville as mapped by Miller and Fuller.

G. A. Cooper, 1956, Smithsonian Misc. Colln., v. 127, pt. 1, p. 22–23. Name has been widely used in eastern United States and Canada as formation name, but such use should be discouraged outside New York, Ontario, and Quebec. Only in these latter regions can the formation be shown to be a laterally continuous unit. Elsewhere name has use only in facies sense for so-called dove limestones. In type section, formation is 34 feet thick. Overlies Pamelia formation; underlies Chaumont formation.

Well exposed at Lowville, Lewis County, N.Y.

Lowvillian (stage)

Ordovician (Black Riveran): New York.

Marshall Kay, 1958, Am. Jour. Sci., v. 256, no. 2, p. 94 (table 3). Name used in list of stage names for middle division of Black Riveran series. Older than newly named Chamontian [stage]; younger than newly named Pamelian [stage].

Name probably derived from Lowville, Lewis County, for which Lowville limestone is named.

Loyal Creek[1] Member (of Utica Formation)

Middle Ordovician: Eastern New York.

Original reference: R. Ruedemann and G. H. Chadwick, 1935, Science, new ser., v. 81, p. 100.

G. M. Kay, 1937, Geol. Soc. America Bull., v. 48, no. 2, p. 282–283. Loyal Creek member has been defined as the middle Utica or zone of *Dicranograptus nicholsoni* Hoplinson; black laminated shale; thickness about 130 feet on Loyal Creek near Fort Plain. Overlies Nowadaga member; underlies Holland Patent member.

Occurrence is in upper Mohawk Valley, westernmost Montgomery County.

Loyalhanna Limestone[1]

Loyalhanna Limestone Member (of Greenbrier Limestone)[1]

Mississippian: Western and central Pennsylvania, western Maryland, and West Virginia.

Original reference: C. Butts, 1904, U.S. Geol. Survey Geol. Atlas, Folio 115, p. 5.

Charles Butts, 1945, U.S. Geol. Survey Geol. Atlas, Folio 227. Described in Hollidaysburg-Huntingdon area, Pennsylvania. Formation occupies stratigraphic interval above Burgoon sandstone member of Pocono and below Mauch Chunk formation. Thickness about 40 feet.

T. W. Amsden, 1954, Maryland Dept. Geology, Mines and Water Resources Bull. 13, p. 38–43. Member of Greenbrier limestone. At base of formation. Thickness 67 feet, excluding 8-foot covered interval at base. Underlies unnamed upper member of Greenbrier. Area of report, Garrett County.

Carlyle Gray and others, 1960, Geologic map of Pennsylvania (1:250,000), Pennsylvania Geol. Survey, 4th ser. Mauch Chunk formation as mapped includes Greenbrier limestone in Fayette, Westmoreland, and Somerset Counties: Loyalhanna limestone at base in southwestern Pennsylvania.

Named for exposures in gorge in which Loyalhanna Creek flows across Chestnut Ridge is Westmoreland County, Pa.

Loyd Sandstone Member (of Mancos Shale)

Upper Cretaceous: Northwestern Colorado.

Kenji Konishi, 1959, Rocky Mountain Assoc. Geologists 11th Field Conf., Symposium, p. 69–70, pl. 1. Thick massive greenish-gray sandstone; fine to very fine grained, very calcareous, and nodular at certain horizons where it becomes quite fossiliferous; without prominent development of bedding planes; weathers to rounded lumplike masses; about 100 feet thick at type locality and apparently thins out eastward but keeps constant thickness southward and westward. Located about 60 feet below top of formation at type locality.

Type locality: Center sec. 36, T. 5 N., R. 92 W. Type section in Cliff on southeastern end of Iles Mountain, which is about 0.2 mile from Colorado Highway 13. Named for little town about 5 miles southwest of type locality.

Loysburg Formation[1]

Middle Ordovician: Central and central southern Pennsylvania.

Original reference: R. M. Field, 1919, Am. Jour. Sci., 4th, v. 48, p. 404, 410.

G. M. Kay, 1941, Geol. Soc. America Bull., v. 52, no. 12, pt. 2, p. 1969. Formation comprises Clover member (new) 46 to 60 feet thick, in upper part and pre-Clover laminated magnesian and pure limestone, at least 400 feet thick. Underlies Hatter limestone (new).

G. M. Kay, 1943, Econ. Geology, v. 38, no. 3, p. 193. Includes unnamed member and Clover member. Underlies Hatter formation which is subdivided into (ascending) Eyer, Grazier, and Hostler members. Chazyan series.

G. M. Kay, 1944, Jour. Geology, v. 52, no. 1, p. 3 (fig. 2), 4–6, 7 (table 1). Loysburg formation was described as dark and impure dolomitic limestone lying between the Beekmantown and first "intraformational zone" of Carlim limestone. Clover limestone, classed as upper member of Loysburg, comprises 60 feet of relatively pure, sublithographic limestone overlying the "tiger-striped" lithology of interlaminated dark and buff-weathering ostracode-bearing limestone in type section [of Clover]. Inasmuch as the "first intraformational zone" is in the "tiger-striped" member, the Clover is added to original Loysburg. Carlim limestone included the "transition beds" or "tiger-striped", the Clover, and the Hatter formation in Tyrone district. Underlying magnesian beds were classified as Bellefonte dolomite (Butts, Swartz, and Willard, 1939, Pennsylvania Geol. Survey, 4th ser., Bull. 96) and were considered Canadian age, but they may be a facies of the Loysburg, which has been considered "Stones River" or "Chazyan".

Named for village of Loysburg, Bedford County.

Luapelani Flow

Recent: Maui Island, Hawaii.

Grote Reber, 1959, Geol. Soc. America Bull., v. 70, no. 1, p. 1246 (fig. 1). Shown on map of recent lava flows.

On southwest side of Halekala.

Lucas Formation (in Detroit River Group)

Lucas Dolomite[1]

Middle Devonian: Ohio and southeastern Michigan, and western Ontario, Canada.

Original reference: C. S. Prosser, 1903, Jour. Geology, v. 11, p. 521, 540.

G. M. Ehlers, 1950, (abs.) Geol. Soc. America Bull., v. 61, no. 12, pt. 2, p. 1455–1456. Detroit River group revised. Oldest unit, Sylvania, is succeeded by Amherstburg dolomite, Lucas dolomite, and Anderdon limestone.

K. K. Landes, 1951, U.S. Geol. Survey Circ. 133, p. 1, 2 (fig. 2), 3–7. In order to apply outcrop terminology so far as possible to sediments of central part of Michigan basin, the Lucas is defined, in this report, as a formation that includes the thick evaporite sequence which overlies dolomite sequence, (Richfield member, new), downdip from outcrop area. Thickness (subsurface) 68 to 1,204 feet. Anderdon limestone, which overlies the Lucas in southeastern Michigan, not recognizable in subsurface; hence, the Lucas underlies Dundee formation.

G. M. Ehlers, E. C. Stumm, and R. V. Kesling, 1951, Devonian rocks of southeastern Michigan and northwestern Ohio: Ann Arbor, Mich., Edwards Bros., Inc., p. 8 (fig. 2), 9–10, 13. Thickness about 84 feet in quarries at Silica, Ohio, and in Detroit region 170 feet.

Named for exposures in Lucas County, Ohio.

Lucas limestone[1]

Middle Devonian: Central eastern Iowa.

Original reference: C. R. Keyes, 1912, Iowa Acad. Sci. Proc., v. 19, p. 149; 1913, Iowa. Acad. Sci. Proc., v. 20, p. 205, 206.

Named for a locality in Johnson County.

Lucerne Granite

Age not stated: Eastern Maine.

L. A. Wing, 1957, Maine Geol. Survey GP. and G. Survey 1, sheet 1. Coarse-textured porphyritic biotite granite. Makes up large percentage of intrusive material in area mapped.

Report discusses parts of Hancock and Penobscot Counties.

Lucia Shale

Eocene: West-central California.

R. R. Thorup, 1941, (abs.) Geol. Soc. America Bull., v. 52, no. 12, pt. 2, p. 1958. Listed as underlying The Rocks sandstone and overlying Junipero sandstone (both new). Thickness 100 to 500 feet.

R. R. Thorup, 1943, California Div. Mines Bull. 118, pt. 3, p. 465. Described as greenish- to steel-gray thin-bedded nodular mudstone and shale. Lucia is gradational with both underlying Junipero sandstone and overlying The Rocks sandstone. Formerly considered part of Vaqueros which is herein stratigraphically restricted in its type area.

Type locality: NE¼ sec. 34, N½ sec. 35, SE¼ sec. 26, T. 20 S., R. 6 E., Junipero Serra quadrangle, Monterey County.

Lucien shale member[1]

Permian: Central northern Oklahoma.

Original reference: F. L. Aurin, H. G. Officer, and C. N. Gould, 1926, Am. Assoc. Petroleum Geologists Bull., v. 10, p. 786–799.

Named for exposures at Lucien, Noble County.

Lucile Series

Upper Triassic: Central western Idaho and northeastern Oregon.

W. R. Wagner, 1945, Idaho Bur. Mines and Geology Pamph. 74, p. 5, pl. 1. Comprises (ascending) graphitic schist and calcareous shale member, limestone member which has some intercalated tuffaceous lenses, and phyllitic and schistose member containing some volcanic flows. At Lucile, graphitic schist is gray to black fine-grained rock with well-developed schistosity; over 400 feet thick locally, but very lenticular, disappearing not more than 1 mile northwest of Lucile. Shale is white to light gray and pink; thin bedded, limy, and shows signs of flowage; about 100 feet thick one-half mile south of Cold Springs Lookout. Limestone is gray to bluish gray, except for some thin white to light-gray beds; thickness at Lucile 500 feet, and elsewhere ranges from 50 to more than 500 feet; at several points, beds of tuffaceous materials from few feet to over 50 feet thick and from 50 feet to over a mile long are intercalated with limestone. Phyllites and phyllitic schists are fine- to medium-grained light- to dark-brownish-gray micaceous rocks which show increase in grain size on approach to Idaho batholith to the east; thickness of more than 2,000 feet exposed at Riggins. Overlies Seven Devils volcanics.

Named for occurrence at Lucile, Idaho County, Idaho. Exposed in canyon walls of Salmon River from Lucile to Riggins and in canyons of Salmon and Little Salmon east and south of Riggins.

Luck-Sure Series[1]

Age(?): Southeastern Arizona.

Original reference: W. P. Blake, 1902, Tombstone and its mines.

Well developed in mineral claims formerly known as Lucky Cuss, Luck Sure, Wedge, Sunset, Knoxville (Stonewall), Anchor, and Grand Dipper, Tombstone district.

Lucky Bill Formation

Miocene(?): Southwestern New Mexico.

R. M. Hernon, W. R. Jones, and S. L. Moore, 1953, New Mexico Geol. Soc. Guidebook 4th Field Conf., p. 120. Listed in table of formations. Gravel, sand, and pumiceous tuffs; well-sorted and stratified in places. Thickness as much as 600 feet. Unconformably underlies unnamed rhyolite tuffs; overlies Rubio Peak formation (new).

In Santa Rita quadrangle.

Lucky Cuss Limestone[1]

Ordovician(?): Southeastern Arizona.

Original reference: J. A. Church, 1903, Am. Inst. Mining Engrs. Trans., v. 33, p. 3–37.

Tombstone district.

Lucky S Argillite[1]

Upper Jurassic: Northern California.

Original reference: C. H. Crickmay, 1933, Geol. Soc. America Bull., v. 44, no. 1, p. 81.

Type locality: Forman Ravine, west end of Forman Ridge, Mount Jura. Named for Lucky S mine.

†Ludlow conglomerate member[1]

Devonian or Carboniferous: Northwestern Pennsylvania.

Original reference: K. E. Caster, 1933, Geol. Soc. America Bull., v. 44, no. 1, p. 202.

Ludlow Member (of Fort Union Formation)

Ludlow Formation (in Fort Union Group)

Ludlow Lignitic Member (of Lance Formation)[1]

Paleocene: Northwestern and northern South Dakota, northeastern Montana, and southwestern North Dakota.

Original reference: E. R. Lloyd and C. J. Hares, 1915, Jour. Geology, v. 23, p. 523-547.

W. M. Laird and R. H. Mitchell, 1942, North Dakota Geol. Survey Bull. 14, p. 16–18. Formation described in southern Morton County where it is 17 to 49 feet thick, overlies Hell Creek formation and underlies and is in gradational contact with Cannonball formation which it replaces westward. Fort Union group. Paleocene.

N. H. Darton, 1951, Geologic map of South Dakota (1:500,000): U.S. Geol. Survey. Ludlow formation mapped in northwestern South Dakota.

R. A. Brant, 1953, U.S. Geol. Survey Circ. 226. p. 1, 11, 12. Basal member of Fort Union formation in North Dakota. Equivalent to Tullock member and Lebo shale member in lignite fields of southeastern Montana. Underlies Tongue River member. In Marmarth lignite field, consists of 250 feet of alternating shale, sandstone, and lignite beds. Thins to the east and interfingers with Cannonball formation. Overlies Hell Creek formation. Paleocene.

P. R. May, 1954, U.S. Geol. Survey Bull. 995–G, p. 267–268. Member of Fort Union. Described in Wibaux area, where it crops out along banks of Yellowstone River in Dawson County, and on southwestern edge of area as far east as vicinity of Hodges, Mont. Thickness about 250 feet. Underlies Tongue River member; overlies Hell Creek formation. In most of older geologic reports, the Ludlow member and Hell Creek formation, which are similar in character, were not distinguished from each other but were referred to as Lance formation.

R. E. Stevenson, 1954, Areal geology of the Morristown quadrangle (1:62,500): South Dakota Geol. Survey. Formation, in Morristown quadrangle, overlies Hell Creek formation and underlies Cannonball formation. Thickness about 250 feet. Includes Shadehill coal facies at base and Hillen facies about 60 feet above Shadehill facies.

B. C. Petsch, 1956, Area geology of the Mouth of Bull Creek quadrangle (1:62,500): South Dakota Geol. Survey. Formation, in Mouth of Bull Creek quadrangle, overlies Hell Creek formation and underlies Tongue River formation. Includes Shadehill facies at base, Hillen facies near middle, and Giannonatti facies at or near top. Thickness about 250 feet.

Type locality: Vicinity of Ludlow, Harding County, S. Dak.

Ludlow Sandstone[1]

Middle Devonian: Central Pennsylvania.

Original reference: J. P. Lesley, 1892, Pennsylvania 2d Geol. Survey Summ. Final Rept., v. 2, p. 1236–1237.

Perry County.

†Ludlowville Group[1]

Middle Devonian: New York.

Original reference: J. Hall, 1842, Am. Jour. Sci., 1st, v. 42, p. 57–62.

Well exposed along Cayuga and Seneca Lakes.

Ludlowville Shale (in Hamilton Group)[1]

Middle Devonian: Western and central New York.

Original reference: J. Hall, 1839, New York Geol. Survey 3d Rept., p. 298.

Burnett Smith, 1935, New York State Mus. Bull. 300, p. 44–51. Formation, in Skaneateles quadrangle, subdivided into (ascending) Otisco, Ivy Point, Spafford, and Owasco members (all new). Restricted at base to exclude Centerfield member herein placed in Skaneateles formation.

G. A. Cooper and A. S. Warthin, 1941, Washington Acad. Sci. Jour., v. 31, no. 6, p. 259. In Chenango Valley, Morrisville quadrangle, includes Stone Mill member (new).

R. G. Sutton, 1951, Rochester Acad. Sci. Proc., v. 9, nos. 5–6, p. 361–372, pl. 1. Formation, in Batavia quadrangle, comprises (ascending) Centerfield, Ledyard-Wanakah, Tichenor, and Deep Run members. Overlies Skaneateles formation; underlies Moscow formation. Thickness about 113 feet.

R. S. Boardman, 1960, U.S. Geol. Survey Prof. Paper 340, p. 3–7. Includes (ascending) Centerfield limestone, Ledyard, Wanakah shale, Tichenor limestone, and Deep Run members. In Cayuga Lake area, includes King Ferry member equivalent to Wanakah shale, Tichenor limestone, and Deep Run members to west. Hamilton group. Trepostomamous Bryozoa discussed.

Reference section: Sequence on Paines Creek at Aurora beginning with the Centerfield at Moonshine Falls and terminating with Portland Point beds at Black Rock, Erie County. Named for occurrence at Ludlowville, Tompkins County.

Lueders Limestone (in Wichita Group)[1]

Lueders Group

Permian: Central northern and central Texas.

Original reference: W. E. Wrather, 1917, Southwestern Assoc. Petroleum Geologists Bull., v. 1, p. 94, chart opposite p. 96.

M. G. Cheney, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 1, p. 66 (fig. 1), 94. Rank raised to group. Includes (ascending) Paint

Rock limestone, Maybelle limestone, and Lake Kemp formation. Overlies Belle Plains group (expanded) ; underlies Clear Fork group.

R. C. Moore, 1949, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 80, sheet 2. Described in Colorado River valley as a formation where, in Runnels County, it is about 225 feet thick. Consists mainly of very even limestone beds, 1 foot or a little less to about 3 feet thick; in part of section, these beds succeed one another with only an inch or two of intervening shale; in other parts, shale or marl between the limestones ranges in thickness to about 5 feet; limestones characterized by fine algal pellets or particles of type called Osagia. Overlies Talpa limestone member of Clyde formation; underlies Arroyo formation. No basis was found for recognizing any limestone beds of the Lueders as corresponding to Maybelle and Lake Kemp beds, respectively. "Paint Rock" limestone is considered a synonym for Talpa limestone.

P. T. Stafford, 1960, U.S. Geol. Survey Bull. 1081–G, p. 276. In Brazos River valley, consists of persistent alternating beds of limestone and shale whose thickness ranges from 75 feet in northwestern Callahan County to 50 feet in west-central Throckmorton County. Separated from underlying Talpa limestone member by unnamed shale unit 30 to 70 feet thick. Underlies Arroyo formation of Clear Fork group. Wichita group.

Named for small town on Clear Fork of Brazos River, eastern Jones County.

Lueders Limestone Member (of Lueders Formation)[1]

Permian : Central northern Texas.

Original reference: M. M. Garrett, A. M. Lloyd, and G. E. Laskey, 1930, Texas Bur. Econ. Geology, geol. map.

In Jones and Taylor Counties.

†Lufkin Beds (in Claiborne Group)[1]

Eocene: Eastern Texas.

Original reference: W. Kennedy, 1892, Texas Geol. Survey 3d Ann. Rept., p. 45, 58.

H. B. Stenzel, 1939, Texas Univ. Bur. Econ. Geology Pub. 3945, p. 885–904 [1940]. Discussion of Yegua problem. Terms Lufkin, Yegua, and Cockfield have been used for beds herein called Yegua. Although present writer [Stenzel] has retained name Yegua, he advocates use of Lufkin as name for these beds.

Named for Lufkin, Angelina County.

Lufkin Member (of Cook Mountain Formation)[1]

Eocene: Eastern Texas.

Original reference: B. C. Renick, 1928, Am. Assoc. Petroleum Geologists Bull., v. 12, p. 531, 534.

Lufkin rhyolite[1]

Tertiary: Southwestern New Mexico.

Original reference: C. R. Keyes, 1908, Am. Inst. Mining Engrs. Bi-monthly Bull. 19, p. 7–21.

Type locality: Lufkin Mountain, near Lake Valley, Sierra County.

Lugert Granite[1]

Precambrian: Southwestern Oklahoma.

Original reference: C. H. Taylor, 1915, Oklahoma Geol. Survey Bull. 20.

C. A. Merritt, 1958, Oklahoma Geol. Survey Bull. 76, p. 40–47, p. 1 Described in Lake Altus area as reddish medium-crystalline granite, locally containing xenoliths of gabbro, andesite, and aplite, as well as pebbles derived from an older granite conglomerate. Geographically restricted to rock of Taylor's type area, the Lugert region.

Occurs in vicinity of Lugert, Kiowa County.

Luisian Stage[1]

Miocene, middle: California.

Original reference: R. M. Kleinpell, 1934, Am. Assoc. Petroleum Geologists Bull., v. 18, no. 3, p. 376–378.

R. M. Kleinpell, 1938, Miocene stratigraphy of California: Tulsa, Okla., Am. Assoc. Petroleum Geologists, p. 121–127. Superjacent to Relizian stage and subjacent to Mohnian stage. Comprises three zones: *Siphogenerina reedi*, lower; *Siphogenerina nufiformis*, middle; and *Siphogenerina collomi*, upper. Systematic catalogue.

Type locality: On Highland monocline about 4½ miles west of Indian Creek, San Luis Obispo County.

Lukachukai Member (of Wingate Sandstone)

Upper Triassic: Northeastern Arizona, western Colorado, northwestern New Mexico, and eastern Utah.

G. A. Kiersch, 1955, Mineral Resources, Navajo-Hopi Indian Reservations, Arizona-Utah, v. 2, p. 5, fig. 1. Massive cliff-forming reddish-brown cross-stratified sandstone. Overlies Rock Point member (new). Name credited to Harshbarger and others (unpub. ms.).

J. W. Harshbarger, C. A. Repenning, and J. H. Irwin, 1957, U.S. Geol. Survey Prof. Paper 291, p. 3 (fig. 2), 8 (fig. 5), 10–12, pl. 2. Pale reddish-brown fine- to very fine-grained sandstone at type locality. Lithology homogenous throughout Navajo country. Limestone lenses locally common in area between Chinle, Ariz., and the Four Corners State junction. Massive crossbedded sandstone that weathers into sheer cliffs above slope forming Rock Point member. Intertongues with Rock Point member in type area. Constitutes lower half of original Wingate sandstone as defined by Darton; underlies Entrada sandstone. Intertongues with Dinosaur Canyon sandstone member of Moenave formation in extreme southwestern part of Navajo country. Thickness about 300 feet throughout Navajo country. From Fort Wingate eastward, progressively thinner and pinches out within 30 miles south of Laguna, N. Mex. Thins and pinches out to west and south as well as to east of Navajo country. Northwestward along Ward Terrace it disappears between Chinle and basal member of Moenave formation. Type locality designated.

Type locality: Sandstone that forms vertical cliff on escarpment northeast of Lukachukai, Apache County, Ariz. Present throughout most of Navajo Indian Reservation.

Lukachukai sandstone[1]

Triassic(?): Northeastern Arizona and northwestern New Mexico.

Original reference: C. R. Keyes, 1922, Pan-Am. Geologist, v. 38, p. 250, 337.

Charles Keyes, 1936, Pan-Am. Geologist, v. 65, no. 1, p. 63 (table). Underlies Nazlini shales.

Crops out in Lukachukai Valley, at north end of Chuska Mountains [northwestern New Mexico].

Luke Clay (in Allegheny Formation)[1]

Pennsylvanian: Western Maryland.

Original reference: C. K. Swartz, W. A. Price, and H. Bassler, 1919, Geol. Soc. America Bull., v. 30, p. 572.

Exposed in cut on B. & O. Railroad opposite Luke, Allegany County.

Luke Hill Formation[1] or Limestone[1]

Lower Ordovician: Northwestern Vermont, and southeastern Quebec, Canada.

Original reference: H. W. McGerrigle, [1931], Vermont State Geologist 17th Rept., p. 182, 184, 185.

J. A. Dresser and T. C. Denis, 1944, Quebec Dept. Mines Geol. Rept. 20, v. 2, p. 396, 399. Contains as much as 1 foot of sandy rubble at base, followed by a few tens of feet of fine-grained crossbedded sandstone. Above are dark limestones, characterized by yellow-weathering interbeds which make up bulk of formation. Thickness 160 feet. Overlies Naylor Ledge formation. Underlies Solomons Corner formation. Phillipsburg series. Beekmantown.

Exposed from northern part of St. Albans quadrangle, Vermont, across international border for about 20 miles into Quebec.

Lukfata Sandstone

Cambrian(?): Southeastern Oklahoma.

W. D. Pitt, 1955, Oklahoma Geol. Survey Circ. 34, p. 13–15, pl. 1. Consists of three unnamed members: lower made up mostly of interlaminations of thin-bedded limestone and shale; middle of interbedded platy sandstone and shale; and upper of more massively bedded sandstone which contains some laminae of shale. Thickness at least 145 feet. Underlies Collier shale.

Type sections: Lower member, at concrete high-water ford on Lukfata Creek near center of sec. 17, T. 5 S., R. 24 E., and locally within 400 yards upstream and downstream from this location; middle member, about 400 yards downstream from concrete ford; upper member, cliff section on west bank of Lukfata Creek, SE¼SE¼ sec. 8, T. 5 S., R. 24 E., McCurtain County. Occurrences are in core of Ouachita Mountains.

Lula facies (of Cow Bayou Member of Logansport Formation)

Paleocene (Midway): Northwestern Louisiana.

G. E. Murray, 1948, Louisiana Dept. Conserv. Geol. Bull. 25, p. 112–114. Named as upper facies of member. Consists of 40 to 75 feet of gray to brown thin-bedded micaceous fine-grained argillaceous sands and silts with numerous limonitic sand laminae and disc-shaped limonitic concretions; characterized by well-preserved leaves and plant fragments. Transitional from underlying Benson facies.

Type locality: Exposures in roadcuts and gullies in the W½ sec. 11, T. 10 N., R. 14 W., along State Highway 747 from ½ to 1½ miles north of village of Lula, De Soto Parish.

Lulbegrud Clay[1]

Lulbegrud Conglomerate

Silurian (Niagaran): East-central Kentucky.

Original reference: A. F. Foerste, 1905, Kentucky Geol. Survey Bull. 6, p. 145; 1906, Kentucky Geol. Survey Bull. 7, p. 10, 50.

C. K. Swartz and others, 1942, Geol. Soc. America Bull., v. 53, no. 4, chart 3. Shown on correlation chart as Lulbegrud conglomerate. Occurs below Waco limestone and above Oldham limestone.

Named for Lulbegrud Creek, Clark and Powell Counties.

Luman Tongue (of Green River Formation)

Eocene, lower: Southwestern Wyoming.

G. N. Pipiringos, 1955, Wyoming Geol. Assoc. Guidebook 10th Ann. Field Conf., p. 100, 101 (chart). Sequence of oil shale, fossiliferous calcareous sandstone, varved siltstone, and clay shale. Contains several tongues of low-grade oil shale. In north-central part of Great Divide Basin base of lowest oil shale tongue contains so-called pastel limestone marker bed. Thickness 180 feet at Luman Butte and thickens eastward to 270 feet in vicinity of Lost Creek Butte; about 200 feet at Tipton Station and about 390 feet at Frewen Station. Overlies Red Desert tongue (new) and underlies Niland tongue (new) of Wasatch formation. Intertongues with Battle Spring formation (new) to north.

Named for exposures on south slope of Luman Butte, sec. 34, T. 24 N., R. 97 W., Sweetwater County.

Lunasan series[1]

Lunasian series[1]

Carboniferous: New Mexico.

Original reference: C. R. Keyes, 1915, Conspectus of geologic formations of New Mexico: Des Moines, Robert Henderson, State Printer, p. 3, 8.

In Manzano Mountains.

Lunenburg Schist[1]

Upper Cambrian: Northeastern Vermont.

Original reference: C. H. Richardson, 1906, Vermont State Geologist 5th Rept., p. 79–82.

Probably named for village or township of Lunenburg, Essex County.

Luning Formation[1]

Upper Triassic: Southwestern Nevada.

Original reference: S. W. Muller and H. G. Ferguson, 1936, Geol. Soc. America Bull., v. 47, p. 241–252.

S. W. Muller and H. G. Ferguson, 1939, Geol. Soc. America Bull., v. 50, no. 10, p. 1594–1603. In most places, conformably underlies Gabbs formation; locally underlies Dunlap formation. Rests unconformably on Excelsior formation and in Shoshone Mountains overlies Grantsville formation (new).

H. G. Ferguson, S. W. Muller, and S. H. Cathcart, 1954, U.S. Geol. Survey Quad. Map GQ–45. Described in Mina quadrangle where six units are mapped. Thickness 8,000 feet at type locality, top not exposed (upper limestone 2,500 feet, slate and conglomerate 3,000 feet, lower limestone 2,500 feet); less in other ranges, no complete section.

N. J. Silberling, 1959, U.S. Geol. Survey Prof. Paper 322, p. 14–25, pls. Described in Union district, Shoshone Mountains, where approximately 3,000 feet is exposed in vicinity of West Union Canyon where top of section is obscured by Tertiary volcanic rocks. Four informal members recognized: clastic member, composed of siliceous conglomerate, sandstone, and argillite 600 feet thick; shaly limestone, 600 feet; calcareous shale, 550 feet; and carbonate member, composed of massive limestone and dolomite, at least 2,000 feet. Disconformably overlies Grantsville formation; underlies Gabbs and Sunrise formations undifferentiated.

Type locality: North slope of Pilot Mountains, about 12 miles southeast of Luning, Mina quadrangle, Mineral County.

Lupine Quartzite (in Missoula Group)

Precambrian (Belt Series): Northwestern Montana.

A. B. Campbell, 1960, U.S. Geol. Survey Bull. 1082–I, p. 563–565, pl. 28. Thin- to massive-bedded light-pinkish-brown vitreous to subvitreous fine-grained quartzite with many thin dusky-red purple argillite interbeds; becomes more vitreous and massive bedded higher in section. Brown-weathering grayish-pink dolomitic quartzite lenses 1 to 3 inches thick and several inches to several feet long are common and diagnostic. Some beds felspathic. Thickness about 3,000 feet. Overlies Spruce formation (new); underlies Sloway formation (new).

Type section (lower 2,750 feet): West side Blacktail Mountain, sec. 34, T. 17 N., R. 27 W., and sec. 4, T. 16 N., R. 27 W.; type section (top 300 feet): sec. 18, T. 16 N., R. 26 W., Named from exposures along Lupine Creek, a tributary of Trout Creek, near south edge of mapped area, sec. 33, T. 16 N., R. 26 W., St. Regis-Superior area, Mineral County.

Luquillo Formation[1]

Upper Cretaceous: Puerto Rico.

Original reference: H. A. Meyerhoff, 1931, New York Acad. Sci. Scientific survey of Porto Rico and Virgin Islands, v. 2, pt. 3, p. 279.

R. C. Mitchell, 1954, Puerto Rico Univ. Agr. Expt. Sta. Tech. Paper 13, p. 36 (table 2), 60 (table 7). Thickness 2,500 feet. Overlies Río conglomerate; underlies Trujillo Alto limestone. Upper Cretaceous.

Named for exposures at town of Luquillo, Fajardo district, where it forms low but prominent cliffs both along shoreline and along banks of Río Sabana near its mouth. In this area, Río conglomerate, La Muda limestone, and Guaynabo formation are absent, and the Luquillo rests directly on Hato Puerco tuffs.

Lurich Formation or Group

Middle Ordovician (Chazyan): Virginia and West Virginia.

Marshall Kay, 1956, Geol. Soc. America Bull., v. 67, no. 1, p. 59 (fig. 2), 61, 63, 69–72. Top of lowest part of Ordovician limestone sequence is white-weathering calcilutite that contrasts sharply with siliceous cherty calcarenite. The calcilutite, of variable thickness passes down into beds having nodular black chert; these beds overlie impure dolomite. From Bolar southwestward, chert-pebble conglomerate zones are within and at base of dolomite. To the southwest, sequence is continuous upward from Blackford (Butts, 1942) [1940] chert-pebble conglomerate and dolomite to Elway (Cooper, 1951) *Dinorthis*-bearing calcilutite with black chert, to Five Oaks (Cooper and Prouty, 1943) calcilutite; these three units with younger formations formed Cliffield group (Cooper and Prouty, 1943) subsequently suppressed by Cooper (1951). Loysburg formation in Pennsylvania with Clover calcilutite at top is very like northern sections in the Virginias. In Appalachian Valley to east, term St. Paul group has been proposed for essentially same sort of sequence (Neuman, 1951). In area of this study, unit is designated Lurich formation, or Lurich group where separable into formations.

Thickness generally about 300 feet. Lies above Canadian series and below Lincolnshire formation (Chazyan).

Type locality: Lurich, Giles County, Va.

Lurichian Stage

Middle Ordovician (Chazyan): Virginia and West Virginia.

Marshall Kay, 1956, Geol. Soc. America Bull., v. 67, no. 1, p. 100. Name applied to older of two stages of Chazyan epoch in discussion of Middle Ordovician formations of eastern and southern West Virginia and western Virginia.

Name probably derived from Lurich, Giles County, Va., for which Lurich formation is named.

Lusk cyclothem (in Caseyville Group)

Pennsylvanian: Southern Illinois.

H. R. Wanless, 1955, Am. Assoc. Petroleum Geologists Bull., v. 39, no. 9, p. 1764 (table 2). Caseyville group includes (ascending) Lusk, Battery Rock, and Pounds cyclothems.

H. R. Wanless and Raymond Siever, 1956, Illinois Geol. Survey Circ. 217, p. 9, pl. 1. Includes Lusk shale. Type locality designated.

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 52 (table 2), pl. 1. At base of Caseyville Formation (redefined). Below Battery Rock cyclothem. Presentation of new rock-stratigraphic classification of Pennsylvanian strata in Illinois; cyclical classification is independent of rock-stratigraphic classification.

Type locality: Tps. 12 and 13 S., R. 6 E., Pope County.

Lusk[1] (limestone)

Mississippian: Southeastern Illinois.

Original reference: C. R. Keyes, 1923, Pan-Am. Geologist, v. 39, no. 4, p. 320.

Derivation of name not stated but probably named for small village very near Golconda, Pope County.

Lusk Shale Member (of Caseyville Formation)

Lusk Formation (in Caseyville Group)

Pennsylvanian: Southeastern Illinois and western Kentucky.

J. M. Weller, 1940, Illinois Geol. Survey Rept. Inv. 71, p. 36–37. Basal formation of group; occurs at base of Pennsylvanian throughout most of southern Illinois. Consists principally of sandy shale and shaly sandstone with more or less massive locally developed sandstones, one or more thin coals and zones of poorly preserved marine fossils. Maximum thickness 200 feet in Tps. 12 and 13 S., R. 6 E., and T. 12 S., R. 5 E.; commonly less than 100 feet. Underlies Battery Rock formation. Name Wayside was formerly applied to strata included in Lusk.

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 29, 30, 44 (table 1), 61–62, pl. 1. Rank reduced to member status in Caseyville formation (redefined). Occurs below Battery Rock sandstone member. Thickness 49 feet at type section of Caseyville; about 141 feet at reference section of Caseyville. Lusk and Drury shale members are composite units, but until subdivided names are useful and are retained. Presentation of new rock-stratigraphic classification of Pennsylvanian strata in Illinois.

Type locality: Along Lusk Creek, Tps. 12 and 13, S., R. 6 E., Pope County, Ill.

†Luta Limestone (in Sumner Group)[1]

Luta Limestone Member (of Winfield Limestone)

Permian: Central and southern Kansas and northern Oklahoma.

Original reference: J. W. Beede, 1909, Jour. Geology, v. 17, p. 710–729.

J. M. Jewett, 1941, Kansas Geol. Survey Bull. 39, p. 83, 85–88. Uppermost member of Winfield limestone. Overlies Cresswell member; underlies Odell shale. Formerly regarded as part of overlying Sumner group.

R. C. Moore and others, 1951, Kansas Geol. Survey Bull. 89, p. 44. Shaly beds which have been called Luta limestone are included in Cresswell member of Winfield limestone.

Type locality: Five miles northeast of Marion, Kans., on Chicago, Rock Island, and Pacific Railroad. Named for Luta Brook, a tributary of Antelope Creek, just north of Marion, Marion County, Kans.

Luthers Mills Coquinite[1] (in New Milford Formation)

Upper Devonian: Northeastern Pennsylvania.

Original reference: Bradford Willard, 1936, Geol. Soc. America Bull., v. 47, no. 4, p. 571, 580, 583, 589, 592.

Bradford Willard, 1939, Pennsylvania Geol. Survey, 4th ser., Bull. G–19, p. 279, 291, 297, 298. At top of New Milford formation. Uppermost New Milford beds are post-Chemung; in the east, they are continental and assigned to Catskill facies; in the west, they carry the marine Luthers Mills coquinite.

Named for crossroads east of Burlington, Bradford County, near which it is exposed along highway.

Lutie Member (of Theodosia Formation)

Lower Ordovician: Southern Missouri and northern Arkansas.

J. S. Cullison, 1944, Missouri Univ. School Mines and Metallurgy Bull., Tech. Ser., v. 15, no. 2, p. 25, 27–31, pl. 2. Lower member of formation. Underlies Blackjack Knob member (new); unconformably overlies Rich Fountain formation (new). Thickness as much as 170 feet. Includes Rockaway conglomerate beds at base, Hercules Tower sandstone near middle, and Pocket Hollow oolite near top. Top of member is slightly above midpoint between Pocket Hollow oolite bed and Gainesville sandstone bed of Blackjack Knob member.

Type section: Between post offices of Theodosia and Lutie in western part of Ozark County, Mo.

Lydia Granodiorite

Age not stated: Western Virginia.

W. A. Nelson, 1949, (abs.) Virginia Acad. Sci. Proc. 1948–1949, p. 139. Hypersthene granodiorite separated from overlying Catoctin greenstone by about 400 feet of metamorphosed sediments.

Report discusses structure and stratigraphy of Blue Ridge in Albemarle and adjacent counties. Main Blue Ridge mountain is overturned anticline, with axial plane dipping 28° to southeast, and a thrust fault bordering it on its western edge.

†Lykens Series[1]

Pennsylvanian: Eastern Pennsylvania.

Original reference: D. White, 1900, U.S. Geol. Survey 20th Ann. Rept., pt. 2, p. 755.

Lykins Formation[1]

Permian(?) and Triassic(?): Eastern Colorado.

Original reference: N. M. Fenneman, 1905, U.S. Geol. Survey Bull. 265.

L. W. LeRoy, 1946, Colorado School Mines Quart., v. 41, no. 2, p. 14 (fig. 3), 15 (table 1), 30–47. In Golden-Morrison area, subdivided into five members (ascending): Harriman shale, Falcon limestone, Bergen shale, Glennon limestone, and Strain shale. Thickness 410 to 463 feet. Underlies Ralston formation; disconformably(?) overlies Lyons formation. Permian-Triassic.

T. S. Lovering and E. N. Goddard, 1950, U.S. Geol. Survey Prof. Paper 223, p. 34. Conformably overlies Lyons sandstone throughout eastern border of Front Range. Consists of poorly consolidated red sandy shales and siltstone with a few thin beds of limestone and gypsum. Thickness varies from about 200 feet in Castle Rock quadrangle to approximately 1,000 feet near Colorado Springs; average about 600 feet. In northern Colorado, unconformably underlies Jurassic Sundance; to the south Sundance wedges out and Lykins underlies Morrison formation. Permian(?) and Triassic(?).

T. L. Broin, 1958, Dissert. Abs., v. 19, no. 1, p. 114. In northern Colorado, near Wyoming boundary, includes the following members (descending): Red Hill shale (new), Park Creek limestone (new), Stonewall Creek shale (new), Poudre limestone (new), Livermore shale (new), Forelle limestone, Glendo shale, Falcon tongue of Minnekahta limestone, Harriman shale, and Blaine gypsum. Thickness about 1,000 feet; upper 750 feet consists of red clastics, and lower 250 feet consists of interbedded limestone, gypsum, and red clastic sediments.

Named for Lykins Gulch, about 9 miles north of Boulder, Boulder County.

Lyman Formation[1]

Silurian(?): Northwestern New Hampshire.

Original reference: C. H. Hitchcock, 1874, Am. Jour. Sci., 3d, v. 7, p. 468–476.

Named for exposures over wide area around village of Lyman, Grafton County.

Lyman Series[1]

Silurian(?): Northwestern New Hampshire.

Original reference: F. H. Lahee, 1916, Jour. Geology, v. 24, p. 366–381.

Probably named for exposures over wide area around village of Lyman, Grafton County.

Lyme Granite Gneiss[1]

Pre-Triassic: Southeastern Connecticut.

Original reference: H. E. Gregory, 1906, Connecticut Geol. Nat. History Survey Bull. 6, p. 115, 148, 152, and map.

John Rodgers and others, 1956, Preliminary geological map of Connecticut (1:253,440): Connecticut Geol. Nat. History Survey. Unit referred to as granitic gneiss. Pre-Triassic.

Crops out in parts of town of Lyme, Old Lyme, and East Lyme, New London County.

Lynch Dolomite[1]

Middle(?) and Upper Cambrian: Central northern Utah.

Original reference: J. Gilluly, 1932, U.S. Geol. Survey Prof. Paper 173.

J. C. Young, 1955, Utah Geol. and Mineralog. Survey Bull. 56, p. 20. Upper part of type Lynch dolomite considered early Ordovician in age.

J. K. Rigby, 1959, Utah Geol. Soc. Guidebook 14, p. 14 (table 1). Table of comparison of stratigraphic terminology applied in this report [southern Oquirrh Mountains and Fivemile Pass-northern Boulter Mountain area] and that applied by Gilluly (1932) shows (ascending) Bluebird dolomite, Cole Canyon dolomite, Opex dolomite, and most of Stansbury formation equivalent to Lynch dolomite. Term Lynch not extended into this area.

Named for exposures on Lynch Ridge, north of Ophir, Tooele County.

Lynchburg Gneiss[1]

Lynchburg Formation

Precambrian: Virginia and northern North Carolina.

Original reference: A. I. Jonas, 1927, Geol. Soc. America Bull., v. 38, p. 844, 845.

A. I. Jonas and G. W. Stose, 1939, Am. Jour. Sci., v. 237, no. 8, p. 575–593. Lynchburg was formerly considered equivalent to argillaceous sediments that are the basement rocks of the injection complex, but because the gneiss in places is underlain by Rockfish conglomerate, which is derived from the injection gneiss, the Lynchburg is now known to be younger than the injection complex and is believed to be equivalent to the younger Precambrian series which includes Catoctin metabasalt at top.

G. W. Stose and A. J. Stose, 1944, Am. Jour. Sci., v. 242, no. 8, p. 409. Lynchburg gneiss and its equivalents in northern Virginia lie on east limb of Catoctin Mountain-Blue Ridge anticlinorium to a point about 20 miles southwest of Lynchburg; southwest of that point in Virginia and North Carolina, the Lynchburg has been thrust northwestward on Gossan Lead thrust fault over early Precambrian injection complex and overlying Lower Cambrian rocks of Holston Mountain block.

R. O. Bloomer, 1948, Am. Jour. Sci., v. 248, no. 11, p. 764–768. Lynchburg as shown on Geologic map of Virginia (1928) indicates two distinct formations: in vicinity of Rockfish River unconformably overlies granitized basement complex; west of Lynchburg and in vicinity of Bedford the formation grades into Lovingston facies of granitized complex. Thus, the Lynchburg in its type locality and northeast of Lynchburg is younger than the "Lynchburg" west of Lynchburg. The two formations resemble each other but older formation appears migmatitic. In this report, name Lynchburg refers to younger formation; older formation not named in this report. Also stratigraphy in Loudoun County appears confused. Keith (1894) evidently chose an exposure [Loudoun] near Aldie as unspecified type section of the Loudoun in preference to some locality along northwest side of Blue Ridge. The formation in the "type" locality seems to underlie the Catoctin and is thus equivalent to the Lynchburg, whereas the "Loudoun" along northwest side of the Blue Ridge overlies the Catoctin. Thus, it appears that the Lynchburg and

Loudoun in the respective localities are equivalent. According to the rule, name Lynchburg should be abandoned and replaced by older name Loudoun.

W. A. Nelson, 1949, (abs.) Virginia Acad. Sci. Proc. 1948–1949, p. 140. In Albemarle and adjacent counties, underlies Johnson Mill graphite schist (new).

W. R. Brown, 1953, Kentucky Geol. Survey, ser. 9, Spec. Pub. 1, p. 91 (fig. 1), 92. On southeast limb of Blue Ridge-Catoctin Mountain anticlinorium, Lynchburg gneiss, which locally has at its base Rockfish conglomerate, unconformably overlies Lovingston gneiss and Reusens migmatite; from the James River northeastward, it is overlain by Catoctin greenstone.

G. H. Espenshade, 1954, U.S. Geol. Survey Bull. 1008, p. 11–14, pl. 1. Discussed in James River-Roanoke River manganese district. Crops out in narrow strip bordering northwestern side of district and in three domal structures in southern part of district; these structures are bordered by rocks of Evington group. Along the western border of the district, rocks of Evington group are thrust over the Lynchburg. Late Precambrian age assigned to the Lynchburg by earlier workers is provisionally accepted here. Plate 1 shows age Precambrian(?).

A. J. Stose and G. W. Stose, 1957, Virginia Div. Mineral Resources Bull. 72, p. 63–72, pl. 1. Lynchburg gneiss described in Gossan Lead district. Includes several facies: staurolite schist, muscovite-garnet schist, biotite quartzite, ferruginous mica schist, and quartzite. No estimate of thickness made. Occurs in overthrust position on older Precambrian and Lower Cambrian; age cannot be determined from relations in this district. Considered same general age as Mount Rogers volcanic series.

W. R. Brown, 1958, Virginia Div. Mineral Resources Bull. 74, p. 8 (fig. 2), 18–22. In Lynchburg quadrangle, Lynchburg gneiss, 10,000 feet thick, overlies Virginia Blue Ridge complex (new) and underlies Catoctin greenstone. "Late Precambrian".

R. V. Dietrich, 1959, Virginia Polytech. Inst. Bull., Engineering Expt. Sta. Ser. 134, p. 69–74, pl. 1. Formation described in Floyd County. Term formation used in preference to gneiss because unit in Floyd County may not be correlative with type locality Lynchburg and because unit contains schists, phyllites, amphibole-rich foliates, and other metamorphic rocks as well as gneiss. Overlies Little River gneiss (new) with transitional contact; in some areas overlies Willis phyllite (new) or includes Willis phyllite. Also includes Alum phylite (new). Top of Lynchburg not recognized in area.

Typically exposed at Lynchburg, Va.

Lynch Creek Bed (in Strawn Formation)[1]

Pennsylvanian: Central Texas.

Original reference: N. F. Drake, 1893, Texas Geol. Survey 4th Ann. Rept., pt. 1, p. 375.

D. A. Zimmerman and G. D. Glover, 1956, Soc. Econ. Paleontologists and Mineralogists Permian Basin Sec. [Guidebook] Spring Mtg., p. 75. Sandy clay and shaly to massive sandstone. Overlies Bend division; underlies Burnt Branch bed. Strawn series.

D. H. Eargle, 1960, U.S. Geol. Survey Prof. Paper 315–D, p. 58, pl. 27. Drake (1893) separated rocks of Strawn group [division] into 20 units of alternating sandstone and shale beds. He gave local names to these units, or "beds" as he termed them, and numbered them from bottom to top, 4 to 23. Only Drake's name for the upper unit, the Ricker, is in common use today, and that name has been restricted to the base of Drake's Ricker bed.

Named for Lynch Creek, west and northwest of Nix, Lampasas County.

Lyndon Gypsum Bed[1]

Silurian (Cayugan) : Central New York.

Original reference: G. H. Chadwick, 1930, Geol. Soc. America Bull., v. 41, p. 81.

Occurs in old quarries at Lyndon, Syracuse region.

Lyndon Limestone[1]

Lyndon Limestone (in Bright Angel Group)

Middle Cambrian: Eastern Nevada, northwestern Arizona, southeastern California, and western Utah.

Original references: L. G. Westgate and A. Knopf, 1927, Am. Inst. Mining Metall. Engineers Trans. 1647, p. 5; 1932, U.S. Geol. Survey Prof. Paper 171.

Charles Deiss, 1938, Geol. Soc. America Bull., v. 49, no. 7, p. 1158 (fig. 6), 1160. Thickness emended type section 345 feet. Underlies Chisholm shale; overlies Comet shale.

H. E. Wheeler, 1943, Geol. Soc. America Bull., v. 54, no. 12, pt. 1, p. 1794, 1816, pl. 1. Geographically extended into western Grand Canyon area, Arizona, where it is about 70 feet. Overlies Pioche shale; underlies Chisholm shale.

H. E. Wheeler, 1948, Nevada Univ. Bull., Geology and Mining Ser., no. 47, p. 31. Geographically extended into Wah Wah Range, Utah, and to Nopah and Resting Springs Ranges in California. In latter region, consists of member 5E of Hazzard's (1938 [1937], California Jour. Mines and Geology, v. 33, no. 4) Cadiz formation, is thinned to 35 feet, and underlies Tecopa shale (new).

H. E. Wheeler and V. S. Mallory, 1953, Am. Assoc. Petroleum Geologists Bull., v. 37, no. 10, p. 2413 (fig. 2), 2414. Generalized discussion of designation of stratigraphic units. Lyndon limestone is included in Bright Angel group and comprises (ascending) Tincanebits member, unnamed member, and Meriwitica member.

Typically exposed [type section] in Lyndon Gulch, Pioche region, Nevada.

Lynn Volcanic Complex[1]

Late Paleozoic: Northeastern Massachusetts.

Original reference: C. H. Clapp, 1910, Igneous rocks of Essex County, Mass.

Occurs north of Boston Basin.

Lynnfield Serpentine[1]

Precambrian or Cambrian: Northeastern Massachusetts.

Original reference: C. H. Clapp, 1910, Igneous rocks of Essex County, Mass.

Named for occurrence at Lynnfield, Essex County.

Lyon Series (Lyonian Epoch)

Permian(?): North America.

C. C. Branson, 1960, Oklahoma Geology Notes, v. 20, no. 9, p. 229–235. Name proposed for American standard section of early Permian(?) rocks. Type Wolfcamp section is incomplete, and its basal contact is not well known. Kansas section of rocks of Sakmarian age is complete and well exposed over wide and accessible area, including parts of Oklahoma and Nebraska. Name Wolfcamp and time term Wolfcampian should not be used in Kansas, Oklahoma, and Nebraska. In Kansas, the series would include rocks from top of Brownville limestone to top of Herington limestone—that is, it would consist of Admire, Council Grove, and Chase groups. Faunally it would include the zone of *Pseudoschwagerina*, of primitive *Schwagerina*, and of advanced *Triticites*; the zone of *Peritrochia* and *Properrinites*. In Oklahoma, series would include, in Pawnee County, the seven mapped units of Chase group, eight of Council Grove group, and the Admire shale; in Lincoln County would include undivided shale and sandstone sequence below Fallis sandstone, Red Eagle limestone, Johnson shale, and Foraker limestone, and Admire formation.

Name derived from Lyon County, Kans., site of type localities of Admire group and Americus limestone. Council Grove is a few miles west of the county, and Chase County is adjacent on the west.

Lyon Mountain Granite Gneiss

Lyon Mountain Granite[1]

Precambrian: Northern New York.

Original reference: W. J. Miller, 1919, Jour. Geology, v. 27, p. 29; 1919, Econ. Geology, v. 14, p. 512.

A. W. Postel, 1951, Geology of the Dannemora quadrangle, New York: U.S. Geol. Survey Geol. Quad. Map [GQ–14]. Described and mapped as Lyon Mountain granite gneiss. Medium-grained foliated rock of complex composition, usually pink. Includes microperthite, microcline, plagioclase, and microantiperthite granite gneisses.

A. W. Postel, 1952, U.S. Geol. Survey Prof. Paper 237, p. 8, 10, 37. Miller described Lyon Mountain granite as including facies which he termed Hawkeye granite. In this report, Hawkeye granite gneiss is considered to be an older, separate unit.

Well exposed in and near village of Lyon Mountain, Clinton County.

Lyons Limestone[1]

Pennsylvanian(?): Central Oklahoma.

Original reference: A. I. Levorsen, 1928, Oklahoma Geol. Survey Bull. 40BB, p. 17, 43.

Lyons Sandstone[1]

Lyons Sandstone (in Cassa Group)

Permian: Central northern Colorado.

Original reference: N. M. Fenneman, 1905, U.S. Geol. Survey Bull. 265.

G. E. Condra, E. C. Reed, and O. J. Scherer, 1940, Nebraska Geol. Survey Bull. 13, p. 3 (fig. 2), 6. Included in Cassa group (new). Underlies Opeche shale; overlies Owl Canyon formation (new).

T. S. Lovering and E. N. Goddard, 1950, U.S. Geol. Survey Prof. Paper 223, p. 34. Lies directly on Fountain formation south of Loveland but rests on younger and younger beds northward. Thickness 50 feet near Colorado-Wyoming boundary; approximately 200 feet at Morrison and Colorado Springs. Conformably underlies Lykins formation.

Well developed at Lyons, a few miles north of Boulder district.

Lyre Formation

Eocene, upper: Northwestern Washington.

C. E. Weaver, 1937, Washington [State] Univ. Pubs. in Geology, v. 4, p. 121, 123. Unconformably overlying unnamed sandy clay shale bed are more than 500 feet of firmly cemented massive medium- to coarse-grained conglomerate, which in southern limb of Clallam syncline are sufficiently resistant to erosion to allow a range of moderately high hills to exist parallel to and immediately north of the high basaltic ridge; conglomerates are persistent along northern border of Olympic Peninsula for more than 100 miles but decrease in thickness toward Cape Flattery. Above the conglomerates are approximately 4,120 feet of interstratified hard gray to grayish-brown coarse-grained massive sandstone with pebbly conglomerate layers, together with subordinate amounts of brownish-gray thinly bedded sandy shale. These sandstones and shales together with the lower thick conglomeratic member appear to constitute a lithologic unit, and for purposes of reference are referred to as Lyre formation. Thickness at type section (Lyre River Canyon), 2,200 feet; here includes 750 feet of conglomerate and massive sandstone and the lower 1,450 feet of the more firmly cemented gray sandstones and sandy shale. Conformably underlies 2,700-foot section of stratified concretionary sandstones and sandy shale. At type section, overlies Boundary shale (new) which forms uppermost part of middle Eocene Crescent formation. Intervening Cowlitz formation not present.

J. W. Durham, 1942, Jour. Paleontology, v. 16, no. 1, p. 86. In vicinity of Port Townsend, underlies Townsend shale (new).

J. W. Durham, 1944, California Univ. Dept. Geol. Sci. Bull., v. 27, no. 5, p. 106–107. In Quimper Peninsula area, Quimper sandstone overlies Lyre conglomerates, Townsend shale, and various parts of Eocene section.

R. D. Brown, Jr., P. D. Snavely, Jr., and H. D. Gower, 1956, Am. Assoc. Petroleum Geologists Bull., v. 40, no. 1, p. 94–107. Sequence of beds referred to by Weaver as basal 750 feet of conglomerate and massive sandstone is a distinctive and mappable lithologic unit. Name Lyre formation here restricted to this unit. At redefined type locality, formation is 1,270 feet thick and consists of two parts: an upper conglomerate 890 feet thick and a lower sandstone unit of which 380 feet are exposed. Throughout most of the mapped area, the Lyre is divisible into upper conglomerate facies and lower sandstone facies; contact between the two facies is gradational and is commonly marked by a zone in which the two types are intercalated. Overlain with erosional unconformity by strata containing Foraminifera of late Eocene age.

R. D. Brown, Jr., H. D. Gowér, and P. D. Snavely, Jr., 1960, U.S. Geol. Survey Oil and Gas Inv. Map OM–203. In this report [Port Angeles-Lake Charles area], term used as restricted by Brown, Snavely, and

Gower. Rests conformably upon and, in places interfingers with, Aldwell formation (new). Thickness 0 to 3,280 feet.

Type section: Lyre River Canyon, Olympic Peninsula, Clallam County. As redefined, extends along Lyre River from point 2,850 feet south, 3,600 feet west NE cor. sec. 10, T. 30 N., R. 9 W., to point 950 feet south, 3,690 feet west, NE cor. sec. 10, T. 30 N., R. 9 W.

Lysite Member (of Wind River Formation)

†Lysite Formation[1]

Eocene, lower: Northern Wyoming.

Original reference: W. J. Sinclair and W. Granger, 1911, Am. Mus. Nat. History Bull., v. 30, p. 104.

H. E. Wood 2d and others, 1941, Geol. Soc. America Bull., v. 52, no. 1, p. 24, 25, pl. 1. Referred to as member (or formation) of Wind River formation (or group). Valid mappable lithologic unit. Underlies Lost Cabin member. Wasatchian.

H. A. Tourtelot, 1948, Wyoming Geol. Soc. Guidebook 3d Ann. Field Conf., p. 113 (fig. 1), 114, 115–118. Although lithologic differences between rocks of Lysite and Lost Cabin units were described by Sinclair and Granger, most later workers considered the names to represent only faunal zones. Recent work has substantiated opinion of Wood and others that the units are lithologically separable as members of Wind River formation. Member consists of hard ledgy yellow to brown sandstone interbedded with brick-red, orange-red, tan, and gray sandy siltstone and claystone. Maximum thickness 660 feet, as exposed at west end of Cedar Ridge, Fremont County; this thickness includes at its base 385 feet of rocks considered to be possibly the same age as Gray Bull beds (Tourtelot, 1946, U.S. Geol. Survey Oil and Gas Inv. Prelim. Chart 22). Overlaps older rocks, possibly of Cretaceous age, in Cedar Ridge, but relation of Lysite to earlier Tertiary rocks not known; contact with Lost Cabin gradational. Nature of distinguishing criteria suggests that names Lysite and Lost Cabin should not be applied to lithologic units in places other than along southern margin of Big Horn Mountains. Report includes historical summary of usage of name.

Type area: On Lysite and Cottonwood Creeks north of Lost Cabin, Fremont County.

Lytle Formation (in Dakota Group)

Lytle Sandstone Member (of Purgatoire Formation)[1]

Lower Cretaceous: Eastern Colorado.

Original reference: G. I. Finlay, 1916, U.S. Geol. Survey Geol. Atlas, Folio 203.

K. M. Waagé, 1955, U.S. Geol. Survey Prof. Paper 274–B, p. 19–24. Beds of sandstone, conglomeratic sandstone, and variegated claystone that make up lower part of pre-Benton Cretaceous sequence are correlated here with Lytle sandstone member of Purgatoire formation in south-central Colorado, and name Lytle, raised to rank of formation, is applied to them throughout northern Front Range foothills. In northern foothills, unit is characterized by abrupt lateral variation in local dominance of its sandstone or claystone fraction. At one extreme, consists almost entirely of sandstone and conglomerate and resembles its more consistently arenaceous southern equivalent, Lytle sandstone member of

Purgatoire. At other extreme, Lytle lacks conglomeratic beds and consists of approximately equal amounts of fine- to medium-grained sandstone and variegated claystone in alternating lenses. Thickness about 70 to 80 feet. No persistent mappable subdivision recognized in northern foothills. Underlies Plainview sandstone member of South Platte formation (both new). Morrison-Lytle contact indefinite in many places because conglomeratic beds are not persistently present at base of Lytle and rocks in upper part of Morrison are similar to those in the Lytle. Data on type locality; thickness at typical exposure 48 to 53 feet; underlies Glencairn member of Purgatoire formation.

Type locality: Lytle School, situated along Lytle Road just south of Turkey Creek in SW¼NW¼ sec. 2, T. 17 S., R. 67 W., Timber Mountain quadrangle. Finlay took name Lytle from small settlement of homes along Turkey Creek in southwestern part of old Colorado Springs 15-minute quadrangle.

Lytle Limestone Member (of Arroyo Formation)

Lytle Limestone[1] Member (of Clear Fork Formation)

Permian (Leonard): Central northern Texas.

Original reference: A. M. Lloyd and W. C. Thompson, 1929, Am. Assoc. Petroleum Geologists Bull., v. 13, p. 948, 949, pl. 9.

M. G. Cheney, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 1, p. 66 (chart). Shown on correlation chart as member of Arroyo formation. Lies below Standpipe limestone member and above Rainey [Rainy] limestone member.

Robert Roth, 1940, Geol. Soc. America and Affiliated Soc. 53d Ann, Mtg., Austin, Dec. 26–28, Excursions, p. 113 (table). Name Lytle is preoccupied.

Gayle Scott and others, 1941, West Texas Geol. Soc. [Guidebook] Spring Field Trip, May 10–11, p. 33. Lytle limestone and dolomites crop out on east bank of Lytle Lake.

Probably named for Lytle Creek, Taylor County.

†Lytton Formation[1]

Eocene: Central Texas.

Original reference: R. T. Hill and T. W. Vaughan, 1902, U.S. Geol. Survey Geol. Atlas, Folio 76, p. 6.

Named for Lytton Springs, Caldwell County.

Mabb Amygdaloid[1]

Precambrian (Keweenawan): Northern Michigan.

Original reference: L. L. Hubbard, 1898, Michigan Geol. Survey, v. 6, pt. 2, p. 132, 135, 136.

Exposed in old Mabb workings and dump, Houghton County, and along north line of sec. 6–55–33.

Mabb Flow[1]

Precambrian (Keweenawan): Northern Michigan.

Original reference: B. S. Butler and W. S. Burbank, 1929, U.S. Geol. Survey Prof. Paper 144 (chart compiled by M. G. Wilmarth).

Copper district of Keweenaw Point.

Mabury Formation

Mabury Member (of Lodo Formation)

Eocene, middle: Central California.

Martin Van Couvering and H. B. Allen, 1943, California Div. Mines Bull. 118, pt. 3, p. 496–500. Coarse tan sandstone about 315 feet thick. Underlies Credal formation (new); overlies undifferentiated Paleocene and Cretaceous rocks.

V. S. Mallory, 1959, Lower Tertiary biostratigraphy of the California Coast Ranges: Tulsa, Okla., Am. Assoc. Petroleum Geologists, p. 10, 281–282. Rank reduced to member status in Lodo formation. Overlies an unnamed member; underlies Credal member.

Occurs in Devils Den oil field district, northwestern Kern County, adjacent to Kings County line, about 40 miles from Paso Robles and about 60 miles northwest of Bakersfield.

McAlester Formation[1] or Shale[1] (in Krebs Group)

Pennsylvanian (Des Moines Series): Eastern Oklahoma and western Arkansas.

Original reference: J. A. Taff, 1899, U.S. Geol. Survey 19th Ann. Rept., pt. 3, p. 437.

C. W. Wilson, Jr., 1935, Am. Assoc. Petroleum Geologists Bull., v. 19, no. 4, p. 507–508. Formation (shale) includes four recognizable members (ascending): McCurtain shale, Warner sandstone, Lequire sandstone, and Cameron sandstone (all new). Upper Hartshorne coal occurs near base. Thickness 125 to 382 feet. Overlies Hartshorne sandstone; underlies Savanna sandstone.

M. C. Oakes and M. M. Knechtel, 1948, Oklahoma Geol. Survey Bull. 67, p. 17, 26–44. Redefined; stratigraphically expanded below to include Lower Hartshorne coal and underlying shale; expanded above to include Tamaha sandstone and Keota sandstone members formerly included in Savanna formation. As thus redefined, includes (ascending) McCurtain shale, Warner sandstone, unnamed shale, Lequire sandstone, unnamed shale, Cameron sandstone, unnamed shale, Keota sandstone, and unnamed shale members. Thickness 700 to 2,000 feet; thinning is northward. Overlies Hartshorne sandstone; underlies Savanna formation. Des Moines series.

M. C. Oakes, 1953, Am. Assoc. Petroleum Geologists Bull., v. 37, no. 6, p. 1523–1526. Assigned Krebs group (new).

Named for exposures around McAlester, Pittsburg County, Okla.

McArthur Member (of Pottsville Formation)[1]

Pennsylvanian: Southeastern Ohio.

Original reference: H. Morningstar, 1922, Ohio Geol. Survey, 4th ser., Bull. 25, p. 116.

Named from typical exposures in vicinity of McArthur, Vinton County.

McBean Formation[1] (in Claiborne Group)

Eocene, middle: Eastern Georgia and central South Carolina.

Original reference: J. O. Veatch and L. W. Stephenson, 1911, Georgia Geol. Survey Bull. 26, p. 60, 237–284.

C. W. Cooke, 1936, U.S. Geol. Survey Bull. 867, p. 55–72. Described in coast plain of South Carolina. Thickness about 100 feet. Includes unit termed Warley Hill phase by Sloan (1905). Overlies Tuscaloosa formation or Black Mingo formation; unconformably underlies Santee limestone or Barnwell sand, both of Jackson age.

C. W. Cooke and F. S. MacNeil, 1952, U.S. Geol. Survey Prof. Paper 243–B, p. 20 (fig. 2), 22, 23–24. In historical summary of Congaree formation, authors state that Cooke and Shearer (1918, U.S. Geol. Survey Prof. Paper 120–C) supposed that all of their Congaree clay member was of Jackson age and transferred it to Barnwell formation under name of Twiggs clay member; later Cooke (1943, U.S. Geol. Survey Bull. 941) restored that facies consisting of thin-bedded or laminated sand and clay to McBean formation. The McBean is here restricted to include only the Cook Mountain equivalent, the *Ostrea sellaeformis* zone, of the Lisbon formation. This is represented at McBean, Ga., and in South Carolina by white sandy marl and massive yellow or red sand, which appears to be at least partly residual from sandy marl. Santee limestone, heretofore supposed to be of early Jackson age, represents the *Ostrea selaeformis* zone and seems to be offshore facies of restricted McBean. Warley Hill phase is raised to formation rank. Included in lower Claiborne.

Named for exposures at McBean and on McBean Creek, Richmond County, Ga.

McBryde Limestone Member (of Clayton Formation)

Paleocene: Southwestern Alabama.

F. S. MacNeil, 1946, U.S. Geol. Survey Strategic Minerals Inv. Prelim. Rept. 3–195, p. 7–8. Proposed for the Nautilus rock of early authors. In type area, hard white fine-grained sandy limestone, 20 to 25 feet thick. Overlies Pine Barren member (new) and underlies calcareous tongue of Porters Creek clay; thin ledges of limestone similar to the McBryde are interspersed through several feet of the Porters Creek. To the east, in Butler County, thickens to about 100 feet, breaks up into shaly more sandy beds with concretionary layers; still farther east, passes into limestone of middle part of undifferentiated Clayton; westward, thins and becomes more argillaceous; loses its distinctive lithologic character in western Wilcox County.

Type exposures are in roadcuts along State Highway 100 in secs. 28 and 33, T. 12 N., R. 10 E., Wilcox County, about 3 miles west of McBryde Station.

McCann Sandstone[1]

Permian: Central northern Oklahoma.

Original reference: C. N. Gould, 1900, Kansas Univ. Quart., v. 9, p. 175–177.

Named for McCann's quarry, on Deer Creek, 20 miles southwest of Blackwell, Kay County.

McCarthy Shale[1] or Formation[1]

Upper Triassic: Central Alaska.

Original reference: O. Rohn, 1900, U.S. Geol. Survey 21st Ann. Rept., pt. 2, p. 426.

J. T. Dutro, Jr., and T. G. Payne, 1957, Geologic map of Alaska (1:2,500,000): U.S. Geol. Survey. Appears on map legend; in Copper River region.

Typically exposed on McCarthy Creek, Nizina-Tanana region.

†McCarthy Creek Shale[1]

Upper Triassic: Alaska.

Original reference: O. Rohn, 1900, U.S. Geol. Survey 21st Ann. Rept., pt. 2, p. 426.

Well exposed on McCarthy Creek, Nizina-Tanana region.

McCartys Basalt Flow[1]

Recent: Northwestern New Mexico.

Original reference: R. L. Nichols, 1934, Geol. Soc. America Proc. 1933, p. 453.

R. L. Nichols, 1939, Am. Geophys. Union Trans., v. 20, pt. 3, p. 432–433. In an area approximately 2 miles long, there are about 100 collapse-depressions near terminus of McCartys flow.

Named in San Jose Valley, Valencia County.

McCaulley Dolomite[1]

McCaulley Dolomite (in Blaine Formation)

Permian: Central northern Texas.

Original reference: M. G. Cheney, 1929, Texas Univ. Bull. 2913, p. 26, pl. 1.

Gayle Scott and others, 1941, West Texas Soc. [Guidebook] Spring Field Trip May 10–11, p. 44–45. Reallocated to Blaine formation.

First described from occurrences near McCaulley, Fisher County.

McClearys Bluff Coal Member (of Mattoon Formation)

Pennsylvanian: Central and southeastern Illinois.

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 40, 51 (table 1), 82, pl. 1. Name applied to 3-inch coal bed that lies an estimated 50 feet above Friendsville coal member. Presentation of new rock-stratigraphic classification of Pennsylvanian of Illinois. Cyclical classification retained but is entirely independent of rock-stratigraphic classification.

Type locality: NW¼SW¼SE¼ sec. 29, T. 2 S., R. 13 W., Wabash County. Named for McClearys Bluff.

McClearys Bluff Formation[1]

Pennsylvanian: Southeastern Illinois and southwestern Indiana.

Original reference: Marshall Harrell, 1935, Indiana Div. Geology Pub. 133, p. 73 (chart).

H. R. Wanless, 1939, Geol. Soc. America Spec. Paper 17, p. 94. A division of post-Alleghenian between Grayville above and Friendsville formation; these formations may not actually belong in sequence stated. Derivation of name given.

Named for exposures in McClearys Bluff on Wabash River, Wabash County, Ill.

McClellan Peak Olivine Basalt

Pleistocene: Western Nevada.

G. A. Thompson, 1956, U.S. Geol. Survey Bull. 1042–C, p. 59–60, pl. 3. Replaces preoccupied American Flat basalt of Gianella (1936). Described as flows and cinder cones of gray to black basalt with prominent yellowish-green olivine phenocrysts. Thickness 50 feet. Lies unconformably on Alta formation, Hartford Hill rhyolite tuff, and pre-Tertiary rocks. Not directly overlain by younger rocks.

Remnants of flows are found on east slope of McClellan Peak, on American Flat, and in American Ravine, Virginia City quadrangle, Nevada.

†McCloud Formation[1]

Mississippian and Permian(?) : Northern California.

Original reference: J. P. Smith, 1894, Jour. Geology, v. 2, p. 592–593.

Well developed in region of McCloud River, in Shasta County, and from which it receives its name.

McCloud Limestone[1]

Permian: Northern California.

Original reference: H. W. Fairbanks, 1894, Am. Geologist, v. 14, p. 29–30.

N. E. A. Hinds, 1940, 6th Pacific Sci. Cong. Proc., v. 1, p. 274; C. W. Merriam and S. A. Berthiaume, 1943, Geol. Soc. America Bull., v. 54, no. 2, p. 163. Referred to as Lower Permian.

A. H. Coogan, 1960, California Univ. Pubs. Geol. Sci., v. 36, no. 5, p. 243–255. Consists of light- to dark-gray, medium- to thin-bedded, fossiliferous limestone. Thickness 1,600 feet in Bollibokka area. Conformably overlies Baird formation. Underlies Bollibokka group (new). Fossiliferous beds are dated as Wolfcampian and Leonardian.

Exposed along McCloud River, Redding region.

†McCloud Shales[1]

Permian: Northern California.

Original reference: H. W. Fairbanks, July 1894, Am. Geologist, v. 14, p. 30.

Occurs on east bank of McCloud River, about 20 miles north of U.S. Fisheries, Redding region.

McClure Sandstone Member (of Norton Formation)[1]

Lower Pennsylvanian: Southwestern Virginia.

Original reference: J. B. Eby, 1923, Virginia Geol. Survey Bull. 24, p. 63, 67.

Named for McClure River, Dickinson County.

McColley Canyon Member (of Nevada Formation)

Devonian: Northeastern Nevada.

Donald Carlisle and others, 1957, Am. Assoc. Petroleum Geologists Bull., v. 41, no. 10, p. 2178 (fig. 2), 2180–2182. Well-bedded limestone, calcareous dolomite, and dolomite with no appreciable amount of quartz sand, excepting local quartzose facies at base. Thickness 420 feet at type section; thickens southward to 625 feet south of Bald Mountain; thins northward to approximately 200 feet. Underlies Union Mountain member (new) : overlies Lone Mountain dolomite.

Type locality: McColley Canyon, Sulphur Springs Range, northern Mineral Hill quadrangle.

McCombs Limestone Member (of Bell Canyon Formation)

Upper Permian (Guadalupe Series) : Western Texas and southern New Mexico.

N. D. Newell and others, 1953, The Permian reef complex of the Guadalupe Mountains region Texas and New Mexico: San Francisco, W. H. Freeman and Co., p. 15, 53. McComb limestone member lies between the Lamar limestone member above, and the Radar limestone member below.

P. B. King and N. D. Newell, 1956, Am. Assoc. Petroleum Geologists Bull., v. 40, no. 2, p. 386–387. Unit had been described as flaggy limestone bed about 10 feet thick, lying about a third of the way up in 400-foot sandy interval between Rader and Lamar limestone members (King, 1948). McCombs limestone member of Newell and others (1953) is same as this flaggy limestone described by King. Derivation of name given, and type locality designated.

Type section: Bed 15, section 34, of King (1948), short distance southeast of McCombs Ranch and present route of U.S. Highway 62, near former route of highway as it existed before 1939, Culberson County, Tex. Strong persistent scarp-maker traceable for 30 miles or more southward from Guadalupe Mountains across Delaware Mountains.

McCormick Group

Lower and Middle Pennsylvanian: Illinois.

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 8 (fig. 1), 26 (fig. 4), 27, 28–31, 44 (table 1), pl. 1, geol. sections. Lowest group in Pennsylvanian of Illinois. Includes Caseyville and Abbott (new) formations. As thus defined, includes strata formerly included in Caseyville group and lower part of Tradewater group. Underlies Kewanee group (new). Group is characterized by prominence of thick commonly massive relatively pure quartz sandstones that constitute 50 to 60 percent of strata; sandy shale and siltstone normally make up 40 percent or more of section. Coals are characteristically thin and limited in continuity; limestones uncommon to rare, although fossiliferous sandy beds or sandy limestones are present locally. Presentation of new rock-stratigraphic classification of Pennsylvanian of Illinois. Cyclical classification retained but is independent of rock-stratigraphic classification.

Type locality: Vicinity of McCormick, northwestern part of Pope County.

McCoy Formation[1]

Pennsylvanian or Permian: Northwestern Colorado.

Original reference: R. Roth, 1930, Am. Assoc. Petroleum Geologists Bull., v. 14, no. 10, p. 1265–1267.

C. A. Arnold, 1941, Michigan Univ. Mus. Paleontology Contr., v. 6, no. 4, p. 60–61, 68. Plant remains of McCoy formation are decidedly Permian in appearance and affinities. The plants are not proof of Permian or even late Pennsylvanian age but may be an early appearance due to conditions of environment. Contains *Walchia*-bearing bed.

H. F. Donner, 1949, Geol. Soc. America Bull., v. 60, no. 8, p. 1220 (fig. 2), 1223–1228, pl. 1. Described in McCoy area where it is redefined to include over 3,500 feet of coarse arkosic sandstones and grits with interbedded shales and limestones. *Walchia* bed recognized as member of formation. As redefined, includes strata termed Weber(?), Maroon, and Rock Creek, which terms are abandoned in this area. Conformably underlies State Bridge siltstone; disconformably overlies Leadville limestone; north of the area, disappears within a few miles; 6 miles east of Yarmony Mountain, overlaps underlying formation and rests on Precambrian rocks. Early Pennsylvanian, probably Des Moines.

K. G. Brill, Jr., 1952, Geol. Soc. America Bull., v. 63, no. 8, p. 823. On West side of McCoy area, separated from overlying State Bridge by Schoolhouse tongue of Weber sandstone.

Named for exposures at McCoy, Eagle County.

McCoy Mountains Formation

Upper Paleozoic or Triassic: Southern California.

W. J. Miller, 1944, California Jour. Mines and Geology, v. 40, no. 1, p. 12, 32, 49–52. Comprises metavolcanics, mainly original tuffs, together with some interbedded metasediments. Southwesterly dips of 30° to 50° prevail in southwestern part of McCoy Mountains and suggest a thickness many thousands of feet for formation. Cut by Coxcomb granodiorite (new).

Typical occurrence in southern part of McCoy Mountains, Palm Springs-Blythe area, Riverside County. Also covers about 15 square miles in southern part of Coxcomb Mountains.

McCoytown Sandstone[1]

Silurian: Central Pennsylvania.

Original reference: J. P. Lesley, 1878, Pennsylvania 2d Geol. Survey Rept. F., p. xxvii.

Near McCoytown, in Tuscarora Valley.

McCracken Sandstone Member (of Elbert Formation)

Upper Devonian: Subsurface in southeastern Utah, northeastern Arizona, southwestern Colorado, and northwestern New Mexico.

R. L. Knight and J. C. Cooper, 1955, Four Corners Geol. Soc. Guidebook [1st] Field Conf., p. 56, 57 (fig. 1); J. C. Cooper, 1955, Four Corners Geol. Soc. Guidebook [1st] Field Conf., p. 62 (table 1), 63. Consists predominantly of white, light-gray to red sandstone, fine- to medium-grained, some coarse, generally poorly sorted, commonly glauconitic, with a few streaks of sandy dolomite. Thickness of 112 feet in type well, between depths of 8,059 and 8,161 feet. Underlies unnamed upper member of Elbert formation with transitional contact; overlies Aneth formation (new) probably unconformably. Interfingers out into Elbert formation undifferentiated to the west.

Type locality: In Shell Bluff Unit No. 1 well on McCracken Mesa near town of Blanding, San Juan County, Utah. Location of Shell Bluff Unit No. 1 given as sec. 32, T. 39 S., R. 23 E. on page 56, and as sec. 32, T. 29 S., R. 22 E. on page 63.

Maccrady Shale[1]

Maccrady Series

Mississippian: Southwestern Virginia and western West Virginia.

Original reference: G. W. Stose, 1913, U.S. Geol. Survey Bull. 530, p. 233, 234.

P. H. Price and E. T. Heck, 1939, West Virginia Geol. Survey [Rept.] Greenbrier County, p. 280–282, measured sections. Maccrady series, comprising beds between Greenbrier series and Pocono series, is distinct and well-defined stratigraphic division in area of this report. Consists of deep-red shale and weakly bedded sandstone. Thickest in southeast part of outcrop and thinnest in north and northwest. Estimated thickness 250 feet in Caldwell section; about 60 feet near Pocahontas County line.

Charles Butts, 1940, Virginia Geol. Survey Bull. 52, pt. 1, p. 350–354. Maccrady shale was named by Stose (1913) from village of Maccrady, 2 miles northeast of Saltville. This shale was also named Pulaski by Campbell (1894). Name Pulaski was preoccupied and was abandoned. Main body of rocks included in Maccrady of Stose is of Warsaw age and cannot be included with the red shale (Maccrady restricted) at its base which is of Osage age and closely related to Price formation. Hence, Maccrady is restricted to red beds at base of Maccrady as defined by Stose. In section published by Stose, the lower bed, 90 feet thick, seems to be based on an exposure at Broadford and includes all red rock of the Maccrady (restricted) and perhaps some of upper Price. The Maccrady directly overlies the Price. In Greendale syncline, including type locality, and in Big Stone area, the overlying formation is of Warsaw age. Near Duffield, Scott County, the Maccrady is 40 feet thick and underlies St. Louis limestone.

Paul Averitt, 1941, Virginia Geol. Survey Bull. 56, p. 18, 19 (fig. 2), 21. Shale in Scott and Washington Counties, Va., overlies Price sandstone and underlies Little Valley limestone (new). Thickness 50 to 100 feet.

R. H. Wilpolt and D. W. Marden, 1949, U.S. Geol. Survey Oil and Gas Inv. Prelim. Chart 38. In area of this report [southwestern Virginia, southern West Virginia, and eastern Kentucky], Greenbrier limestone rests unconformably on Maccrady shale which consists of red, green, and gray shales, siltstones, fine-grained to very fine-grained sandstones, and some andhydrite locally in subsurface. Buff to gray, sometimes greenish-buff, locally dolomitic, thin- to medium-bedded sequence of impure limestones is present in many places between top of Maccrady shale and base of Hillsdale member of Greenbrier. This sequence ranges in thickness from a few feet to 60 feet in this area but is thicker in Greendale syncline. It has been referred to as strata of Warsaw age, and strata in Little Valley, Scott County, Va., have been called Little Valley limestone. These strata are not named in this report.

Named for exposures at Maccrady, Smyth County, Va.

McCraney Limestone (in North Hill Group)

McCraney Limestone Member (of Hannibal Shale)

Mississippian (Kinderhook Series): Southeastern Iowa and central western Illinois.

R. C. Moore, 1928, Missouri Bur. Geology and Mines, v. 21, 2d ser., p. 20, 21, 22, 49, 58–59. [Original reference as McKerney limestone.]

M. A. Stainbrook, 1950, Am. Jour. Sci., v. 248, no. 3, p. 208–209. Lithologic and faunal similarity and apparently identical stratigraphic position of McCraney and Louisiana strata lead to conclusion that they are parts of same body of limestone. Therefore, McCraney is not member of Hannibal formation, and because Louisiana has precedence term McCraney should be dropped.

L. E. Workman and Tracey [Tracy] Gillette, 1956, Illinois Geol. Survey Rept. Inv. 189, p. 8 (fig. 1), 28–30. Rank raised to formation in North Hill group. Basal formation of group. Conformably underlain by English River siltstone and seemingly gradational with it; conformably overlain by Prospect Hill siltstone with contact marked in outcrops by sharp change in lithology. Where Prospect Hill is not present (as at type locality) McCraney is unconformably overlain by Burlington limestone of Osage age. Thickness 58 feet in Hancock and Adams Counties, Ill., thins eastward and westward; eastern edge lies along line of maximum thickness of English River, where basal Osage unconformity bevels the two formations.

Named from exposures in ravine in Mississippi River bluffs south of McCraney (misspelled McKerney in original reference) Creek, north of Kinderhook, Pike County, Ill.

McCune Limestone[1]

Middle Ordovician: Central eastern Missouri.

Original reference: C. R. Keyes, 1898, Iowa Acad. Sci. Proc., v. 5, p. 59, 61.

W. H. Twenhofel and others, 1954, Geol. Soc. America Bull., v. 65, no. 3, chart 2 (column 51). Shown on correlation chart below Maquoketa shale and above Kimmswick limestone.

Named for exposures near McCune Station, Pike County.

McCurtain Shale Member (of McAlester Formation)[1]

Pennsylvanian (Des Moines Series) : Eastern Oklahoma.

Original reference: C. W. Wilson, Jr., 1935, Am. Assoc. Petroleum Geologists Bull., v. 19, no. 4, p. 503–520.

M. C. Oakes and M. M. Knechtel, 1948, Oklahoma Geol. Survey Bull. 67, p. 31–32. Described in Haskell County where it consists predominantly of shale but locally contains thick succession of sandstone beds many of which are massive. Thickness about 500 feet at south side of county; thins northward to about 200 feet. Lowest member of formation; underlies Warner sandstone member; overlies Hartshorne coal of Hartshorne formation.

Named for fact McCurtain, Haskell County, is built on this shale.

McCutcheon Volcanic Series

Tertiary: Southwestern Texas.

G. K. Eifler, Jr., 1951, Geol. Soc. America Bull., v. 62, no. 4, p. 342–345, pl. 1. Succession of five lavas alternating with five tuffs, some of which contain sandstones, breccias, and fresh-water limestones. Aggregate thickness 1,500 to 1,700 feet. Divided into (ascending) Huelster formation, Star Mountain rhyolite, and Seven Springs formation. Base is lowest sandstone and conglomerate which overlie marine Upper Cretaceous; the top, the highest lava, is exposed along syncline crossed by Fort Davis-Toyahvale highway north of Star Mountain.

Name derived from Willis McCutcheon Ranch 7 miles south of Toyahvale, northwestern part of Barrilla Mountains, Reeves County.

McDermott Member (of Animas Formation)

McDermott Formation[1]

Upper Cretaceous: Southwestern Colorado and northwestern New Mexico.

Original reference: J. B. Reeside, Jr., 1924, U.S. Geol. Survey Prof. Paper 134, p. 22–25.

Harley Barnes, E. H. Baltz, Jr., and P. T. Hayes, 1954, U.S. Geol. Survey Oil and Gas Inv. Map OM–149. Reeside's (1924) typical section of McDermott in SW¼NW¼ sec. 19, T. 32 N., R. 11 W., subdivided as follows: lowest 95 feet of pebble-bearing sandstone and sandy shale is assigned to Kirtland formation: overlying 127 feet of purplish beds is here termed McDermott member of Animas formation; top 106 feet is included in upper part of Animas.

C. H. Dane and G. O. Bachman, 1957, U.S. Geol. Survey Misc. Geol. Inv. Map I–224. Formation mapped in San Juan basin and Zuni Mountains. Overlies Kirtland shale which, as mapped, includes an unseparated equivalent of McDermott formation in San Juan County; underlies Ojo Alamo sandstone.

Named for McDermott Arroyo, southwestern La Plata County, Colo.

MacDonald Formation[1]

Precambrian: Southern British Columbia, Canada, and northwestern Montana.

Original reference: R. A. Daly, 1912, Canada Geol. Survey Dept. Mines Mem. 38, maps 2, 3.

C. L. Fenton and M. A. Fenton, 1937, Geol. Soc. America Bull., v. 48, no. 12, p. 1881. Correlated with Appekunny formation.

Named for fact it underlies extensive surface in MacDonald Range, British Columbia.

McDonald Shale or Shale Member (of Monterey Formation)

Miocene, upper: Southern California.

J. A. Cushman and P. P. Goudkoff, 1938, Cushman Lab. Foram. Research Contr., v. 14, pt. 1, p. 1. Referred to as McDonald shale, developed along west side of San Joaquin Valley.

R. R. Simonson and M. L. Krueger, 1942, Am. Assoc. Petroleum Geologists Bull., v. 26, no. 10, p. 1616–1617. Termed member of Monterey. Differentiated from underlying Devilwater-Gould member by its characteristic siltiness and massiveness; brownish gray and purplish gray. Thickness 2,250 feet. Conformably underlies Antelope shale member. Crops out in belt east of Devilwater-Gould member.

H. H. Heikkila and G. M. MacLeod, 1951, California Div. Mines Spec. Rept. 6, p. 4 (table 1), 5 (table 2), 13–14, pl. 1. Member described in Bitterwater Creek area, Kern County, where it is 1,200 to 3,000 feet thick and consists mostly of light-colored siliceous shales interbedded with variable amounts of sandstone and buff and rusty-brown colored limestone; diatomaceous in part. To the south of Bitterwater Creek, over 1,900 feet of the McDonald conformably overlies Gould-Devilwater member; in middle of McDonald section are 380 feet of friable fine-grained quartzose sandstone with streaks of silty shale, and this sandstone, although entirely within the McDonald, is considered to be the Twisselmann sandstone member (new); portion of the McDonald overlying the Twisselmann consists of about 600 feet of hard, gray to light-brown, siliceous and porcelaneous shale of uniform character. In Shale Hills area, disconformably overlies Eocene Point of Rocks sandstone.

L. B. McMichael, chm., 1959, San Joaquin Geol. Soc. Guidebook Field Trip, May 9, Road log, topog. profile, columnar section. McDonald shale member, in Chico Martinez Creek area, underlies Antelope shale member and overlies Devilwater silt member. Thickness about 2,300 feet. McDonald shale, Antelope shale, and Chico Martinez chert (new) members are equivalent to McLure shale member of Monterey.

First described in Crocker Flat landslide area, vicinity of Recruit Pass, east side of Temblor Range, San Luis Obispo County.

Macedonia cyclothem (in Abbott-Spoon Formation)

Macedonia cyclothem (in Tradewater Group)

Pennsylvanian: Southern Illinois.

H. R. Wanless, 1955, Am. Assoc. Petroleum Geologists Bull., v. 39, no. 9, p. 1764 (table 2). Cyclothem in Tradewater group. In sequence, occurs above Delwood cyclothem and below unnamed cyclothem (Bald Hill coal).

H. R. Wanless and Raymond Siever, 1956, Illinois Geol. Survey Circ. 217, pl. 1. In sequence, occurs below Stonefort cyclothem and above Delwood cyclothem. Gives type locality of formation and cyclothem.

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 52 (table 2), 55 (table 3). In Abbott-Spoon Formations (both new). Presentation of new rock-stratigraphic classification of Pennsylvanian strata in Illinois; cyclical classification is independent of rock-stratigraphic classification.

Type locality: NW sec. 27, T. 10 S., R. 6 E., Saline County. Name derived from school 6 miles south of Harrisburg.

Macedonia Formation (in Tradewater Group)

Pennsylvanian: Southern Illinois.

J. M. Weller, 1940, Illinois Geol. Survey Rept. Inv. 71, p. 39, 40. Consists of thick basal sandstone, here named Murray Bluff sandstone, and overlying series of shaly strata including several coals and one persistent marine limestone, the Curlew. Attains thickness of 100 feet or more. Underlies Stonefort formation; overlies Delwood formation (new).

H. R. Wanless and Raymond Siever, 1956, Illinois Geol. Survey Circ. 217, pl. 1. Gives type locality of formation and cyclothem.

Type locality: NW¼ sec. 27, T. 10 S., R. 6 E., Saline County. Name derived from school 6 miles south of Harrisburg.

†McElmo Formation[1]

Upper Jurassic: Southwestern Colorado, northwestern New Mexico, and southwestern Utah.

Original reference: W. Cross, 1899, U.S. Geol. Survey Geol. Atlas, Folio 57.

W. L. Stokes, 1944, Geol. Soc. America Bull., v. 55, no. 8, p. 967–968. Coffin (1921, Colorado Geol. Survey Bull. 16) proposed term post-McElmo for beds between the McElmo and Dakota of southwestern Colorado. He stressed the fact that the beds could not be included with either the underlying or overlying beds without exceeding limits of type sections. Since Coffin's work, term McElmo has been abandoned, and because term Morrison has been applied liberally it now includes the post-McElmo as well as the McElmo.

Named for exposures on McElmo Creek, Montezuma County, Colo.

McElroy Formation (in Jackson Group)

McElroy Member (of Fayette Sandstone)[1]

Eocene, upper: South-central Texas.

Original reference: O. L. Brace, 1931, Am. Assoc. Petroleum Geologists Bull., v. 15, no. 7, p. 779–781.

D. H. Eargle, 1959, Am. Assoc. Petroleum Geologists Bull., v. 43, no. 11, p. 2624 (fig. 1), 2626 (table 1), 2628–2631. Ellisor (1933, Am. Assoc.

Petroleum Geologists Bull., v. 17, no. 11) divided the McElroy formation into Manning beds at top, Wellborn sands, and Wooleys Bluff clays. Ellisor considered the McElroy to extend upward to base of Dilworth sand member of Whitsett formation as she grouped these units. Renick (1936, Texas Univ. Bull. 3619) rejected name McElroy and considered the Manning a formation, including in it the Dilworth and Yuma sandstone members. Because name McElroy is in common use in south-central Texas area, it is believed that name McElroy should be retained but the formation expanded to include Dilworth sandstone and overlying Falls City shales of Ellisor (here renamed Conquista clay). McElroy, as redefined here, is practically equivalent to Manning formation of Renick (1936) and consists chiefly of bentonitic clays and tuffs with some interbedded sandstones. Includes (ascending) Manning clay, Dilworth sandstone, and Conquista clay members. Overlies Wellborn sandstone; underlies Whitsett formation. Jackson group. Exposures described. New type locality designated because locality given by Ellisor (1933) could not be located.

Type locality: Cuts along Farm Road 705, in southern Augustine County, about 8 or 10 miles west and southwest of McElroy; road connects Brookeland with State Highway 147 to San Augustine and traverses eastern edge of Angelina National Forest.

McGee Glaciation

McGee glacial stage[1]

McGee Till

Pleistocene: East-central California.

Original references: E. Blackwelder, 1930, Geol. Soc. America Bull., v. 41, p. 91–92; 1931, Geol. Soc. America Bull., v. 42, p. 865–922.

W. C. Putnam, 1949, Geol. Soc. America Bull., v. 60, no. 8, p. 1289. Aeolian Buttes till (new) may be equivalent in age to McGee glacial stage but the Aeolian Buttes can be dated with respect to local volcanic and glacial events; McGee at its type locality 25 miles southeast cannot; therefore, new name is proposed.

W. C. Putnam, 1960, California Univ. Pubs., Geol. Sci., v. 34, no. 5, p. 233. Name Aeolian Buttes till considered invalid as representing an earlier Pleistocene, pre-Sherwin stage. Hence, glacial sequence on eastern slope of Sierra Nevada is McGee, Sherwin, Tahoe, and Tioga.

Name amended to glaciation in compliance with 1961 Code of Stratigraphic Nomenclature.

Exposed on high ridge west of McGee Peak, Mount Morrison quadrangle, Mono County.

McGhee Peak Formation (in Bisbee Group)

Lower Cretaceous: Southwestern New Mexico.

Elliot Gillerman, 1958, New Mexico Bur. Mines Mineral Resources Bull. 57, p. 45–47, pl. 1. Lithic characteristics vary greatly vertically, and individual beds traced laterally for only short distances. Conglomerate and sandstone especially abundant; a few beds of shale and brown-weathering black limestone and some gray limestone in upper part of formation. In most areas, basal beds composed of ill-sorted conglomerate consisting of rounded cobbles and pebbles of quartzite, limestone, and chert in quartz-sand matrix. Conglomerate similar to basal beds occurs throughout formation, but percentage of limestone fragments increases in higher beds. Abundance of limestone-pebble conglomerate characterizes formation. Basal part of formation formed by 75 feet of medium-grained white sandstone instead of usual conglomerate, sandstone overlain by 31 feet of conglomerate, above which is mostly sand. Sandstone of formation ranges from white to gray and red. Red sandstone, siltstone, and shale prominent locally. Thickness on McGhee Peak 370 feet; 546 and about 600 feet measured at other sections in range. Conformably underlies Carbonate Hill limestone (new) ; unconformably overlies several Permian limestones—on McGhee Peak it overlies Earp formation.

Named from exposures on McGhee Peak, which is midway between Granite Gap and Steins on crest of main ridge of Peloncillo Mountains, Hidalgo County. Crops out on top of peak and is exposed in northwest-trending belt on east side of main ridge of Peloncillo Mountains in vicinity of McGhee Peak, and elsewhere in mountains to south.

McGlone Limestone

Middle Ordovician (Bolarian) : Western Virginia and eastern and southern West Virginia.

Marshall Kay, 1956, Geol. Soc. America Bull., v. 67, no. 1, 64, 66, 78, 82–83. Name proposed for well-bedded calcilutite with variable quantities of calcilutite pebble conglomerate and laminated quartzose calcisiltite. Contains calcarenite with algal fossils at top southwest of Gap Mills. Metabentonite present in one section. Thickness 62 feet at type locality; thins to southeast. Underlies McGraw limestone (new) with sharp contact; overlies Benbolt limestone. Consists of beds previously referred to as Snyder in Virginia; use of that name has been criticized although unit is believed equivalent to Snyder limestone of Pennsylvania.

Type section: Near McGraw Gap, Alleghany County, Va. Named from McGlone in Turkey Cove, west of Gap Mills, Monroe County, W. Va.; beds are exposed along north flank of anticline to the east.

MacGowan Concretionary Bed (in Kevin Shale Member of Marias River Shale)

Upper Cretaceous: Northwestern Montana.

W. A. Cobban and others, 1959, Am. Assoc. Petroleum Geologists Bull., v. 43, no. 12, p. 2792 (fig. 3), 2795–2796; 1959, Billings Geol. Soc. [Guidebook] 10th Ann. Field Conf., p. 92. Thin resistant conglomerate bed. Consists of concretionary dolostone and limestone, weathering light-brown, orange-brown, or very dusky-red, which serve as matrix for abundant small pellets of light-olive-gray phosphatic siltstone of local concretionary origin, and of varying amounts of polished rounded granules and small pebbles of gray and black chert. This coarse material produces distinctive, easily recognized polka-dot pattern. Thickness 18 inches. In type section of Kevin member, the bed is about 314 feet below top of member, which is almost exactly at middle of member.

Named for exposures on the MacGowan lease in SE¼SW¼NE¼ sec. 4, T. 35 N., R. 3 W., Kevin-Sunburst oil field, Toole County.

McGrath Gneiss

Precambrian (early Algoman) : Central Minnesota.

M. S. Woyski, 1949, Geol. Soc. America Bull., v. 60, no. 6, p. 1002, 1014, pl. 1. Pink and black banded medium-grained foliated augen gneiss. Penetrates the Thomson formation lit-par-lit.

Largest exposures are 2 miles southwest of McGrath, Aitkin County.

McGraw Limestone

Middle Ordovician (Bolarian): Western Virginia and eastern and southern West Virginia.

Marshall Kay, 1956, Geol. Soc. America Bull., v. 67, no. 1, p. 63, 66, 78, 83–84. Name proposed for well-bedded heavy-ledged brittle, rather pure calcitite. Generally occurs at 6-inch to 1-foot ledges of dense calcitite broken into rectangular joint blocks; each ledge is irregularly laminated, has thin calcarenite lenses, and commonly has ramifying cylindrical fucoidal structures which are less resistant and leave holes upon weathering. Thickness 9 feet in type section; maximum over 40 feet with thinning to extinction southeastward. Underlies Nealmont limestone; contact is an erosional disconformity and rarely exposed. Overlies McGlone limestone (new) with sharp contact. Previously called Stover limestone, but extension of that name from Pennsylvania has been criticized.

Type section: In southeast end of Warm Spring Cove, northern Alleghany County, Va. Named from McGraw Gap southeast of the cove.

McGregor Limestone Member (of Platteville Formation)

McGregor Member (of Platteville Formation)[1]

Middle Ordovician: Northwestern Iowa, northwestern Illinois, southeastern Minnesota, and southwestern Wisconsin.

Original reference: A. C. Trowbridge, 1935, Kansas Geol. Soc. Guidebook 9th Ann. Field Conf., p. 64, 70, 71, fig. 1.

A. F. Agnew and A. V. Heyl, Jr., 1946, Am. Assoc. Petroleum Geologists Bull., v. 30, no. 9, p. 1585–1587. Underlies Quimbys Mill member (new).

M. P. Weiss, 1955, Jour. Paleontology, v. 29, no. 5, p. 759–763). Where typically developed, Carimona member (new) overlies McGregor member. Carimona occupies same stratigraphic interval as Quimbys Mill member, but the two are lithologically distinct and not known to overlap.

M. P. Weiss, 1957, Geol. Soc. America Bull., v. 68, no. 8, p. 1030, 1031–1032. In southeasternmost Minnesota, the Platteville is composed of (ascending) Pecatonica, McGregor, and Carimona members. The McGregor is present throughout Fillmore County and lies directly on the Glenwood formation where the Pecatonica member is absent. Member is 20 feet thick in southeast, where it overlies the Pecatonica, and thins to about 16 feet in central part of county; about 25 feet thick in southwestern Wisconsin; 14 feet or less in vicinity of Rochester, and northwest of there changes in character until name McGregor is no longer applicable.

M. P. Weiss and W. C. Bell, 1956, Geol. Soc. America Guidebook for Field Trips Minneapolis Mtg., Field Trip 2, p. 58 (table 1), 58–60. Constitutes major part of Platteville in southeastern Minnesota and northeastern Iowa. Rocks of McGregor member have at some times and places been classified as Magnolia and Mifflin members (Bays and Raasch, 1935; Bays, 1938). Although uppermost foot or two of McGregor in Fillmore County, Minn., appears smoother and thicker bedded than lower beds, the distinction is vague. In region south from Rochester, Minn., to McGregor, Iowa, there is virtually no evidence of the Magnolia and Mifflin members. However, in the Twin Cities, where interval is somewhat dolomitic, Majewske (1953, unpub. thesis) has shown that what in the past has been lumped together as McGregor is the Mifflin and Magnolia separated by hitherto unnamed member, Hidden Falls. McGregor is used where special characters of Mifflin, Hidden Falls, or Magnolia are absent or insufficiently distinct to permit use of names.

A. F. Agnew and others, 1956, U.S. Geol. Survey Prof. Paper 274–K, p. 274–275. At reference section of Platteville, McGregor limestone member consists of lower unit (Mifflin of Bays, 1938), 15.1 feet thick and upper unit (Magnolia of Bays and Raasch, 1935), 15.8 feet thick; overlies Pecatonica dolomite member and underlies Quimbys Mill member.

Type section: Ravine south of highway, 1½ miles west of McGregor, Clayton County, Iowa.

McHale Slate (in Deer Trail Group)

Precambrian (Belt Series): Northeastern Washington.

Ian Campbell and J. S. Loofbourow, Jr., 1941, (abs.) Geol. Soc. America Bull., v. 57, no. 12, pt. 2, p. 1250. Named as third of five formations in group. Younger than Edna dolomite (new); older than Stensgar dolomite.

Machegit Conglomerate Member (of Tagpochau Limestone)

Miocene: Mariana Islands (Saipan).

P. E. Cloud, Jr., R. G. Schmidt, and H. W. Burke, 1955, U.S. Army Corps of Engineers, *in* Military geology of Saipan, Mariana Islands: U.S. Army Corps of Engineers, Far East Command., v. 1, p. 9, pl. 2. Incidental mention.

P. E. Cloud, Jr., R. G. Schmidt, and H. W. Burke, 1956, U.S. Geol. Survey Prof. Paper 280–A, p. 63, 71–72, chart 1, pl. 1. Well-rounded and deeply weathered cobbles and boulders of andesite in matrix of finer material of essentially same composition, the whole rather loosely consolidated. Average thickness 20 to 40 feet; type section 40 feet. Occurs above Donni member of transitional facies or is laterally equivalent to them. At type section appears to underlie inequigranular facies and overlie transitional facies.

Type section: Immediately east of southern part of Machegit cliff and just north of Adelug cliff, about 350 yards northwest of Donni Springs. Total areal extent about 65 acres.

McHenry Formation[1]

Pleistocene and Recent: Northeastern Maryland.

Original reference: P. R. Uhler, 1901, Maryland Acad. Sci. Trans., new ser., v. 1, p. 395–400.

Extends over parts of recent beaches of Patapsco River and Chesapeake Bay, and near Baltimore composes upper part of Fort McHenry Plateau.

Machias Formation (in Canadaway Group)

Machias Member (of Canadaway Formation)

Machias Shale[1]

Upper Devonian: Western New York.

Original reference: G. H. Chadwick, 1923, Geol. Soc. America Bull., v. 34, p. 69.

J. G. Woodruff, 1942, New York State Mus. Bull. 326, p. 17 (fig. 4), 18–23. Machias formation in Wellsville quadrangle is limited by Rushford sandstones below, and Cuba formation above. Thickness about 400 feet.

I. H. Tesmer, 1955, New York State Mus. Sci. Service Circ. 42, p. 10 (fig. 1), 17. "Machias" is used here to designate the member between the Rushford and Cuba members, of Canadaway formation, but the Rushford has not been traced far laterally and is not recognized in vicinity of the Machias which has never been assigned definite limits at its type locality.

Well exposed in Pierce quarry, west of Machias, Cattaraugus County.

Macho Member (of Tererro Formation)

Lower Mississippian: Northern New Mexico.

E. H. Baltz and C. B. Read, 1960, Am. Assoc. Petroleum Geologists Bull., v. 44, no. 11, p. 1754–1756, 1760–1762, 1770, 1771, 1772, 1773. Composed of limestone breccia derived in large part from solution and collapse of cavernous parts of upper part of Espiritu Santo formation (new) and in minor part from collapsed parts of overlying Manuelitas member (new). Thickness 3 to 30 feet. In part, possibly as old as Devonian(?) and, in part, Early Mississippian.

Typically exposed on steeply sloping hill west of church at El Macho, north side of Macho Creek, west of confluence with Pecos River, 5.3 miles south of Tererro, San Miguel County.

Macho Pyroxene Andesites

Tertiary, lower(?): Southwestern New Mexico.

H. L. Jicha, Jr., 1954, New Mexico Bur. Mines Mineral Resources Bull. 37, p. 39–40, pl. 1. Form fairly thick series of flows, flow breccias, and tuffs. Pyroxene andesite flows mostly dark-purple to purplish-gray porphyritic rocks. Breccias are purple to brownish red and contain fragments of pyrogene andesite flow rock in a groundmass similar to the flow rock except for color. Tuffs appear to form earliest part of series; they range from bright purple through chocolate brown to bright red and pale bluish gray. These rocks are mostly porphyritic. Tuffs often interbedded with white or green-gray magnetite-bearing sandstones and lenses of red conglomerate. Unconformably underlie late Tertiary volcanics. Thickness about 1,000 feet.

Named from Macho mining district at W½ sec. 20, T. 19 S., R. 7 W., Lake Valley quadrangle, Luna and Sierra Counties, where rocks form fairly thick series. Tuff exposed only in Old Hadley district.

McIntire Upper Conglomerate[1]

Pennsylvanian: Northeastern Pennsylvania.

Original reference: I. C. White, 1881, Pennsylvania 2d Geol. Survey Rept. G_5, p. 45, 46, 48.

Well exposed along railroad, about one-half mile south of depot, and at many places around Scranton.

McIntosh Formation

Eocene, middle to upper: Southwestern Washington.

P. D. Snavely, Jr., and others, 1951, Am. Assoc. Petroleum Geologists Bull., v. 35, no. 5, p. 1052–1061. Name proposed for sequence of dark-gray marine siltstone and claystone and interbedded arkosic and basaltic sandstone. Thickness 4,000 to 4,500 feet. Base of sequence not exposed; underlies volcanic rocks. Correlated with Mill Creek and Sacchi Beach beds of local usage and perhaps Burpee formation of Oregon.

P. D. Snavely, Jr., and others, 1951, U.S. Geol. Survey Coal Inv. Map C–8, sheet. 1. Underlies Northcraft formation (new).

P. D. Snavely, Jr., and others, 1958, U.S. Geol. Survey Bull. 1053, p. 12–22, pl. 1. Dark shale and arkosic sandstone described by Culver (1919) as part of

Newaukum series are mapped as McIntosh formation of this report [Centralia-Chehalis district]. Underlies Northcraft formation.

Type area: Central and southeastern parts of T. 16 N., R. 1 W., extending into northern parts of secs. 2 and 3, T. 15 N., R. 1 W. Named from McIntosh Lake near which formation is well exposed; Centralia-Chehalis district.

McKee Sandstone (in Simpson Group)

Middle Ordovician: Western Texas (subsurface).

Taylor Cole, C. D. Cordry, and H. A. Hemphill, 1942, Am. Assoc. Petroleum Geologists Bull., v. 26, no. 2, p. 279–281. Proposed for upper sandstone in Simpson group. Lies between depths of 5,228 to 5,281, in type well. Top occurs about 305 below first red shale break in the Simpson and about 840 feet above top of Ellenburger, though this interval varies somewhat in wide area. Occurs above Waddell sandstone (new).

Type well: Magnolia Petroleum Co.'s J. S. McKee No. 1–A, in sec. 24, Block 9, H and GN Survey, Pecos County.

Mackentire Redbeds Tongue (of Phosphoria Formation)

Mackentire Tongue (of Woodside Formation)

Permian: Northern Utah.

J. S. Williams, 1939, Am. Assoc. Petroleum Geologists Bull., v. 23, no. 1, p. 91–93. Concomitantly with the thinning of Rex member of Phosphoria, gray and red sandstones, siltstones, and shales appear between the calcareous sandstones and main body of Woodside shale. They are here named Mackentire red beds tongue of Phosphoria. Thickness as much as 100 feet.

H. D. Thomas, 1939, Am. Assoc. Petroleum Geologists Bull. v. 39., no. 8, p. 1249–1250. Discussion of Williams' paper. Proper designation should be Mackentire redbeds tongue of Woodside formation.

V. E. McKelvey and others, 1956, Am. Assoc. Petroleum Geologists Bull., v. 40, no. 12, p. 2855–2856. Complex problem of nomenclature of these beds discussed. Report follows Thomas (1939) and Thomas and Krueger (1946, Am. Assoc. Petroleum Geologists Bull., v. 30, no. 8, pt. 1) in designating rocks above the Franson in northeastern Utah as Woodside and in considering the Mackentire as tongue of Woodside. Thin beds of purple, greenish-gray, yellowish-orange, and gray shale and siltstone are present in Mackentire at type locality; east of Lake Fork, unit is dominantly greenish-gray and pale yellowish-orange siltstone, some redbeds commonly present. Thins north, east, and west of type locality.

Named for exposures at mouth of Mackentire Draw, a small tributary of West Fork of Lake Fork in sec. 27, T. 2 N., R. 5 W., Uinta Base and Meridian, Duchesne County.

McKenzie Lavas, Flows

Recent: Southwestern Oregon.

E. T. Hodge, 1925, Oregon Univ. Pub., v. 2, no. 10, p. 46–51, 62. Discussion of Mount Multnomah ancient ancestor of the Three Sisters. Term McKenzie lava flows is applied to flood of lava which covered ancient McKenzie River valley.

McKenzie River valley is in eastern Lane County and western Deschutes County. Flows lie north of Scott Mountain, extend around west base of Black Crater and reach as far north as Mount Washington.

McKenzie Limestone or **Formation**

McKenzie Formation or Limestone (in Cayuga Group)[1]

McKenzie Member (of Mifflin Formation)

Middle Silurian: Western Maryland, central Pennsylvania, northern Virginia, and northeastern West Virginia.

Original reference: E. O. Ulrich, 1911, Geol. Soc. America Bull., v. 22, p. 522, 545, 591, pl. 28.

H. P. Woodward, 1941, West Virginia Geol. Survey, v. 14, p. 8, 116–145, measured sections. Formation described in West Virginia where it is as much as 290 feet thick. Overlies Rochester shale of Clinton group. Includes Rabble Run sandstone member. Underlies Williamsport sandstone. Middle Silurian, Niagaran series. This is "Niagara limestone" of earlier reports.

Ernst Cloos, 1951, Maryland Dept. Geology, Mines and Water Resources Washington County [Rept. 14], p. 74–77. Formation described in Maryland where it is included in Cayuga group. Includes Rabble Run sandstone member. Underlies Bloomsburg formation (also referred to as member of Wills Creek shale). Overlies Rochester formation, contact gradational. Thickness 100 to 240 feet.

H. H. Arndt and others, 1959, Geol. Soc. America Guidebook Pittsburgh Mtg., p. 5, 20, 23. Rank reduced to member status in Mifflin formation (new). Uppermost member of formation; overlies Rochester member; underlies Bloomsburg formation. Thickness at Mifflintown section 240 feet; at this locality the upper McKenzie has been incorporated with the Bloomsburg. In Mount Union area referred to as McKenzie formation. Thickness here 360 feet; has intraformational conglomerate at base. Underlies Bloomsburg formation; overlies Rochester formation. Silurian.

U. S. Geological Survey does not include the McKenzie in Cayuga Group.

Type locality: Nine miles southwest of Cumberland, Allegany County, Md. Named for McKenzie Station on Baltimore and Ohio Railroad.

McKenzie Hill Limestone[1] **or Formation** (in Arbuckle Group)

Lower Ordovician: Central southern Oklahoma.

Original reference: C. E. Decker, 1933, Tulsa Geol. Soc. Digest, p. 55, 56.

C. E. Decker, 1939, Oklahoma Geol. Survey Circ. 22, p. 16 (table 1), 23–24; 1939, Geol. Soc. America Bull., v. 50, no. 7, p. 1318–1319, table 1. Formation divided into two members: Chapman Ranch below and McMichel (new) above. Thickness 674 to 1,122 feet in Arbuckles; 223 to 1,019 feet in Wichitas. Overlies Butterly formation (new); underlies Strange formation (new); or where the Strange is absent, underlies Cool Creek formation. Type section and derivation of name given.

Type section: Near top of McKenzie Hill on its western slope. Named for McKenzie Hill, a limestone hill about 7 miles northwest of Lawton and 1 mile south of Signal Mountain in secs. 8 and 9, T. 2 N., R. 12 W., Comanche County.

McKerney Limestone Member (of Hannibal Shale)[1]

See McCraney Limestone, correct spelling.

Mackinac Breccia

Mackinac Limestone[1]

Silurian and Middle Devonian: Northern Michigan.

Original reference: C. C. Douglass, 1839?, Michigan Leg. House Doc. 27, p. 97–111.

K. K. Landes and G. M. Ehlers, 1945, Michigan Dept. Conserv., Geol. Survey Div. Pub. 44, Geol. Ser. 37, p. 23, 33–34, 123–153. Douglass Houghton, first State Geologist of Michigan, named rocks of Mackinac Island and Straits the "Mackinac Limestone." In his handwritten journal (ms., Rare Book Room, Michigan Univ. Library) Houghton states: "For a distance of about half a mile west from Goose Island the bottom of the lake was seen to be composed of water-worn masses of white (Mackinac) limestone" (p. 167, Aug. 1, 1839). A few pages further, referring to shore line a short distance west of St. Ignace: "A naked point of Mackinaw limestone was noticed which attained an estimated altitude of about 180 feet" (p. 178, Aug. 14, 1839). The opposite page (179) contains map of "North Side of Lake Michigan" on which "Mackinaw L. Rock" is written across St. Ignace Peninsula. Apparently first published reference to Mackinac formation is in Fourth Annual Report of the State Geologist published in 1841 (Houghton, 1841, Michigan Senate Documents, v. 1, p. 486). A brief description of the Mackinac limestone is given on page 548 of same report in section by C. C. Douglass, Assistant Geologist. Houghton in his first use of the word in his journal spelled it "Mackinac," but elsewhere spelling "Mackinaw" is used. Douglass consistently wrote "Mackinac," the accepted spelling today. Present study has shown that this "formation" includes not only breccia but also sedimentary beds which range in age from Silurian to Mid-Devonian; and that pluglike extensions of the breccias penetrate rocks of varying ages. New formation names (Pointe aux Chenes, St. Ignace, Garden Island, and Bois Blanc) are given to the sedimentary units, and term Mackinac breccia is applied exclusively to breccias of the Straits region. Brecciated rocks range in age from within Pointe aux Chenes (Cayugan) through Detroit River group (Devonian).

Named for occurrence on Mackinac Island.

McKinney Basalt[1]

Recent: Southern Idaho.

Original references: H. T. Stearns, 1932, Correlation chart of Idaho, compiled by M. G. Wilmarth, dated Sept. 1, 1932; 1936, Jour. Geology, v. 44, no. 4, p. 434–439.

H. T. Stearns, Lynn Crandall, and W. G. Steward, 1938, U.S. Geol. Survey Water-Supply Paper 774, p. 30, 76–78, pl. 5. Thickness about 500 feet. Rests on Hagerman lake beds and Malad basalt. Pleistocene, but age difficult to determine.

U.S. Geological Survey currently designates age of McKinney Basalt as Recent on the basis of a study now in progress.

Type locality: McKinney Butte, from which the basalt issued, northwest of Gooding in Gooding County.

McKinney Knob Member (of Brodhead Formation)

Lower Mississippian: Central Kentucky.

P. B. Stockdale, 1939, Geol. Soc. America Spec. Paper 22, p. 76, 157, 162, 163, pl. 15. A cliff-forming siltstone about 30 feet thick at top of middle part of Brodhead formation, Liberty facies (new). Underlies Clementsville limestone member (new); probably correlative to Caney Creek member (new) to the west; overlies New Providence formation, Junction City facies (new).

Type section: At small knob with prominent cliff, on a spur three-fourths mile southeast of McKinney in west-central Lincoln County.

McKissick Shale Formation[1]

Pennsylvanian: Southwestern Iowa and southeastern Nebraska.

Original reference: W. A. VerWiebe and W. R. Vickery, 1932, Kansas Geol. Soc. Guidebook 6th Ann. Field Conf., p. 110.

Probably named for McKissick's Grove, 2 miles northeast of Hamburg, Fremont County, Iowa.

McKissick Grove shale (in Wabaunsee Group)[1]

Pennsylvanian: Southwestern Iowa and southeastern Nebraska.

Original reference: G. L. Smith, 1909, Iowa Geol. Survey, v. 19, p. 617, 631, 638, 645.

M. R. Mudge and H. R. Burton, 1959, U.S. Geol. Survey Bull. 1068, p. 30–31. Originally, strata comprising Root shale was included in McKissick Grove shale member of Wabaunsee formation by Condra (1927, Nebraska Geol. Survey Bull. 1, 2d ser.). Moore (1936, Kansas Geol. Survey Bull. 22) discarded name McKissick Grove and divided strata into 11 formations of which three, Friedrich shale, Jim Creek limestone, and French Creek shale are now classified as members of Root shale.

Named for McKissick's Grove, 2 miles northeast of Hamburg, Fremont County, Iowa.

†McKittrick Formation[1]

Pliocene and Pleistocene, lower(?): Southern California.

Original reference: R. Arnold, 1909, U.S. Geol. Survey Bull. 396, p. 22.

J. R. Schultz, 1938, Carnegie Inst. Washington Pub. 487, p. 115–215, pls. Discussion of a late Quaternary mammal fauna from tar seeps of McKittrick, Calif. Terms McKittrick brea, McKittrick asphalt, and McKittrick formation are used in various places in text.

W. E. Ver Planck, Jr., 1950, California Div. Mines Bull. 156, p. 224; 1952, California Div. Mines Bull. 163, p. 58. Report on gypsum makes incidental mention of McKittrick formation.

R. W. Pack (1920, U.S. Geol. Survey Prof. Paper 116) raised term McKittrick formation to group rank to include Etchegoin formation, probably including a representative of Jacalitos formation, and Paso Robles ("Tulare") formation. Terms McKittrick formation and group were abandoned by U.S. Geological Survey in 1940 when Woodring, Stewart, and Richards redefined the Etchegoin.

Named for exposures one-half mile south of McKittrick, Kern County.

Macksburg Sandstone[1]

Pennsylvanian: Southeastern Ohio.

Original reference: E. Lovejoy, 1888, Ohio Geol. Survey, v. 6, p. 628, 635.

Probably named for Macksburg, Washington County.

Mackworth Slate (in Casco Bay Group)[1]

Pennsylvanian(?): Southwestern Maine.

Original reference: F. J. Katz, 1917, Washington Acad. Sci. Jour., v. 7, p. 198.

Named for development on Mackworth Island, Casco Bay.

McLeansboro Group

McLeansboro Formation[1]

Upper Pennsylvanian: Illinois and western Kentucky.

Original reference: F. W. DeWolf, 1910, Illinois Geol. Survey Bull. 16, p. 181.

J. A. Culbertson, 1932, The paleontology and stratigraphy of the Pennsylvanian strata between Caseyville, Kentucky, and Vincennes, Indiana: Urbana, Ill., Univ. Illinois, Abs. Thesis, p. 6–9. Formation includes, in addition to coal units, the following members (ascending): Anvil Rock sandstone, Somerville limestone, Inglefield sandstone, St. Wendells limestone (new), Claypole Hills sandstone (new), Mumford Hills sandstone (new), Grayville limestone, Lawrenceville shale (new), New Haven limestone, Little Chain limestone (new), Little Wabash sandstone (new), and Henshaw or Dixon sandstone.

J. M. Weller, 1940, Illinois Geol. Survey Rept. Inv. 71, p. 36. Caseyville, Tradewater, Carbondale, and McLeansboro, considered formations in previous publications, are now given group status.

H. R. Wanless, 1957, Illinois Geol. Survey Bull. 82, p. 50 (fig. 22), 114–122. Group classified on cyclothemic basis. Includes (ascending) Sparland, Gimlet, Exline, and Trivoli cyclothems. Named members include Copperas Creek sandstone, Farmington shale, Gimlet sandstone, Lonsdale limestone, Exline limestone, Trivoli sandstone, and Trivoli limestone.

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 8 (fig. 1), 36–41, 48–51 (table 1), 71–84, pl. 1. Group includes (ascending): Modesto, Bond, and Mattoon formations (all new). Formation name originally applied to all Pennsylvanian strata above No. 6 coal as described from coreholes of two diamond drill holes near McLeansboro. As herein redefined group includes all strata above top of Danville (No. 7) coal. Maximum thickness about 1,200 feet in Jasper County, but more than 1,600 feet of McLeansboro reported from test hole in western Kentucky. Overlies Kewanee group (new). Presentation of new rock-stratigraphic classification of Pennsylvanian in Illinois. Cyclical classification is retained but is independent of rock-stratigraphic classification.

Type locality: SE¼SW¼SW¼NE¼ sec. 25, T. 4 S., R. 5 E., McLeansboro quadrangle, Hamilton County, Ill. Named for town of McLeansboro.

McLish Formation[1] (in Simpson Group)

Middle Ordovician: Central southern Oklahoma.

Original reference: E. O. Ulrich, 1930, U.S. Nat. Mus. Proc., v. 76, art. 21, p. 73.

R. W. Harris, 1957, Oklahoma Geol. Survey Bull. 75, p. 68–77, charts 1, 2, fig. 1. Consists of two divisions: basal sandstone and an overlying section of thin sandstone, interbedded green shale, and variable limestones. Thickness about 200 feet at type locality; about 500 feet on West Spring Creek. Disconformable relationship with both underlying Oil Creek and overlying Tulip Creek. Ostracodal evidence indicates an age of Black River (possibly Lowville).

Type locality: On McLish Ranch, about 4 miles northwest of town of Bromide, Johnson County.

McLure Shale Member (of Monterey Shale)[1]

McLure Formation or Shale

Miocene, upper: Southern California.

Original reference: G. Henny, 1930, Am. Assoc. Petroleum Geologists Bull., v. 14, no. 4, p. 403–404.

S. S. Siegfus, 1939, Am. Assoc. Petroleum Geologists Bull., v. 23, no. 1, p. 31–32. Reef Ridge shale is restricted at its type locality to exclude brown shales and silts in lower part of formation as originally defined because that part of the section had been previosly included in McLure shale by Henny (1930). Barbat and Johnson (1934, Jour. Paleontology, v. 8, no. 1) included within Reef Ridge formation the upper or No. 1 zone of Henny's type McLure. McLure consists of three units: lower silty sandy member, middle cherty member, and an upper silty member. Overlies Temblor formation; underlies type Reef Ridge shale(restricted).

W. P. Woodring, Ralph Stewart, and R. W. Richards, 1940, U.S. Geol. Survey Prof. Paper 195, p. 122–125, pls. Rank reduced to member of Monterey shale. Thickness 552 feet on north slope of Reef Ridge. Overlies Temblor sandstone; underlies Reef Ridge shale.

Martin Van Couvering and H. B. Allen, 1943, California Div. Mines Bull. 118, pt. 3, p. 496, 497 (fig. 211), 499 (fig. 213). Columnar section of Devils Den district shows McLure shale, 1,660 feet thick, above Alferitz formation (new) and below Jacalitos formation.

Umberto Young, 1943, California Div. Mines Bull. 118, pt. 3, p. 524 (fig. 224), 525. Underlies Belridge diatomite in Midway-Sunset area.

J. E. Kilkenny, 1948, Am. Assoc. Petroleum Geologists Bull., v. 32, no. 12, p. 2260. Described as formation in Salinas Valley. Consists of siliceous and diatomaceous shales, mudstone, and silts with locally interbeded sands. Maximum thickness 700 feet. Overlies Santa Margarita sand on the Northeast fault block, to which it is confined in its outcrop; in Cholame Hills unconformable with overlying Poncho Rico formation.

L. B. McMichael, chm., 1959, San Joaquin Geol. Soc. Guidebook, May 9, p. 13. Chart of formations in Chico-Martinez Creek area shows Monterey formation comprises (ascending) Gould shale, Devilwater silt, McLure shale (equivalent to McDonald shale, Antelope shale, and Chico-Martinez chert), and Chico-Martinez (Belridge) diatomite.

O. T. Marsh, 1960, California Div. Mines Spec. Rept. 62, p. 7 (fig. 3), 32–33, pls. 1, 2. McLure shale crops out in continuous belt along western border of Orchard Peak area. Thickness at least 1,700 feet. Includes Polonio sandstone tongue (new). Conformably overlies Temblor sandstone. Not overlaid by younger rocks in mapped area. Upper Miocene.

Type locality: In Canyon crossing Tent Hills south of Avenal Creek near west line of sec. 6, T. 24 S., R. 17 E., Fresno and Kings Counties. Borders McLure Valley.

McMenamy Limestone

Pennsylvanian (Desmoinesian): North-central Texas (subsurface).

H. H. Bradfield, 1959, *in* Petroleum Geology of southern Oklahoma, v. 2: Tulsa, Okla., Am. Assoc. Petroleum Geologists, p. 68 (fig. 3), 71 (fig. 4), 72. Light gray to light brown, varying to dark gray or brownish gray, finely crystalline to chalky or earthy. Average thickness 25 to 30 feet in northwestern Grayson County; thins eastward and disappears east of line drawn southward and slightly eastward from Big Mineral field; southward from Whitesboro area, increases to maximum of 70 feet near its southwestern termination; in its maximum development has biostromal characteristics. Occurs 250 to 400 feet above top of "Red Strawn." Produces at depth of 2,120 feet in Nortex No. 1 McMenamy in R. V. Banks Survey southwest of Macomb field.

First noted in well drilled on McMenamy land in 1937 by Denver Producing and Refining in J. Hartzog Survey, A–528, Grayson County.

McMichel Member (of McKenzie Hill Formation)

Lower Ordovician: Southwestern Oklahoma.

C. E. Decker, 1939, Geol. Soc. America Bull., v. 50, no. 7, p. 1319, table 1; 1939, Oklahoma Geol. Survey Circ. 22, p. 24, 44. Name proposed for upper member of formation. Overlies Chapman Ranch member (new). Consists of limestones both heavy bedded and thin bedded.

Named for McMichel Ranch, southwest of McKenzie Hill, in sec. 14, T. 2 N., R. 13 W., Comanche County.

McMicken Formation (in Eden Group)

McMicken Member (of Eden Formation)

McMicken Member (of Latonia Shale)[1]

Upper Ordovician: Southwestern Ohio, southeastern Indiana, and north-central Kentucky.

Original reference: R. S. Bassler, 1906, U.S. Natl. Mus. Proc., v. 30, p. 10.

J. B. Patton, T. G. Perry, and W. J. Wayne, 1953, Indiana Geol. Survey Field Conf. Guidebook 6, pl. 1. Shown on correlation chart as uppermost formation in Eden group. Overlies Southgate formation; underlies Mount Hope formation of Maysville group. Consists of shale and limestone 60 to 80 feet thick.

W. C. Sweet and others, 1959, Jour. Paleontology, v. 33, no. 6, p. 1030, 1031. Uppermost member of Eden formation. Overlies Southgate member.

Named for McMicken Avenue, Cincinnati, Ohio.

McMillan Formation (in Maysville Group)[1]

McMillan Formation (in Covington Group)

McMillan Group

Upper Ordovician: Southwestern Ohio, southeastern Indiana, and north-central Kentucky.

Original reference: R. S. Bassler, 1906, U.S. Natl. Mus. Proc., v. 30, p. 10.

A. C. McFarlan, 1943, Geology of Kentucky: Lexington, Ky., Kentucky Univ., p. 26. McMillan group includes Bellevue, Corryville, and Mount Auburn formations as exposed in region around Cincinnati; in southern Blue Grass region the Tate, Gilbert, and Mount Auburn occupy the same interval.

W. C. Sweet and others, 1959, Jour. Paleontology, v. 33, no. 6, p. 1029–1030. Uppermost formation in Covington group. Overlies Fairview formation; underlies Arnheim formation. Fairview and McMillan formations constitute standard for a medial Cincinnatian Maysville stage.

Named for McMillan Street in Cincinnati, Ohio.

McMonnigal Formation

Devonian: Central Nevada.

Marshall Kay, 1960, Internat. Geol. Cong., 21st, Copenhagen, pt. 12, p. 97 (fig. 3). Named on cross section in report on Paleozoic continental margin in central Nevada. Overlies Masket formation (new).

Toquima Range, Nye County.

McNabb Limestone (in Senora Formation)

Pennsylvanian (Desmoinesian): Northeastern Oklahoma.

C. C. Branson, 1954, Oklahoma Geol. Survey Guidebook 2, p. 3, 5. Name appears in list of units included in Senora formation. Occurs in Croweburg coal cycle below underclay below Croweburg coal and above unnamed shale above Sequoyah coal.

Type locality and derivation of name not given.

McNairy Sand or Formation

McNairy Sand Member (of Ripley Formation)[1]

Upper Cretaceous: Western Tennessee, southeastern Illinois, western Kentucky, northern Mississippi, and southeastern Missouri.

Original reference: L. W. Stephenson, 1914, U.S. Geol. Survey Prof. Paper 81, p. 18, 22.

H. S. McQueen and others, 1939, *in* Kansas Geol. Soc. Guidebook 13th Ann. Field Conf., p. 70 (fig. 25), 71, 73 (fig. 26). McNairy formation, in Ardeola Hill section consists of (ascending) fine, white sand—10 feet; Zadoc member (new) about 29 feet; white sand—11 feet; brown micaceous clay with sand lenses—11 feet. Underlies Owl Creek formation.

J. M. Weller, 1940, Illinois Geol. Survey Rept. Inv. 71, p. 43; J. E. Lamar, 1948, Illinois Geol. Survey Rept. Inv. 128, p. 12. Referred to as formation. Probably attains thickness of about 300 feet in southern Illinois although maximum exposed thickness at any one place is 70 feet. Consists mainly of gray sand which is commonly oxidized in exposures to various shades of brown but may include pink or white bands. Underlies Clayton formation (sand).

W. E. Belt and others, 1945, Geologic map of Mississippi (1:500,000): Mississippi Geol. Survey. Mapped as sand member of Ripley formation.

L. W. Stephenson, 1955, U.S. Geol. Survey Prof. Paper 274–E, p. 98, 100, 101. Referred to as McNairy sand in Stoddard and Scott Counties, Mo., and Pulaski County, Ill. Thickness 173 feet in Stoddard County where it unconformably underlies Owl Creek formation. In Pulaski County unconformably underlies Clayton formation.

J. G. Grohskopf, 1955, Missouri Geol. Survey and Water Resources, 2d ser., v. 37, p. 19–20. Referred to as formation. In outcrop area, essentially a series of nonmarine micaceous sand, quartzite, sandy clay, and clay. Underlies Owl Creek formation.

Type locality: Cut on Southern Railway 1½ miles west of Cypress Station, McNairy County, Tenn.

†McNairy shell bed[1]

Upper Cretaceous: Western Tennessee.

Original reference: J. M. Safford and J. B. Killebrew, 1900, Elements of geology of Tennessee, p. 104, 156.

Named for McNairy County.

McNamara Argillite } (in Missoula Group)
McNamara Formation[1] }

Precambrian (Belt Series) : Central western Montana.

Original reference: C. H. Clapp and C. F. Deiss, 1931, Geol. Soc. America Bull., v. 42, p. 680, figs. 2, 3.

W. H. Nelson and J. P. Dobell, 1959, U.S. Geol, Survey Misc. Geol. Inv. Map I–296. In Bonner quadrangle, Montana, McNamara argillite overlies Bonner quartzite (new) and underlies Garnet Range quartzite.

Type section: Along Blackfoot River, in vicinity of McNamaras Landing [Missoula County].

McNulty Rhyolite[1]

Eocene: Western central Colorado.

Original reference: S. F. Emmons, 1898, U.S. Geol. Survey Geol. Atlas, Spec. Folio 48.

Occurs in McNulty Gulch, Tenmile district.

McNulty Gulch Rhyolite[1]

Eocene: Western central Colorado.

Original reference: W. Cross, 1886, U.S. Geol. Survey Mon. 12, p. 350.

Named for occurrence in one large and several small bodies at head of McNulty Gulch, which runs north and enters Tenmile River at Carbonateville, Summit County.

Macomb Granite[1]

Precambrian: Northern New York.

Original reference: H. P. Cushing, 1916, New York State Mus. Bull. 191, p. 13, 17, 18, 19, 25, 26.

R. V. Dietrich, 1954, Am. Jour. Sci., v. 252, no. 9, p. 513. Incidental mention in discussion of Fish Creek phacolith.

Occurs at Macomb, St. Lawrence County.

Macombs Dam gneiss[1]

Age(?) : New York.

Original reference: R. P. Stevens, 1867, New York Lyc. Nat. History Annals, v. 8, p. 116–120.

Along southern shore of Spuyten-Duyvel Creek and Harlem River, Manhattan Island.

Macon City Shale[1]

Pennsylvanian: Northern Missouri.

Original reference: C. H. Gordon, 1893, Missouri Geol. Survey Sheet Rept. 2, v. 9, p. 60.

Named for Macon, Macon County.

Macoupin cyclothem[1] (in McLeansboro Group)

Macoupin cyclothem (in Modesto Formation)

Pennsylvanian: Southwestern Illinois.

Original reference: H. R. Wanless, 1931, Geol. Soc. America Bull., v. 42, p. 801–912.

W. A. Newton and J. M. Weller, 1937, Illinois Geol. Survey Rept. Inv. 45, p. 9, 10, 12–13. In sequence, lies above Flannigan cyclothem (new) and below La Salle cyclothem (new).

J. R. Ball, 1952, Illinois Geol. Survey Bull. 77, p. 21 (table), 38–41. In Carlinville quadrangle, underlies Shoal Creek cyclothem and overlies Burroughs beds, a succession of beds that do not seem to belong to either Macoupin cyclothem or underlying Carlinville cyclothem.

H. R. Wanless and Raymond Siever, 1956, Illinois Geol. Survey Circ. 217, p. 11. Type locality stated.

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 52 (table 2), pl. 1. In Modesto formation (new). Below Shoal Creek cyclothem and above Carlinville cyclothem. Presentation of new rock-stratigraphic classification of Pennsylvanian strata in Illinois; cyclical classification is independent of rock-stratigraphic classification.

Type locality: N½ center sec. 2, T. 9 N., R. 7 W., near Carlinville, Macoupin County.

Macoupin Limestone Member (of Modesto Formation)

Macoupin Limestone (in McLeansboro Formation[1] or Group)

Pennsylvanian: Southwestern and central western Illinois.

Original reference: H. R. Wanless, 1931, Geol. Soc. America Bull., v. 42, p. 804.

J. R. Ball, 1952, Illinois Geol. Survey Bull. 77, p. 21, 40. A limestone in Macoupin cyclothem, McLeansboro group.

H. R. Wanless and Raymond Siever, 1956, Illinois Geol. Survey Circ. 217, p. 11. Type locality stated.

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 37, 50 (table 1), pl. 1. Rank reduced to member status in Modesto formation (new). Occurs above Womac coal member (new) and below New Haven coal member. Presentation of new rock-stratigraphic classification of Pennsylvanian strata in Illinois. Cyclical classification is retained but is entirely independent of rock-stratigraphic classification.

Type locality: Center NE¼NW¼ sec. 2, T. 9 N., R. 7 W., Macoupin County.

McPherson Formation[1]

Pleistocene: Central Kansas.

Original reference: E. Haworth and J. W. Beede, 1897, Kansas Univ. Geol. Survey, v. 2, p. 287–296.

S. W. Lohman and J. C. Frye, 1939, (abs.) Econ. Geology, v. 34, no. 8, p. 942–943; 1940, v. 35, no. 7, p. 849–851. Term McPherson Equus beds was used by previous investigators to include all unconsolidated deposits in Harvey and McPherson Counties, and all these beds were held to be of Pleistocene age. Present investigation shows that although part of these deposits is Pleistocene in age, a large part appears to be Pliocene in age. Proposed herein to remove Pliocene beds from McPherson Equus beds of Haworth and Beede and to assign to them name Emma Creek formation. McPherson formation (restricted) is retained to include only fluvial deposits of Pleistocene age.

C. C. Williams and S. W. Lohman, 1949, Kansas Geol. Survey Bull. 79, p. 59–70, pls. 1, 7. Formation, as redefined in this report, includes all unconsolidated stream and slope deposits of Pleistocene age which occur in McPherson Valley and Arkansas River valley; includes Emma Creek formation at the type locality and much of the loess of Lohman and Frye (1940). In general, formation consists of early Pleistocene stream deposits, later and coarser Pleistocene stream channel deposits, and still later Pleistocene silt, clay, and fine sand. Locally, conglomeratic bed 1 to 6 feet thick occurs at base formation; material in this conglomerate is similar to materials comprising so-called Abilene conglomerate. Volcanic ash present locally. Overlies Delmore formation (new).

J. C. Frye and A. B. Leonard, 1952, Kansas Geol. Survey Bull. 99, p. 94, 110. McPherson Equus beds included in list of units which are classed at least in part as Sanborn formation. Meade formation in [McPherson] Valley was formerly included within broadly inclusive McPherson formation.

Named for exposures in McPherson County, Kans.

McPherson Marble[1]

Middle Ordovician: Central eastern Missouri.

Original reference: B. F. Shumard, 1873, Missouri Geol. Survey Rept. 1855–1871, p. 307.

Named for McPherson's marble quarry, Jefferson County.

McRae Formation

Upper Cretaceous and Tertiary(?): Southwestern New Mexico.

V. C. Kelley and Caswell Silver, 1952, New Mexico Univ. Pubs. in Geology 4, p. 114 (fig. 14), 115–120. Comprises 100 to 200 feet of pebbly to bouldery conglomerate at base interbedded with shale or siltstone. Some beds are breccia. Above basal unit are many hundreds of feet of alternating shale and sandstone units. Conglomerate beds unusual and generally thin. Shale outcrops generally weather maroon, reddish brown, or purplish, and sandstone beds weather light gray or buff. Fresh exposures of sandstone are grayish green or pinkish. Thickness possibly more than 3,000 feet. Contact with underlying Mesaverde formation in different places appears to be transitional, disconformable, or sharp.

H. P. Bushnell, 1955, Compass, v. 33, no. 1, p. 11–17. Subdivided into lower, Jose Creek member, and upper, Hall Lake member.

Type locality: Crops out around base of Elephant Butte and along most of eastern shoreline of Elephant Butte Reservoir for several miles north of the dam. Named from old Fort McRae, located in eastern tributary to Rio Grande about 3 miles north of Elephant Butte.

McShane Formation

Upper Cretaceous: West-central Alabama and east-central Mississippi.

L. C. Conant and W. H. Monroe, 1945, U.S. Geol. Survey Oil and Gas Inv. Prelim, Map 37. Consists of more or less glauconitic crossbedded sand, gravelly sand, and laminated clay—marine deposits in contrast to preponderantly nonmarine beds of the underlying Tuscaloosa group. Thickness about 25 feet. Present in relatively small outliers in mapped region. Beds were formerly included in the Eutaw formation.

W. H. Monroe, L. C. Conant, and D. H. Eargle, 1946, Am. Assoc. Petroleum Geologists Bull., v. 30, no. 2, p. 204–207. Unconformably overlies continental Gordo; unconformably underlies marine Eutaw formation. Basal bed does not necessarily contain principal conglomerate of formation; at many places basal 6 to 20 feet of formation, consisting of laminated and rippled very fine-grained glauconitic sand lies abruptly on sand and gravel of Gordo formation and is in turn overlain by as much as 40 feet of gravelly sand. At designated type locality, beds are more or less lenticular an intergradational. Thickness in type area about 200 feet; 240 feet in Warrior River valley but thinner to northwest; 57 feet in Itawamba County, Miss.

W. S. Parks, 1960, Mississippi Geol. Survey Bull. 87, p. 22, 26–30. Described in Prentiss County where it is about 28 feet thick; overlies Gordo formation and underlies Eutaw formation. In Mississippi, the McShane occupies a somewhat narrow irregular outcrop area which includes parts of Tishomingo, Prentiss, Itawamba, and Monroe Counties. In Prentiss County, is at surface only on lower slopes of creek branches in southeastern part of county. Thickness about 28 feet.

Type locality: A continuous series of roadcuts near middle of formation on Tuscaloosa-Columbus Highway (U.S. 82) in secs. 17 and 18, T. 19 S., R. 15 W., 1½ miles north of McShan, Pickens County, Ala.

McWain Sandstone Member (of Bond Formation)

McWain Sandstone (in McLeansboro Group)

Pennsylvanian: Southwestern Illinois.

J. R. Ball, 1943, Illinois Acad, Sci. Trans., v. 36, no. 2, p. 151. Name applied to a channel sandstone about 10 feet thick in Carlinville quadrangle:

J. R. Ball, 1952, Illinois Geol. Survey Bull. 77, p. 44–45, 89, 90, 91. Sandstone rests on upper strata of Macoupin cyclothem; it occupies normal position of basal sandstone of Shoal Creek cyclothem; however, similar material not observed elsewhere at base of Shoal Creek; hence, McWain is considered only a local sandstone.

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 39, 50 (table 1), pl. 1. Rank reduced to member status in Bond formation (new). Occurs above Shoal Creek limestone member and below Sorento limestone member (new). Presentation of new rock-stratigraphic classification of Pennsylvanian strata in Illinois. Cyclical classification is retained but is entirely independent of rock-stratigraphic classification.

Type locality: SE¼ sec. 25, T. 10 N., R. 7 W., Macoupin County. Named for occurrence on McWain Farms.

Macy Formation (in Plattin Group)

Middle Ordovician: Southeastern Missouri.

E. R. Larson, 1951, Am. Assoc. Petroleum Geologists Bull., v. 35, no. 9, p. 2058–2060. Named as uppermost formation in group. Fine-textured fucoidal calcite rock overlain by fossiliferous calcite rock with shaly partings and a widespread metabentonite near top. Thickness at type exposure 87 feet; approximately 125 feet thick in Perry County. Includes Hook member (new), at base, and Zell member (new). Underlies Decorah formation; overlies Hager formation (new).

Type exposure: Along Missouri Highway 25 in SE¼NE¼ sec. 27, T. 38 N., R. 8 E., 3 miles west of Macy, Ste. Genevieve County.

Maddox Limestone[1]

Silurian: West-central Tennessee.

Original reference: A. F. Foerste, 1903, Jour. Geology, v. 11, p. 565, 579.

C. W. Wilson, Jr., 1949, Tennessee Div. Geology Bull. 56, p. 245. Foerste placed the Osgood and all of the Laurel exposed at Maddox Mill in Maddox formation. This report, however, uses names Osgood and Laurel at Maddox Mill, as elsewhere.

Named for Maddox Mill, Hardin County.

Madera Diorite[1]

Madera Diorite and Granodiorite

Precambrian: Central Arizona.

Original reference: F. L. Ransome, 1903, U.S. Geol. Survey Prof. Paper 12.

E. D. Wilson, 1941, Arizona Bur. Mines Bull. 148, Geol. Ser. 14, p. 28, 29. Referred to as diorite and granodiorite. Intrudes Pinal schist.

N. P. Peterson, 1954, U.S. Geol. Survey Geol. Quad. Map GQ-41. Mapped as diorite in Globe quadrangle. Rock is gray medium-grained granodiorite, petrographically identical with Madera diorite of Pinal Mountain area.

Named for Mount Madera, one of the peaks of Pinal Range of which it occupies the crest; Globe quadrangle.

Madera Limestone[1] **or Formation** (in Magdalena Group)

Middle and Upper Pennsylvanian: Central and northern New Mexico and southern Colorado.

Original reference: C. R. Keyes, 1903, Ores and Metals, v. 12, p. 48.

M. L. Thompson, 1942, New Mexico Bur. Mines and Mineral Resources Bull. 17, p. 21–22. Keyes (1903) proposed name Madera for upper limestones of Pennsylvanian ("Upper Carboniferous") in region of Sandia Mountains. Keyes (1906, Jour, Geology, v. 14) used term Madera (Maderan) with reference to Permian limestones. Later workers have applied term Madera to different parts of the massive limestones of Pennsylvanian of central New Mexico, ranging in age from lower Des Moines series to upper Virgil series. Since term Madera was so poorly defined originally by Keyes and apparently used in so many different senses by Keyes and others, it is herein proposed that term Madera be dropped from Pennsylvanian nomenclature of New Mexico. Term Coyote sandstone member should be abandoned also.

C. B. Read and D. A. Andrews, 1944, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 8. In upper Pecos River and Rio Galisteo region, New Mexico, includes lower gray limestone member (0 to 700 feet) and arkosic member (0 to 1,300 feet). Overlies Sandia formation; underlies Sangre de Cristo formation.

C. B. Read and others, 1944, U.S. Geol. Survey Oil and Gas Inv. Prelim, Map 21. In San Miguel, Santa Fe, Sandoval, Bernalillo, Torrance, and Valencia Counties, Madera limestone conformably overlies Sandia formation. Subdivided into lower gray limestone member and overlying arkosic limestone member. Lower member includes sequence of gray cherty limestones and calcareous shales and contrasts sharply with overlying member which consists of alternations of red or brown arkosic sandstones, arkosic limestones, and limestones that are chiefly light gray. Throughout much of area the contact between upper and lower members is gradational and there is much interfingering. Locally, there is an unconformity between the two members and at some places in the Sangre de Cristo Mountains the upper member overlaps the lower and rests directly on Precambrian basement rocks. Underlies red arkosic clastics of Permian(?) age. These strata are assigned to Abo formation in western part of area and to Sangre de Cristo in northeastern part of area. At most places, contact of the Abo or Sangre de Cristo formations is gradational.

V. C. Kelley and G. H. Wood, 1946, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 47. Divided into (ascending) Gray Mesa, Atrasado, and Red Tanks members in Lucero area. Thickness 1,600 to 2,000 feet. Underlies Abo formation; overlies Sandia formation.

R. H. Wilpolt and others, 1946, U.S. Geol. Survey Prelim. Map 61. Madera limestone, in La Joya area, Los Pinos Mountains, and northern Chupadera Mesa, divided into a lower gray limestone member and an upper arkosic limestone member. These units are approximately equivalent to Gray Mesa, Atrasado, and Red Tanks members of Lucero uplift. Lower member ranges in thickness from 80 feet in Joyita Hills to 830 feet in east-central Los Pinos Mountains. Upper member, not present in Joyita Hills, attains maximum thickness for area of 520 feet in southern Los Pinos Mountains. Overlies Sandia formation; underlies Permian Bursum formation (new).

R. L. Bates and others, 1947, New Mexico Bur. Mines and Mineral Resources Bull. 26, p. 17–20, 21–23, pl. 3. Term, as used in this report [Gran Quivira quadrangle], includes all strata between Sandia formation below and Bursum formation above. Divided into marine limestone member (665 feet) below and arkosic limestone member (437 feet) above.

K. G. Brill, Jr., 1952, Geol. Soc. America Bull., v. 63, no. 8, p. 816–819, pl. 1. Geographically extended into Colorado. Includes Gray limestone member, arkosic limestone member, and Whiskey Creek Pass limestone member (new). Underlies Sangre de Cristo; overlies Clastic member of Sandia formation.

E. H. Baltz, Jr., and G. O. Bachman, 1956, New Mexico Geol. Soc. Guidebook 7th Field Conf., p. 99–100. Madera is Middle and Late Pennsylvanian (Atoka, Des Moines, and Missouri) in age in southeastern part of Sangre de Cristos; to the north, formation may be no younger than Des Moines in age because of lateral replacement of upper parts of arkosic limestone member by lower beds of Sangre de Cristo formation. Thickness 0 to 3,000 feet.

D. W. Bolyard, 1959, Am. Assoc. Petroleum Geologists Bull., v. 43, no. 8, p. 1904 (fig. 6), 1910–1918. In Sangre de Cristo Mountains between La Veta Pass and Westcliffe, Colo., about 3,068 feet thick. Divided into lower Gray limestone member, 533 feet thick; arkosic limestone member, 2,369 feet; and Whiskey Creek Pass limestone member, 166 feet. Overlies Deer Creek formation (new); at most places, underlies Sangre de Cristo formation; underlies Pass Creek sandstone (new). Grades northward into its equivalent, the Minturn. Name Madera replaces Hermosa and Rico formation as used by Goddard and Burbank (1937, Geol. Soc. America Bull., v. 48, no. 7) in south-central Colorado; at La Veta Pass, replaces Veta Pass limestone member of Sangre de Cristo conglomerate of Melton (1925).

Probably named either for the Madera area of Sandia Mountains or for village of La Madera, N. Mex.

†Madison Beds (in Richmond Group)[1]

Upper Ordovician: Indiana, north-central Kentucky, and southwestern Ohio.

Original reference: W. W. Borden, 1874, Indiana Geol. Survey 5th Ann. Rept., p. 139.

Named for Madison, Jefferson County, Ind.

Madison Hornblendic Gneiss

Carboniferous(?), middle: South-central Connecticut.

W. G. Foye, 1949, Connecticut Geol. Nat. History Survey Bull. 74, p. 54, pl. 1. Described as hornblendic gneiss composed chiefly of oligoclase, biotite, quartz, and hornblende.

H. M. Mikami and R. E. Digman, 1957, Connecticut Geol. and Nat. History Survey Bull. 86, p. 26. Replaced by term Haddam tonalite.

Mapped in towns of Madison, New Haven County, and Clinton, Middlesex County.

Madison Limestone,[1] Formation, or Group

Lower and Upper Mississippian: Montana, Colorado, Idaho, Wyoming, and Utah.

Original reference: A. C. Peale, 1893, U.S. Geol. Survey Bull. 110.

W. H. Weed, 1899, U.S. Geol. Survey Geol. Atlas, Folio 55. Madison limestone subdivided into (ascending) Paine shale, Woodhurst limestone, and Castle limestone. Overlies Monarch formation; underlies Quadrant formation. Thickness 1,300 feet. Carboniferous.

C. F. Deiss, 1933, Montana Bur. Mines and Geology Mem. 6. p. 45–48. Formation in northwestern Montana subdivided into (ascending) Silvertip conglomerate, Saypo limestone, Dean Lake chert, and Monitor Mountain limestone members.

H. W. Scott, 1935, Jour. Geology, v. 43, no. 8, pt. 2, p. 1023, 1030 (table 6). Name Big Snowy group applied to strata that occurs between Madison limestone and Amsden formation in central Montana.

C. C. Branson, 1937, Jour. Paleontology, v. 11, no. 8, p. 650–660. Madison limestone underlies Sacajawea formation (new) at type section of Sacajawea in Wind River Mountains, Wyo.

L. L. Sloss and R. H. Hamblin, 1942, Am. Assoc. Petroleum Geologists Bull., v. 26, no. 3, p. 305–335. Madison group in Montana comprises (ascending) Lodgepole limestone with Paine and Woodhurst members and Mission Canyon limestone. Overlies Three Forks formation; underlies Kibbey sandstone, Ellis formation, or Amsden formation. Lower Mississippian. Type section suggested.

G. W. Berry, 1943, Geol. Soc. America Bull., v. 54, no. 1, p. 16–18, (fig. 5). Formation in Three Forks area, Montana conformably overlies Sappington sandstone (new). Underlies Amsden formation.

A. R. Glockzin and C. J. Roy, 1945, Geol. Soc. America Bull., v. 56, no. 8, p. 819–828. In Fremont County, Colo., basal beds of Fountain formation rest across truncated edges of Madison, Harding, and Manitou formations. Madison consists mainly of reddish-brown to cream-colored dolomitic limestone with local sandy facies. Maximum thickness 180 feet.

J. S. Williams, 1948, Geol. Soc. America Bull., v. 59, no. 11, p. 1141–1142. Madison limestone well represented along Logan Peak syncline, Utah, by about 850 feet of thin-bedded cherty, fossiliferous limestone, with minor shale member at base. Unconformably overlies Beirdneau sandstone member (new) of Jefferson formation; conformably underlies Brazer formation.

G. E. Untermann and B. R. Untermann, 1949, Am. Assoc. Petroleum Geologists Bull., v. 33, no. 5, p. 689 (table 1). Generalized columnar section of Green and Yampa River Canyons shows Lower Mississippian Madison formation, 600 feet thick, unconformable above Lodore formation and separated from overlying Morgan formation by 185-foot unnamed interval of sandstone, conglomerate, and carbonaceous shale.

J. C. Maher, 1950, U.S. Geol. Survey Oil and Gas Inv. Prelim. Chart 39. Lower part of beds previously called Madison limestone along Front Range of Colorado form lithologic unit bounded by two unconformities. This unit is herein named Hardscrabble limestone. Upper part of finely sandy and finely oolitic limestone beds of sequence previously called Madison in vicinity of Beulah are considered a formation in this report and named Beulah limestone.

M. E. Denson, Jr., and N. S. Morrisey, 1952, Wyoming Geol. Assoc. Guidebook 7th Ann. Field Conf., p. 37–43. As delimited in this report [Big Horn and Wind River basins, Wyoming], Madison group consists of continuous sequence of limestones and dolomites between overlying Amsden formation and underlying pre-Mississippian strata. Top of group is picked on basis of lithology and (or) erosional evidence at transition from calcareous to noncalcareous sediments. Base of Madison marked by unconformity which truncates beds ranging in age from Cambrian through Devonian. As delimited herein, group includes transitional strata of possible Meramec age. Comprises Lodgepole formation, Mission Canyon formation, and, locally between Mission Canyon and basal Darwin sandstone of Amsden formation, beds of unknown age designated "Upper Madison." Thickness of this unit varies from near 0 to 80 feet.

F. D. Holland, Jr., 1952, Am. Assoc. Petroleum Geologists Bull., v. 36, no. 9, p. 1723–1731. Madison limestone in northeastern Utah conformably overlies Leatham formation (new). Thickness 803 feet in Leatham Hollow, Logan, Utah, area. Underlies Brazer limestone.

W. R. Lowell and M. R. Klepper, 1953, Geol. Soc. America Bull., v. 64, no. 2, p. 240, 241. Underlies Beaverhead formation (new), angular unconformity, near Armstead, Mont. At type section of Beaverhead, a plate of Madison limestone has been thrust over the Beaverhead.

A. B. Shaw and W. G. Bell, 1955, Am. Assoc. Petroleum Geologists Bull., v. 39, no. 3, p. 333–337. New collections of fossils from lower part of Amsden formation at Cherry Creek, Wind River Mountains, Wyo., place Mississippian-Pennsylvanian boundary more than 48 feet and less than 63 feet above Madison limestone. Name Sacajawea formation rejected for Mississippian beds at Cherry Creek.

J. M. Andrichuk, 1955, Am. Assoc. Petroleum Geologists Bull., v. 39, no. 11, p. 2170–2210. Discussion of Madison stratigraphy and sedimentation in Wyoming and southern Montana. Madison group includes entire Mississippian carbonate sequence. Group is divided into three units based on depositional environment as interpreted by lithic and faunal variations. Lower unit includes Lodgepole and lower part of Mission Canyon; middle unit includes part of Mission Canyon and lower part of Charles formation of Williston basin subsurface; upper unit includes upper part of Charles formation.

C. P. Abrassart and G. A. Clough, 1955, Intermountain Assoc. Petroleum Geologists Guidebook 6th Ann. Field Conf., p. 65, 70. In Juniper Mountain area, Colorado, Madison formation, about 270 feet thick, underlies Morgan formation and overlies Cambrian(?) beds. Mississippian-Pennsylvanian contact placed at base of lowest sandstone above thick series of limestone and dolomites of Madison formation.

V. R. Chamberlain, 1955, Billings Geol. Soc. Guidebook 6th Ann Field Conf., p. 78, 79. Group, as used in this report [Sweetgrass arch area], comprises (ascending) Exshaw-Bakken formation, Lodgepole formation, Mission Canyon formation, and Sun River dolomite (new). Sun River is considered equivalent to Charles formation.

H. T. Morris, 1957, Utah Geol. Soc. Guidebook 12, p. 14–17. Name Madison limestone is preferred to name Gardner dolomite for rocks of Lower Mississippian age in East Tintic Mountains inasmuch as Gardner dolomite, as originally defined by Loughlin (1919), erroneously included some beds of Late Devonian age, and name was essentially restricted in its usage to East Tintic Mountains. Subdivided into two unnamed members. Lower member, 250 to about 350 feet thick, consists of eight distinctive lithologic units that are persistent throughout area; upper member, 450 to 550 feet thick, consists of two units. Overlies Pinyon Peak limestone; underlies Deseret limestone. Term Madison will be used as group name to include two new formations in report currently being prepared. Names have not been officially adopted by U.S. Geological Survey, hence are not used in present report.

M. R. Klepper, R. A. Weeks, and E. T. Ruppel, 1957, U.S. Geol. Survey Prof. Paper 292, p. 38. Alexander (1951, unpub. thesis) extended name Livingston formation into Whitehall area, and in formation there included more than 9,600 feet of andesitic flows and tuffs that are continuous with Elkhorn Mountains volcanics (new) of this report [southern Elkhorn Mountains, Jefferson and Broadwater Counties, Mont.]. These, he says, are unconformable on folded and truncated Madison formation. These volcanic rocks in Whitehall area are assigned to Elkhorn Mountain volcanics.

J. K. Rigby, 1958, Utah Geol. Soc. Guidebook 13, p. 40. Discussion of geology of Stansbury Mountains, Tooele County. Mississippian nomenclature is currently in state of flux. Recent work by U.S. Geological Survey in Tintic district has revised nomenclature there, but names have not been officially proposed. Because of this situation, nomenclature used in present report follows that established earlier, modified by Lovering and others (1949, Econ. Geology Mon. 1), for some units recognized within Stansbury Mountains are named only in Tintic district, even though some of these names are now being modified. In present report, term Gardner dolomite is used with two member subdivisions, in practically the same sense as applied by Lovering and others (1949) and includes all of Madison group of Morris (1957) except the upper cherty beds, herein mapped separately as basal unit of Pine Canyon formation.

W. J. Mapel, 1959, U.S. Geol. Survey Bull. 1078, p. 17–20, pls. Madison limestone, in Buffalo-Lake De Smet area, north-central Wyoming, overlies Bighorn dolomite and unconformably underlies Amsden formation. Consists of light-gray limestone, dolomitic limestone, and dolomite. Thickness 665 feet. Lower Mississippian.

W. J. Sando, J. T. Dutro, Jr., and W. C. Gere, 1959, Am. Assoc. Petroleum Geologists Bull., v. 43, no. 12, p. 2746. Area of report is Randolph quadrangle, Utah. Limestones underlying Brazer dolomite, mapped as Madison limestone by Richardson (1913, Am. Jour. Sci., 4th, v. 36, p. 406–416) are herein assigned to Lodgepole limestone of Madison group.

H. J. Bissell, 1959, Utah Geol. Soc. Guidebook 14, p. 37–38, 41, 43, 45. Discussion of geology of southern Oquirrh Mountains and Fivemile Pass-Northern Boulter Mountain area, Tooele and Utah Counties. Gilluly

(1932, U.S. Geol. Survey Prof. Paper 173) used name Madison limestone for Lower Mississippian strata of Oquirrh Mountains. Total thickness of 462 feet of gray fossiliferous and in part cherty limestone was assigned to the Madison; an extensive faunal list provided by Girty evidently provided part of basis for using name Madison limestone. In Stansbury Mountains to west of Oquirrh Mountains, Rigby (1958) used name Madison group and referred Gardner dolomite to the lower formation and the overlying cherty unit of the Pine Canyon to upper part of group. Madison group at type locality and in many areas of outcrop in Montana contains distinct mappable lithologic formations. There the group consists of Lodgepole limestone, Mission Canyon limestone, and Charles formation. It seems unwise, however, to attempt to apply name Madison limestone to quite dissimilar lithic units in central Utah just because some faunal elements are common in both regions. Only a few beds of upper Gardner bear superficial resemblance to some strata of Lodgepole formation. It is believed that name Madison group (or formation) should be restricted to areal extent of typical Madison lithology. In present report, lower half of Gilluly's Madison is allocated to upper member of Gardner formation, and some upper strata of what Gilluly mapped as Madison are included in lower part of Pine Canyon limestone and, in reality, comprise its lower member.

W. J. Sando and Thomas Dutro, Jr., 1960, Wyoming Geol. Assoc. Guidebook 15th Ann. Field Conf., p. 117–126. Group at type section comprises Lodgepole limestone, 733 feet, and Mission Canyon limestone, 1,050 feet. The Lodgepole is believed to include both the "Laminated limestones" and "Massive limestones" of Peale (1893), a different interpretation from that of Holland (1952) and Strickland (1956, Wyoming Geol. Assoc. Guidebook 11th Ann. Field Conf.). Intervals assigned to Paine and Woodhurst members of Sloss and Hamblin (1942) were identified in the section, but units are not recognized in present report because of difficulty in placing boundary between them in other sections studied. Preliminary studies of Mission Canyon faunas supported the possibility that beds of Meramec age are present. Writers [Sando and Dutro] agree with Andrichuk and Strickland that entire Mississippian carbonate sequence below Amsden in western Wyoming can be assigned to Madison group. However, Andrichuk's subdivisions of group rejected because they are not defined according to rules of stratigraphic nomenclature. Strickland's restriction of Mission Canyon and recognition of an "Upper Madison" unit of formational rank rejected. Strickland seems to have differentiated his "Upper Madison" from Mission Canyon mainly on basis that rocks allocated to "Upper Madison" are supposed to be separated from Mission Canyon by major unconformity. This apparently led Strickland to conclude that "Upper Madison" is of Meramec age. This concept of major unconformity separating Meramec from older rocks in Cordilleran region was originally suggested by Laudon (1948, Jour. Geology, v. 56, no. 4). Authors [Sando and Dutro] found no convincing evidence of major unconformity within Madison in western Wyoming or southwestern Montana. Breccias occur a hundred feet or more below top of group at many localities, but they are interpreted as collapse features and cave fillings related to extensive development of karst topography on top of Madison. Laudon's ideas concerning nature and significance of Meramec boundary have not been widely accepted. Although there is faunal evidence for Meramec equivalents in upper part of Madison group, general rarity of fossils in this part of sequence makes it difficult to place Osage-Meramec boundary at most localities. Mission Canyon undoubtedly contains some beds younger than those present in its type section in central Montana, but this does not necessitate recognition of separate unit in uppermost Madison. If future work should support further subdivision of upper part of Madison, it is herein suggested that such new units should be recognized as member of Mission Canyon, rather than as separate formations. Coral zonation discussed.

Type section (Sloss and Hamblin): Exposed along Gallatin River at Logan, Mont. Named for Madison Range, central part of Three Forks quadrangle, Montana.

†Madison Sand (in Vicksburg Group)[1]

Oligocene, lower: Southwestern Mississippi.

Original reference: E. N. Lowe, 1915, Mississippi Geol. Survey Bull. 12, p. 82.

Named for exposures near Madison and for Madison County.

Madison Sandstone[1]

Upper Cambrian: Southern Wisconsin.

Original reference: R. D. Irving, 1875, Am. Jour. Sci., 3d, v. 9, p. 442.

G. O. Raasch, 1952, Illinois Acad. Sci. Trans., v. 44, p. 150. Sunset Point formation proposed to replace term Madison; application of term Madison to these strata has created confusion owing to widespread use of same name for Mississippian limestone in Montana and Wyoming.

Type locality: At Madison, Dane County.

†Madison Water Limestone (in Richmond Group)[1]

Upper Ordovician: Southeastern Indiana.

Original reference: D. D. Owen, 1859, Rept. geol. reconn. Indiana made in 1837, p. 28.

Named for Madison, Jefferson County.

Madisonic period[1]

Precambrian: Montana.

Original reference: C. R. Keyes, 1926, Pan-Am. Geologist, v. 46, p. 203.

Madison Valley Beds[1]

Madison Valley Formation

Miocene, upper: Central southern Montana.

Original reference: E. Douglass, 1903, Carnegie Mus. Annals, v. 2, p. 151–155.

H. E. Wood 2d, and others, 1941, Geol. Soc. America Bull., v. 52, no. 1, p. 25, pl. 1. Referred to as formation. Barstovian.

J. A. Dorr, Jr., 1954, (abs.) Geol. Soc. America Bull., v. 65, no. 12, pt. 2, p. 1245. Formation is fluviatile deposit with occasional lacustrine lenses. Type locality mentioned. Very late Miocene (late Barstovian).

J. A. Dorr, Jr., 1956, Jour. Paleontology, v. 30, no. 1, p. 62–74. In past Madison Valley formation (Douglass, 1907, Carnegie Mus. Annals, v. 4, no. 2) has been variously called Bozeman lake beds, Loup Fork, Madison Valley beds, and Bozeman formation. It underlies and is locally exposed on high bench that declines gently eastward from eastern bluffs to Gallatin River valley. A fluviatile deposit with rare lacustrine lenses, the

Madison Valley formation overlies Miocene *Leuciscus turneri* lake beds (H. E. Wood 2d, 1941). Late Miocene mammals have been collected from formation from exposures in river bluffs, but localities and stratigraphic levels from which many came remain uncertain or are inexactly recorded. New collections from a gray volcanic ash channel fill in formation southeast of type locality have yielded faunule here named Ancency local fauna. Fossil horizon probably correlates with beds in upper quarter of type section. Latest Miocene.

Type locality: Eastern bluffs of lower Madison River valley south of Three Forks, Gallatin County.

Madisonville Limestone Member (of Lisman Formation)

Madisonville Limestone (in McLeansboro Formation)[1]

Upper Pennsylvanian: Western Kentucky.

Original reference: C. J. Norwood, 1878, Kentucky Geol. Survey, new ser., v. 4, p. 319–320.

E. J. Harvey, 1956, U.S. Geol. Survey Water-Supply Paper 1356, p. 64. Reallocated to member status in Lisman formation. In Henderson area is youngest member of formation; overlies Anvil Rock sandstone member.

Named for Madisonville, Hopkins County.

Madras Formation[1]

Pliocene: Central northern Oregon.

Original reference: E. T. Hodge, 1927, Geol. Soc. America Bull., v. 38, p. 163.

E. T. Hodge, 1940, Oregon State Coll. Studies in Geology Mon. 1 [map with text]. Conformably underlies Cascan formation; overlies Columbia River basalt. Upper Pliocene.

Howel Williams, 1957, Geologic map of the Bend quadrangle, Oregon, and a reconnaissance geologic map of the central portion of the high Cascade Mountains (1:125,000): Oregon Dept. Geology and Mineral Industries in cooperation with U.S. Geol. Survey. Pliocene and Pleistocene.

U.S. Geological Survey currently designates the age of the Madras as Pliocene on the basis of a study now in progress.

Formation exposed in vicinity of Madras, Jefferson County.

Madrid Formation

Age not stated: West-central Maine.

A. R. Cariani, 1959, Dissert. Abs., v. 19, no. 10, p. 2577. Composed predominantly of calcareous quartzite with lime-silicate minerals in middle grade metamorphic zones. Contains only minor amounts of argillaceous rocks and calcareous beds; sulfides absent or inconspicuous. Quartzites grade upward into Dyer Hill member (new). Younger than Parmachenee formation (new).

I. E. Furlong, 1960, Dissert. Abs., v. 21, no. 4, p. 848. In Farmington quadrangle overlies Smalls Falls formation (new).

Present in Anson and Farmington quadrangles.

†Madrid Formation[1]

Upper Cretaceous: Central northern New Mexico.

Original reference: D. W. Johnson, 1903, School Mines Quart., v. 24, p. 338.

In Cerrillos Hills, Santa Fe County. Named for Madrid.

Madson Basalt[1] (in Snake River Group)

Pleistocene, upper: Southern Idaho.

Original references: H. T. Stearns, 1932, Correlation chart of Idaho compiled by M. G. Wilmarth, dated Sept. 1, 1932; 1936, Jour. Geology, v. 44, no. 4, p. 434–439.

H. T. Stearns, Lynn Crandall, and W. G. Steward, 1938, U.S. Geol. Survey Water-Supply Paper 774, p. 30, 72–74, pl. 4. Thickness about 200 feet. Older than Malad basalt. Stratigraphically above Hagerman lake beds. Underlies McKinney basalt. Derivation of name.

U.S. Geological Survey currently classifies the Madson Basalt as a formation in Snake River Group on basis of study now in progress.

Named after Madson Spring, which issues from alluvium some distance below outcrops of basalt. Crops out directly above talus and beneath basalts in east wall of Snake River Canyon near Steele Springs, half a mile downstream from mouth of Big Wood River, Gooding County.

Magdalena Group[1]

Magdalena Limestone

Pennsylvanian and Permian; New Mexico and western Texas.

Original reference: C. H. Gordon, 1907, Jour. Geology, v. 15, p. 807–816.

L. A. Nelson, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 1, p. 157–172. At Silver City, N. Mex., Magdalena formation [group] is divided into two formations, Oswaldo below, about 400 feet thick, and Syrena above, about 400 feet thick; unconformably overlies Lake Valley limestone. In northern end of Oscura Mountains, the Magdalena rests on Precambrian granite, and is about 1,000 feet thick. Increases northward to Taos region to about 3,000 feet. Southward from Oscura Mountains, in regions of San Andres and Organ Mountains, has thickness of about 3,000 feet and is composed almost entirely of limestone. In San Andres and northern end of Organ Mountains, overlies Lake Valley limestone; in southern end of Organ Mountains, apparently overlies Fusselman limestone. In Sacramento Mountains, overlies Lake Valley limestone. In Hueco and Franklin Mountains disconformable above the Helms. In Franklin Mountains, formation consists of (ascending) La Tuna, Berino, and Bishops Cap members. Underlies Abo sandstone.

G. F. Loughlin and A. H. Koschmann, 1942, U.S. Geol. Survey Prof. Paper 200, p. 16, 19–20, pls. 2, 8, 31. Group, in Magdalena mining district, New Mexico, comprises (ascending) Sandia formation and Madera limestone. Thickness about 850 feet. Overlies Kelly limestone; underlies Abo limestone.

M. L. Thompson, 1942, New Mexico Bur. Mines Mineral Resources Bull. 17, p. 22–23. Presentation of new classification of Pennsylvanian in New Mexico. Term Magdalena seems to be essentially synonymous with systemic term Pennsylvanian. Term Magdalena not used in nomenclature of Pennsylvanian rocks in this report. Terms Oswaldo, Syrena, La Tuna, Berino, Bishops Cap, Madera, and Coyote sandstone are not used in this report. Term Sandia retained.

P. B. King, 1942, Am. Assoc. Petroleum Geologists Bull., v. 26, no. 4, p. 674–677, 687. Northwest of Delaware basin, later Paleozoic rocks are divided into Magdalena and Manzano groups. Magdalena is marine deposit, containing many limestone beds, and is generally classed as Pennsylvanian.

Basal formation of Manzano is Abo sandstone. In previous reports, the Abo was considered approximately equivalent to Wolfcamp series, and supposed unconformity at its base was supposed to be same as that at base of Wolfcamp. It is herein suggested that Abo is mostly or wholly post-Wolfcamp and that equivalent of Wolfcamp series lies in upper part of Magdalena group as at present defined and mapped. In Sacramento, San Andres, and other mountains of New Mexico, the usual limestones and other marine sediments of Magdalena group pass upward into several hundred feet of interbedded limestones, red and gray shales, sandstones, and arkosic conglomerates. The limestones contain fusulinids and other invertebrates, and the shales contain fossil plants. This unit forms upper part of Magdalena group and no doubt will be classed as separate formation when further work is done. Future work may indicate desirability of shifting unit from Magdalena to Manzano group. Evidence suggests that upper unit of Magdalena group, as now defined, is traceable southward into Hueco limestone of Wolfcamp series.

R. E. King, 1945, New Mexico Bur. Mines Mineral Resources Bull. 23, p. 21. Thompson (1942) did not use term Magdalena in his Pennsylvanian classification. King (1942) referred to Hueco equivalent in mountains of southern New Mexico as "upper part of Magdalena group." He suggested that "future work would no doubt indicate desirability of shifting the unit to the Manzano group" (Abo, Yeso, and San Andres). Such change has not been made and name Magdalena has become more entrenched in recent geologic literature of U.S. Geological Survey, in which the Hueco is continued to be classed as Magdalena. Names Pennsylvanian and Hueco are fully adequate for designation of these strata. It is herein recommended that term Magdalena be permanently abandoned.

R. L. Bates and others, 1947, New Mexico Bur. Mines Mineral Resources Bull. 26, p. 17. On grounds of redundancy in stratigraphic nomenclature, New Mexico Bureau of Mines and Mineral Resources no longer uses term Magdalena.

C. B. Read and G. H. Wood, 1947, Jour. Geology, v. 55, no. 3, pt. 2, p. 220–236. Term Magdalena group is applied to all marine beds between Mississippian below and Permian nonmarine Abo above. This usage is in rather close agreement with earlier definitions of the term. Upper limit of Magdalena group, as term is used here, is not a time line but represents limit of marine sedimentation in area.

V. C. Kelley and Caswell Silver, 1952, New Mexico Univ. Pub. in Geology, no. 4, p. 88–97. In Caballo Mountains, Magdalena group is divided into (ascending) Red House, Nakaye, and Bar B formations (all new). Thickness 1,120 to 1,700 feet. Overlies Cutter formation, Upham dolomite, Cable Canyon sandstone, Percha formation, or Nunn member of Lake Valley limestone. Underlies Abo formation. Thompson's (1942) Pennsylvanian terminology rejected in this report.

L. C. Pray, 1954, New Mexico Geol. Soc. Guidebook 5th Field Conf., p. 93. Composite columnar section, Sacramento Mountains, shows Magdalena group comprises (ascending) Gobbler (new), Beeman (new), Holder (new), and Bursum formations. Bursum is Permian. Overlies Helms formation; underlies Abo formation.

H. L. Jicha, Jr., 1954, New Mexico Bur. Mines Mineral Resources Bull. 37, p. 21–23, 34 (fig. 3). In Cooks Range, Lake Valley quadrangle, a section of 182 feet of Pennsylvanian sediments is referred to Magdalena group.

Unconformably overlies Lake Valley formation; unconformably underlies Lobo formation.

Named for exposures in Magdalena Mountains, Socorro County, N. Mex.

Magenta Member (of Rustler Formation)

Permian (Ochoa): New Mexico.

J. E. Adams, 1944, Am. Assoc. Petroleum Geologists Bull., v. 28, no. 11, p. 1600 (fig. 2), 1614. Name applied to a 30-foot gypsiferous dolomite about 30 feet below top formation. About 150 feet above a 35-foot bed of dolomite termed Culebra member. Name suggested by W. B. Lang, who (1938, New Mexico State Engineer 12th and 13th Bienn. Rept.) measured the section and divided Rustler into 11 units; unit No. 2 in this sequence (descending) is Magenta.

Occurs east of Pecos River, in central Eddy County.

Magnolia Member (of Platteville Limestone)[1]

Middle Ordovician: Southwestern Wisconsin, northwestern Illinois, northeastern Iowa, and southeastern Minnesota.

Original reference: C. A. Bays and G. O. Raasch, 1935, Kansas Geol. Soc. 9th Ann. Field Conf. Guidebook, p. 297–300.

C. A. Bays, 1938, (abs.) Geol. Soc. America Proc. 1937, p. 269. Overlies Mifflin member (new).

M. P. Weiss and W. C. Bell, 1956, Geol. Soc. America Guidebook for Field Trips Minneapolis Mtg., Field Trip 2, p. 58 (table 1), 60, 61–62. Rocks of McGregor member have at some times and places been classified as the Magnolia and Mifflin members of the Platteville (Bays and Raasch, 1935; Bays, 1938). In region south from Rochester, Minn., to McGregor, Iowa, there is virtually no evidence of Magnolia and Mifflin members. However, in Twin City area, where interval is somewhat dolomitic, Majewske (1953, unpub. ms.) has shown that what in the past has been lumped together as the McGregor is the Mifflin and Magnolia separated by hitherto unnamed member, Hidden Falls. McGregor is used where special characteristics of Mifflin, Hidden Falls, or Magnolia are absent or insufficiently distinct. From the Twin Cities, where it is about 8 feet thick, the Magnolia member extends eastward into Wisconsin and is 11 feet thick at River Falls. Member wedges out southward from Twin Cities, perhaps partly by gradation into lower Carimona member, and is not present at Cannon Falls and Fairbault.

Type exposure: On or near Highways 13 and 14, 1 mile south of Magnolia, in NW¼ sec. 26, T. 3 N., R. 10 E., Rock County, Wis.

Magoffin Beds[1]

Magoffin Limestone (in Breathitt Formation)

Pennsylvanian: Eastern Kentucky.

Original reference: W. C. Morse, 1931, Kentucky Geol. Survey, ser. 6, v. 36, p. 296, 301.

H. R. Wanless, 1939, Geol. Soc. America Spec. Paper 17, p. 94; R. C. Moore and others, 1944, Geol. Soc. America Bull. 55, no. 6, chart 6 (columns 21, 22, 23). Marine shale with large concretions of limestone in Breathitt formation.

Well exposed in Breathitt County. Can be traced through Knott and Breathitt Counties to North Fork of Kentucky River at Coplan.

Magog Conglomerate[1]

Lower Ordovician: Northeastern Vermont, and Quebec, Canada.

Original reference: J. A. Dresser, 1925, Royal Soc. Canada Proc. and Trans., 3d ser., v. 19, sec. 4, p. 116.

Magothy Formation[1]

Upper Cretaceous: Maryland, Delaware, New Jersey, Long Island and other islands of New England Coast.

Original reference: N. H. Darton, 1893, Am. Jour. Sci., 3d, v. 45, p. 407–419.

C. W. Carter, 1937, Maryland Geol. Survey, v. 13, p. 248–250. Described along Chesapeake and Delaware Canal. Lowermost member is fine yellow iron-stained to buff micaceous compact sand containing variable proportions of clay of same color, plus additional small patches or lenses of black sticky clay; comprises more than half the thickness of formation. Middle member consists of white sand and clay. Upper member is black clay. Maximum thickness about 34 feet. Overlies Raritan formation; underlies Crosswicks clay of Matawan group.

W. B. Spangler and J. J. Peterson, 1950, Am. Assoc. Petroleum Geologists Bull., v. 34, no. 1, p. 21–23, 27. Unconformably overlies Raritan in New Jersey. In outcrop reaches thickness of 150 feet at Raritan Bay and thins southwest where, in southern part of state, it is 25 feet thick. Maximum width in outcrop 4 miles. Underlies Merchantville member of Matawan formation. Southernmost exposures are near District of Columbia. Well exposed along Severn River in Maryland and along Chesapeake and Delaware Canal in Delaware. Thickness varies from about 25 feet along Delaware River to 15 feet in Prince Georges County, Md. Rests with disconformity on "Raritan" formation.

Gerald Meyer, 1952, Maryland Dept. Geology, Mines and Water Resources Bull. 10, p. 98–99. Formation in Prince Georges County, consists essentially of light-gray crossbedded coarse sand containing small amount of glauconite and pyrite; particles of carbonaceous matter or lignite common throughout formation. In and near outcrop, thickness ranges from nearly nothing to about 60 feet. Farther down dip, it is at least 49 feet thick, and, so far as is known from well logs, it is nowhere absent. Overlapped by Monmouth formation.

Well exposed on Magothy River, Anne Arundel County, Md.

Magpie Dolomite Member (of Blaine Gypsum)[1]

Permian: Western Oklahoma.

Original reference: C. N. Gould, 1902, Oklahoma Geol. Survey 2d Bien. Rept., p. 42, 48.

Named for permanent camp of an Arapahoe chief of that name on Bitter Creek, Blaine County.

Mahala Sandstone and Conglomerate (in Puente Formation)

Miocene, upper: Southern California.

M. L. Krueger, 1943, California Div. Mines Bull. 118, p. 363. Shown on structure section as overlying Peculiar shale (new).

A. O. Woodford, T. G. Moran, and J. S. Shelton, 1946, Am. Assoc. Petroleum Geologists Bull., v. 30, no. 4, p. 521. Coarse conglomerate with minor sandstone and sandy shale; perhaps in part Pliocene. Thickness 30 to more than 115 feet. Upper part of Puente. Measured section noted.

Exposed in Slaughter Canyon, in the southeastern Puente Hills, between Chino and Santa Ana River, San Bernardino County.

Mahan Formation

Middle Ordovician (Mohawkian): Southeastern Tennessee.

G. A. Cooper, 1956, Smithsonian Misc. Colln., v. 127, pt. 1, p. 76, chart 1 (facing p. 130). Name proposed for 200 feet of ribbon-banded to thick-bedded dove-gray calcilutite, lower half of which is characteristically studded with plates and nodules of black chert. Upper part is even-bedded calcilutite with numerous shaly interbeds. Overlies Long Savannah formation (new). Top defined at type locality by a red mudstone, one of several red intercalations in a thick succession of ribbon-banded limestones. Name attributed to B. N. Cooper and G. A. Cooper.

Type section: Along Mahan Road, Snow Hill (TVA 112–NE) quadrangle, about 1,900 feet west-northwest of intersection with Tennessee Highway 60, Hamilton County.

Mahanoy Black Shale Member[1] (of Marcellus Formation)

Middle Devonian: Central Pennsylvania.

Original reference: Bradford Willard, 1935, Geol. Soc. America Bull., v. 46, Proc. Pal. Soc. Feb. 28, p. 202–203.

Bradford Willard, 1939, *in* Bradford Willard, F. M. Swartz, and A. B. Cleaves, Pennsylvania Geol. Survey, ser. 4, Bull. G–19, p. 173–174. Usually lithologically indistinguishable from Shamokin black shale member below unless intervening sandy members are present.

H. H. Arndt and others, 1959, Geol. Soc. America Guidebook Field Trips Pittsburgh Mtg., p. 4, 27. In Juniata, Mifflin, and Perry Counties the Marcellus is subdivided into (ascending) Shamokin shale, Turkey Ridge sandstone, and Mahanoy shale.

Named for Mahanoy Township, southwestern Northumberland County.

Mahantango Formation[1] (in Hamilton Group)

Middle Devonian: Central Pennsylvania.

Original reference: Bradford Willard, 1935, Geol. Soc. America Bull., v. 46, Proc. Pal. Soc., Feb. 28, p. 202, 205–223.

Bradford Willard, 1937, Am. Jour. Sci., 5th ser., v. 33, no. 196, p. 274, 275, 276 (table 2). Formation is dominated by coarse sandstone, the Montebello member, in lower Susquehanna and Juniata Valleys.

Bradford Willard, 1939, Pennsylvania Geol. Survey, 4th ser., Bull. G–19, p. 133–134, 176–194. Designation of Mahantango formation is retained for beds of Hamilton group above Marcellus formation in Pennsylvania even where the equivalents of the Moscow, Ludlowville, and Skaneateles formations of New York are more or less clearly recognized. Hence, Hamilton group of Pennsylvania has two formations: Mahantango above and Marcellus below; these in turn are locally analyzed into lesser units or facies; thus, Mahantango includes Skaneateles, Ludlowville, and Moscow facies.

H. H. Arndt and others, 1959, Geol. Soc. America Guidebook Pittsburgh Mtg., p. 3–4. Formation embraces that part of Hamilton group above Marcellus formation and below Susquehanna group. Correlative with Montebello and Sherman Ridge (new) formations in east-central Pennsylvania. Consists principally of greenish-gray thin- to medium-bedded slightly carbonaceous shale. Sporadic sandstone zones appear throughout area and thicken eastward. In east-central Pennsylvania, the sandstones are well developed and form Montebello formation which overlies Marcellus.

Carlyle Gray and others, 1960, Geologic map of Pennsylvania (1:250,000): Pennsylvania Geol. Survey, 4th ser. Contains "Centerfield coral bed" in eastern Pennsylvania.

T. M. Kehn, 1960, (abs.) Geol. Soc. America Bull., v. 71, no. 12, pt. 2, p. 2018. Geologic mapping has revealed that, contrary to previously published reports and maps, there are two outcrop belts of Oriskany, Onondaga, and Marcellus formations between Schuylkill and Susquehanna Rivers. Mapped area is bounded on north by Second Mountain and on south by Blue Mountain. Marcellus is overlain by Montebello sandstone member of Mahantango formation, a buff to light-gray-brown coarse locally conglomeratic quartzitic sandstone about 800 feet thick at the Susquehanna and about 20 feet thick at the Schuylkill.

Named for exposures in valley, North Branch of Mahantango Creek, Snyder County.

Mahaska till[1]

Mahaskan glacial epoch[1]

Pleistocene: Iowa.

Original references: C. R. Keyes, 1931, Pan-Am. Geologist, v. 55, p. 145; 1932, Pan-Am. Geologist, v. 58, p. 203.

Mahogany Member (of Ankareh Formation)

Lower Triassic: Northeastern Utah and western Wyoming.

Bernhard Kummel, 1953, Intermountain Assoc. Petroleum Geologists Guidebook 4th Ann. Field Conf., fig. 1 facing p. 48; 1954, U.S. Geol. Survey Prof. Paper 254–H, p. 166 (fig. 17), 178 (fig. 21), 180. Name applied to red strata between the Gartra grit member above and Thaynes formation below. Interfingers with Thaynes. In Wasatch and Uinta Mountains.

W. F. Scott, 1959, Intermountain Assoc. Petroleum Geologists Guidebook 10th Ann. Field Conf., p. 104. Kummel (1953) divided Ankareh formation into Mahogany, Gartra grit, and Stanaker members. All of these members are mappable units and deserve formational rather than member rank. "Mahogany" is an unnecessary synonym of Boutwell's Ankareh or at least Williams (1945) Ankareh (restricted).

E. D. McKee and others, 1959, U.S. Geol. Survey Misc. Geol. Inv. Map I–300. Lower Triassic. Extended into Wyoming.

Named after Mahogany Hill, north of Weber River, T. 1 S., R. 6 E., Summit County, Utah.

Mahomet Beds[1]

Pleistocene: Central eastern Illinois.

Original reference: E. J. Cable, 1921, Some phases of the Pleistocene of Iowa: Cedar Falls, Iowa, Wolverton Bros., p. 59.

Leland Horberg, 1953, Illinois Geol. Survey Rept. Inv. 165, p. 18 (footnote). Not same as Mahomet sand (Horberg, 1946). Cable's usage of "Mahomet beds" does not imply formal stratigraphic usage.

Located near Mahomet, Champaign County.

Mahomet Sand

Pleistocene (pre-Wisconsin): Northeastern Illinois (subsurface).

Leland Horberg, 1946, (abs.) Geol. Soc. America Bull., v. 57, no. 12, pt. 2, p. 1204. A fill of gravel and sand within the Mahomet (? Teays) bedrock valley.

Leland Horberg, 1953, Illinois Geol. Survey Rept. Inv. 165, p. 18–19. Defined as oldest deposit which underlies glacial till or clearly related outwash along Mahomet bedrock valley; known only from subsurface; well samples indicate deposit consists of sand and gravel in roughly equal proportions and is composed of a wide variety of rocks and minerals, dominantly of sedimentary origin. Not to be confused with "Mahomet beds" of Farmdale age exposed near same locality and referred to by Cable (1921); Cable's reference does not imply formal stratigraphic usage.

Named from village of Mahomet, Champaign County, where a number of borings penetrate the deposit and samples are available for its full thickness down to bedrock.

Mahoning Clay

Mahoning Fire Clay (in Conemaugh Formation)[1]

Pennsylvanian (Conemaugh Series): Northern West Virginia, western Maryland, and western Pennsylvania.

Original reference: I. C. White, 1903, West Virginia Geol. Survey, v. 2, p. 309.

R. E. Lamborn, 1942, Ohio Geol. Survey, 4th ser., Bull. 43, p. 9, 23. A clay (in Conemaugh series) underlying Mahoning coal is referred to as Mahoning or Thornton clay.

First mentioned in Monongalia County, W. Va.

Mahoning cyclothem

Pennsylvanian (Conemaugh Series): Southeastern Ohio.

N. K. Flint, 1949, Ohio Acad. Sci. [Guidebook] 24th Ann. Field Conf., p. 12. Incidental mention in road log.

N. K. Flint, 1951, Ohio Geol. Survey, 4th ser., Bull. 48, p. 57–60, table 1, geol. map. Includes (ascending) Lower Mahoning shale and (or) sandstone, 35 feet; Mahoning limestone, 6 inches to 18 feet; Thornton clay, as much as 17 feet; and Mahoning coal. Occurs below Mason cyclothem and above Upper Freeport cyclothem of Allegheny series. In this report [Perry County] the Conemaugh series is described on cyclothemic basis; seven cyclothems are named (ascending): Mahoning, Mason, Brush Creek, Wilgus, Anderson, Barton, and Harlem; about one-half of the strata of the series are present in county.

M. T. Sturgeon and others, 1958, Ohio Geol. Survey Bull. 57, p. 94–95 (table 11), 97–102. Comprises (ascending) Lower Mahoning sandstone, Lower Mahoning redbed, Lower Mahoning limestone, Thornton (Mahoning) underclay, and Lower Mahoning coal members. In this report [Athens County], Conemaugh series is described on cyclothemic basis; 15 cyclothems are named (ascending): Mahoning, Mason, Lower Brush Creek, Upper Brush Creek, Wilgus, Anderson, Upper Bakerstown, Harlem, Ames, Gaysport, Duquesne, Elk Lick, Little Clarksburg, Lower Little Pittsburgh, and Upper Little Pittsburgh.

Named derived from Mahoning Creek(s) in Indiana and Jefferson Counties, Pa.

Mahoning Formation[1]

Pennsylvanian: Southwestern Pennsylvania.

Original reference: G. H. Ashley, 1926, Pennsylvania Topog. and Geol. Atlas 65, p. 25–26, pl. 4.

Punxsutawney quadrangle.

Mahoning Limestone (in Conemaugh Formation)[1]

Mahoning limestone member

Pennsylvanian (Conemaugh Series): Western Pennsylvania, western Maryland, eastern Ohio, and northern West Virginia.

Original reference: H. D. Rogers, 1858, Geology Pennsylvania, v. 2, pt. 1, p. 477, 489.

N. K. Flint, 1951, Ohio Geol. Survey, 4th ser., Bull. 48, p. 57, 59–60, table 1. Included in Mahoning cyclothem in Perry County. Thickness 6 inches to 18 feet.

D. L. Norling, 1958, Ohio Geol. Survey Bull. 56, p. 27–28. Term Mahoning limestone was originally applied to a limestone in the Pottsville series by Rogers (1858). I. C. White (1879, Pennsylvania 2d Geol. Survey Rept. Q) renamed this lower Pennsylvanian bed the Upper Mercer limestone. White (1891, U.S. Geol. Survey Bull. 65) reapplied term Mahoning to limestone overlying lower part of massive Mahoning sandstone of Pennslyvania. Thus, in Ohio, Mahoning limestone member (Conemaugh series) is the limestone overlying Lower Mahoning sandstone and shale member; underlies Thornton clay. Poorly exposed in Morgan County.

Named from Mahoning River, Lawrence County, Pa.

Mahoning Red Bed (in Conemaugh Formation)[1]

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

Original reference: C. K. Swartz, 1922, Maryland Geol. Survey, v. 11, p. 57; pl. 6.

M. T. Sturgeon and others, 1958, Ohio Geol. Survey Bull. 57, p. 100–101, 106. Lower Mahoning redbed member included in Mahoning cyclothem. Upper Mahoning redbed member included in Mason cyclothem. Area of report is Athens County.

Name Mahoning taken from Mahoning Creek(s) in Indiana and Jefferson Counties, Pa.

Mahoning Sandstone Member (of Conemaugh Formation)[1]

Mahoning Sandstone (in Conemaugh Group)

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

Original reference: J. P. Lesley, 1856, Manual of Coal, p. 94, 97–98.

M. T. Sturgeon and others, 1958, Ohio Geol. Survey Bull. 57, p. 97, 98, 104. Name Mahoning was first used in geologic literature by Lesley (1856) and has been applied primarily to sandstones lying between Upper Freeport (No. 7) coal and Lower Brush Creek limestone. Two Mahoning sandstones are commonly present, known as Upper and Lower Mahoning sandstones. In present report, Lower Mahoning sandstone is included in Mahoning cyclothem, and Upper Mahoning sandstone is included in Mason cyclothem.

Carlyle Gray, and others, 1960, Geologic map of Pennsylvania (1:250,000): Pennsylvania Geol. Survey, 4th ser. Mapped in Conemaugh formation.

Name taken from Mahoning Creek(s) in Indiana and Jefferson Counties, Pa.

Mahopac granite[1]

Precambrian: Southeastern New York.

Original reference: C. P. Berkey and Marion Rice, 1919, New York State Mus. Bulls. 225–226, p. 54–56.

K. E. Lowe, 1950, Geol. Soc. America Bull., v. 61, no. 3, p. 143. In place of Canada Hill, Reservoir, and Mahopac granites described by Berkey and Rice (1919), term Canada Hill granite phase of Hudson Highlands complex is used to include all rocks representative of granitic igneous activity in the Hudson Highlands after the Pochuck diorite phase and earlier than the Storm King granite intrusion.

Type locality: Along road running from Kent Cliffs to Mahopac mines, especially on fault scarp north of mines, in Putnam County.

Main Street Limestone (in Washita Group)

Main Street Formation (in Washita Group)

Main Street Limestone Member (of Denison Formation)[1]

Main Street Limestone Member (of Georgetown Limestone)

Lower Cretaceous (Comanche Series): Central and southern Oklahoma and central and northeastern Texas.

Original reference: R. T. Hill, 1894, Geol. Soc. America Bull., v. 5, p. 302, 303, 317, 328–331.

R. W. Imlay, 1944, U.S. Geol. Survey Oil and Gas Inv. Prelim. Chart 3. Chart shows Main Street limestone in Washita group; occurs below Grayson shale and above Pawpaw formation. Lower Cretaceous. [Denison formation abandoned.]

D. L. Frizzell, 1954, Texas Univ. Bur. Econ. Geology Rept. Inv. 22, p. 29, table 4. Foraminifera of Main Street formation described.

W. J. Fox and O. N. Hopkins, Jr., 1960, Baylor Geol. Soc. Guidebook 5th Field Trip, p. 88, 93. In central Texas, considered uppermost member of Georgetown limestone. Approximately 25 feet thick in north-central Texas, thickens to 50 feet in Johnson and Tarrant Counties, thins southward to about 35 feet in McLennan County. Overlies Pawpaw shale member; underlies Del Rio clay. Predominantly nodular limestone with interbedded thin shales.

B. F. Perkins, 1960, Geol. Soc. America Mem. 83, p. 9 (fig. 3), 12 (fig. 4), 34 (fig. 14), 35, 36 (fig. 15). Member of Denison formation. In Tarrant County, Tex., member is composed chiefly of alternating thickly bedded marly limestone and thin marl and marly clay beds. Thickens southward from about 20 feet to more than 40 feet at southern border of county. Overlies Pawpaw shale member; underlies Grayson marl member.

Named for occurrence on East Main Street, Denison, Grayson County, Tex.

Maitlen Phyllite

Lower or Middle Cambrian: Northeastern Washington.

C. F. Park, Jr., 1938, Econ. Geology, v. 33, no. 7, p. 713 (chart), 714 (fig. 2). Named on map and stratigraphic chart. Thickness about 5,000 feet. Underlies Metaline limestone and overlies Gypsy quartzite (both new).

C. F. Park, Jr., and R. S. Cannon, Jr., 1943, U.S. Geol. Survey Prof. Paper 202, p. 6 (table), 15–17, pl. 1. Described as greenish gray, fine grained, and conspicuously banded; includes beds of limestone near top and platy quartzite near base. Gradational into Gypsy quartzite, contact placed at top of a prominent bed rich in fucoidal impressions where quartzite becomes subordinate in quantity to phyllite; underlies Metaline limestone, contact gradational Derivation of name given.

C. D. Campbell, 1947, Geol. Soc. America Bull.. v. 58, no. 7, p. 606–608, 611, pl. 1. Remapping of northeastern Stevens County and discovery of Cambrian and Ordovician fossils are thought to justify adoption there of formation names established by Park and Cannon (1943) for the Metaline quadrangle. The new names replace those given by Weaver (1920). Correlative with the Maitlen phyllite are parts of Weaver's Northport limestone, Boundary argillite, Deep Lake argillite, and all of the Cedar Creek argillite.

R. G. Yates and J. F. Robertson, 1958, U.S. Geol. Survey Mineral Inv. Field Studies Map MS–137. Mapped in Leadpoint quadrangle, Stevens County. Consists of quartzite, schist, and phyllite. Underlies Metaline formation. Cambrian.

Named from valley of intermittently flowing Maitlen Creek, east of Ione, Pend Oreille County.

Majagua Formation

Oligocene, middle: Panamá.

Karl Sapper, 1937, Mittelamerika, Handbuch der regionalen Geologie: Heidelberg, v. 8, pt. 4a, no. 29, p. 134 (correlation chart). Name appears on chart. Above David formation. Middle Oligocene.

W. P. Woodring *in* R. Hoffstetter and others, 1960, Lexique Strat. Internat., v. 5, Amérique Latine, fasc. 2a, p. 338. Undefined name. Oligocene(?).

In Chiriquí Province. Río Majagua (presumed source of name) is one of numerous streams flowing southward from Volcan de Chiriquí, a tributary of Río David.

Makaino Basaltic Andesite (in Hana Volcanic Series)

Pleistocene(?) : Maui Island, Hawaii.

G. A. Macdonald *in* H. T. Stearns and G. A. Macdonald, 1942, Hawaii Div. Hydrography Bull. 7, p. 230 (table), 246–247, pl. 1. Nonporphyritic aa with poorly to moderately well-defined fluidal structure. Buried by Mossman picritic basalt, but erosion has reexposed it in small windows. Maximum exposed thickness 125 feet. Each member in series is unconformably underlain by local erosional unconformity.

G. A. Macdonald and D. A. Davis *in* Jacques Avias and others, 1956, Lexique Strat. Internat., v. 6, Océanie, fasc. 2, p. 111. Pleistocene(?).

Named for exposures along Makaino stream. A single flow which filled a small gulch, east of present Hanawi Gulch, formed by erosion after extrusion of Waiaako lava.

Makalapa Tuff[1] (in Honolulu Volcanic Series)

Pleistocene, upper: Oahu Island, Hawaii.

Original reference: H. T. Stearns, 1935, Hawaii Div. Hydrography Bull. 1.

G. A. Macdonald and D. A. Davis *in* Jacques Avias and others, 1956, Lexique Strat. Internat., v. 6, Océanie, fasc. 2, p. 111. Subaerial gray tuff, about 300 feet thick. Overlies Aliamanu tuff and Fort Shafter gravels; contemporary with Salt Lake tuff.

Named for Makalapa Crater, the vent from which it issued.

Makanaka Drift and Glaciation

Pleistocene: Hawaii Island, Hawaii.

C. K. Wentworth and W. E. Powers, 1939, (abs.) Geol. Soc. America Bull., v. 50, no. 12, pt. 2, p. 1942; 1941, Geol. Soc. America Bull., v. 52, no. 8, p. 1206–1207. Four stages of glaciation, presumably correlative with Ice Age elsewhere, occurred on Mauna Kea. These are (beginning with latest) Makanaka, Waihu, Pohakuloa, and pre-Pohakuloa stages.

H. T. Stearns, 1945, Geol. Soc. America Bull., v. 56, no. 3, p. 269–270. Of glacial stages and deposits described by Wentworth and Powers, only Makanaka can be accepted as definitely glacial. Makanaka deposits consist of outwash and drift.

Drift well exposed at 10,000 feet in amphitheater head of Pohakuloa Gulch. Fans of unconsolidated material lie at mouths of Waikahalulu and Pohakuloa Gulches on plain at 6,500 feet.

Makanda Sandstone Member (of Caseyville Formation)

Makanda Sandstone Member (of Pottsville Formation)[1]

Pennsylvanian: Southwestern Illinois.

Original reference: S. St. Clair, 1917, Illinois Geol. Survey Bull. 35, p. 48, pl. 4.

H. R. Wanless, 1939, Geol. Soc. America Spec. Paper 17, p. 35, 94. Reallocated to member status in Caseyville formation. Upper sandstone of the formation.

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 30. Discontinued. Pounds sandstone member of Caseyville formation (redefined) extended in area to include strata formerly considered to be lower part of Makanda.

Named for town of Makanda, Jackson County.

Makapipi Basalts (in Hana Volcanic Series)

Pleistocene(?): Maui Island, Hawaii.

G. A. Macdonald *in* H. T. Stearns and G. A. Macdonald, 1942, Hawaii Div. Hydrography Bull. 7, p. 231 (table), 241–243, pl. 1. A group of lavas stratigraphically between Big Falls picritic basalts (new) and Waiaaka basaltic andesite (new). Several separate lava flows present; surfaces of individual lavas marked by thin layers of red soil but show little evidence of erosion. Lavas are fine-grained olivine basalts tending toward basaltic andesites. Both pahoehoe and aa present with aa predominant. Some clinkers present. Average thickness about 75 feet; greatest measured thickness, 155 feet in test hole 27.

G. A. Macdonald and D. A. Davis *in* Jacques Avias and others, 1956, Lexique Strat. Internat., v. 6, Océanie, fasc. 2, p. 112–113. Pleistocene(?).

Named for exposures along Makapipi Gulch. Well exposed along Hanaui Gulch from Waiaaka Stream to Hanawi Spring no. 1. Between Waiaaka and Waiohue Stream, lavas fill valley cut into Kula and Honomanu lavas.

Makasin Hill zone (in Negaunee Formation)[1]

Precambrian (middle Huronian) : Northern Michigan.

Original reference: J. L. Adler, 1935, Jour. Geology, v. 43, no. 2, p. 113–132.

Type area: Makasin Hills, Marquette County.

Makawao Breccia[1] (in Honolulu Volcanic Series)

Pleistocene, upper: Oahu Island, Hawaii.

Original reference: H. T. Stearns, 1935, Hawaii Div. Hydrography Bull. 1.

G. A. Macdonald and D. A. Davis *in* Jacques Avias and others, 1956, Lexique Strat. Internat., v. 6, Océanie, fasc. 2, p. 113. Dark-gray well-cemented generally unbedded breccia containing numerous blocks of Koolau lavas, some of which are more than 3 feet in diameter; elsewhere fine-grained laminated brown tuff. Thickness of breccia phase more than 200 feet. Breccia believed to fill vent blasted through Koolau volcanic series; tuff intercalated in alluvium underlying Ainoni volcanics. Extent noted.

Named for Makawao Stream in which, at 600 feet altitude, two beds of tuffaceous phase are exposed; typical breccia well exposed in Maunawili Ranch about 1¾ miles south and a little west of Olomana Peak. Main patch of breccia is one-half mile long and one-quarter mile wide, 1¾ miles south-southwest of Olomana Peak on northeast side of Koolau Range 8 miles northwest of Makapuu Head.

Makaweli Formation (in Waimea Canyon Volcanic Series)

Pliocene(?) : Kauai Island, Hawaii.

G. A. Macdonald, D. A. Davis, and D. C. Cox, 1954, Volcano Letter 526, p. 2; D. A. Davis and G. A. Macdonald *in* Jacques Avias and others, 1956, Lexique Strat. Internat., v. 6, Océanie, fasc. 2, p. 113–114. Principally lava flows that accumulated in Makaweli graben on southwestern side of major shield volcano of Kauai. Lavas predominantly olivine basalt. Maximum thickness 1,500 feet; base not exposed. Includes Mokuone member (new). Later than Napali formation (new) ; approximately coeval with upper part of Olokele formation (new).

G. A. Macdonald, D. A. Davis, and D. C. Cox, 1960, Hawaii Div. Hydrography Bull. 13, p. 42–49, table facing p. 20, pl. 1. Along Waimea Canyon, the Makaweli is separated from Napali formation to west by scarp formed by erosion of fault scarp that bounded graben. Base not exposed, but believed to rest with erosional unconformity on Napali and Olokele formations. Locally overlain with erosional unconformity by rocks of Koloa volcanic series. Includes Mokuone member. Total thickness unknown; maximum exposed thickness, 1,500 feet. Coeval with upper part of Olokele formation; probably middle or late Pliocene.

Type localities: Western wall of canyon of Makaweli River, and eastern wall of Waimea Canyon between mouth of Omau Stream and confluence of Waimea and Makaweli Rivers. Occupies about 25 square miles in southwestern part of island.

Mak Hill Glaciation

Pleistocene: Southwestern Alaska.

E. H. Muller *in* T. L. Péwé and others, 1953, U.S. Geol. Survey Circ. 289, p. 2, 13 (table 1). Four major glaciations tentatively recognized in northern part of Alaska Peninsula. Mak Hill succeeded Johnston Hill and preceded Brooks Lake glaciations (new). Lateral moraines and glaciated bedrock surfaces of the glaciation are well preserved below summits of previously overridden hills and more than 600 feet above marginal deposits of subsequent advances. West of foothills, moraines, where preserved, characterized by partly filled kettle basins, incompletely integrated surface drainage and knobs, and ridges considered modified by subsequent mass wasting. Name credited to Abrahamson (unpub. dissert.).

Named for knoll composed of glacial till, 9 miles east of Naknek, northern Alaska Peninsula.

Makua Flow

Recent: Maui Island, Hawaii.

Grote Reber, 1959, Geol. Soc. America Bull., v. 70, no. 9, p. 1245, 1246, pl. 1, (fig. 2). Complex of several flows. Radiocarbon dating gives age of about 590 years.

On southwest side of Haleakala.

Malad Member (of Thousand Springs Basalt)

Malad Basalt[1]

Pleistocene, upper: Southern Idaho.

Original references: H. T. Stearns, 1932, Correlation chart of Idaho compiled by M. G. Wilmarth, dated Sept. 1, 1932; 1936, Jour. Geology, v. 44, no. 4, p. 434–439.

H. T. Stearns, Lynn Crandall, and W. G. Steward, 1938, U.S. Geol. Survey Water-Supply Paper 774, p. 30, 74–75, pl. 4. Thickness about 400 feet. In some areas, rests on Hagerman lake beds. Wedges out between Madson and McKinney basalts. Older than Thousand Springs lava.

U.S. Geological Survey currently classifies the Malad as a member of Thousand Springs Basalt on basis of a study now in progress.

Exposed in Malad Canyon, Gooding County. Near Malad power plant it forms cliff over 400 feet high.

Malade Valley Group[1]

Pliocene(?): Southeastern Idaho and northeastern Utah.

Original reference: A. C. Peale, 1879, U.S. Geol. and Geog. Survey Terr. 11th Ann. Rept., p. 641.

Malade River valley.

Malaga Mudstone Member (of Monterey Shale)[1]

Miocene, upper: Southern California.

Original reference: W. P. Woodring, M. N. Bramlette, and R. M. Kleinpell, 1936, Am. Assoc. Petroleum Geologists Bull., v. 20, no. 2, p. 146.

W. P. Woodring, M. N. Bramlette, and W. S. W. Kew, 1946, U.S. Geol. Survey Prof. Paper 207, p. 11 (fig. 3), 14 (table), 15 (fig. 4), 37–39, pls. 1, 14. Described as consisting chiefly, and in some areas almost entirely, of massive radiolarian mudstone or fine-grained siltstone; at

Malaga Cove includes laminated diatomite and diatomite and diatomaceous shale in thin streaks or in well-defined units several feet thick; limestone occurs as concretions and lenses in both massive mudstone and laminated diatomite; mudstone is light chocolate brown or olive gray when dry and almost black when wet. Thickness 300 to 600 feet. Overlies Valmonte diatomite member; underlies Repetto siltstone.

Type region: Malaga Cove, at northwest end of the hills (where lower and upper parts of member, but possibly not entire thickness, are exposed), Palos Verdes Hills area, Los Angeles County.

Malagan series

Paleozoic (Late Carbonic): New Mexico.

Charles Keyes, 1940, Pan-Am. Geologist, v. 74, no. 2, p. 106 (chart). Comprises (ascending) Carlsbad, Hess, Maravilla, and Castile terranes.

Malam (Maremu) (Marem) Beds or Formation

Miocene: Caroline Islands (Kasaie).

Risaburo Tayama, 1952, Coral reefs in the South Seas: Japan Hydrog. Office Bull., v. 11, p. 69, table 5 [English translation in library of U.S. Geol. Survey, p. 84]; S. Hanzawa *in* Jacques Avias and others, 1956, Lexique Strat. Internat., v. 6, Océanie, fasc. 2, p. 29. Malam (Maremu) beds or formation included in East Caroline beds (formation).

Malden Sandstones (in Kanawha Formation)[1]

Pennsylvanian: West Virginia.

Original reference: I. C. White, 1908, West Virginia Geol. Survey, v. 2A, p. 271, 425.

Occurs on both banks of Great Kanawha River in vicinity of Malden, Kanawha County.

Malheur Formation[1]

Recent: Northeastern Oregon.

Original reference: W. D. Smith, 1926, Oregon Univ. Commonwealth Rev., v. 8, p. 207–214.

Type locality: Malheur, Harney County.

Mallett Dolomite[1]

Mallett Member (of Dunham Dolomite)

Lower Cambrian: Northwestern Vermont.

Original reference: Arthur Keith, 1923, Am. Jour. Sci., 5th ser., v. 5, p. 110.

W. M. Cady, 1945, Geol. Soc. American Bull., v. 56, no. 5, p. 528–529. Rank reduced to member in upper part of Dunham dolomite.

Named for fine exposures on shores of Mallett[s] Bay 5 miles north of Burlington, Chittenden County.

Malone Drift or Till

Malone Glaciation

Pleistocene: Northwestern New York.

Paul MacClintock, 1958, Glacial geology of St. Lawrence seaway and power projects: New York State Mus. and Sci. Service, p. 6–25. Older of two episodes of glaciation in area. Ice advanced from the northeast toward the southwest. Followed by Fort Covington glaciation (new) wherein ice advanced from the northwest.

Named from Malone, Franklin County, in vicinity of which till is well exposed. Also exposed in Lawrence seaway excavations.

Malone Formation[1]

Upper Jurassic: Western Texas.

Original reference: J. A. Taff, 1891, Texas Geol. Survey 2d Ann. Rept., p. 720–721, 736.

C. C. Albritton, Jr., 1937, Field and Lab., v. 5, no. 2, p. 48–50. Age of Malone fauna, described by Cragin (1905, U.S. Geol. Survey Bull. 266) has been subject of uncertainty. Chiefly on basis of ammonites, Cragin assigned entire sedimentary sequence in Malone Mountains and Hills to Upper Jurassic. Later workers agreed that while ammonites described by Cragin are Jurassic, some pelecypods proved existence of Cretaceous strata in Malone formation. Adkins (1933) proposed name Torcer for hypothetically Cretaceous fraction of the Malone, restricting the latter to include only beds of Jurassic age. Present study shows that interbedded limestone and gypsum constituting some 300 feet of basal part of Cragin's Malone are of Permian (Leonard) age. Previously these beds have been variously regarded as Permian, Jurassic, or Cretaceous. Malone formation, is herein again emended to include only beds of Jurassic age; unconformably overlies Permian strata. Consists of lower division of limestone, conglomerate, sandstone, sandy shale, and impure limestone, and upper division dominantly of impure limestone. Maximum thickness about 1,000 feet. Underlies Torcer formation redefined to include only Lower Cretaceous fraction of original Malone. Malone fauna, despite its misleading pelecypods, is Jurassic in age as Cragin maintained.

C. C. Albritton, 1938, Geol. Soc. America Bull., v. 49, no. 12, pt. 1, p. 1754 (fig. 2), 1758–1764. Overlies Permian Briggs formation (new); underlies Torcer formation. Thickness as much as 1,000 feet.

R. W. Imlay, 1943, Am. Assoc. Petroleum Geologists Bull., v. 27, no. 11, p. 1485. Formation has been considered to include rocks in Malone Mountains and in hills north and east of Malone. Adkins and Albritton have restricted formation to include only rocks of Jurassic age. However, fossil evidence for Lower Cretaceous rocks in area defined is inadequate. Only positive evidence of age is furnished by late Upper Jurassic ammonites representing early middle Kimmeridgian and upper Portlandian stages. Until undoubted Lower Cretaceous fossils are found in Malone Mountains, it does not seem necessary to modify concept of Malone formation.

Named for Malone Mountain and hills north and east of Malone (now Torcer) Station on Southern Pacific Railway, Hudspeth County.

Maloney Metamorphic Series[1]

Ordovician: Central Washington.

Original reference: W. S. Smith, 1916, Jour. Geology, v. 24, p. 559–570.

Skykomish Basin.

Malpais Basalt[1]

Pliocene(?): Southwestern Nevada.

Original reference: F. L. Ransome, 1909, U.S. Geol. Survey Prof. Paper 66, p. 28, 72.

Caps Malpais Mesa, southwestern part of Goldfield district.

Mamacoke Gneiss[1]

Precambrian: Southeastern Connecticut.

Original reference: H. E. Gregory, 1906, Connecticut Geol. Nat. History Survey Bull. 6, p. 114, 150–152, map.

W. G. Foye, 1949, Connecticut Geol. Nat. History Survey Bull. 74, p. 60–61, pl. 1. Pre-Permian. Difficult to map since transitional into both Sterling orthogneiss and Monson orthogneiss. Same as Stonington gneiss of Martin (1925).

John Rodgers and others, 1956, Preliminary geological map of Connecticut (1:253,440): Connecticut Geol. Nat. History Survey. Largely medium-grained gray banded gneiss. In some belts, includes biotite gneiss and schist, quartzite, and hornblende gneiss and amphibolite; in others, gray and pink granitic gneiss. Pre-Triassic. Derivation of name stated.

H. M. Mikami and R. E. Digman, 1957, Connecticut Geol. Nat. History Survey Bull. 86, p. 26. Not used on present map. A mixed zone of granite and Haddam tonalite.

Named for Mamacoke Island or Hill on west bank of Thames River in town of Waterford, New London County.

Mammoth Andesite[1]

Tertiary: Central Nevada.

Original reference: A. Knopf, 1921, U.S. Geol. Survey Bull. 725-H.

Well exposed on Mammoth claim, Cedar Mountains.

†Mammoth Limestone[1]

Lower, Middle, and Upper Cambrian and Lower Ordovician: Central northern Utah.

Original reference. G. W. Tower, Jr., and G. O. Smith, 1899, U.S. Geol. Survey 19th Ann. Rept., pt. 3, p. 620, footnote.

Well exposed at and around Mammoth, Juab County.

Mammoth Cave Limestone

Mammoth Cave Series[1]

Mississippian: Western central Kentucky.

Original reference: A. M. Miller, 1919, Table of geological formations of Kentucky, p. 3.

A. C. McFarlan, 1954, Kentucky Geol. Survey Spec. Pub. 4, p. 11. Mammoth Cave limestone is a general term covering a number of Mississippian limestones including the St. Louis, Ste. Genevieve, and lower Chester. These are the limestones in which Mammoth Cave and other large Kentucky caves occur. Occurs below Beattyville shale and above Waverly formation.

Apparently named for Mammoth Cave, Edmondson County.

Mammoth Mountain Rhyolite

Mammoth Mountain Rhyolite (in Potosi Volcanic Series)[1]

Middle or late Tertiary: Southwestern Colorado.

Original reference: W. H. Emmons and E. S. Larsen, 1923, U.S. Geol. Survey Bull. 718.

Named for Mammoth Mountain, Creede district.

Mamou Member (of Foley Formation)

Pliocene: Southwestern Louisiana (subsurface).

P. H. Jones, *in* P. H. Jones, A. N. Turcan, Jr., and H. E. Skibitzke, 1954, Louisiana Dept. Conserv. Geol. Bull. 30, p. 60–61 Sequence of thin lenticular fine-grained beds containing pyrite, marcasite, and organic remains. Thickness about 1,200 feet. Overlies Steep Gully member (new) with contact gradational; underlies graveliferous deposits of early Pleistocene age.

Named for town of Mamou in Evangeline Parish, about 45 miles south of Alexandria, near which it occurs typically in deposits penetrated by a water-well test hole, in T. 5 S., R. 1 E.

Manana Tuff[1] (in Honolulu Volcanic Series)

Pleistocene, upper, or Recent: Oahu Island, Hawaii.

Original reference: H. T. Stearns, 1935, Hawaii Div. Hydrography Bull. 1.

G. A. Macdonald and D. A. Davis *in* Jacques Avias and others, 1956, Lexique Strat. Internat., v. 6, Océanie, fasc. 2, p. 114–115. Gray to brown palagonitized tuff, erupted from two vents and constituting the tuff cone of Manana Island. Highest point of island has altitude of 361 feet, but tuff extends unknown distance below sea level. On adjacent mainland, tuff unconformably overlies Koolau volcanic series and overlies reef believed to have been formed during the plus 25-foot (Waimanalo) stand of sea. Extent noted.

Forms Manana Island, a nearly circular island about 0.4 mile in diameter, 1½ miles northwest of Makapuu Head.

Manasquan Formation (in Rancocas Group)

Manasquan Marl[1]

Eocene, lower and middle: New Jersey.

Original reference: W. B. Clark, 1893, New Jersey Geol. Survey Ann. Rept. 1892, p. 205–208.

H. G. Richards, 1945, Geol. Soc. America Bull., v. 56, no. 4, p. 402. There is no evidence, faunal or stratigraphic, for an unconformity between Manasquan and Shark River formations (Eocene). It is more probable that these two formations represent a single unit.

W. B. Spangler and J. J. Peterson, 1950, Am. Assoc. Petroleum Geologists Bull., v. 34, no. 1, p. 4 (fig. 2), 8 (fig. 4), 59–61. Originally described as separate formations, Manasquan and Shark River marls now thought to be equivalent. Manasquan-Shark River formation is reported to overlie conformably the Vincentown and dips on average about 15 feet per mile southeast. No good exposures of formation occur in which both upper and lower limits are exposed; hence, thickness is not known but is probably 25 to 30 feet. Since Manasquan and Shark River are equivalent, it is not known what part of the Manasquan the Shark River beds represent. Chart shows the Shark River-Manasquan stratigraphically below Kirkwood formation. Considered Wilcox in age.

H. W. Miller, Jr., 1956, Am. Assoc. Petroleum Geologists Bull., v. 40, no. 4, p. 733–735. Manasquan formation with its Shark River member is definitely Eocene, but its position within the Eocene is doubtful. In view of its stratigraphic position, overlying lower Eocene Vincentown formation, and first appearance of several typical Eocene genera in section, it is writer's [Miller] opinion that the Manasquan is mid-Eocene Claiborne in age.

J. P. Minard and J. P. Owens, 1960, U.S. Geol. Survey Prof. Paper 400-B, p. B184. Rancocas group includes (ascending) Hornerstown sand, Vincentown formation, and Manasquan formation.

Named for exposure on Manasquan River, Monmouth County. Exposures chiefly from Asbury Park southwest to Marlton.

Manassas Sandstone (in Newark Group)[1]

Upper Triassic: Virginia.

Original reference: J. K. Roberts, 1923, Pan-Am. Geologist, v. 39, p. 185-200.

R. S. Young and R. S. Edmundson, 1952, (abs.) Virginia Jour. Sci., v. 3, new ser., no. 4, p. 329. A fresh-water limestone, 6 to 9 inches thick, occurs in the Manassas and is exposed in quarry along State Route 3 about 3½ miles east of Culpeper.

Extends in broken belts from a few miles south of Potomac River over all areas to Carolina border.

Manastash Formation[1]

Eocene: Central Washington.

Original reference: G. O. Smith, 1902, U.S. Geol. Survey 22d Ann. Rept., pt. 3, p. 485-486.

C. E. Weaver, 1937, Washington [State] Univ. Pub. in Geology, v. 4, p. 52-53. Massive quartzose sandstone containing interstratified layers of fine-grained brownish-gray shale containing seams of impure coal. Thickness 200 to 300 feet. Rests with basal conglomerate unconformably upon Easton schists; unconformably overlain by Yakima basalts and penetrated by diabase dikes. Formation does not lie in contact with other sedimentary rocks, thus making it difficult on purely stratigraphic grounds to place it definitely in Eocene sequence.

Named from occurrence near headwaters of Manastash and Taneum Creeks on south side of Yakima Valley about 20 miles west of Ellensburg, Kittitas County.

†Manatee River Marl[1]

Miocene, lower or upper: Southern Florida.

Original reference: W. H. Dall, 1892, U.S. Geol. Survey Bull. 84, p. 125-126.

Occurs on right bank of Manatee River, a few miles above Braidentown, Manatee County.

†Manayunk Mica Schists and Gneisses[1]

Precambrian (Glenarm Series): Southeastern Pennsylvania.

Original reference: C. E. Hall, 1881, Pennsylvania 2d Geol. Survey Rept. C_6, p. 27-28, map.

Extends along Schuylkill River from south of Mill Creek to mouth of Wissahickon Creek.

Manchester Group (in Newark Group)[1]

Upper Triassic: Central southern Pennsylvania.

Original reference: G. H. Ashley, 1931, Pennsylvania Topog. and Geol. Survey Bull. G_1, p. 77.

Occurs in Manchester Township, York County.

Manchester Schist

Manchester Formation (in Pine Mountain Group or Series)

Precambrian: Central western Georgia.

G. W. Crickmay *in* L. M. Prindle, 1935, Georgia Geol. Survey Bull. 46, p. 32–33. Formation made up mainly of mica schist and garnet-biotite gneiss. Includes quartzite member, 50 to 300 feet thick, about 850 feet above base. Overlies Hollis quartzite. In Pine Mountain series.

D. F. Hewett and G. W. Crickmay, 1937, U.S. Geol. Survey Water-Supply Paper 819, p. 29, pl. 1. Mica schist and biotite gneiss; in vicinity of Warm Springs contains enough graphite to mark paper; about 850 feet above base, contains persistent bed of quartzite that ranges from 50 to 300 feet in thickness. Overlies Hollis quartzite.

J. W. Clarke, 1952, Georgia Geol. Survey Bull. 59, p. 6 (table), 14–23. In Thomaston quadrangle, referred to as formation in Pine Mountain group. Consists of three unnamed members (ascending): kyanite-muscovite schist and biotite schist, 1,200 to 3,000 feet; quartzite, 200 to 800 feet; and mica schist and feldspathic mica schist, 1,500 feet. Intruded by Jeff Davis granite (new). Precambrian(?).

Named for Manchester, Meriwether County. Exposed in two belts that extend generally northeast, one is north of Pine Mountain and the other south of Oak Mountain; area is south of Towaliga fault.

Manchester Shale[1]

Eocene: Southwestern Arkansas.

Original reference: R. T. Hill, 1888, Arkansas Geol. Survey Ann. Rept. 1888, v. 2, p. 52, 188.

Named for exposures at Manchester Landing, near mouth of L'Eau Frais, Clark County.

Mancos Sandstone[1]

Upper Cretaceous: Northwestern Colorado.

Original reference: R. D. Crawford, 1920, Colorado Geol. Survey Bull. 23, p. 11–15, map.

Name applied to sandstone about 350 to 400 feet above base of Mancos shale in Routt County.

Mancos Shale[1]

Mancos Group

Lower and Upper Cretaceous: Western Colorado, northeastern Arizona, northwestern New Mexico, eastern Utah, and southern and central Wyoming.

Original reference: W. Cross, 1899, U.S. Geol. Survey Geol. Atlas, Folio 57.

W. T. Lee, 1912, Geol. Soc. America Bull., v. 23, p. 594–598. In central New Mexico, includes Tres Hermanos sandstone member, 150 feet thick, in lower part. Includes the rocks, mainly shale, above Dakota sandstone and below Mesaverde formation.

C. T. Lupton, 1914, U.S. Geol. Survey Bull. 541, p. 128. Mancos shale near Green River, Utah, includes Ferron sandstone member (new), 50 to 100 feet thick, about 400 feet above base. Overlies Dakota sandstone.

C. R. Longwell and others, 1923, U.S. Geol. Survey Prof. Paper 132–A, p. 3–4 (table), 15, 21–22. Discussion of rock formations in Colorado Plateau of Utah and Arizona. To rocks above Dakota(?) sandstone in Henry Mountains, Gilbert (1877) applied local names (ascending) Tununk shale, Tununk sandstone, Blue Gate shale, Blue Gate sandstone, Masuk shale, and Masuk sandstone. Only Gilbert's names for the sandstones have been adopted by U.S. Geological Survey, and in present report his names for the shales are used in quotation marks because of doubt regarding relations of this whole succession of sandstone and shale to named units to north and east. R. C. Moore tentatively correlates "Tununk shale," Tununk sandstone, and "Blue Gate shale" with Mancos shale of southwestern Colorado and east-central Utah; Blue Gate sandstone he tentatively correlates with Mesaverde formation, "Masuk shale" with Lewis shale, and Masuk sandstone with so-called Laramie sandstone of southwestern Colorado. Some geologists, however, believe entire succession corresponds to Mancos shale.

J. B. Reeside, Jr., 1924, U.S. Geol. Survey Prof. Paper 134, p. 9–13. Described in San Juan basin, New Mexico, where it is about 1,800 feet thick, overlies Dakota sandstone and underlies Point Lookout sandstone of Mesaverde group. Contains Tocito sandstone lentil (new) about 735 feet above base.

E. T. Hancock, 1925, U.S. Geol. Survey Bull. 757, p. 7 (table), 10–13. Thickness 5,000 feet in Axial and Monument Butte quadrangle, Moffat County, Colo. Includes Morapos sandstone member (new) about 800 feet below top. Overlies Dakota sandstone; underlies Iles formation (new) of Mesaverde group.

E. M. Spieker and J. B. Reeside, Jr., 1925, Geol. Soc. America Bull., v. 36, no. 3, p. 436–440. Mancos shale, in southern part of Wasatch Plateau, comprises five members (ascending): unnamed lower shale, Ferron sandstone, middle unnamed shale, Emery sandstone (new), and upper unnamed shale. Grades upward into Star Point sandstone (new) of Mesaverde group. In Castlegate quadrangle, the middle unnamed shale member contains in upper part a lenticular sandstone named by F. R. Clark (unpub. ms.) Garley Canyon sandstone member of Mancos. Passes by gradual transition into basal formation of Mesaverde group, Star Point sandstone.

C. E. Erdmann, 1934, U.S. Geol. Survey Bull. 851, p. 23 (table), 32, 36–38. In Book Cliffs region, Colorado, overlies Dakota(?) sandstone, underlies and interfingers with Mesaverde group. Anchor Mine tongue (new) of Mancos shale penetrates Sego sandstone of Mesaverde group. Buck tongue (new) of Mancos shale separates Sego and Castlegate sandstones of Mesaverde group. Upper Cretaceous.

J. D. Sears, 1934, U.S. Geol. Survey Bull. 860–A, p. 12–14. In southern part of San Juan basin, New Mexico, includes Mulatto and Satan tongues (both new).

C. B. Hunt, 1936, U.S. Geol. Survey Bull. 860–B, p. 40–45, pls. East of Mount Taylor, N. Mex., there are three prominent sandstones in lower 350 feet of Mancos shale to which name Tres Hermanos sandstone has been applied. Of these, sandstone No. 2, about 75 feet thick, is the most persistent. Main body of Mancos includes Mulatto tongue in lower part, and Satan tongue in upper part. Overlies Dakota(?) sandstone; intertongues with Mesaverde formation.

P. T. Walton, 1944, Geol. Soc. America Bull., v. 55, no. 1, p. 97–98 (table), 99–105. Discussion of Cretaceous geology of Uinta Basin. All strata between Dakota(?) sandstone and lowest member of sequence of sandstone mapped as Mesaverde undivided are designated as Mancos shale. Conformably overlies Dakota(?) sandstone throughout area but intertongues at upper boundary with Mesaverde group. Thickness varies from west to east; 800 feet at Currant Creek; more than 6,000 feet near Utah-Colorado line. Divided into five members (ascending): lower shale, Aspen shale, middle shale, Frontier sandstone, and upper shale. In Vernal region, underlies Asphalt Ridge sandstone formation (new) of Mesaverde group.

J. W. Huddle and F. T. McCann, 1947, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 75. In area of this report [Duchesne River area, Duchesne and Wasatch Counties, Utah], the Mancos, 2,900 to 3,700 feet thick, is dominantly marine formation that interfingers westward with nonmarine sandstone, shale, and coal. Includes lower shale member, 360 to 390 feet thick; Frontier sandstone member, 450 to 600 feet thick; and upper shale member, 1,800 to 2,600 feet thick. Overlies Dakota sandstone; underlies Mesaverde formation.

W. S. Pike, Jr., 1947, Geol. Soc. America Mem. 24, 103 p., pls. Discussion of large-scale intertonguing between marine Mancos and nonmarine Mesaverde strata in New Mexico, Arizona, and southwestern Colorado. Mancos shale crops out in almost unbroken line southward from Mesa Verde along western margin for distance of 180 miles to near Atarque. In addition to Mulatto and Satan tongues as defined by Sears (1934) and Hunt (1936), the Mancos includes Twowells sandstone lentil, Pescado tongue, and Horsehead tongue (all new). Pescado tongue splits Gallup member of Mesaverde into upper and lower parts. Horsehead tongue overlies Atarque member (new) of Mesaverde formation. Suggested that name Tocito sandstone lentil be dropped because it is correlative of Gallup sandstone member of Mesaverde and part of Dilco member of Mesaverde. There is probability that Tres Hermanos sandstone is a tongue of Dakota(?) sandstone.

C. H. Dane, 1948, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 78. In area of this report [eastern side of San Juan basin, Rio Arriba County, N. Mex.], the Mancos comprises the following members (ascending): Graneros shale, Greenhorn limestone, Carlile shale, Niobrara calcareous shale, and unnamed shale member. Thickness about 2,060 feet. Overlies Dakota sandstone; underlies Hosta sandstone member of Mesaverde formation. Upper Cretaceous.

W. B. Hoover, 1951, *in* C. T. Smith and others, New Mexico Geol. Soc. Guidebook 2d Field Conf., p. 13 (chart), 46, 47, 79. Includes Sanastee sandstone member (new) in vicinity of Grants.

H. J. Bissell, 1952, Am. Assoc. Petroleum Geologists Bull., v. 36, no. 4, p. 605–610. Referred to as Mancos group. Comprises (ascending) Mowry shale, Lower Mancos shale, Frontier sandstone, and Upper Mancos shale. Lower and Upper Cretaceous. Area of report is Strawberry Valley quadrangle, Utah.

C. B. Hunt, Paul Averitt, and R. L. Miller, 1953, U.S. Geol. Survey Prof. Paper 228, p. 37 (table), 79–85, pls. In Henry Mountains region, Utah, comprises five members (ascending): Tununk shale, 525 to 650 feet;

Ferron sandstone, 150 to 300 feet; Blue Gate shale, 1,500 feet; Emery sandstone, 198 to 257 feet: Masuk shale, 600 to 800 feet. Overlies Dakota sandstone; underlies Mesaverde formation. Gilbert (1877) used term Masuk sandstone for unit herein referred to as Mesaverde formation.

C. E. Stearns, 1953, Geol. Soc. American Bull., v. 64, no. 4 p. 466. In Tonque Valley, N. Mex., Cano sandstone member (new) of Mesaverde formation is interbedded in upper part of Mancos shale.

Dan Bozanic, 1955, Four Corners Geol. Soc. [1st] Field Conf., p. 91. Term Sanastee was apparently applied to unit which had earlier been named Juana Lopez by Rankin (1944).

D. M. Kinney, 1955, U.S. Geol. Survey Bull. 1007, p. 97–110. In this report [Uinta River-Brush Creek area, Duchesne and Uintah Counties, Utah], Mancos shale, of Late Cretaceous age, is divided into three members (ascending): Mowry shale, 30 to 120 feet, Frontier sandstone, 140 to 270 feet, and upper unnamed shale, 4,900 feet. Overlies Dakota sandstone; underlies Mesaverde formation. Term Mowry is used in preference to term Aspen; term Frontier is retained as a member although the unit may not be strictly equivalent to typical Frontier; term upper shale member is used in preference to continuing use of Hilliard shale in eastern Uinta Mountains.

R. G. Young, 1955, Geol. Soc. America Bull., v. 66, no. 2, p. 177–202. Discussion of sedimentary facies and intertonguing in Upper Cretaceous of Book Cliffs, Utah-Colorado. Dominantly continental deposits of Star Point, Blackhawk, and Price River formations pass eastward into lagoonal deposits which interfinger eastward with marine Mancos shale. As exposed in the cliffs, the Mancos is drab, gray, or slightly bluish; near the top are a few thin lenses of calcareous sandstone, limestone, a few concretionary beds. In central Utah, where it is separated from lower members by Emery sandstone, this upper part of the Mancos is called Masuk member, but, to the east, it is not readily separable. It is about 5,000 feet thick in central Utah and about 4,000 feet thick in western Colorado. However, exposed parts rarely exceed 600 to 700 feet. Upper part of Mancos grades into overlying littoral marine sandstone tongues, with which it interfingers. These tongues of sandstone thin eastward and grade into the shale. Above each sandstone tongue is a tongue of Mancos shale thinning westward. The two largest shale tongues are the Buck and Anchor Mine. This interfingering results in stratigraphic rise of upper boundary toward east, making upper part of Mancos increasingly younger from west to east.

C. A. Repenning and H. G. Page, 1956, Am. Assoc. Petroleum Geologists Bull., v. 40, no. 2, p. 263–271. Mancos shale in Black Mesa, Ariz., represents only small part of type Mancos of southwestern Colorado. Marine shale of Mancos intertongues south and west of type locality with sandstone units of overlying Mesaverde group, the top of Mancos thereby lowering in age in those directions. Evidence on Black Mesa suggests also that base of Mancos rises in age in those directions from type locality. Result is pinch-out of the Mancos in those directions. Black Mesa is in intermediate position between Mancos at type locality and its pinch-out. Underlies Toreva formation (new) of Mesaverde group; overlies Dakota sandstone.

E. C. Beaumont, C. H. Dane, and J. D. Sears, 1956, Am. Assoc. Petroleum Geologists Bull., v. 40, no. 9, p. 2149–2162. In revised nomenclature of Mesaverde group, San Juan basin, New Mexico, name Gallup sandstone as a formation in Mesaverde group will replace Gallup sandstone member, and in its northward extension, replace in its entirety the Tocito sandstone lentil of Mancos shale.

W. H. Tonking, 1957, New Mexico Bur. Mines Mineral Resources Bull. 41, p. 19–20. In Puertecito quadrangle, New Mexico, underlies La Cruz Peak formation (new) of Mesaverde group. In this report, the Mancos is restricted to strata beneath the Tres Hermanos(?) sandstone which is assigned tentatively to Mesaverde group.

D. B. Givens, 1957, New Mexico Bur. Mines and Mineral Resources Bull. 58, p. 7–8, 10. In Dog Springs quadrangle, includes Tres Hermanos member. La Cruz Peak formation as mapped in area of this report differs from the La Cruz Peak as defined by Tonking (1957) in that the shale which he included at base of the formation in Puertecito quadrangle is here included in the Mancos.

C. H. Dane, A. A. Wanek, and J. B. Reeside, Jr., 1957, Am. Assoc. Petroleum Geologists Bull., v. 41, no. 2, p. 181–197. Report is reinterpretation of section of Cretaceous rocks in Alamosa Creek valley area, Catron and Socorro Counties, N. Mex. Winchester's (1920) Bell Mountain sandstone at top of his Miguel formation is upfaulted duplication of his Gallego sandstone member from which it was supposed to be separated by nearly 1,000 feet of beds. Winchester's names. Miguel formation, Chamiso formation (for Mesaverde rocks overlying the Miguel), and Bell Mountain sandstone member are abandoned and stratigraphic names used in San Juan basin are extended to units recognized in Alamosa Creek valley. The marine shale tongue of Mancos shale (Pescado tongue of Pike, 1947) underlying Gallego sandstone member, now of Gallup sandstone, is shown to be of latest Carlile age, although it contains some species heretofore regarded as indicative of Niobrara age. Name D-Cross tongue of Mancos is herein proposed for this marine shale unit, which may be a somewhat higher and younger tongue than Pescado tongue at its type locality. Lower part of Gallup sandstone tongues out into Mancos shale in southeastern part of Mount Taylor coal field.

R. G. Young, 1959, Rocky Mountain Assoc. Geologists 11th Field Conf., Symposium, p. 18 (fig. 1), 19 (fig. 2), 20 (fig. 3), 21–22, 23 (fig. 4); 1960, Am. Assoc. Petroleum Geologists Bull., v. 44, no. 2, p. 159 (fig. 2), 176–180. In southwestern Colorado, disconformably overlies Naturita formation (new) of Dakota group. Because of intertonguing with underlying Dakota deposits, base of Mancos becomes progressively younger to west.

R. E. Kucera, 1959, Rocky Mountain Assoc. Geologists 11th Field Conf., Symposium, p. 41–43. Mancos shale in Yampa district, northwestern Colorado, is restricted to thick succession of shale, sandy shale, and thin-bedded sandstone overlying Niobrara formation and underlying Mesaverde group. Shales and sandstones of Mancos grade upward and interfinger with Tow Creek sandstone member of Iles formation. Includes Devils Grave sandstone member (new) in lower part and Hunt Creek sandstone member (new) in upper part.

Kenji Konishi, 1959, Rocky Mountain Assoc. Geologists 11th Field Conf., Symposium, p. 67–73. Discussion of Axial basin and Williams Fork area, Moffat and Routt Counties, Colo. Mancos shale at type locality is 2,000 feet thick. In northwestern Colorado, section of Mancos above Frontier formation maintains thickness of about 5,000 feet. As indicated in the difference in thickness when compared with type locality, the Mancos in northwestern Colorado includes younger deposits than are included at type locality. Mowry shale and Frontier formation (within Mancos shale of older terminology) have been given formational status; that is, Mancos shale as herein used includes that part of original Mancos above Frontier formation. Mancos is oldest stratigraphic unit exposed in area; basal contact with underlying Frontier is in subsurface. Upper boundary with Mesaverde group (Iles formation) is gradational. Several mappable sandstone members and tongues recognized in upper 1,200 feet of Mancos. They are (ascending) Morapos sandstone member, "Second Mancos sandstone tongue," "First Mancos sandstone tongue," and Loyd sandstone member (new). Meeker sandstone member (new) occurs about 700 feet below Morapos sandstone member. Basal 600 to 700 feet of Mancos is distinguished from other parts of formation by its calcareous nature and its fauna.

U.S. Geological Survey currently classes the Juana Lopez Sandstone as a member of the Mancos Shale on the basis of a study now in progress.

Named for occurrence in Mancos Valley and about town of Mancos, between La Plata Mountains and the Mesa Verde, Montezuma County, Colo.

Mancosian series[1]

Cretacic: Arizona, Colorado, and New Mexico.

Original reference: Name credited to C. R. Keyes. [Original reference not located by present compilers.]

Charles Keyes, 1936, Pan-Am. Geologist, v. 66, no. 3, p. 225 (fig. 11). Name given as Mancosan [apparently a lapsus for Mancosian]. Cretacic. Overlies Dakotan sandstone.

Mandan Amygdaloid[1] (in Central Mine Group)

Precambrian (Keweenawan): Northern Michigan.

Original reference: A. C. Lane, 1911, Michigan Geol. and Biol. Survey Pub. 6, geol. ser. 4, p. 177, 205, 206, 248, 409, 490, 491, figs. 23, 24, 25, 29, 34.

Named for occurrence in Mandan mine, Keweenaw County.

Mandan Flow[1]

Precambrian (Keweenawan): Northern Michigan.

Original reference: B. S. Butler and W. S. Burbank, 1929, U.S. Geol. Survey Prof. Paper 144 (chart compiled by M. G. Wilmarth).

H. R. Cornwall, 1951, Geol. Soc. America Bull., v. 62, no. 2, p. 161, 167, pl. 1. Typically ophitic basalt with pegmatitic layers in its upper part in Michigan copper district. Along the strike, thickness ranges from a few feet to 400 feet. Occurs about 300 feet stratigraphically below Greenstone flow.

In Houghton and Keweenaw Counties.

Mandanan series[1]

Tertiary(?): Western North Dakota and South Dakota.

Original reference: C. R. Keyes, 1925, Pan-Am. Geologist. v. 43, p. 135.

Probably named for exposures at and around village of Mandan, Morton County, N. Dak.

Mandata Formation (in Helderberg Group)

Mandata Member (of Helderberg Formation)

Lower Devonian: Central and south-central Pennsylvania and western Maryland.

F. M. Swartz, 1938, (abs.) Geol. Soc. America Bull., v. 49, no. 12, pt. 2, p. 1923; 1939, Pennsylvania Geol. Survey, 4th ser., Bull. G–19, p. 65–69, 80–81. Formation consists of shale and chert. Comprises several rock units (ascending): thin-bedded shale with thin bed of impure limestone; thin-bedded gray shale and four interbedded layers of dark-gray finely crystalline limestone; thin-bedded dark-gray shale and few interbedded impure chert layers; medium-bedded impure dark chert and interbedded dark-gray shale, with thin bed of impure limestone; and thin-bedded unfossiliferous shale. Thickness 91 feet at type locality; thins westward. Underlies cherts of Oriskany age, Shriver chert in some areas; overlies cherty New Scotland limestone. In Perry County, overlies Falling Springs sandstone member (new) of New Scotland. Contacts not well exposed but appear sharp. Type locality designated. Geographically extended to Maryland.

H. H. Arndt and others, 1959, Geol. Soc. America Guidebook Pittsburgh Mtg., p. 4, 13. Referred to as member of Helderberg formation.

Type locality: On highway to Berrysburg, one-fourth mile south of Mandata (Bull Run of Millersburg topographic sheet), Northumberland County, Pa.

Manele Basalt[1] (in Lanai Volcanic Series)

Pleistocene(?): Lanai Island, Hawaii.

Original reference: C. K. Wentworth, 1925, Bernice K. Bishop Mus. Bull. 24, p. 39.

G. A. Macdonald and D. A. Davis *in* Jacques Avias and others, 1956, Lexique Strat. Internat., v. 6, Océanie, fasc. 2, p. 114–115. Crater remnant that forms headland south and west of Manele harbor, including all basalt south of sandy neck of land at Manele. Unit of Lanai basalt included in Lanai volcanic series. Relationships to rest of Lanai basalt not given.

Type locality: Headland south and west of Manele Harbor. Exposed over about one-fourth square mile at south edge of Lanai.

Maness Shale (in Washita Group)

Maness Shale Member (of South Tyler Formation)

Cretaceous (Comanche Series): Northeastern Texas (subsurface).

T. L. Bailey, F. G. Evans, and W. S. Adkins, 1945, Am. Assoc. Petroleum Geologists Bull., v. 29, no. 2, p. 176–178, pl. 1. In type well, consists of faintly laminated to massive bronze or copper-colored and dark-gray somewhat calcareous clay shale and claystone. Underlies Woodbine formation; overlies Buda limestone. Occurs at depths of 4,705 to 4,766 feet.

R. T. Hazzard, B. W. Blanpied, and W. C. Spooner, [1947], Shreveport Geol. Soc. 1945 Ref. Rept., v. 2, p. 476. Included at base of newly defined South Tyler formation.

Type well: Shell Oil Co.'s Maness well No. 1, eastern Cherokee County.

Mangas quartzite[1]

Upper Cambrian: Southwestern New Mexico.

Original references: C. R. Keyes, Iowa Acad. Sci. Proc., v. 22, p. 257–259; 1915, Conspectus of geologic formations of New Mexico. Des Moines, Robert Henderson, State Printer, p. 4, 9.

Exposed near Silver City, Grant County.

Mangum Dolomite Member (of Blaine Gypsum)[1]

Mangum Dolomite Member (of Dog Creek Formation)

Permian: Southwestern Oklahoma and central northern Texas.

Original reference: C. N. Gould, 1905, U.S. Geol. Survey Water-Supply Paper 148, p. 71.

T. S. Jones, 1953, Stratigraphy of the Permian basin of West Texas: West Texas Geol. Soc., p. 30 (fig. 9). Shown on correlation chart as member of Dog Creek formation. Underlies Guthrie dolomite member; overlies Shimer dolomite member of Blaine formation. Permian (Guadalupe).

G. L. Scott, Jr., and W. E. Ham, 1957, Oklahoma Geol. Survey Circ. 42, p. 17 (fig. 3), 25–26, pl. 1. In Carter area, Oklahoma, member of Blaine formation; consists of gray limy dolomite, about 1½ feet thick, typically weathering to honeycombed pattern. Overlies Collingsworth gypsum member; underlies Van Vactor gypsum member (new).

Named for Mangum, Greer County, Okla.

†Manhasset Boulder Bed[1]

Pleistocene: Southeastern New York.

Original reference: J. B. Woodworth, 1901, New York State Mus. Bull. 48.

Mapped along eastern side of Manhasset Neck, Long Island.

Manhasset Formation[1]

Pleistocene: Southeastern New York and southern New England islands.

Original reference: J. B. Woodworth, 1901, New York State Mus. Bull. 48, pl. 1, text.

Lawrence Weiss, 1954, U.S. Geol. Survey Prof. Paper 254–G, p. 146. Thickness 150 to 200 feet. Includes (ascending) Herod gravel, Montauk till, and Hempstead gravel members. Overlies Jacob sand. Fuller (1914) believed Manhasset formation to be of Illinoian age and that an interglacial erosional interval, the Vineyard stage, intervened between period of deposition of the Manhasset and that of younger Wisconsin drift. Recent workers feel that lack of any noticeable difference in weathering between the Manhasset and younger Wisconsin drift, and absence of any generalized interglacial deposits, preclude existence of interglacial stage; thus, the Manhasset is believed to be of Wisconsin age.

First described in vicinity of Manhasset Neck, Long Island. Present on Block Island, Nantucket, Marthas Vineyard, No Mans Land, and Cape Cod.

†Manhattan Beds[1]

Permian: Northern Kansas.

Original reference: Robert Hay, 1893, Kansas State Bd. Agric. 8th Bienn. Rept., p. 101.

Named for Manhattan, Riley County.

Manhattan Drift

Pleistocene (Wisconsin): Northern Illinois.

J. S. Templeton and H. B. Willman, 1952, Tri-State Geol. Soc. Guidebook 16th Ann. Field Conf., p. 12 (fig. 4). Shown on columnar section of Pleistocene deposits as Manhattan-Rockdale drift. Occurs below Valparaiso drift and above Minooka drift.

Tills present in Joliet area.

†Manhattan Gneiss[1]

Precambrian: New York.

Original reference: D. S. Martin, 1888, Geol. map of New York City and vicinity.

†Manhattan Group[1]

Precambrian: Southeastern New York.

Original reference: R. P. Stevens, 1867, New York Lyc. Nat. History Annals, v. 8, p. 116–120.

J. J. Prucha, 1956, Am. Jour. Sci., v. 254, no. 11, p. 673. Proposed that term Manhattan group be abandoned and unit comprised of Fordham gneiss, Inwood marble, and Manhattan formation (new) be renamed New York City group.

Type locality not stated. Term first applied to rocks on Manhattan Island.

†Manhattan Limestone (in Council Grove Group)[1]

Permian: Northern Kansas.

Original reference: C. S. Prosser, 1894, Geol. Soc. America Bull., v. 6, p. 37, 40–41.

Named for Manhattan, Riley County.

Manhattan Schist[1]

Manhattan Formation (in New York City Group)

Precambrian: Southeastern New York and western Connecticut.

Original reference: F. J. H. Merrill, 1890, Am. Jour. Sci., 3d, v. 39, p. 390.

J. J. Prucha, 1956, Am. Jour. Sci., v. 254, no. 11, p. 673. Manhattan formation is uppermost unit in New York City group (new). Name Manhattan schist considered inappropriate. Formation is dominantly a garnetiferous quartz-biotite-plagioclase gneiss characterized by sillimanite and locally much muscovite. Overlies Inwood marble. Inwood is indistinguishable lithologically from marble layers occurring in Manhattan formation. Age of group not certain; may ultimately prove to be correlative of Cambro-Ordovician series north of Hudson Highlands.

J. W. Clarke, 1958, Connecticut Geol. Nat. History Survey Quad. Rept. 7, p. 4, 21–26, geol. map. Formation mapped in Danbury quadrangle. Was called Becket gneiss on State geological map of 1906; and Balk (1936, Geol. Soc. America Bull., v. 47, no. 5). Term Manhattan formation used because of apparent physical continuity with type locality. Overlies Inwood marble.

Named for exposures on Manhattan Island, N.Y.

Manheim Formation (in Pocono Group)

Mississippian: Northern West Virginia.

J. L. Dally, 1956, Dissert, Abs., v. 16, no. 12, p. 2425. Named as lower unit in group in northern part of state. Underlies Burgoon formation.

Possibly named for Manheim, Preston County.

Manila Agglomerate or Andesite

Eocene(?): Mariana Islands (Rota)

Risaburo Tayama, 1939, Correlation of the strata of the South Sea Islands: Geol. Soc. Japan Jour., v. 46, no. 549, p. 346 (correlation chart) [English translation in library of U.S. Geol. Survey]. Manila andesite named on correlation chart. Eocene.

Risaburo Tayama, 1952, Coral reefs in the South Seas: Japan Hydrog. Office Bull., v. 11, p. 48, table 4 [English translation in library of U.S. Geol. Survey, p. 57]. Referred to as Manila agglomerate. Correlated with Kagman andesite, Marino agglomerate, Baranos andesite, and Aimiliiki agglomerate. Eocene.

S. Hanzawa *in* Jacques Avias and others, 1956, Lexique Strat. Internat., v. 6, Océanie, fasc. 2, p. 43. Manila agglomerate forms basement complex of island. Consists of two pyroxene-, hypersthene-, common-augite-andesites and their agglomerates. Conformably underlies Mariiru limestone. Eocene(?). Refers to S. Sugawara (1939, unpub. ms.) and K. Asano (1939, Jubilee Pub. Yabe's 60th Birthday).

Type locality: Manila Hill, highest part of Rota Island.

Maniobra Formation

Eocene, lower and middle: Southern California.

J. C. Crowell and Takeo Susuki, 1959, Geol. Soc. America Bull., v. 70, no. 5, p. 581–592, pl. 1. Consists of interbedded siltstone, sandstone, and breccia along with sandy limestone and conglomerate. Total thickness about 4,800 feet. In thickest part, is differentiated into two mappable units which intertongue. One unit, consisting of coarse sedimentary breccia and conglomerate, in the main lies lower in the section; the other unit, composed of light-buff siltstone with conspicuous sandstone and grit layers, predominates high in section but extends also as lenses and tongues to within a few feet of the base. On east at base of section, large granitic boulders up to 30 feet in diameter lie along the unconformity with basement granite; these give way upward to thick lenses of coarse granitic conglomerate and breccia with interbeds of buff siltstone and arkosic sandstone; upper part of section on east consists of massive buff siltstone with sandstone and boulder beds. On west, section consists largely of interbedded siltstone and sandstone with conspicuous isolated boulders of granite. Type section lies between granitic basement on north and basal conglomerate of overlying unnamed nonmarine rocks on south.

Type locality: Just west of the valley herein named Maniobra Valley. Valley was part of maneuver area used during World War II by armored units from Desert Training Center. Since many of the topographic names in region have come from Spanish, maneuver is herein translated into the Spanish maniobra. Strata are exposed in northeastern Orocopia Mountains in Colorado Desert, Riverside County. Beds lie about 15 miles northeast of San Andreas fault zone and are preserved in broad east-west structural depression in border zone between Transverse Ranges and Basin and Range Province.

Manistee Limestone[1]

Mississippian: Western Michigan.

Original reference: C. C. Douglass, 1839?, Michigan Leg. H. Doc. 27, p. 97–111.

Occurs near Manistee River in T. 15 N.

Manistique Dolomite

Manistique Group

Manistique Series[1] or Formation

Middle Silurian (Niagaran Series): Northern Michigan and eastern Wisconsin.

Original reference: R. A. Smith, 1916, Michigan Geol. Survey Pub. 21, p. 152.

R. B. Newcombe, 1933, Michigan Geol. Survey Pub. 38, p. 23, 37. Manistique formation divided into Schoolcraft and Cordell members.

C. K. Swartz and others, 1942, Geol. Soc. America Bull., v. 53, no. 4, chart 3. Manistique dolomite (Wisconsin and Michigan) includes Schoolcraft dolomite below and Cordell dolomite above.

G .M. Ehlers and R. V. Kesling, 1957, Michigan Geol. Soc. [Guidebook] Ann. Geol. Excursion, p. 2 (table), 19–22, 31 (fig. 2). Rank raised to group, and members to formations. Overlies Burnt Bluff group; underlies Engadine dolomite. Thickness as much as 210 feet.

Named for exposures at Manistique, Schoolcraft County, Mich.

†Manitoban Substage[1]

Pleistocene: Great Lakes region.

Original reference: M. M. Leighton, 1931, Jour. Geology, v. 77, p. 51–53.

The name Manitoban is taken from province of Manitoba, Canada.

Manitou Amygdaloid[1]

Precambrian (Keweenawan): Northern Michigan.

Original reference: B. S. Butler and W. S. Burbank, 1929, U.S. Geol. Survey Prof. Paper 144 (chart compiled by M. G. Wilmarth).

Named for occurrence in Manitou mine, Keweenaw County.

Manitou Flow[1]

Precambrian (Keweenawan): Northern Michigan.

Original reference: B. S. Butler and W. S. Burbank, 1929, U.S. Geol. Survey Prof. Paper 144 (chart compiled by M. G. Wilmarth).

Probably named for occurrence in Manitou mine, Keweenaw County.

Manitou Limestone,[1] Dolomite, or Formation

Lower Ordovician: Eastern Colorado.

Original reference: W. Cross, 1894, U.S. Geol. Survey Geol. Atlas, Folio 7.

A. E. Brainerd, H. L. Baldwin, Jr., and I. A. Keyte, 1933, Am. Assoc. Petroleum Geologists Bull., v. 17, no. 4, p. 379–382. Representative type section designated in which name Manitou is restricted to Ordovician limestone lying between Cambrian Sawatch sandstone and Devonian limestone herein named Williams Canyon. Thickness 218 feet.

Q. D. Singewald and B. S. Butler, 1941, U.S. Geol. Survey Bull. 911, p. 8 (table 1). In London fault area, Mosquito Range, the Manitou is as much as 130 feet thick; overlies Peerless shale member of Sawatch quartzite; underlies Parting quartzite member of Chaffee formation.

J. H. Johnson, 1944, Geol. Soc. America Bull., v. 55, no. 3, p. 308 (table 1), 314–320. Ordovician sequence along Sawatch Range includes remnants of three formations: Manitou dolomite, Harding sandstone, and Fremont limestone. The Manitou consists of thinly bedded dolomites and dolomitic limestone; very siliceous in places. Thickness 100 to 370 feet.

Separated by unconformities from Sawatch quartzite below and Harding sandstone above. Lower Ordovician.

J. C. Maher, 1950, U.S. Geol. Survey Oil and Gas Inv. Prelim. Chart 39. Restricted at base to exclude 8 to 14 feet of dolomite herein named Ute Pass dolomite. Thickness of restricted Manitou about 187 feet. Underlies Williams Canyon limestone.

Q. D. Singewald, 1951, U.S. Geol. Survey Bull. 970, p. 9 (table 1). In Blue River area, Summit County, consists of thin-bedded white to medium-blue mostly crystalline dolomite. Thickness about 70 feet. Overlies Peerless formation; disconformably underlies Parting quartzite member of Chaffee formation.

N. W. Bass and S. A. Northrop, 1953, Am. Assoc. Petroleum Geologists Bull., v. 37, no. 5, p. 892 (fig. 2), 893, 905–911. Manitou formation of this report [White River Plateau] includes a little more than upper half of Dotsero dolomite (Bassett, 1939). Term formation preferred to limestone because unit includes variety of rock types. Subdivided into (ascending) Dead Horse conglomerate and Tie Gulch dolomite members (both new). Thickness 80 to 155 feet. Overlies Clinetop algal limestone member (new) of Dotsero formation; underlies Parting member of Chaffee formation.

M. G. Dings and C. S. Robinson, 1957, U.S. Geol. Survey Prof. Paper 289, p. 11–12, pl. 1. Manitou dolomite described in Garfield quadrangle, Gunnison and Chaffee Counties. At most places, rests unconformably on irregular surface of Sawatch quartzite, but in southern part of Tomichi district, and in Monarch district, rests on Precambrian granite. Manitou dolomite is equivalent to the limestone below the quartzite in Tomichi limestone of Crawford's (1913) nomenclature. Thickness 175 to 250 feet. Manitou is characteristically bluish-gray crystalline well-bedded dolomite. Individual beds range in thickness from a few inches to several feet in thickness. Metamorphic processes, particularly those related to intrusion of Mount Princeton quartz monzonite, have locally changed the dolomite to marble. Unconformably underlies Harding quartzite.

R. R. Berg and R. J. Ross, Jr., 1959, Jour. Paleontology, v. 33, no. 1, p. 106–119. On basis of faunal correlations, unit termed Ute Pass at Williams Canyon is reassigned to lower part of Manitou. On bases of lithology and stratigraphic position, the Ute Pass of Missouri Gulch is correlated with Peerless formation and term Ute Pass dolomite abandoned. The Manitou consists of finely to coarsely crystalline limestone and minor amounts of dolomite that total 195 feet at type locality. Here section is sparingly fossiliferous and contains trilobite and brachiopod fauna in lower part and gastropod fauna above. To northwest in Manitou Park, formation consists chiefly of dense red dolomite as in vicinity of Missouri Gulch, and trilobites occur mainly in thin beds of limestone. South of Williams Canyon, the Manitou is massive dense unfossiliferous dolomite. Faunal evidence indicates that the Manitou slowly lapped southward over eroded pre-Ordovician surface. From north to south, formation rests successively on Peerless formation, Sawatch quartzite, and Precambrian rocks. Overlapped by Middle Ordovician Harding sandstone.

Type section: Measured on east side of canyon above the Narrows of Williams Canyon, north of Manitou, SW¼ sec. 32, T. 13 S., R. 67 W., El Paso County.

Manitou Series[1]

Precambrian: Minnesota.

Original reference: N. H. Winchell, 1899, Minnesota Geol. and Nat. History Survey, v. 4, p. 297–298.

F. J. Pettijohn, 1937, Geol. Soc. America Bull., v. 48, no. 1, p. 166–170. Discussion of northern Lake Superior region. Manitou series is represented by granite-pebble-bearing conglomerates, arkose, quartzite, slate, and a little agglomerate and tuff. Mapped in six areas. Early Precambrian.

Named for exposures on Manitou River, Lake County.

Manitoulin Dolomite Member (of Cataract Formation)[1]

Manitoulin Dolomite (in Cataract Group)

Manitoulin Dolomite (in Medina Group)

Lower Silurian: Ontario, Canada and northern Michigan and western New York.

Original reference: M. Y. Williams, 1913, Ottawa Nat., v. 27, p. 37.

D. W. Fisher, 1954, Am. Assoc. Petroleum Geologists Bull., v. 38, no. 9, p. 1981 (fig. 2), 1982 (fig. 3), 1989–1990. Discussion of stratigraphy of Medinan group in Ontario and New York. Manitoulin ranges in thickness from 50 feet at type locality to 4 feet along Niagara Gorge. Not positively identified east of gorge. Underlies Cabot Head shale. Overlies Whirlpool sandstone in Hamilton and vicinity; overlies Fish Creek shale (new) at DeCew Falls and in Niagara Gorge. Name Manitoulin has been applied to shale equivalent of the dolomite in Niagara Gorge, but this is not proper since it is a different lithologic unit. In west, the Manitoulin is light-gray irregularly bedded dolomitic limestone changing toward east so that in Niagara Gorge it is yellowish-gray sandy and silty phosphatic dolomite weathering pale buff. In restored stratigraphic cross section (fig. 2) of Medinan group, datum is Manitoulin-Cabot Head contact, the line along which dominant transgression changed to dominant regression; hence this contact closely approached a true time-line.

G. M. Ehlers and R. V. Kesling, 1957, Michigan Geol. Soc. [Guidebook] Ann. Geol. Excursion, p. 2 (table), 4 (fig. 4), 5. Best exposures of Manitoulin dolomite in Michigan are on or near shore of Scott Bay on northwest side of Drummond Island, Chippewa County. Only two exposures are known west of Drummond Island; one of these is northwest shore Manistique Lake in Luce County where unit is about 9 feet thick. Basal formation in Cataract group; underlies Cabot Head shale. Alexandrian series.

Named for exposures on Manitoulin Island, Ont.

Manitoulin Limestone[1]

Silurian (pre-Niagaran): Michigan, and Ontario, Canada.

Original reference: J. J. Bigsby, 1824, Notes on geography and geology of Lake Huron, p. 199–204.

Manix Lake Beds[1]

Pleistocene: Southern California.

Original reference: J. P. Buwalda, 1914, California Univ. Pub., Dept. Geol. Bull.. v. 7, p. 444.

F. M. Byers, Jr., 1960, U.S. Geol. Survey Bull. 1089–A, p. 45–46, pl. 2. Described in Alvord Mountain quadrangle, where beds occur chiefly between the 1,780- and 1,800-foot contours and mark approximate shoreline of Lake Manix in Pleistocene time. Mammalian vertebrate fossils and fossil birds collected from Manix Lake beds suggest a late Pleistocene age.

Well exposed along Mohave River 2 miles southeast of Manix, San Bernardino County, about 120 miles northeast of Los Angeles.

Mankato Stade, Drift

Mankato (Mankatoan) Substage[1] or Subage

Pleistocene (Wisconsin): Mississippi Valley.

Original references: M. M. Leighton, 1931, Jour. Geology, v. 39, no. 1, p. 51–53; 1933, Science, v. 77, p. 168.

W. E. Wright, Jr., and Meyer Rubin, 1956, Science, v. 124, no. 3223, p. 625–626. Radiocarbon dates discussed in this report suggest that surface drift at Mankato should be correlated with the Cary (pre-Two Creeks) rather than with Valders (post-Two Creeks). Use of term Valders is favored over term Mankato for last major substage of the Wisconsin. Adoption of this term would establish the several important intervals of the middle and late Wisconsin—Tazewell, Cary, Two Creeks, and Valders—as units of reference based on activity of a single ice lobe (Lake Michigan lobe).

M. M. Leighton, 1957, Science, v. 125, no. 3256, p. 1037–1038. Wright and Rubin (1956) expressed view that Mankato drift should be correlated with the Cary (pre-Two Creeks) rather than with Valders (post-Two Creeks). They favor term Valders over term Mankato for last major substage of the Wisconsin. Evidence cited to show that even though Mankato is older than Two Creeks it is still younger than Cary.

M. M. Leighton, 1957, Jour. Geology, v. 65, no. 1, p. 108–109. Wisconsin stage reclassified to include the following substages (ascending): Farmdale, Iowan, Tazewell, Cary, Mankato, and Valders. Mankato includes Port Huron and Manistee drifts.

R. V. Ruhe, Meyer Rubin, and W. H. Scholtes, 1957, Am. Jour. Sci., v. 255, no. 10, p. 671–689. New radiocarbon dates in Iowa permit a grouping of age values and raise new problems in stratigraphic correlation of late Pleistocene deposits in Iowa and adjacent regions. Older group of ages greater than 29,000 years dates Iowan substage and pre-Iowan deposits. Old group of ages of 22,900 to 25,100 years dates the Farmdale substage. Intermediate group of ages ranges 14,000 to 17,000 years. Parts of Des Moines lobe previously classified as Mankato are dated at 11,600 to 11,800 years and antedate Two Creeks interstadial.

R. J. Mason, 1958, Michigan Univ. Mus. Anthropology, Anthropol. Paper 11, p. 23, 27 (table 6). In Wisconsin sequence, the Two Creeks interstadial represents the period between end of Mankato retreat and next and last glacial advance (Valders). The Cochrane is not represented in Michigan [this report].

Meyer Rubin, 1960, Am. Geophysical Union Trans., v. 41, no. 2, p. 288–289. Discussion of changes in Wisconsin glacial stage chronology by C^{14} dating. Type Mankato till dated at approximately 12,000 years, making it older than Valders till of Thwaites at Two Creeks and actually placing it into Cary substage range of ages.

J. C. Frye and H. B. Willman, 1960, Illinois Geol. Survey Circ. 285, p. 1, 3–4, 7. Presentation of revised time-stratigraphic classification of Wisconsinan stage of Lake Michigan lobe. Consists of (descending) Valderan, Twocreekan, Woodfordian, Farmdalian, and Altonian substages. Radiocarbon dates indicate that till in type area of Mankato is older than Valders till and Two Creeks forest bed of Wisconsin, rather than equivalent in age to Valders till as previously correlated. Transposition of term Mankato within Lake Michigan lobe from the till above Two Creeks forest bed to till below Two Creeks forest bed introduces a complicating modification of both Mankato and Cary, produces an unneeded substage, and retains a name from outside of Lake Michigan Lobe. The Woodfordian includes that part of Cary that has been assigned to the Mankato (Leighton, 1957; Wright, 1957, Science, v. 125, no. 3256).

M. M. Leighton, 1960, Jour. Geology, v. 68, no. 5, p. 529–552. Presentation of classification of Wisconsin glacial stage of north-central United States. Mankato glacial substage separated from older Cary glacial substage by Bowmanville intraglacial substage (new) and from younger Valders glacial substage by Two Creeks intraglacial substage. Author [Leighton] does not agree with classification recently proposed by Frye and Willman (1960). Mankato glacial substage was thought to have its greatest areal extent in Keewatin field; hence, its name was taken from that area. Substage was that of Leverett's (1933, Science, v. 77) Late Wisconsin. Recently it has been found by Ruhe (1952, Am. Jour. Sci., v. 250, no. 1; 1955, Jour. Geology, v. 63, no. 1; 1957, Am. Jour. Sci., v. 255, no. 10) that much of southern part of Des Moines lobe is of Cary age. Mankato, Minn., lies in an area of drift known to be younger than Cary and older than Valders. Hence, name of substage [Mankato] remains unchanged. Circular 285 (Frye and Willman) is confusing on this point. The circular also ignores stratigraphic relations and history of Mankato substage by placing it in the so-called "Woodfordian substage." To put all three substages, Tazewell, Cary, and Mankato, into the Woodfordian is to overlook two important intervals: the Tazewell-Cary (St. Charles) intraglacial and Cary-Mankato (Bowmanville) intraglacial intervals. In Keewatin field, a valley train issued from Mankato glacial lobe, recorded in terrace, remnants of Mississippi River valley. This is Festus terrace of Robertson (1938, St. Louis Acad. Sci. Trans., v. 29, no. 6). Present writer traced Festus terrace to outwash plain of Mankato drift in Dakota County, Minn. A low terrace below it, formerly called "Late Mankato" by Leighton and Willman (1949, Illinois Geol. Survey Field Conf., June 12–25) is now regarded by writer as Valders valley train.

Name amended to Mankato Stade to comply with stratigraphic code adopted 1961.

Name derived from Mankato County, Minn.

Mankomen Formation[1]

Permian: Southeastern Alaska.

Original reference: W. C. Mendenhall, 1905, U.S. Geol. Survey Prof. Paper 41, p. 40, map.

F. H. Moffit, 1954, U.S. Geol. Survey Bull. 989–D, p. 104–108. Exposures in upper Chistochina Valley, north of Mankomen Lake looked on as type locality for the Permian (Mankomen formation) of upper Cooper River region. Stratigraphic section displayed in type locality not duplicated elsewhere. Type locality was place of dominant lime deposition.

Type locality: Upper Chistochina Valley north of Mankomen Lake, central Copper River region.

Manley Coal Member (of Abbott Formation)

Pennsylvanian: Western Illinois.

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 31, 44 (table 1), pl. 1. Proposed for coal formerly called Babylon coal.

Overlies Babylon sandstone member; underlies Tarter coal member. Presentation of new rock-stratigraphic classification of Pennsylvanian of Illinois. Cyclical classification is retained but is entirely independent of rock-stratigraphic classification.

Type locality: On west bank of Spoon River in NE¼NE¼ sec. 14, T. 7 N., R. 1 E., Fulton County. Name derived from small settlement of Manley 4 miles west of type outcrop.

Manlius Limestone (in Helderberg Group)

Manlius Limestone (in Cayuga Group)[1]

Manlius Limestone (in Keyser Group)

Lower Devonian: New York.

Original reference: L. Vanuxem, 1840, New York Geol. Survey 5th Rept., p. 376.

Burnett Smith, 1929, New York State Mus. Bull. 281, p. 25–36. Manlius group subdivided into (ascending) Olney limestone, Elmwood beds, Clark Reservation limestone, Jamesville limestone, Pools Brook limestone, and Bishop Brook limestone.

C. K. Swartz and F. M. Swartz, 1941, Geol. Soc. America Bull., v. 52, no. 8, p. 1182–1184. Term Keyser group proposed to include Decker sandstone, Rondout limestone, and Manlius limestone. These formations replace Keyser limestone in northern area. Manlius limestone is equivalent to part of White's (1882) Stormville limestone and conglomerate.

G. H. Davis, 3d, 1953, New York State Mus. Circ. 35, p. 5–29. Transitional Manlius-Coeymans contact discussed in upper New York State. Manlius section measured at edge of town of Manlius. Unit names used for this section were proposed by Smith (1929); Jamesville and Pools Brook limestones represent upper two members of Manlius; Bishop Brook limestone is considered Coeymans in age.

1955, New York State Geol. Assoc. Guidebook 27th Ann. Mtg., p. 2, 3–4. Columnar section (page 2) shows Manlius group comprises (ascending) Cobleskill, Rondout, and Olney limestone members, and Elmwood beds. Overlies Salina group; underlies Clark Reservation and Jamesville limestone shown as transitional beds between Manlius group and Helderberg group. Pages 3 and 4 refer to Manlius formation comprising above named members.

L. V. Rickard, 1955, New York State Geol. Assoc. Guidebook 27th Ann. Mtg., p. 7. Formation subdivided into (ascending) Thacher (new), Olney, Elmwood, Clark Reservation, and Jamesville members. The higher limestone members named by Smith (1929) pass laterally in Coeymans limestone of eastern New York and hence are undoubtedly of Devonian age. Overlies Rondout formation. Helderbergian series. Lower Devonian. Coeymans limestone of central New York, overlying Jamesville member of Manlius, is entirely younger than Coeymans of eastern New York. Name Deansboro proposed for this member of Coeymans.

L. V. Rickard, 1955, (abs.) Geol. Soc. America Bull., v. 66, no. 12, pt. 2, p. 1608. Westward from Helderbergs of eastern New York, Coeymans limestone thickens to nearly 100 feet at Cherry Valley. This thickened Coeymans splits into three parts—lower and middle parts grade laterally into Olney, Elmwood, Clark Reservation, and Jamesville members of type Manlius. Thus nearly all of Manlius of central New York is facies of Coeymans of eastern New York and should be included in Lower Devonian. Manlius of eastern New York is entirely pre-Olney. It thins westwardly, is absent west of Jamesville, and is seemingly replaced by underlying thickening Rondout dolomite.

L. V. Rickard, 1956, Dissert, Abs., v. 16, no. 1, p. 102. West of Cherry Valley, the thickened Coeymans splits into three parts. Lower part, for which name Dayville limestone is proposed, grades laterally into Olney limestone of Syracuse area. Middle part changes into Elmwood, Clark Reservation, and Jamesville members of Manlius. For upper beds of Coeymans, which continue westward as far as Chittenango Falls, name Deansboro limestone is proposed. Bishop Brook limestone at Manlius is a reappearance of the Deansboro further west. Evidence indicates that entire type Manlius near Syracuse, central New York, is equivalent in age to Lower Devonian Coeymans and Kalkberg formations of eastern New York. So-called Manlius of eastern New York is entirely older; name Thacher limestone is proposed for this latter unit. Helderbergian series.

U.S. Geological Survey currently classifies the Manlius Limestone as a formation in the Helderberg Group on the basis of a study now in progress.

Named for occurrence at Manlius, Onondaga County.

Mannetto Gravel[1]

Tertiary(?) or Pleistocene(?): Southeastern New York and southeastern Massachusetts.

Original reference: M. L. Fuller, 1905, Geol. Soc. America Bull., v. 16, p. 367–390.

C. W. Cooke, Julia Gardner, and W. P. Woodring, 1943, Geol. Soc. America Bull., v. 54, no. 11, p. 1715, chart 12. Shown on correlation chart as Pliocene(?). Occurrence of Mannetto at altitude above 270 feet presumably excludes it from the marine Pleistocene.

Wallace de Laguna and N. M. Perlmutter, 1949, New York State Water Power and Control Comm. Bull. GW–18, p. 39–40. Age of Mannetto uncertain. It may be related to either the Jerseyan or so-called Illinoian glacial periods of New Jersey, but few facts are available and no correlation is possible. Or, it may be a late Tertiary deposit that has no relation to Pleistocene ice sheets; this seems unlikely since none of the Tertiary deposits of New Jersey resembles the Mannetto. Existing evidence strongly indicates that Mannetto gravel is early or mid-Pleistocene in age.

Lawrence Weiss, 1954, U.S. Geol. Survey Prof. Paper 254–G, p. 145. Considered older than Jameco gravel on basis of degree of weathering. Gravel is oldest post-Cretaceous deposit on Long Island. Presumably Pleistocene glacial outwash, although some workers have suggested that it is of late Tertiary age. Restricted to Mannetto and Wheatley Hills areas; not observed in eastern part of island.

Named for Mannetto or High Hill south of Huntington, Long Island.

Mannie Shale (in Richmond Group)

Mannie Clay (in Richmond Group)[1]

Upper Ordovician: Western Tennessee.

Original reference: A. F. Foerste, 1903, Jour. Geology, v. 11, p. 39, 44.

C. W. Wilson, Jr., 1949, Tennessee Div. Geology Bull. 56, p. 215–219, fig. 73. Mannie shale is, in general, a succession of greenish argillaceous limestone, calcareous shale, and shale. Thickness commonly 15 to 25 feet; in Marion County as much as 50 feet. Locally, shale is overlain by about 10 feet of fine-grained quartz sandstone referred to as Mannie sandstone member. Conformably overlies Fernvale limestone; both the Mannie and Fernvale grade into Sequatchie formation; unconformably underlies Brassfield limestone or Chattanooga shale and, possibly, the Osgood formation; in Wells Creek basin, occurs as a small block with Hermitage formation, surrounded by Devonian and Mississippian beds. Type section stated.

Type section: Northwest of Riverside, Lewis County. Named from exposures north of west end of railroad bridge across Buffalo River near mouth of Allens Creek (formerly Mannie Creek).

Manning Clay Member (of McElroy Formation)

Manning Beds[1]

Manning Formation (in Jackson Group)

Manning Member (of Fayette Formation)

Eocene, upper: Eastern Texas.

Original reference: E. T. Dumble, 1915, Geol. Soc. America Bull., v. 26, p. 462, 463.

C. D. Harris, 1941, Texas Univ. Bur. Econ. Geology Mineral Resources Survey Circ. 33, p. 22, 26–28. In Lee County, Fayette formation is divided into three members (ascending) : Caddell clays and sands, Wellborn sandstone, and Manning beds.

H. B. Stenzel, 1953, Am. Assoc. Petroleum Geologists Guidebook Field Trips Houston Mtg., p. 45. Contains Plum bentonite (new).

W. L. Russell, 1955, Gulf Coast Assoc. Geol. Soc. Trans., v. 5, p. 165–172. Strata of Manning formation comprise sandstones, shales, and volcanic ash. Basal 100 feet contains greater percentage of lignite than is normal for rest of formation. At the top of this lower lignitic zone in Brazos and Grimes Counties is a sandstone herein named Goodbread. At the top of the Manning are two sandstones each from 5 to 50 feet thick. They are separated by a shale zone 30 to 60 feet thick. Upper sandstone was named Yuma by Renick. Lower sandstone named Dilworth by Renick on assumption that it was equivalent to Dilworth sandstone of Gonzales County. However, there is no conclusive proof of this equivalence, and lower sandstone is herein named Tuttle. Overlies Wellborn; underlies Whitsett.

D. H. Eargle, 1959, Am. Assoc. Petroleum Geologists Bull., v. 43, no. 11, p. 2626 (table 1), 2629–2630. Rank reduced to member status in McElroy formation (redefined). Underlies Dilworth sandstone member; overlies Wellborn sandstone. Renick (1936, Texas Univ. Bull. 3619) considered the Manning a formation and included in it Dilworth and Yuma sandstones as members. He also included as much as 25 feet of clay above the Yuma sandstone member in the Manning. Manning formation of Renick is, with possible exception of his Yuma sandstone member, equivalent to McElroy formation as classified in present report, and Manning clay member of present report is equivalent to Manning beds of Ellisor (1933, Am. Assoc. Petroleum Geologists Bull., v. 17, no. 11). Note on type locality.

Named for exposures at Manning Station on St. Louis & Santa Fe Railway, Angelina County. The railroad and town, formerly the site of a lumbermill, are now abandoned; so is Manning Church, shown on Angelina County map of Texas State Highway Department. Only one inhabited house, that of M. M. Flourney, remains at site of village and mill, which is on Farm Roard 844, 10.2 miles by road south-southwest of Huntington.

Manning Canyon Shale[1]

Manning Canyon Formation

Upper Mississippian and Lower Pennsylvanian: Northern Utah.

Original references: T. B. Nolan, 1930, Washington Acad. Sci. Jour., v. 20, no. 17, p. 423 (table 1), 430–431 (name credited to Gilluly); J. Gilluly, 1932, U.S. Geol. Survey Prof. Paper 173.

A. A. Baker, 1947, U.S. Geol. Survey Oil and Gas Inv. Prelim. Chart 30. Manning Canyon shale, in vicinity of Provo in Wasatch Mountains, consists mainly of black to dark-brown shale with some interbedded gray limestone and thin beds of medium- to coarse-grained partly conglomeratic sandstone. Overall thickness in headwaters of Rock Canyon, near divide between Rock Canyon and Pole Canyon, is 1,645 feet. At this locality, the shale contains a prominent ledge of gray fossiliferous limestone near the middle. In vicinity of Provo, thickness of shale is about 500 feet greater than in Oquirrh Mountains. North of thrust fault in upper American Fork, Manning Canyon shale is either absent or is represented in thin shale and limestone unit that overlies Humbug formation in some areas. Overlies Great Blue limestones; underlies Oquirrh formation.

Walter Sadlick, 1955, Wyoming Geol. Assoc. Guidebook 10th Ann. Field Conf., p. 50 (table 1), 53–54, 56. Discussion of Carboniferous formations of northeastern Uinta Mountains. Correlations of beds assigned in this paper to Manning Canyon shale have been problematical. Williams (1943) apparently included these beds in the Brazer. Thomas and others (1945, U.S. Geol. Survey Oil and Gas Inv. Prelim. Chart 16) termed them lower member of the Morgan. Baker and others (1949, Am. Assoc. Petroleum Geologists Bull., v. 33, no. 7) are of the opinion that the beds in the Uintas correlate with a shale and limestone sequence, exposed in American Fork and Big Cottonwood Canyons, assigned to lower Great Blue limestone. Bissell (1950, Utah Geol. Soc. Guidebook 5) suggested a correlation with the Manning Canyon shale. Untermann and Untermann (1954, Utah Geol. and Mineralog. Survey Bull. 42) believe that the beds are Pennsylvanian and may correlate with upper part of Manning Canyon shale. Because the stratigraphic unit in question is essentially black shale and its fauna and its stratigraphic relationship to either the Great Blue limestone or the Manning Canyon shale are unknown, the term "Black shale unit" has also been applied to these beds. Sadlick (1954, Jour. Sed. Petrology, v. 24, no. 2; Jour. Paleontology, v. 28, no. 4) correlated this unit with Manning Canyon shale on paleontologic evidence. Manning Canyon of Uinta Mountains contains dark-gray to black shale and limestone, with minor amounts of sandstone. On western end of Uintas, formation is essentially shale with about 11 percent limestone. About midway along length of Uintas, although exposures are poor, formation appears to be black shale with a few dark argillaceous limestone beds. In eastern Uintas, silt and sand increase progressively eastward at expense of shale and if carbonaceous shale were not present in these clastic beds, the Manning Canyon would be separated with difficulty from shore facies of underlying Humbug. Thickness about 545 feet in Sols Canyon. Overlies Great Blue limestone and underlies Oquirrh formation in Oquirrh basin; underlies Round Valley formation (new) in eastern and western Uinta Mountains. Manning Canyon shale of Uinta Mountains has average maximum thickness of about 500 feet. Strata about 170 feet below top contain fauna regarded as upper Chesterian and represent part of *Eumophoceras-Cravenoceros* zone. Beds higher in formation contain many undescribed species and a fauna Mississippian in total aspect although a few forms suggestive of Pennsylvanian are present. Uppermost 100 feet of Manning Canyon is relatively unfossiliferous and probably contains Mississippian-Pennsylvanian boundary because no distinct unconformity can be detected in field and boundary does occur in upper parts of Manning Canyon in Oquirrh basin.

Walter Sadlick, 1957, Intermountain Assoc. Petroleum Geologists Guidebook 8th Ann. Field Conf., p. 68–69. Gilluly (1932) described 16 units (1–16 descending) in Soldier Canyon section. Section was restudied in detail for present report, and 42 units were recognized with thickness of 1,324 feet. Contact between Manning Canyon shale and overlying Oquirrh formation is placed at base of unit 1 of Gilluly's section. So selected, the contact can be readily mapped on aerial photographs since overlying beds are typically like the gray limestone ledges of lower Oquirrh formation. In writer's Soldier Creek section of Manning Canyon shale, about 64 percent of the formation is shale (865 feet), limestone slightly more than 7 percent (96 feet), and remaining 29 percent is siltstone and mudstone (363 feet). By placing unit 1 of Gilluly in Oquirrh formation, his measured section of the Manning Canyon in Soldier Creek totals only 995 feet, or 370 feet less than the 1,324 feet measured by writer. Gilluly's units 15, 13, 9, 7, 4, 3, and 2 are similar to those of writer. Units 10 to 12 of Gilluly total 95 feet; corresponding units of writer total almost 400 feet. Writer's unit 6 is almost 75 feet more than Gilluly's unit 6. Although Gilluly reported thickness 750 to 1,140 feet, only latter figure was most reliable. At present, Mississippian-Pennsylvanian boundary cannot be located accurately in type section of Manning Canyon shale. Some geologists are not convinced that shale unit in Uinta Mountains is Manning Canyon shale but believe that the shale correlates with some part of Great Blue limestone of Oquirrh basin.

H. T. Morris, 1957, Utah Geol. Soc. Guidebook 12, p. 15 (fig. 4), 22, pl. 1. In East Tintic Mountains, conformably overlies Great Blue limestone and underlies Oquirrh formation. Consists of three members: lower, composed of fissile brown-weathering fossiliferous black shale; limestone member that is blue gray, medium to massive bedded, fine grained, and essentially devoid of fossils; and upper member composed principally of black, brown-weathering shale that includes many beds of dark-gray to black limestone and several lenses of brown-weathering quartzite that intergrade along strike with pebble conglomerate. Thickness about 1,050 feet.

J. K. Rigby, 1958, Utah Geol. Soc. Guidebook 13, p. 38 (fig. 5), 48–49, geol. map. Formation described in Stansbury Mountains where it is 200 to 1,600 feet thick. Three units differentiated. lower black shale, medial dark-gray predominantly limestone unit, and upper black shale and quartzite. Overlies Great Blue limestone; underlies Oquirrh formation.

H. R. Ritzma, 1959, Utah Geol. and Mineralog. Bull. 66, p. 20 (fig. 1), 23–25. Described in Daggett County, where it is 545 feet thick, underlies Round Valley limestone and overlies Humbug formation.

R. W. Moyle, 1959, Utah Geol. Soc. Guidebook 14, p. 59–92. Described in southern Oquirrh Mountains. Gilluly named formation for exposures in Manning Canyon but stated that section in Soldier Canyon was more representative of formation. In this report, Manning Canyon section is referred to as type locality and Soldier Canyon section as type section. Most data of this report deals with Soldier Canyon section. Thicknesses: Soldier Canyon, 1,559 feet; Ophir Pass, 1,327 feet; Manning Canyon (base faulted), 1,064 feet; West Canyon (top not exposed), 1,683 feet; and Lake Mountain (top not exposed), 1,910 feet. Overlies Great Blue limestone; underlies Oquirrh formation.

H. J. Bissell, 1959, Utah Geol. Soc. Guidebook 14, p. 97. Conformably underlies Hall Canyon member (new) of Oquirrh formation.

M. D. Crittenden, Jr., 1959, Intermountain Assoc. Petroleum Geologists Guidebook 10th Ann. Field Conf., p. 63–74. In view of near identity of faunas and of apparent structural continuity from Wasatch to western Uinta Mountains, it is believed that the black shale of Uinta Mountains are direct lateral equivalent of Doughnut formation in Big Cottonwood Canyon. If this is the case, neither Great Blue nor Manning Canyon is an appropriate name, and extension of term Doughnut to Uinta Mountains is proposed.

Walter Sadlick, 1959, Intermountain Assoc. Petroleum Geologists Guidebook 10th Ann. Field Conf., p. 75–77. Strata assigned to Manning Canyon formation in Uinta Mountains has been so designated because lithologically and paleontologically they are similar to Manning Canyon formation of Oquirrh basin. However, there is a possibility that this unit is shaly facies of Doughnut formation described by Crittenden.

Type section: Soldier Canyon, which is on north side of nose of plunging Ophir anticline approximately 3 to 3½ miles east and south of Stockton. Creek has eroded nose anticline and exposed section which crops out at mouth of canyon and then trends east to ¼ to ½ mile west of mouth of South Fork where it passes under valley floor. Measured section is on north side of canyon about one-half mile above its mouth, sec. 33, T. 5 S., R. 4 W., Tooele County. Type locality: Manning Canyon, SW¼ sec. 4, T. 6 S., R. 3 W., Utah County.

Mannington Sandstone (in Washington Formation)[1]

Mannington Sandstone (in Washington Group)

Mannington sandstone and shale member

Permian (Washington Series): Western West Virginia, eastern Ohio, and southwestern Pennsylvania.

Original references: R. V. Hennen, 1909, West Virginia Geol. Survey Rept. Marshall, Wetzel, and Tyler Counties, p. 226; G. P. Grimsley, 1909, West Virginia Geol. Survey, v. 4, p. 440–441.

W. O. Hickok 4th, and F. T. Moyer, 1940, Pennsylvania Geol. Survey, 4th ser., Bull. C–26, p. 135, 148. Two sandstones, lower and upper Mannington, in Washington group, are separated by Waynesburg B coal. Lower

Mannington overlies Woodglen limestone (new) and lies 105 feet above Waynesburg coal (base of group); upper Mannington lies 120 feet above Waynesburg coal.

D. L. Norling, 1958, Ohio Geol. Survey Bull. 56, p. 10 (fig. 3), 93, geol. map. Mannington sandstone and shale member (Washington series) in Morgan County is 30 to 45 feet thick; in southern part of county, coalesces with stratigraphically lower Waynesburg sandstone to form a nearly solid sandstone section over 50 feet thick. Since Waynesburg "A" (No. 11-A) coal is nonpersistent and Little Washington coal is not recognized in county, both basal and top boundaries of the Mannington are indefinite.

M. T. Sturgeon and others, 1958, Ohio Geol. Survey Bull. 57, p. 203 (table 14), 210–212. Sandstone and shale member of Little Washington cyclothem in report on Athens County. Thickness 31 to 52 feet. Often coalesces with overlying Washington sandstone and underlying Waynesburg sandstone to form massive cliffs up to 100 feet in height.

Named for Mannington, Marion County, W. Va.

Mansfield Beds

Mansfield Red Beds (in Chemung Formation)[1]

Upper Devonian: Central northern and northeastern Pennsylvania.

Original reference: J. P. Lesley, 1875, Pennsylvania 2d Geol. Survey Rept. I, p. 45, 100, 108.

G. A. Cooper and others, 1942, Geol. Soc. America Bull., v. 53, no. 12, pt. 1, chart 4. Correlation chart shows "Mansfield beds" in New York above Fall Creek conglomerate and below Blossburg red beds. Interfinger with Dunkirk shale.

R. G. Sutton, 1951, Rochester Acad. Sci. Proc., v. 9, nos. 5–6, p. 397. Dunkirk shale outcrops from Lake Erie to Mansfield County, Pa., where the facies interfingers with Mansfield beds which are continental. [Atlas does not show any Mansfield County in Pennsylvania; town of Mansfield is in Tioga County.]

Probably named for occurrence at Mansfield, Tioga County.

Mansfield Beds[1]

Pennsylvanian: Southeastern Massachusetts.

Original reference: J. B. Woodworth, 1899, U.S. Geol. Survey Mon. 33, p. 134, 188–191.

Mansfield area, Bristol County.

†Mansfield Formation[1]

Precambrian: Northwestern Michigan.

Original reference: H. L. Smyth, 1899, U.S. Geol. Survey 19th Ann. Rept., pt. 3, p. 114–115.

Crops out at Mansfield mine and north of it near Michigamme River, in T. 43 N., R. 31 W., Felch Mountain district. Named for Mansfield, Iron County.

Mansfield Formation

Mansfield Group

Mansfield Sandstone (in Pottsville Group)[1]

Lower and Middle Pennsylvanian: Southwestern Indiana.

Original reference: T. C. Hopkins, 1896, Indiana Dept. Geology and Nat. Resources 20th Ann. Rept. 1895, p. 186–213.

D. W. Franklin, 1944, Illinois Acad. Sci. Trans., v. 37, p. 87 (fig. 1), 88–89. Mansfield group includes Ferdinand and Fulda limestones (both new).

F. D. Spencer, 1953, U.S. Geol. Survey Circ. 266, p. 14 (fig. 4). Hindostan beds occur in lower part of Mansfield sandstone.

D. J. McGregor, T. C. Perry, and W. J. Wayne, 1957, Indiana Geol. Survey Field Conf. Guidebook 9, p. 6, pl. 2. Mansfield formation, which ranges from 250 to 300 feet in thickness, includes many rock types: crossbedded and wavy-bedded fine- to medium-grained sandstone, locally conglomeratic; gray, commonly silty shale that in many places carries ironstone concretions; thin discontinuous beds of coal and clay; and one thin bed of marine limestone and chert near top. Regional unconformity separates the Mississippian from the Pennsylvanian. Pre-Pennsylvanian erosion has removed progressively older Chester formations at increasing distances north of Ohio River. Because Mansfield directly overlies rocks of late Chester age near Ohio River in Perry County and rests directly on Ste. Genevieve limestone of late Meramec age in central Putnam County, base of Mansfield had descended through a stratigraphic interval of approximately 600 feet in distance of 125 miles. In southern part of area, Mansfield generally rests on Tar Springs formation; to the north, it is typically on Golconda formation; where it rests on a clastic formation in Chester series, distinction between rocks of early Pennsylvanian and Chester age is difficult. Outcrop belt extends in northwesterly direction from Ohio River to Warren County; strata have regional westerly and southwesterly dip of approximately 25 to 30 feet per mile, and main Mansfield outcrop lies immediately west of Chester outcrop belt. In Pottsville series.

F. E. Kottlowski, 1959, U.S. Geol. Survey Coal Inv. Map C–28. Designated formation since it is mappable unit containing large amounts of shale, thin beds of coal, underclay, and limestone and is only locally predominantly sandstone. Thickness about 60 feet. Underlies Brazil formation.

H. H. Gray, R. D. Jenkins, and R. M. Weidman, 1960, Indiana Geol. Survey Bull. 20, p. 22–29, pl. 1. Described in Huron area. As now defined, includes all rocks of Pennsylvanian age below Lower Block coal which forms base of overlying Brazil formation. Divisible into two parts designated as lower and upper. Boundary of lower and upper parts placed at top of Pinnick coal member (new) or at inferred equivalent horizon where coal is absent. Upper part, about 160 feet thick, includes Blue Creek coal member (new) about 100 feet above base. Lower part, 50 to 150 feet thick, includes Pinnick coal member at top and French Lick coal member (new) about 50 feet below top. Unconformably overlies Glen Dean limestone (restricted) of Stephensport group (redefined).

Named for Mansfield, Parke County.

Mansfield Group[1]

Mansfield Subgroup (of Sabine Group)

Eocene: Northwestern Louisiana and western Mississippi.

Original references: E. W. Hilgard, 1869, Am. Jour. Sci., 2d, v. 48, p. 340–341; 1869, Prelim, rept. geol. reconn. Louisiana, p. 8–9.

H. V. Howe and J. B. Garrett, Jr., 1934, Louisiana Dept. Conserv. Geol. Bull. 4, p. 9. Term Mansfield, used by Hilgard (1869) for lignitic beds in northwestern Louisiana, is proposed as a subgroup term of the part of the Sabine group below and the Wilcox equivalents.

G. E. Murray, 1948, Louisiana Dept. Conserv. Geol. Bull. 25, p. 91. Midway group as redefined in Louisiana includes Mansfield subgroup of Howe and Garrett (1934).

C. O. Durham, Jr., and C. R. Smith, 1958, Louisiana Dept. Conserv. Geol. Pamph. 5, p. 10–12. Discussion of Louisiana Midway-Wilcox correlation problems and the validity of subdivisions of the lower Wilcox. Term Mansfield subgroup as used by Howe and Garrett (1934) is used informally for the lower Wilcox although it embraces the subdivisions Naborton, Logansport, and Hall Summit of Murray (1941; 1948). As a term, "Mansfield" allows one name to be assigned to a subgrouping of Wilcox formations which are predominantly continental but contain sufficient fauna to be assigned to the Paleocene. "Mansfield" thus comprises the thicker Louisiana counterpart of Naheola formation of Alabama. Use of the several formational names of Murray is voided in present report because recent work in Sabine, Red River, and Caddo Parishes has indicated need for their revision.

Named for exposures near Mansfield, De Soto Parish, La.

Mansfield Iron-Bearing Slate Member (of Hemlock Formation)

†Mansfield Formation or Slate[1]

Precambrian (Animikie Series) : Northern Michigan.

Original reference: J. M. Clements, 1899, U.S. Geol. Survey 19th Ann. Rept., pt. 3, p. 36–48, 62, pl. facing p. 84.

H. L. James, 1958, U.S. Geol. Survey Prof. Paper 314–C, p. 30 (table 1), 36. Consists in part of chert-siderite iron-formation and in part of slate, with a maximum thickness of about 500 feet. Occurs within lower third of formation; thus, is stratigraphically below newly defined Bird iron-bearing member.

Named for Mansfield mine, Crystal Falls district, Iron County.

†Manti Beds[1]

Eocene, lower: Central Utah.

Original reference: E. D. Cope, 1880, Am. Nat., v. 14, p. 303–304.

Wasatchian: J. A. Dorr, 1952, Geol. Soc. America Bull., v. 63, no. 1, pl. 2.

Apparently named for Manti, Sanpete County.

Mantua Lentil (in Polecat Bench Formation)

Paleocene: Northwestern Wyoming.

G. L. Jepsen *in* W. B. Scott, 1937, A history of land mammals in the Western Hemisphere: New York, Macmillan Co., p. 99; 1940, Am. Philos. Soc. Proc., v. 83, no. 2, p. 233–234, 238 (table). Proposed for massive sandstone, about 130 feet thick, at base of formation; contains diagnostic vertebrate fauna that correlates, approximately, with type Puerco. About 70 feet below Rock Bench quarry beds (new). Underlain by thin coal bed below which dinosaur bones, teeth, and tracks are preserved.

Type section: In sec. 31, T. 57 N., R. 98 W., Park County. Name derived from Mantua coal mines and railroad siding.

Manuelitas Member (of Tererro Formation)

Lower Mississippian: Northern New Mexico.

E. H. Baltz and C. B. Read, 1960, Am. Assoc. Petroleum Geologists Bull., v. 44, no. 11, p. 1754–1756, 1760, 1762–1763, 1769–1770, 1771, 1772, Crystalline limestone, limestone pebble and cobble conglomerate, and calcarenite. In many areas, beds were involved in collapse into large sink holes in Macho member (new) and Espiritu Santo formation (new). Thickness 45 feet at type locality; 25 feet in Pecos River Canyon; as much as 27 feet in southeastern part of Sangre de Cristo Mountains; and as much as 38 feet in north-central part of mountains. Unconformably underlies Cowles member (new). Fossils indicate Early Mississippian age.

Type locality: Gap in hogbacks on Manuelitas Creek 1.6 miles east of Lower Rociada, northwestern San Miguel County.

Manzanan series[1]

Pennsylvanian: New Mexico.

Original reference. C. R. Keyes, 1906, Jour. Geology, v. 14, p. 147–154.

Derivation of name not given.

Manzanita Dacites[1]

Manzanita Lake Lavas

Cenozoic: Northern California.

Original reference: Howel Williams, 1932, California Univ. Pub., Dept. Geol. Sci. Bull., v. 21, no. 8, p. 304–306, geol. map.

O. P. Jenkins, 1943, California Div. Mines Bull. 118, p. 679. Cenozoic.

J. A. S. Adams, 1955, Geochim. et Cosmochim. Acta., v. 8, p. 77 (table 2). Manzanita Lake is in northwestern part of Lassen Volcanic National Park. Listed on table accompanying report on uranium geochemistry of Lassen volcanic rocks.

Manzanita Limestone Member (of Cherry Canyon Formation)

Permian (Guadalupe Series): Western Texas.

P. B. King *in* F. E. Lewis, 1941, Am. Assoc. Petroleum Geologists Bull., v. 25, no. 1, p. 92. Cherry Canyon formation is divided into (ascending) Getaway, South Wells, and Manzanita limestone members.

P. B. King, 1942, Am. Assoc. Petroleum Geologists Bull., v. 26, no. 4, p. 580–581, 585 (fig. 7), pl. 2; 1948, U.S. Geol. Survey Prof. Paper 215, p. 36–38, pl. 3 [1949]. Consists of buff earthy limestone in rather thick beds, with many geode cavities; beds weather to characteristic orange-brown color; intercalated are several beds of volcanic ash and each bed averages about a foot in thickness; locally the ash is altered to green chert resembling turquoise; southward near Long Point, member changes into lumpy, slabby dark-gray limestone containing beds of volcanic ash. Thickness 25 to 100 feet. Lies near top of formation about 100 feet above South Wells limestone member.

Type section: On Nipple Hill east of Manzanita Spring, near Frijole post office, Culberson County. Widely exposed in southern Guadalupe Mountains where it forms first prominent bed below limestone ledges of Hegler and Pinery members of Bell Canyon formation.

†Manzano Group[1]

Permian: New Mexico.

Original references: C. L. Herrick, 1900, Am. Geologist, v. 25, p. 337; Jour. Geology, v. 8, p. 112–126.

Christina Lochman-Balk, 1959, New Mexico Geol. Soc. Guidebook 10th Field Conf., p. 106. Recent mapping has recognized four or five formations (ascending): Bursum, Abo, Yeso, Glorieta sandstone, and San Andres limestone in this series of beds; term Manzano group has lapsed from usage and should be abandoned.

U.S. Geological Survey has abandoned the term Manzano Group.

Derivation of name not stated.

Map Beds or Formation

Miocene: Caroline Islands (Map and Yap).

Risaburo Tayama, 1935, Topography, geology, and coral reefs of the Yap Islands: Tohoku Univ. Inst. Geology and Paleontology Contr. in Japanese Language, no. 19, p. 30–36 [English translation in library of U.S. Geol. Survey, p. 26–32]; 1952, Coral reefs in the South Seas: Japan Hydrog. Office Bull., v. 11, p. 61–62, table 4 [English translation in library of U.S. Geol. Survey, p. 72–73]. Consists of lower unit composed largely of breccia and an upper unit consisting of alternate layers of sandstone, shale, tuff, and marl with conglomerate at base; well bedded. Nonconformably overlies Yap formation.

Chiefly on Map Island, Yap group.

Maple Hill Limestone Member (of Zeandale Limestone)

Maple Hill Limestone (in Wabaunsee Group)[1]

Pennsylvanian (Virgil Series): Eastern Kansas, western Missouri, and southeastern Nebraska.

Original reference: G. E. Condra, 1927, Nebraska Geol. Survey Bull. 1, 2d ser., p. 80.

G. E. Condra and E. C. Reed, 1943, Nebraska Geol. Survey Bull. 14, p. 42, 43, 44. Underlies Langdon formation and overlies Wamego shale (both new).

F. C. Greene and W. V. Searight, 1949, Missour Geol. Survey and Water Resources Rept. Inv. 11, p. vii, 21. Generalized section shows Maple Hill limestone present in Missouri. Overlies Wamego shale and underlies Langdon shale. This is classification agreed upon by State Geological Surveys of Iowa, Kansas, Missouri, and Nebraska, May 1947.

R. C. Moore and M. R. Mudge, 1956, Am. Assoc. Petroleum Geologists Bull., v. 40, no. 9, p. 2274 (fig. 1), 2276. Rank reduced to member status in Zeandale formation (new). Overlies Wamego shale member; underlies Pillsbury shale (new), which name replaces Langdon shale.

Well exposed in Maple Creek, about 2 miles southwest of Maple Hill, Wabaunsee County, Kans.

Maple Mill Formation (in Hannibal Group)

Maple Mill Shale (in Kinderhook Group)[1]

Lower Mississippian (Kinderhook): Southeastern Iowa and western Illinois.

Original reference: H. F. Bain, 1895, Am. Geologist, v. 15, p. 322.

L. A. Thomas, 1949, Geol. Soc. America Bull., v. 60, no. 3, p. 407–408. On basis of conodont assemblage, Maple Mill is redefined as uppermost Devonian shale. Underlies English River siltstone.

M. A. Stainbrook, 1950, Am. Jour. Sci. v. 248, no. 3, p. 209, 210, 211, 212. Not a member of Hannibal formation. Macrofauna is related to Mississippian rather than to Devonian fauna. Kinderhook succession in upper

Mississippi valley seems to be (ascending) Maple Mill shale, English River siltstone, Louisiana limestone, Hannibal shale and siltstone, and Chouteau limestone.

L. E. Workman and Tracey [Tracy] Gillette, 1956, Illinois Geol. Survey Rept. Inv. 189, p. 8 (fig. 1), 23–27. In this report name Maple Mill is used for shale overlying the Glen Park, or where Glen Park is absent, the Louisiana, Saverton, or older rocks; overlain in apparent conformity by English River or Chouteau, and where these are absent, overlain unconformably by Osage. Local black shale facies in west-central part of state is differentiated Nutwood member. Thickness varies inversely with ridges and troughs in Glen Park siltstone; thickness of gray Maple Mill decreases abruptly where it grades laterally into black Maple Mill (Nutwood member); locally, interval between Glen Park and Osage is entirely black shale. Maximum thickness 64 to 70 feet; commonly less than 30 feet where it extends over Vandalia arch. Correlation of Maple Mill (as used in this report) with type Maple Mill in central Iowa uncertain; type section may include beds equivalent to Saverton of this report.

Type locality not stated. Maple Mill section described by Bain is in SE¼NW¼ sec. 4, T. 7 N., R. 8 W., Washington County, Iowa. Beds 1 and 2 of the section represent Maple Mill shales.

Maple Ridge Porphyry

Tertiary: Southwestern Utah.

E. F. Cook, 1960, Utah Geol. and Mineralog. Survey Bull. 70, p. 18 (fig. 1), 41, 43 (map 2). Flow unit of dark biotite-augite andesite(?). Overlies Shoal Creek breccia (new). Stratigraphically below Cove Mountain formation (new). Maximum thickness 300 feet. Name credited to H. R. Blank (unpub. thesis).

Makes up most of Maple Ridge, in west-central part of Bull Valley district, Washington County.

Maple Summit Sandstone

Upper Devonian (Chautauquan): Southwestern Pennsylvania.

W. M. Laird, 1941, Pennsylvania Topog. and Geol. Survey Progress Rept. 126, p. 8–9. Name will probably be used, following more definitive study of area, for unit here termed Sandstone A and described as a member (or parvafacies) consisting of sandstones with a few interbedded shales. Both sandstones and shales are micaceous. Sandstones often coarse-grained; lenses of conglomerate containing both quartz pebbles and clay galls not uncommon. Channel fillings occur on bottom of sandstone layers. Thickness 386 feet in Youghiogheny Gorge through Laurel Hill. Conformably underlies Sandstone B (Youghiogheny sandstone); base not exposed.

Type exposure along cuts of Baltimore and Ohio Railroad about 1 mile west of Bidwell, Fayette County.

†Mapleton Granite[1]

Devonian: Northeastern Maine.

Original reference: H. E. Gregory, 1900, U.S. Geol. Survey Bull. 165, p. 105–106, 146–148.

Named for occurrence on low rounded hill in northeast corner of Mapleton Township, Aroostook County.

Mapleton Sandstone[1]

Upper Devonian: Northeastern Maine.

Original reference: H. S. Williams, 1899, Am. Jour. Sci., 4th ser., v. 8, p. 360, footnote.

W. S. White, 1943, U.S. Geol. Survey Bull. 940–E, p. 129. Upper Devonian.

Outcrop area includes eastern part of Mapleton Township, Aroostook County.

Maplewood Shale[1] (in Clinton Group)

Maplewood Shale Member (of Clinton Formation)

Middle Silurian: Western New York.

Original reference: G. H. Chadwick, 1918, Geol. Soc. America Bull., v. 29, p. 327–368.

R. M. Leggette, L. O. Gould, and B. H. Dollen, 1935, Ground water resources of Monroe County, New York: Monroe County Regional Plan. Board. p. 26, fig. 11. Geologic column of Monroe County, shows Maplewood shale overlies Thorold (Oneida) sandstone and underlies Brewer Dock (Bear Creek) shale. Thickness 18 feet. Member of Clinton formation.

T. G. Payne, 1938, Rochester Mus. Arts and Sci. Guide Bull. 5, p. 69. Formation in Clinton group. Overlies Thorold sandstone: underlies Brewer Dock shaly limestone member of Reynales formation. Thickness 21 feet.

C. K. Swartz and others, 1942, Geol. Soc. America Bull., v. 53, no. 3, chart 3. Correlation chart shows Maplewood shale at base of Clinton group. Niagaran series.

D. W. Fisher, 1959, New York State Mus. Sci. Service Geol. Survey Map and Chart Ser. 1. Maplewood shale, Clinton group, included in Ontarian stage, Middle Silurian.

Well exposed in Genesee Gorge at Maplewood Park, Rochester, Monroe County.

Maquam Group

Middle Ordovician (Chazyan): Northwestern Vermont.

Marshall Kay and W. M. Cady, 1947, Science, v. 105, no. 2736, p. 601. Named to include Carman quartzite and overlying Youngman formation. Overlies Beldens formation.

Named for Maquam Bay 6 miles south of type sections of both formations at Highgate Springs, Franklin County.

Maquinita Granodiorite

Precambrian: Central northern New Mexico.

Fred Barker, 1958, New Mexico Bur. Mines Mineral Resources Bull. 45, p. 56–59, pl. 1. Gray to dark gray, homogeneous, well foliated, and strongly lineated. In some exposures, foliation is faint, but lineation is well marked in all the granodiorite. Locally rock is flaser (lenticular) granodiorite. Intruded Moppin metavolcanic series (new); contact with amphibolites of Moppin series appears to be sharp and parallel with schistosity of the wall rock. Emplaced earlier than Tres Piedras granite (new).

Type locality: In Maquinita Canyon, secs. 3 and 4, T. 28 N., R. 7 E., Las Tablas quadrangle, Rio Arriba County. Plutons lie between American and Cow Creeks, on part of lower north slope of Tusas Mountain, along west side of upper Tusas Valley southeast and northwest from Maquinita

Canyon, and along part of Duran Canyon. Small dikes in area from just north of Burned Mountain to Hopewell and Buckhorn Gulch.

†Maquoketa Series[1]

Ordovician: Upper Mississippi Valley States.

Original reference: F. W. Sardeson, 1897, Am. Geologist, v. 19, p. 330–336.

Maquoketa Shale (in Richmond Group)[1]

Maquoketa Group or Formation

Upper Ordovician: Eastern Iowa, western Illinois, southern Minnesota, eastern Missouri, and southwestern Wisconsin.

Original reference: C. A. White, 1870, Iowa Geol. Survey, v. 1, p. 180–182.

Samuel Calvin, 1906, Iowa Geol. Survey, v. 16, p. 60 (table), 94–109. Maquoketa beds (or formation) divided into (ascending) Elgin shaly limestone, Clermont shale, Fort Atkinson limestone, and Brainard shale members (all new). Overlies Galena limestone; underlies beds belonging to Wapsipinicon stage of Devonian. Table (p. 60) refers to Maquoketa stage, Trenton series.

C. R. Stauffer and G. A. Thiel, 1941, Minnesota Geol. Survey Bull. 29, p. 90–93, measured sections. Formation in southeastern Minnesota comprises Dubuque member below and Wykoff member above. Overlies Stewartville member of Galena formation; in some areas, underlies Devonian Cedar Valley limestone; in some areas, covered by glacial drift.

A. F. Agnew and others, 1956, U.S. Geol. Survey Prof. Paper 274–K, p. 259. In zinc-lead district, Wisconsin, Illinois, and Iowa, Maquoketa shale (Upper Devonian) is commonly grayish dolomitic shale and dolomite. Thickness 110 feet in southern part of district; thickens northeast to 240 feet in locality 25 miles west of Madison, Wis.; thickens to northwest, 220 to 260 feet being common northwest of Dubuque, Iowa. Characterized by facies changes. Appears to lie conformably on the Galena; underlies Silurian dolomite.

M. P. Weiss, 1957, Geol. Soc. America Bull., v. 68, no. 8, p. 1029 (fig. 1), 1042, pl. 1. In Fillmore County, Minn., Ordovician rocks above Dubuque formation are assigned to Maquoketa formation, which is not differentiated into members. Relation of these rocks to members of Maquoketa in Iowa is not known, and relation of Sardeson's (1892) Wykoff formation to body of Maquoketa is uncertain. Formation consists of about 70 feet of argillaceous dolomitic limestone that is massively bedded, generally microangular, grayish yellow, vuggy in lower part, and poorly fossiliferous except in streaks; at top is a thin bed with sand and abundant chert and quartz granules.

T. J. Laswell, 1957, Missouri Geol. Survey and Water Resources Rept. Inv. 22, p. 9 (fig. 2), 12–15, pl. 1. Formation described in Bowling Green quadrangle, Pike County, Mo., where it is typically thin laminated shale which is interbedded with shaly limestone layers. Average thickness about 100 feet. Unconformably overlies Middle Ordovician Kimmswick formation; where Edgewood is absent, a phosphatic conglomerate of Grassy Creek formation lies immediately above Maquoketa. Upper Ordovician (Richmond).

A. M. Gutstadt, 1958, Am. Assoc. Petroleum Geologists Bull., v. 42, no. 3, p. 513–547. In this report, Upper Ordovician rocks in western Indiana and eastern and southern Illinois are assigned to Maquoketa group, composed of (ascending) Eden shale, Cape limestone (new), and Orchard Creek shale. Upper Ordovician rocks in northwestern Illinois and eastern Iowa are assigned to Maquoketa shale.

C. E. Brown and J. W. Whitlow, 1960, U.S. Geol. Survey Bull. 1123-A, p. 22-31, pls. 1, 3. Described in Dubuque South quadrangle, Iowa-Illinois. Divided into three lithologic units (ascending) brown shaly unit, Brainard member, and Neda member. Thickness 114 to 250 feet. Overlies Dubuque shaly member of Galena dolomite; underlies Mosalem member (new) of Edgewood dolomite. Upper Ordovician.

Named for exposures on Little Maquoketa River, Dubuque County, Iowa.

†Marais des Cygnes coal series[1]

Pennsylvanian: Eastern Kansas and northwestern Missouri.

Original reference: G. C. Swallow, 1866, Kansas Geol. Survey Prelim. Rept., p. 22-24.

Named for exposures on Marais des Cygnes River, Kans.

†Marais des Cygnes Shales[1]

Pennsylvanian: Kansas and Missouri.

Original reference: C. R. Keyes, 1900, Iowa Acad. Sci. Proc., v. 7, p. 84.

Named for Marais des Cygnes River, Kans.

Marathon Conglomerate[1]

Precambrian (upper Huronian): Central northern Wisconsin.

Original reference: S. Weidman, 1907, Wisconsin Geol. Nat. History Survey Bull. 16, p. 362.

Occurs in and near Marathon, Marathon County.

Marathon Limestone[1]

Lower Ordovician: Southwestern Texas.

Original reference: P. B. King, 1931, Am. Assoc. Petroleum Geologists Bull., v. 15, no. 9, p. 1066-1069, 1079.

W. B. N. Berry, 1960, Texas Univ. Bur. Econ. Geology Pub. 6005, p. 8-19, strat. sections. As measured in Marathon anticlinorium, limestone is between 840 and 890 feet thick. Divisible into three parts: Monument Spring dolomite member and beds above and below it. In Dagger Flat anticlinorium, limestone is intensely folded and faulted; no continuous section can be measured on northwest limb, and only a partial section on southeast limb. In Solitario and old Jones Ranch areas, Alsate shale is absent between characteristic limestones of Marathon limestone and Fort Pena formation; in its place is a white to buff quartzose sandstone 20 to 50 feet thick that is here named Rodriquez Tank sandstone. Graptolite faunas discussed. Tremadoc fossils found 25 feet above contact with Dagger Flat sandstone and 225 feet below contact. If Tremadoc belongs in Ordovician, as is now commonly considered, then, with exception of uppermost graptolite zone, Marathon is Early Ordovician. Top 30 feet is Whiterock (early Middle Ordovician) age.

Named for exposures in town of Marathon, Brewster County.

Marathon sandstone member[1] (of Ithaca facies subgroup)

Upper Devonian: South-central New York.

Original reference: K. E. Caster, 1933, Geol. Soc. America Bull., v. 44, pt. 1, p. 202.

G. A. Cooper and others, 1942, Geol. Soc. America Bull., v. 53, no. 12, pt. 1, p. 1768, chart 4. Sandstone included in Ithaca shale.

Occurs in Ithaca region.

†Marathon Series[1]

Upper Cambrian and Lower and Middle Ordovician: Western Texas.

Original reference: J. A. Udden, C. L. Baker, and E. Böse, 1916, Texas Univ. Bur. Econ. Geology and Tech. Bull. 44, p. 37–38.

Marathon region.

Maravilla dolomite[1]

Permian: Texas.

Original reference: C. R. Keyes, Feb. 1936, Pan-Am. Geologist, v. 65, no. 1, p. 42, 49, 50.

Named for intermittent stream that flows by Marathon town to Rio Grande but heads in the Glass Range, where it is the drainage channel of the deep Gilliland Canyon.

Maravillas Chert[1]

Upper Ordovician: Western Texas.

Original reference: J. A. Udden, C. L. Baker, and E. Böse, 1916, Texas Univ. Bur. Econ. Geology and Tech. Bull. 44, p. 38–39.

J. L. Wilson, 1954, Am. Assoc. Petroleum Geologists Bull, v. 38, no. 12, p. 2458 (fig. 2), 2460 (fig. 3), 2462, 2463. In Marathon folded belt, West Texas, underlies Persimmon Gap shale (new); overlies Woods Hollow formation.

W. B. N. Berry, 1960, Texas Univ. Bur. Econ. Geology Pub. 6005. p. 6. 13, 27–31, 33–34, 36, 113–116. On basis of graptolite fauna, Maravillas chert represents late Middle Ordovician and all of Late Ordovician.

Named for Maravillas Gap, Brewster County.

Marble Limestone

Precambrian (Chuaran series): Northern Arizona.

Charles Keyes, 1938, Pan-Am. Geologist, v. 70, no. 2, p. 107 (chart), 112–113. Limsetone bed, 15 feet in thickness, which occurs in midst of the great shales-section of this region. Top layer is characteristic *Stromatopora* zone. Underlies Final shales (new); overlies Venus formation (new).

Its name refers to its fine exposures in a deep side-canyon opening into Marble Canyon from the Nunkoweap Valley; Grand Canyon region.

Marble Cliff Limestone (in Columbus Limestone)[1]

Middle Devonian: Central Ohio.

Original reference: C. S. Prosser and W. C. Morse, 1915, Outlines of field trips in geology in central Ohio, p. 14, 17.

Well exposed in banks of Scioto River and at Marble Cliff, Franklin County.

Marble Falls Limestone (in Bend Group)[1]

Marble Falls Group

Lower and Middle Pennsylvanian: Central Texas.

Original reference: R. T. Hill, 1889, Am. Geologist, v. 3, p. 289.

N. H. Darton, L. W. Stephenson and Julia Gardner, 1937, Geologic map of Texas (1:500,000): U.S. Geol. Survey. Lower formation in Bend group; underlies Smithwick shales.

M. G. Cheney, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 1, p. 66 (fig. 1), 80. In this report, type Marble Falls beds are considered a group, being part of Morrow series. Underlies Big Saline group (new).

F. B. Plummer, 1944, Texas Univ. Bur. Econ. Geology Mineral Resources Circ. 33, p. 3, 5, 6, 8. Marble Falls limestone includes [sequence not stated] Lemons Bluff (new), Big Saline, and Sloan (new) members.

F. B. Plummer, 1945, Texas Univ. Bur. Econ. Geology Pub. 4401, p. 64–69. Consists generally of dark-gray and black siliceous fossiliferous limestones and black shales; upper limestones grade eastward into shales. Thickness 30 to more than 400 feet. Divided into four units (ascending): Lemons Bluff member, Big Saline member, Sloan member, and Gibbons conglomerate lentil (new). Underlies Smithwick shale; overlies Barnett formation in some places and in others the Ellenburger.

R. C. Spivey and T. G. Roberts, 1946, Am. Assoc. Petroleum Geologists Bull., v. 30, no. 2, p. 181–183. Presence of fusiform fusulinids in Marble Falls limestone indicates that formation is post-Morrow in age. If Morrow beds are present at all in type Marble Falls, only a small part of lower part could be so classified, and, until some evidence of its Morrow equivalence is found, beds at Marble Falls should be regarded as post-Morrow in age. Term Marble Falls should be restored to its former meaning; that is, to include all beds at Marble Falls and equivalent beds in other parts of central Texas. Included in Atoka series.

F. B. Plummer, 1947, Jour. Paleontology, v. 21, no. 2, p. 142–146. Big Saline formation east of Cavern Ridge comprises (ascending) Gibbons conglomerate, Aylor oolite, Lemons Bluff spiculite, and Brister limestone members. Term Big Saline limestone as used east of Cavern Ridge includes the type section of the Marble Falls limestone and other sections of the Marble Falls limestone east of Cavern Ridge discussed by Thompson (1947, Jour. Paleontology, v. 21, no. 2, p. 147–164).

F. B. Plummer, 1950, Texas Univ. Bur. Econ. Geology Pub. 4329, p. 46–77. Group comprises Sloan formation below and Big Saline formation above. Underlies Smithwick formation.

Type locality: Exposure along banks of Colorado River from dam at Marble Falls to base of strata 1 mile below highway bridge at Marble Falls, Burnet County.

Marblehead Limestone Member (of Columbus Formation)[1]

Middle Devonian: Northwestern Ohio.

Original reference: E. Orton, 1888, Ohio Geol. Survey, v. 6, p. 75, 746–750, 758.

J. W. Wells, 1944, Geol. Soc. America Bull., v. 55, no. 3, p. 276 (fig. 1). Underlies Venice member; overlies Bellpoint member.

Named for Marblehead Peninsula, near Sandusky, Erie County.

Marble Hill Marble (in Richmond Group)[1]

Upper Ordovician: Southeastern Indiana.

Original reference: D. D. Owen, 1859, Rept. geol. reconn. Indiana made in 1837, p. 28, 29.

Named for Marble Hill, near Madison, Jefferson County.

Marblemount Quartz Diorite

Pre-Mesozoic: Northwestern Washington.

Peter Misch, 1952, The Mountaineer, v. 45, no. 13, p. 4 (geol. map). Sheared and partly metamorphosed to chloritic schist. Earlier than Mesozoic folding. Older than Skagit gneisses.

Marblemount is in Skagit County.

Marble Point Stage

Marble Point Till

Pleistocene: Southwestern Montana.

W. B. Hall, 1960, Billings Geol. Soc. [Guidebook] 11th Ann. Field Conf., p. 197–199. Discussion of multiple glaciation in Madison and Gallatin Ranges. Three stages recognized: Marble Point (oldest), intermediate, and Sawmill. Marble Point is most extensive episode in area. Marble Point till is present at elevation of more than 8,000 feet. Apex till (new) is present at average elevation of 9,000 feet. Believed that high-level glacial episode, represented by Marble Point and Apex tills, is either early Wisconsin in age or only slightly older.

Named for till deposit on Marble Point, secs. 4 and 9, T. 9 S., R. 4 E., Gallatin County.

Marburg Schist

Marburg Schist (in Wissahickon Formation)

Lower Paleozoic(?) (Glenarm Series): Western Maryland and southwestern Pennsylvania.

A. I. Jonas and G. W. Stose, 1938, Washington Acad. Sci. Jour., v. 28, no. 8, p. 346–347. Blue and green muscovite-chlorite schist and chloritoid schist with infolded quartzite beds; probably in part equivalent to Ijamsville phyllite (new). Lies northeast, east, and southeast of area of Ijamsville phyllite, volcanic flows, and Wakefield marble (new). In York County, Pa., the Marburg lies northwest of albite-chlorite schist facies of the Wissahickon, and extends northeastward into area of McCalls Ferry quadrangle where it [Marburg] is much coarser in grain, contains abundant muscovite, and was included with the Wissahickson by Knopf and Jonas (1929). Glenarm series. Precambrian(?).

Carlyle Gray and others, 1960, Geologic map of Pennsylvania (1:250,000): Pennsylvania Geol. Survey, 4th ser. Marburg schist mapped with Wissahickon formation. Probably Lower Paleozoic.

Named from Marburg, York County, Pa. Stratigraphically continuous into Carroll County, Md.

Marca Shale Member (of Moreno Formation)

Upper Cretaceous: Southern California.

M. B. Payne, 1941, (abs.) Geol. Soc. America Bull., v. 52, no. 12, pt. 2, p. 1954; 1951, California Div. Mines Spec. Rept. 9, p. 6 (fig. 2), 9, pls. 2, 3, 4, 5. White-weathering calcareous shale, 300 feet thick. Underlies Dos Palos shale member (new); overlies Tierra Loma shale member (new). On basis of this mapping, it is concluded that Anderson and Pack (1915) show base of Moreno formation in Ortigalita Creek some 1,800 feet stratigraphically lower than their type Moreno in Moreno Gulch.

Type locality: Escarpado Canyon, secs. 7 and 8, T. 15 S., R. 12 E., Panoche Hills, Fresno County. Escarpado Canyon is 6 miles south of Moreno Gulch and 2 miles north of Panoche Creek. Named for Marca Canyon with mouth at center sec. 13, T. 14 S., R. 12 E.

Marcellon Quartz Porphyry[1]

Precambrian (pre-Huronian?) : Central southern Wisconsin.

Original reference: R. D. Irving, 1877, Geology Wisconsin, v. 2, p. 519.

Occurs in sec. 7, town of Marcellon, Columbia County.

Marcellus Shale (in Hamilton Group)[1]

Marcellus Shale Member (of Romney Shale)

Marcellus Member (of Millboro Shale)

Middle Devonian: New York, western Maryland, New Jersey, Ohio, eastern and central Pennsylvania, Virginia, and West Virginia.

Original reference: J. Hall, 1939, New York Geol. Survey 3d Rept., p. 295–296; L. Vanuxem, 1840, New York Geol. Survey 4th Rept.

G. A. Cooper, 1930, Am. Jour. Sci., 5th ser., v. 19, no. 110, p. 129–134. Marcellus of this report [Hamilton group of New York] is used in same way as Vanuxem used it in 1840 and is placed in Hamilton group as formation correlative in rank with Skaneateles and other formations. Upper limit of Marcellus is base of Stafford and Mottville members of Skaneateles; lower limit is Onondaga. Following divisions recognized: Oatka Creek shale, Chittenango, Cherry Valley, Union Springs, Cardiff shale, Bridgewater, and Pecksport members.

G. A. Cooper, 1933, Am. Jour. Sci., 5th ser., v. 24, no. 156, p. 543–551. Marcellus, in region east of Schoharie contains Berne and Otsego members. Name Berne is used for shale that is equivalent in Berne quadrangle to Union Springs, Cherry Valley, and Chittenango members. In Schoharie Valley, the Panther Mountain shale and sandstone includes upper part of the Marcellus, the Skaneateles, and the Ludlowville, which cannot be separated lithologically. Suggested that name Panther Mountain be used in Susquehanna and Cherry Valley for interval between Solsville and Portland Point members where Pecksport and Mottville are lithologically indistinguishable and Skaneateles and Ludlowville cannot be separated on this basis.

Bradford Willard, 1935, Geol. Soc. America Bull., v. 46, no. 2, p. 202–204. Formation, in central Pennsylvania, is 200 to 675 feet. Includes (ascending) Shamokin black shale, Turkey Ridge sandstone, Mexico sandstone, and Mahanoy black shale members. Underlies Mahantango formation; overlies Onondaga. Hamilton group.

B. N. Cooper, 1939, Virginia Geol. Survey Bull. 55, p. 42–43. Member of Millboro shale. Thickness 100 to 150 feet. Overlies Naples member.

Charles Butts, 1940, Virginia Geol. Survey Bull. 52, pt. 1, p. 308-317. Millboro shale used for mappable unit because Marcellus and Naples constituents cannot be readily separated and mapped. Includes only Marcellus and Naples (basal Portage) shales of original Romney.

G. A. Cooper, 1941, Washington Acad. Sci. Jour., v. 31, no. 5, p. 179–180; G. A. Cooper, 1943, *in* Winifred Goldring, New York State Mus. Bull. 332, p. 247–279. Includes Stony Hollow member (new) which is equivalent to Cherry Valley limestone. Beds hitherto classified as "Marcellus" shale (Bakoven of Chadwick) immediately underlie Stony Hollow member and are now proved to be equivalent of Union Springs member. The Stony Hollow underlies Mount Marion formation of Grabau at its type section; hence, the Mount Marion is interpreted as sandy facies of Chittenango black shale member of Marcellus overlying Cherry Valley to west.

G. A. Cooper and others, 1942, Geol. Soc. America Bull., v. 53, no. 12, pt. 1, p. 1772, chart 4. Because of presence of *Paraspirifer* in the Mottville and its abundance below the Mottville in eastern New York, seems best to transfer the Mottville-Stafford to the Marcellus.

Ernst Cloos, 1951, Maryland Dept. Geology, Mines and Water Resources Washington County Rept. 14, p. 87–88. Middle Devonian of Maryland is included in single formation, the Romney, which is divided into Onondaga, Marcellus, and Hamilton members. Thickness of Marcellus about 500 feet.

H. H. Arndt and others, 1959, Geol. Soc. America Guidebook Pittsburgh Mtg., p. 4, 27, pl. 1. In western part of trip area, relationship with underlying Onondaga is largely transitional; in Mifflin, Juniata, and Perry Counties, contact is sharp. Marcellus is typically dark-gray to black thin-bedded or laminated partly calcareous shale; numerous large limestone concretions present and pyrite common. In Juniata, Mifflin, and Perry Counties, Marcellus subdivided into (ascending) Shamokin shale, Turkey Ridge sandstone, and Mahanoy shale. Total thickness increases in this area, and formation apparently intertongues with overlying Montebello sandstone. Thickness 75 to 500 feet.

Type section (Cooper, 1930): Slate Hill, about 1 miles south of Marcellus. Complete section exposed in Jackknife ravine on northeast slope of hill. Named for exposures at Marcellus village, Onondaga County, N.Y.

Marcem Formation

Middle Ordovician (Mohawkian): Southwestern Virginia and northeastern Tennessee.

G. A. Cooper, 1956, Smithsonian Misc. Colln., v. 127, pt. 1, p. 76–77, chart 1 (facing p. 130). Name applied to unit consisting of conglomerate at base with light-gray to pink massive calcarenite above. Minor parts of shale, mudstone, and calcilutite may be present. Thickness 120 to 300 feet. Underlies Lincolnshire formation. Name attributed to B. N. Cooper and G. A. Cooper.

Named from Marcem quarry 2 miles west of Gate City, Scott County, Va. Occurs along northwest base of Clinch Mountain west of Gate City.

Marcy Anorthosite[1]

Precambrian: Northern New York.

Original reference: H. P. Cushing, 1899, New York State Geologist 18th Ann. Rept.

A. F. Buddington, 1939, Geol. Soc. America Mem. 7, p. 19–21, table 3, pl. 4. Discussion of Adirondack igneous rocks and their metamorphism. Main massif of anorthositic rocks occupies about 1,200 square miles. Two facies of the anorthositic rocks have been defined, named, and differentiated on published geologic maps. One facies, the Whiteface, originally named by Kemp (1898), is almost wholly restricted to borders of anorthosite masses. Miller (1919 New York State Mus. Bulls. 213, 214) named the rock characteristic of the core of the anorthosite massif the Marcy anorthosite and described it as typically bluish-gray coarse- to very coarse-grained anorthosite with less than 10 percent dark minerals. Terms Marcy and Whiteface have thus been used in sense of formation names rather than of closely defined rock types, and it is with this significance that the terms are used in this report. Locally, there are belts of anorthositic rocks which do not fit the requirements for either the Marcy or Whiteface facies and term "transitional facies" is used to cover them. "Border facies" includes both the Whiteface and "transition" facies and in addition, as along exposed border of St. Regis-Marcy anorthosite, a facies which has coarse Marcy txeture but is commonly gabbroic anorthosite and contains garnet.

Named for exposures on Mount Marcy, Essex County.

Maremu (Marem) Beds or Formation

See Malam Beds or Formation.

†Mareniscan Series[1]

Precambrian: Michigan.

Original reference: C. R. Van Hise, 1892, U.S. Geol. Survey Bull. 86, p. 490.

Name derived from Marenisco Township, south of Gogebic Range, Gogebic County, where these rocks have a typical development.

Maretburg facies (of Muldraugh Formation)

Lower Mississippian: Central Kentucky.

P. B. Stockdale, 1939, Geol. Soc. America Spec. Paper 22, p. 76, 212–214. Consists of (1) limestone, generally bedded, siliceous, dense, and in places massive; and (2) shale, in zones of various thickness up to 5 or 6 feet, distributed throughout formation, and in a basal member up to 18 feet thick, bounded by bands of glauconite. Thickness 35 to 60 feet. Contains Cummins Station member (new) at base. Merges with Steels Knob facies (new) on west and Hummel facies (new) on east. Underlies unclassified Upper Mississippian rocks; overlies Floyds Knob formation.

Type section: Along Louisville and Nashville Railroad and nearby hillsides, midway between Maretburg and Brodhead, one-half mile west of Cummins Station, Rockcastle County. Named for town of Maretburg, west-central Lincoln County.

Margeson Creek Gneiss

Precambrian: Northern Michigan.

J. E. Gair and K. L. Wier, 1956, U.S. Geol Survey Bull. 1044, p. 18–27, pl. 1. Consists mainly of banded gneiss of granodioritic to tonalitic composition and granitic rocks ranging in composition from granite to tonalite; granitic rocks are mainly inequigranular and well foliated; less common are equigranular nonfoliated and pegmatitic varieties. Unconformably underlies Randville dolomite. Rocks of the Margeson Creek gneiss were considered "Archean" in age by earlier workers. Present study corroborates this conclusion although term "Archean" is not used. The gneiss is in a position analogous to lower Precambrian granitic and gneissic rocks of Dickinson County although it does not necessarily correlate with them.

Name derived from Margeson Creek along which there are many exposures in sec. 12, T. 44 N., R. 32 W.; secs. 6 and 7, T. 44 N., R. 31 W.; and sec. 31, T. 45 N., R. 31 W., Kiernan quadrangle, Iron County.

Maria Formation

Post-Cambrian (probably upper Paleozoic) : Southern California.

W. J. Miller, 1944, California Jour. Mines and Geology, v. 40, no. 1, p. 12, 25–28. Consists of crystalline limestone, gypsum beds, quartzites, and schists. In southern half of western area, the Maria is characterized by an escarpment 1,000 to 1,500 feet high. In the face of the escarpment, Maria beds strike northeast and dip 30° to 40° NW. Unconformably overlies Chuckwalla complex (new).

R. A. Hoppin, 1954, California Div. Mines Spec. Rept. 36, p. 8–15, 24. Described in connection with gypsum deposits in Palen Mountains. Lies in fault contact (may or may not be reverse) with sediments tentatively assigned to McCoy Mountains formation. Upper Paleozoic(?).

Named for typical occurrence in the Maria and Little Maria Mountains, Palm Springs-Blythe area, Riverside County.

Maria Plutonic Complex

Upper Paleozoic(?) : Southern California.

W. J. Miller, 1944, California Jour. Mines and Geology, v. 40, no. 1, p. 12, 29–32, pl. 4. Contains crystalline dolomitic limestones, quartzites, and schists, cut by dioritic and granitic rocks, usually in the form of sills, and by many pegmatite dikes; metasediments are granitized and locally injected lit-par-lit by pegmatitic granite. Both the diorite and the granite are younger than the Paleozoic Maria beds [formation]; hence, they may be late Paleozoic or even as young as late Mesozoic. They are tentatively assigned to late Paleozoic.

Covers an area of about 10 square miles in Maria Mountains, Palm-Springs-Blythe area, Riverside County.

Maria Creek Limestone Member (of Shelburn Formation)

Maria Creek Limestone

Upper Pennsylvanian: Southwestern Indiana.

C. A. Malott, 1947, Indiana Acad. Sci. Proc., v. 57, p. 125. Incidental mention as Maria Creek limestone.

F. E. Kottlowski, 1954, U.S. Geol. Survey Coal Inv. Map C–11. Formally named Maria Creek limestone member of Shelburn formation. Consists of a basal limestone unit 6 inches to 6 feet thick and an upper limestone unit 3 to 10 feet thick; limestones are separated by 2 to 11 feet of varicolored shale. Member varies both laterally and vertically, one or more units generally being absent locally. Thickness of member at type section 6½ feet. Separated from underlying Busseron member by a shale and sandstone interval that contains coal beds; overlain by gray sandy shale as much as 27 feet thick. Name credited to George Heap (unpub. thesis).

Type section: NE¼SE¼ sec. 9, T. 6 N., R. 8 W., Sullivan County. Named for exposures along Maria Creek, 4 miles east of Carlisle.

Mariana Limestone

Pliocene and Pleistocene: Mariana Islands (Tinian and Saipan).

Risaburo Tayama, 1936, Geomorphology, geology, and coral reefs of Tinian Island together with Aguijan and Naftan Islands: Tohoku Univ., Inst. Geology and Paleontology Contr. in Japanese Language no. 21, p. 26–27, 31 [English translation in library of U.S. Geol. Survey, p. 25–27, 31-32]. Coralline limestone with conglomerate at base; locally a *Halimeda* limestone. Unconformably overlies rocks older than Carolinas limestone.

Josiah Bridge *in* W. S. Cole and Josiah Bridge, 1953, U.S. Geol. Survey Prof. Paper 253, p. 12–13. Consists of white to yellowish-white poorly stratified soft to hard porous limestone. Unconformably overlies Naftan limestone.

P. E. Cloud, Jr., R. G. Schmidt, and H. W. Burke, 1956, U.S. Geol. Survey Prof. Paper 280–A, p. 78–84, pl. 2, chart 1. On Saipan includes: rubbly facies of impure fragmental limestones; *Acropora*-rich facies of calcareous clays and impure limestones; massive facies of mainly unbedded porous clastic to constructional limestones; and *Halimeda*-rich facies. Thickness ranges from featheredge to probably more than 400 feet thick, and perhaps 500 feet or more. Unconformably above Tagpochau limestone; older than Tanapag limestone. Naftan limestone of Tayama (1938) included in Mariana of this report; it is part of *Halimeda*-rich facies. Pleistocene. Standard reference section designated.

Reference section: Exposures in area known as Dandan (southeastern Saipan). This site refers to that part of Dandan included between Wallace Highway at north, Dandan Point at south, Laulau Bay at east, and Gonno Cliffs at west.

Marianna Limestone (in Vicksburg Group)[1]

Oligocene, middle: Western Florida, southern Alabama, and Mississippi.

Original reference: L. C. Johnson, 1892, Geol. Soc. America Bull., v. 3, p. 128–132.

F. S. MacNeil, 1944, Am. Assoc. Petroleum Geologists Bull., v. 28, no. 9, p. 1315 (fig. 1), 1324–1329. Sediments included in formation consist of soft chalky limestone, locally called chimney rock; some local, hard limestone; tough to hard ledges in the chimney rock; sandy glauconitic limestone; marl; calcareous sand; lignitic clay. Thickness probably not more than 60 feet. In Mississippi and western Alabama, includes Mint Spring marl member in basal part. At Marianna, overlies Ocala limestone; in Mississippi and Alabama, Forest Hill sand and Red Bluff clay. Underlies Byram formation (Glendon limestone member).

C. W. Cooke, 1945, Florida Geol. Survey Bull. 29, p. 75–81. In Mississippi and western Alabama, the Marianna is separated from Eocene formations by lower Oligocene Red Bluff clay, but, in Florida it lies directly on Ocala limestone. Seems probable that Marianna overlaps lower Oligocene deposits somewhere in Alabama and lies unconformably on Ocala in Florida. Underlies Byram limestone. Thickness about 30 feet at Marianna; as much as 80 feet in western Alabama. Not recognized east of Chattahoochee and Apalachicola Rivers, either in Georgia or Florida. Middle Oligocene.

Named for exposures at Marianna, Jackson County, Fla.

Marias River Shale (in Colorado Group)

Upper Cretaceous: Northwestern Montana.

W. A. Cobban and others, 1959, Am. Assoc. Petroleum Geologists Bull., v. 43, no. 12, p. 2792 (fig. 3), 2793; 1959, Billings Geol. Soc. [Guidebook] 10th Ann. Field Conf., p. 89 (fig. 1), 90–91. Consists of 900 to 1,200 feet of dark gray shale. Comprises (ascending) Floweree, Cone calcareous, Ferdig shale, and Kevin shale members (all new). Underlies Telegraph Creek formation; overlies Blackleaf formation.

Named from excellent exposures along Marias River, which flows eastward across Sweetgrass arch between South arch and Kevin-Sunburst dome. Here, most of formation is exposed in Marias River saddle, along boundary between Toole and Pondera Counties. Forms bedrock on most of Sweetgrass arch and extends westward into Rocky Mountains.

Mariato formation[1]

Pleistocene(?): Panamá.

Original reference: O. H. Hershey, 1901, California Univ. Dept. Geol. Bull., v. 2, p. 261.

W. P. Woodring *in* R. Hoffstetter and others, 1960. Lexique Strat. Internat., v. 5, Amérique Latine, fasc. 2a, p. 338–339. Poorly defined name for surficial deposits. Pleistocene(?).

Present on Mariato Plain, Veraguas Province.

Maricao Basalt (in Mayagüez Group)

Upper Cretaceous: Southwestern Puerto Rico.

P. H. Mattson, 1958, Dissert. Abs., v. 18, no. 1, p. 197; 1960, Geol. Soc. America Bull., v. 71, no. 3, p. 337–338. pl. 1. Lava and flow breccia with minor breccia and tuff occur above and as lenses in Yauco mudstone (new) in Las Vegas syncline and to lesser extent in Hormigueros syncline. Turonian to Maestrichtian.

Named for exposures on Río Maricao north of Maricao, Mayagüez area.

†Maricopa Shale[1]

Miocene, upper and middle: Southern California.

Original reference: W. A. English, 1916, U.S. Geol. Survey Bull. 621, p. 191–215.

M. L. Hill, S. A. Carlson, and T. W. Dibblee, Jr., 1958, Am. Assoc. Petroleum Geologists Bull., v. 42, no. 12, p. 2989. Saltos shale member (new) of Monterey shale was mapped by English (1916) as Maricopa shale and by Eaton and others (1941, Am. Assoc. Petroleum Geologists Bull., v. 25, no. 2) as "Temblor".

Named for exposures west of Maricopa and Maricopa Flat, Kern County.

Marietta (in Carbondale Formation)[1]

Pennsylvanian: Northwestern Illinois.

Original reference: T. E. Savage, 1930, Illinois Acad. Sci. Trans., v. 22, p. 498.

Probably named for Marietta, Fulton County, just east of McDonough County line.

†Marietta Beds[1]

Lower Cretaceous (Comanche Series): Southern Oklahoma and northeastern Texas.

Original reference: R. T. Hill, 1894, Geol. Soc. America Bull., v. 5, pl. 13, p. 302, 303, 328–337.

C. C. Branson, 1957, Oklahoma Geology Notes, v. 17, no. 11, p. 101. Abandoned by Oklahoma Geological Survey. Name preoccupied. Beds or clays are now classified as Weno.

Named for Marietta, Love County, Okla.

Marietta Sandstone (in Dunkard Group)[1]

Marietta Sandstone (in Washington Formation)

Marietta sandstone member

Permian: Eastern Ohio, western Pennsylvania, and western West Virginia.

Original reference: I. C. White, 1891, U.S. Geol. Survey Bull. 65, p. 35.

R. V. Hennen, 1909, West Virginia Geol. Survey Rept. Marshall, Wetzel, and Tyler Counties, p. 215–218, maps. Interval between Jollytown and Washington coals is often occupied in its lower part by sandstone ledges having total thickness of over 100 feet. These have been named Marietta sandstone by White (1891). In Marshall-Wetzel-Tyler area, these two ledges are termed Upper and Lower Marietta.

W. O. Hickok 4th and F. T. Moyer, 1940, Pennsylvania Geol. Survey, 4th ser., Bull. C–26, p. 149, 150, 151. In Fayette County, consists of three units referred to as Lower, Middle, and Upper Marietta. Unit herein named Davistown sandstone may have been included in Upper Marietta by Hennen (1909). In area where Middle Washington limestone is well developed, it seems preferable that the Upper Marietta be confind to the sandstone strata below this limestone and that the sandstone above it be given another name; hence, term Davistown.

R. L. Nace and P. P. Bieber, 1958, West Virginia Geol. Survey Bull. 14, p. 18 (table 2). In Harrison County, middle and upper units of Marietta sandstone are included in Washington formation, Dunkard series.

D. L. Norling, 1958, Ohio Geol. Survey Bull. 56, p. 10 (fig. 3), 93–94. Lower part of Marietta sandstone member (Washington series) present in Morgan County. In this report, the Washington is considered a series, and term Dunkard is considered synonymous with Permian.

Named for Marietta, Washington County, Ohio.

Marigold Member (of Okaw Formation)

Marigold Oolite (in Chester Group)[1]

Mississippian (Chester): Southwestern Illinois.

Original reference: A. H. Sutton, 1934, Jour. Geology, v. 42, no. 6, p. 626, 627, 628.

J. M. Weller and A. H. Sutton, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 5, p. 834. Many limestones in lower half of Okaw formation (restricted) are more or less oolitic, and one conspicuous oolite, the Marigold member, occurs about 75 feet above the base.

Occurs in area south of Marigold, Randolph County.

Mariiru Beds

Eocene: Mariana Islands (Rota).

Risaburo Tayama, 1939, Correlation of the strata of the South Sea Islands: Geol. Soc. Japan Jour., v. 46, no. 549, p. 346 (correlation chart) [English translation in library of U.S. Geol. Survey]; 1952, Coral reefs in the South Seas: Japan Hydrog. Office Bull., v. 11, p. 49, table 4 [English translation in library of U.S. Geol. Survey, p. 59]. Chiefly limestone. Correlated with Nagas beds on Guam and Matansa beds on Saipan.

S. Hanzawa *in* Jacques Avias and others, 1956, Lexique Strat. Internat., v. 6, Océanie, fasc. 2, p. 45. Formation consists of sandy limestone, marl, limestone, and basal conglomerate. Conformably overlies Manila formation. Refers to S. Sugawara (1939, unpub. ms.) and K. Asano (1939, Jubilee Pub. Yabe's 60th Birthday).

Exposed at Mariiru, Hiirippo, Gargane, and Taihanom, Rota Island.

Marin Sandstone Member (of Franciscan Formation)

Marin Sandstone (in Franciscan Group)[1]

Jurassic and Cretaceous: Northern California.

Original reference: A. C. Lawson, 1902, Science, new ser., v. 15, p. 416 (table).

U.S. Geological Survey currently classifies the Marin Sandstone as a member of the Franciscan Formation on the basis of a study now in progress.

Named for occurrence on Marin Peninsula, Marin County.

Marino Agglomerate or Andesite

Eocene: Mariana Island (Tinian).

Risaburo Tayama, 1939, Correlation of the strata of the South Sea Islands: Geol. Soc. Japan Jour., v. 46, no. 549, p. 346 (correlation chart) [English translation in library of U.S. Geol. Survey]. Marino andesite named on correlation chart. Correlated with Hagman andesite on Saipan, Manila andesite on Rota, and Babelthaup agglomerate on Palau. Eocene.

Risaburo Tayama, 1952, Coral reefs in the South Seas: Japan Hydrog. Office Bull., v. 11, p. 48, table 4 [English translation in library of U.S. Geol. Survey, p. 57]; S. Hanzawa *in* Jacques Avias and others, 1956, Lexique Strat. Internat., v. 6, Océanie, fasc. 2, p. 45. Referred to as Marino agglomerate.

Exposed on slope of Carolinas, or Lalo, Hill, and Shinminato Tableland, Tinian.

Marino Beds

Eocene: Mariana Islands (Tinian).

Risaburo Tayama, 1952, Coral reefs in the South Seas: Japan Hydrog. Office Bull., v. 11, p. 51, table 4 [English translation in library of U.S. Geol. Survey, p. 61]; S. Hanzawa *in* Jacques Avias and others, 1956, Lexique Strat. Internat., v. 6, Océanie, fasc. 2, p. 45. Alternate layers of sandstone, shale, and liparitic tuff. Correlated with Fena beds on Guam and Densenyama beds on Saipan. Figure 40 (p. 51) shows Marino beds stratigraphically above Marino agglomerate.

Exposed in the Carolinas plateau and Banaderon Lemai, Tinian.

Marion Concretionary Limestone (in Chase Group)[1]

Permian: Central Kansas.

Original reference: C. S. Prosser, 1895, Jour. Geology, v. 3, p. 772, 773, 780, 783, 797.

Named for Marion, Marion County.

Marion Flint (in Chase Group)[1]

Permian: Central Kansas.

Original reference: C. S. Prosser, 1895, Jour. Geology, v. 3, p. 773, 779–786, 797.

Named for Marion, Marion County.

†Marion Formation (in Sumner Group)[1]

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

Original reference: C. S. Prosser, 1895, Jour. Geology, v. 3, p. 786–789.

Named for exposures in Marion County, Kans.

Marion Granite[1]

Precambrian (Laurentian): Central southern Wisconsin.

Original reference: R. D. Irving, 1877, Geology Wisconsin, v. 2, p. 522.

Forms three low knobs in town of Marion, Waushara County.

Mariposa Formation

Mariposa Slate[1]

Upper Jurassic: Northern California.

Original reference: G. F. Becker, 1885, U.S. Geol. Survey Bull. 19, p. 18–23.

N. L. Taliaferro, 1942, Geol. Soc. America Bull., v. 53, no. 1, p. 90. Overlies Amador group (new).

J. H. Eric, A. A. Stromquist, and C. M. Swinney, 1955, California Div. Mines Spec. Rept. 41, p. 12–14, pls. 1–4. Formation in Angels Camp and Sonora quadrangles. Lithology varies within mapped area, and in places slate is only a minor constituent; hence, term formation is used. In Sonora quadrangle, about two-thirds of the rocks assigned to formation are dark-gray to black slates and the rest are metamorphosed fine- to coarse-grained sandstone and grit, graywacke, pebble conglomerate, tuffaceous sandstone, and sandy to silty tuff. Believed to be in depositional contact with Logtown Ridge formation along east flank of Peoria Mountain and along flanks of Bear Mountain; in these areas, basal part of Mariposa consists of dark-lead-gray slate with subordinate sandy and pebbly layers. Formation is exposed in a partly fault-bounded northwest-trending belt that lies west of Mother Lode fault system. Major structure of belt east of Bear Mountain, in Angels Camp quadrangle, is not sufficiently known to warrant measurement of thickness of formation. In Sonora quadrangle and adjacent parts of Chinese Camp quadrangle, graded bedding shows top of formation is to east; here formation is about 3,000 feet thick. To the west, Mariposa unconformably overlies Logtown Ridge formation; to the east, it is cut off by Mariposa fault zone so that top of formation is not seen. No type section has been described.

G. H. Curtis, J. F. Evernden, and J. Lipson, 1958, California Div. Mines Spec. Rept. 54, p. 6. Potassium-argon dating of Rocklin granodiorite (new) from Rocklin pluton gave age of 131 million years. Pluton intrudes Mariposa formation.

Named for occurrence on Mariposa estate, in Mariposa County.

Mariposa Group[1]

Mesozoic: East-central California.

Original reference: N. L. Taliaferro, 1933, Geol. Soc. America Bull., v. 44, no. 1, p. 149.

Between Stanislaus River and Mariposa Creek, Tuolumne and Mariposa Counties.

Maris Rhyolite[1]

Miocene, upper, or later: Central Nevada.

Original reference: H. G. Ferguson, 1924, U.S. Geol. Survey Bull. 723, p. 50–51.

Exposed at Maris mine, Manhattan district.

Marjo Canyon Diorite

Age unknown: Southern California.

K. J. Hsu, 1955, California Univ. Dept. Geol. Sci. Bull., v. 30, no. 4, p. 300–301, geol. map. Plutonic rock, medium to coarse grained, typically composed almost entirely of andesine and hornblende in ratio of about 3 to 1.

Named for its exposure at Marjo Canyon amphitheater SW¼ sec. 18, T. 1 N., R. 7 W., San Bernardino County. Also present on east side of San Antonio Canyon.

Marjum Limestone[1]

Marjum Formation

Middle Cambrian: Western Utah.

Original reference: C. D. Walcott, 1908, Smithsonian Misc. Colln., v. 53, no. 1804, p. 9, 10.

Charles Deiss, 1938, Geol. Soc. America Bull., v. 49, no. 7, p. 1129–1132, 1141 (fig. 5), 1147. Thickness emended section 1,530 feet. Overlies Wheeler shale; underlies Weeks limestone. Middle-Upper Cambrian boundary lies at base of Weeks.

H. E. Wheeler, 1948, Nevada Univ. Bull., Geology and Mining Ser., no. 47, p. 41–42. Deiss (1938) redefined Marjum and Weeks limestones on nonlithologic and uncertain paleontologic basis and placed Marjum-Weeks contact at estimated position of Middle-Upper Cambrian boundary. As presently defined, these units are regarded invalid. Their present definition is comparable to Cadiz formation of California and Comet shale in Nevada.

R. E. Cohenour, 1959, Utah Geol. and Mineralog. Survey Bull. 63, p. 12 (table 1), 49–51, 149–150, pls. 1, 17. Described as formation in Sheeprock Mountains where it includes strata between Wheeler formation and Cole Canyon dolomite. Composed of carbonates and some shale. Thickness 1,193 feet. Middle Cambrian; because no fossils were found in upper half of formation, it is possible that part of the Marjum may straddle Middle-Upper Cambrian boundary.

Type locality: Cliffs on south side of Marjum Pass, House Range, Millard County. Emended section measured on spur which forms west side of Rainbow Valley.

Markgraf Member (of Joliet Formation)

Silurian (Niagaran): Northern Illinois.

D. L. Graf, 1952, Illinois Geol. Survey Rept. Inv. 161, p. 2, 3 (table 1). Dense fine-grained slightly argillaceous slightly silty dolomite.

Occurs in Chicago area. [Graf (p. 2) states that he obtained his samples from Willman. Willman (1943, Illinois Geol. Survey Rept. Inv. 90, p. 26–27) divides Joliet formation into five unnamed members, A to E; on p. 26 he [Willman] mentions Markgraf quarry in discussing member A but does not apply the name to any of his units.]

Markham Mill Formation (in Jackfork Group)

Mississippian (Meramecian and Chesterian): Southeastern Oklahoma.

B. H. Harlton, 1938, Am. Assoc. Petroleum Geologists Bull., v. 22, no. 7, p. 854 (fig. 1), 857, 884–886. Defined to include strata underlying Wesley formation (new) and overlying Prairie Mountain formation (new). Consists of basal siliceous shale followed by shales and thin sandstones; at Prairie Mountain, basal shale contains lenses of cherty sandstone conglomerate; conglomerate is coarser northward, becoming bouldery in frontal part of Ouachita Mountains. Thickness varies from 220 to about 500 feet; measured thickness at type locality 400 feet. Pushmataha series.

L. M. Cline, 1960, Oklahoma Geol. Survey Bull. 85, p. 43 (table 3), 54–55. In type area, consists of 400 feet of strata chiefly composed of sandstone which is thick bedded in lower part and thin bedded in upper part. Base marked by 15 to 20 feet of dark-gray siliceous shale which is most characteristic member of formation. Thickness 318 feet and 328 feet respectively in two sections in Kiamichi Range. Formation thins rapidly northward from type section into frontal Ouachitas. Overlies Prairie Mountain formation; underlies Wesley formation. Mississippian (Meramecian and Chesterian).

Type locality: NE cor. SW¼ sec. 21, T. 2 S., R. 14 E., Atoka County. Name taken from saw mill, Markham Mill. Second type locality was chosen in sec. 2, T. 2 S., R. 12 E., along Campbell Creek; this was first considered the type locality, but no name was available in area.

Markley Sandstone Member (of Kreyenhagen Formation)

Markley Sandstone[1]

Eocene, upper: Western California.

Original reference: B. L. Clark, 1918, California Univ. Pub., Dept. Geol. Bull., v. 11, p. 54–111.

B. L. Clark and A. S. Campbell, 1942, Geol. Soc. America Spec. Paper 39, p. 1, 4 (fig. 3), 5, 9. Redefined and subdivided to include newly defined Sidney shale member which lies about 2,000 feet above base of formation. Stratigraphically overlies Kellogg shale (new) and, in some areas, a series of shales and sands locally referred to as "Nortonville shales"; underlies Kirker formation.

C. E. Weaver, 1949, Geol. Soc. America Mem. 35, p. 59–64, 96, 130, 142, pls. 7, 8, 11–13. Described in area immediately north of San Francisco Bay region where it is most widely distributed Tertiary formation. In American Canyon (Carquinez quadrangle), formation is nearly 5,100 feet thick; includes newly defined Jameson shale member, 200 to 1,200 feet thick, about 1,400 feet above base. Wherever base is exposed, it rests on the Domengine; uncomformable beneath Cierbo formation; in some areas, overlapped by Wolfskill formation (new); in some areas, overlain by Putnam Peak basalt (new).

Ralph Stewart, 1949, U.S. Geol. Survey Oil and Gas Inv. Prelim. Chart 34. Rank reduced to member status of Kreyenhagen formation. Underlies "Sidney" shale member; overlies Nortonville shale member.

C. V. Fulmer, 1954, (abs.) Geol. Soc. America Bull., v. 65, no. 12, pt. 2, p. 1341. Here treated as a formation overlying Nortonville formation. Includes Sidney Flat shale member.

Named for exposures in vicinity of Markley Canyon, Mount Diablo region, about 35 miles east of San Francisco.

†Marks Head Marl[1]

Miocene, lower: Eastern Georgia and southern South Carolina.

Original reference: E. Sloan, 1905, South Carolina Geol. Survey geognostic map of South Carolina, advance copies published in 1908, in South Carolina Geol. Survey, ser. 4, Bull. 2; 1907, Summary of mineral resources of South Carolina, p. 12, 18, 19.

Extends from Mark's Head, on scarp of Savannah River Swamp, northwest of Porter's Landing, Effingham County, Ga., by Raysor's Bridge, S.C., and thence below Mount Hope on Santee River, S.C.

Marks-Mills Red Beds

Eocene, upper: Arkansas.

Original reference: G. D. Harris, 1894, Am. Jour. Sci., 3d, v. 47, p. 304.

Probably named from the red beds of Marks Mills Battlefield, Cleveland County.

Mark West andesite[1]

Pliocene: Northern California.

Original reference: V. C. Osmont, 1904, California Univ. Pub., Dept. Geol. Bull., v. 4, p. 58–87.

Probably named for Mark West Springs, Sonoma County.

Marlboro Clay Member (of Nanjemoy Formation)[1]

Eocene, lower: Eastern Maryland and eastern Virginia.

Original reference: W. B. Clark and G. C. Martin, 1901, Maryland Geol. Survey, Eocene Volume, p. 65.

N. H. Darton, 1947, Econ. Geology, v. 43, no. 2, p. 154–155; 1951. Geol. Soc. America Bull., v. 62, no. 7, p. 753–754, 755, 757 (fig. 5), 760. Marlboro clay constitutes lowest member of Nanjemoy formation. Thickness at most places near 30 feet, but clay thins and thickens irregularly. Consists of pure clay, mostly pink, not "argillaceous sand," and some gray clay. Underlies dark green sand of Nanjemoy formation; unconformably overlies glauconitic sand or marl of Aquia formation. Marlboro clay member may have been coextensive with other members of the Eocene in Virginia, but it thins to the west; not far south of lat 38°15′ its western edge is buried under overlap of Miocene diatomaceous earth; clay passes below sea level a shore distance east of Chatterton.

D. J. Cederstrom, 1957, U.S. Geol. Survey Water-Supply Paper 1361, p. 224. In York-James Peninsula, Va., the lower Eocene (Wilcox) part of Nanjemoy formation, the Potapaco clay member, truncates Aquia formation. Downdip from Fall Line, the Aquia formation and Potapaco member, as well as basal Marlboro clay member of Nanjemoy, have been truncated by transgressive sea of middle Eocene time.

First described from exposures near Upper Marlboro, Prince Georges County, Md.; also crops out across Anne Arundel and Charles Counties, and far south across coastal plain of Virginia.

Marlboro Formation[1]

Precambrian(?): Eastern Massachusetts and eastern Rhode Island.

Original reference: B. K. Emerson and J. K. Perry, 1907, U.S. Geol. Survey Bull. 311, p. 7, 8, 11, 13–36, map.

Alonzo Quinn, R. G. Ray, and W. L. Seymour, 1948, *in* Alonzo Quinn and others, Rhode Island Port and Indus. Devel. Comm. Geol. Bull. 3, p. 9, 10. Abandoned in Pawtucket quadrangle, Rhode Island-Massachusetts, since Emerson's (1917) use in this area was based on an incorrect interpretation. Replaced by Blackstone series, which includes Westboro quartzite, formerly thought to underlie the Marlboro. Smithfield limestone member also abandoned in this area.

W. R. Hansen, 1956, U.S. Geol. Survey Bull. 1038, p. 8–14, pl. 1. Described in Maynard quadrangle, Massachusetts. Precambrian(?).

Named for Marlboro, Mass., where exposed along Main Street.

Marlboro Member (of Hudson River Formation)

Ordovician: Southeastern New York.

P. H. Bird, 1941, New York Acad. Sci. Trans., ser. 2, v. 3, no. 5, p. 113–114. Name applied to massive sandstone within Hudson River formation. Probably represents facies change from shale both to east and to west. Appears to be near top of formation, if not at top. Thickness well over 1,000 feet at center and may be as much as 2,000 feet. During deformation, behaved as competent member in comparison with the shale on both sides.

Exposed in tunnel of Delaware Aqueduct, which passes through Hudson River formation. Marlboro member occurs in vicinity of Marlboro Mountain [Ulster County]. In general, structure is asymmetrical syncline with low and gradually increasing dips in western limb and steep dips in eastern limb.

Marlbrook Marl[1]

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

Original reference: R. T. Hill, 1888, Arkansas Geol. Survey Ann. Rept. 1888, v. 2, p. 72, 84–86, 188.

L. W. Stephenson and others, 1942, Geol. Soc. America Bull., v. 53, no. 3, chart 9. Marlbrook marl shown on correlation chart above Annona chalk and below Saratoga chalk.

Typically exposed about 1 mile north of Saratoga, on road to Mineral Springs, Howard County, Ark. Also exposed along Marlbrook Creek in T. 10 S., R. 24 W., Hempstead County, Ark.

Marlife Shale (in Panoche Group)

Upper Cretaceous: Central California.

M. B. Payne, 1960, Soc. Econ. Paleontologists and Mineralogists Pacific Section Guidebook Spring Field Trip. p. 5 (fig. 3), 6 (fig. 4), 7 (fig. 5), 13 (fig. 6). Red cobble conglomerate, lower brown shale, concretionary sandstone, and upper gray shale. Thickness 8,685 feet. Includes Carnerada conglomerate member (new) at base and Llanada sandstone member (new) in upper part. Overlies Ciervo shale (new); underlies Television sandstone (new). Name credited to D. W. Sutton (unpub. thesis).

Type locality: Moreno Gulch, Fresno County. Named derived from Marlife Plateau, secs. 17, 18, 19, 20, 29, and 30, T. 14 S., R. 11 E.

†Marlin Chalk Member (of Taylor Marl)[1]

Upper Cretaceous (Gulf Series) : Eastern Texas.

Original reference: C. H. Dane and L. W. Stephenson, 1928, Am. Assoc. Petroleum Geologists Bull., v. 12, p. 51–55.

Typically exposed 0.4 to 0.9 mile south of courthouse at Marlin, Falls County, along edge of bottom lands of Brazos River, in a small scarp facing west.

Marlinton Formation (in Pocono Group)

Lower Mississippian: Southern West Virginia.

J. L. Dally, 1956, Dissert. Abs., v. 16, no. 12, p. 2425. Named as basal unit in group in southern part of state. Underlies Sunbury shale.

Possibly named for Marlinton, Pocahontas County.

Marlow Formation[1] (in Whitehorse Group)

Marlow Sandstone Member (of Whitehorse Formation)

Permian: Southwestern, central southern, and central Oklahoma and southern Kansas.

Original reference: R. W. Sawyer, 1924, Am. Assoc. Petroleum Geologists Bull., v. 8, no. 3, p. 312–320, map.

G. H. Norton, 1939, Am. Assoc. Petroleum Geologists Bull., v. 23, no. 12, p. 1815. In Kansas, Whitehorse sandstone can be divided into four members: Marlow, Relay Creek dolomite, an even-bedded sandstone member, and an upper shale member, the latter two representing the Rush Springs-Cloud Chief member of Oklahoma section. Thickness 110 feet. Overlies Dog Creek shale.

H. D. Miser and others, 1954, Geologic map of Oklahoma (1:500,000) : U.S. Geol. Survey. As mapped, formation includes Doe Creek sandstone member in northwestern Oklahoma and Verden sandstone member in southwestern Oklahoma.

C. C. Branson, 1955, The Hopper, v. 15, no. 12, p. 137. Doe Creek sandstone lies within the Marlow at higher level than Verden sandstone.

A. J. Myers, 1959, Oklahoma Geol. Survey Bull. 80, p. 24 (fig. 6), 40, pl. 1. In northwestern Oklahoma, Whitehorse group consists of Marlow formation at base and overlying Rush Springs sandstone. Thickness 350 feet. Guadalupe series.

Named for exposures at Marlow, Stephens County, Okla.

Marmaton Group[1]

†Marmaton Formation[1]

Pennsylvanian (Des Moines Series) : Eastern Kansas, southwestern Iowa, western Missouri, and northeastern Oklahoma.

Original reference: C. R. Keyes, 1897, Iowa Acad. Sci. Proc., v. 4, p. 23–24.

J. M. Jewett, 1941, Kansas Geol. Survey Bull. 38, pt. 11, p. 285–344. Group in Kansas comprises (ascending) Fort Scott limestone, Labette shale, Pawnee limestone, Bandera shale, Altamont limestone, Nowata shale, Lenapah limestone, and Memorial shale. Thickness about 250 feet. Overlies Cherokee shale; underlies Bronson group.

R. C. Moore, 1948, Am. Assoc. Petroleum Geologists Bull., v. 32, no. 11, p. 2025 (fig. 3), 2027–2028. Strata from base of Fort Scott limestone (of Blackjack Creek limestone) to disconformity that marks upper limit of Desmoinesian series are designated as Marmaton group. Term Henrietta group used by Missouri Survey is abandoned by interstate conference, both because in common later usage it duplicated Marmaton and because formations overlying Pawnee limestone are not well developed near Henrietta. Overlies Cherokee group; underlies Pleasanton group. Kansas has suppressed term Bourbon group in preference to Pleasanton.

M. C. Oakes, 1952, Oklahoma Geol. Survey Bull. 69, p. 19–47, pl. 1. In Kansas, Marmaton group includes strata from base of Fort Scott to disconformity which marks upper limit of Des Moines series. Marmaton of Oklahoma north of Arkansas River has same limits. For practical cartographic purposes, limits of Marmaton equivalents in area north of Arbuckle Mountain are base of Calvin sandstone below and base of Seminole formation above. In Tulsa County comprises (ascending) Fort Scott limestone, Labette shale, Oologah formation, Nowata shale, Lenapah limestone, and Holdenville (Memorial) shale. Underlies Skiatook group.

W. V. Searight and others, 1953, Am. Assoc. Petroleum Geologists Bull., v. 37, no. 12. p. 2748 (fig. 1). As shown on northern midcontinent composite stratigraphic section, Marmaton group occurs above Cabaniss group.

J. V. A. Trumbull, 1957, U.S. Geol. Survey Bull. 1042–J, pl. 16. Group in southern part of Oklahoma coalfield comprises (ascending) Calvin sandstone, Wetumka shale, Wewoka formation, and Holdenville shale. Overlies Cabaniss group; underlies Skiatook group.

H. G. Hershey and others, 1960, Iowa Highway Research Board Bull. 15, p. 29–33, fig. 5. Sequence of thick shales and sandstones with thin limestones and coals extending from base of Blackjack Creek limestone to top of Cooper Creek limestone, is designated Maramaton group. Includes (ascending) Fort Scott, Labette, Pawnee, Bandera, Altamont, Nowata, and Lenapah formations. Overlies Cherokee group; underlies Pleasanton group. Classification of group used here is that agreed upon by State Geological Surveys in northern midcontinent region (Moore, 1948, Am. Assoc. Petroleum Geologists Bull., v. 32, no. 11). Although Iowa is not entirely in agreement with this classification, it is used here for convenience of those who may be familiar with the grouping as used in other States of the region.

Named for exposures on Marmaton River, Vernon County, Mo., and Bourbon County, Kans.

Marmolejo Formation

Lower Cretaceous: West-central California.

N. L. Taliaferro, 1944, Am. Assoc. Petroleum Geologists Bull., v. 28, no. 4, p. 449, 458–469. Name proposed for Lower Cretaceous of Santa Lucia Range. Consists of 4,000 to 5,000 feet of dark shales with minor amounts of sandstone and conglomerate. Formation is strongly folded and faulted. Rests either disconformably or unconformably on Franciscan-Knoxville rocks. Unconformably underlies Jack Creek formation.

Type section: East of Marmolejo Flats, southern Santa Lucia Range. Base of section exposed, but top is cut off by fault.

Marmor Stage

Middle Ordovician (Mohawkian): North America.

G. A. Cooper, 1956, Smithsonian Misc. Colln., v. 127, pt. 1, p. 8 chart 1 (facing p. 130). Mohawkian series divided into five stages (ascending): Whiterock, Marmor, Ashby, Porterfield, and Wilderness. Marmor stage includes Chazy group of rocks and its correlatives. Name credited to G. A. Cooper and B. N. Cooper.

Marshall Kay, 1958, Am. Jour. Sci., v. 256, no. 2, p. 93, 94. Name replaced by Blackford stage (new) for use as a provincial stage in the Appalachians. Unit was based on formations in Tennessee, and type section is isolated from those of other Ordovician post-Canadian stages of the Appalachian region. Position of unit in Virginia sequence in dispute.

Reference section: Along railroad to the east of Marmor and extends to adjacent Louisville quadrangle. Named from Marmor just east of Friendsville on the Concord quadrangle, Tennessee.

Maromas Granite Gneiss[1]

Mississippian(?) or older: Central Connecticut.

Original reference: H. E. Gregory, 1906, Connecticut Geol. Nat. History Survey Bull. 6, p. 115, 143, map.

E. N. Cameron and others, 1954, U.S. Geol. Survey Prof. Paper 255, p. 20, 21. Paleozoic(?).

John Rodgers and others, 1956, Preliminary geological map of Connecticut (1:253,440): Connecticut Geol. Nat. History Survey. Pre-Triassic. Derivation of name.

Frederick Stugard, Jr., 1958, U.S. Geol. Survey Bull. 1042–Q, p. 619–620, 630–634, pl. 56. Discussion of pegmatites of Middletown area, Connecticut More than 300 concordant and discordant pegmatites were examined. Pegmaties cut metasediments of Bolton schist of pre-Mississippian(?) age and, in ascending order of sequence, mafic gneisses, Glastonbury granite gneiss, Maromas granite gneiss, and Monson gneiss. Position of these formations in stratigraphic column cannot be determined with accuracy; their maximum age is indicated by their relation to the pegmatites which have been dated by uranium- and thorium-lead ratios as about 260 million years old, presumably Mississippian. The Maromas is a gray-medium-grained biotite orthogneiss. Intrudes Bolton schist.

John Rodgers, R. M. Gates, and J. L. Rosenfeld, 1959, Connecticut Geol. Nat. History Survey Bull. 84, p. 19, 22, fig. 3. Unconformably underlies Collins Hill formation (new). Ordovician(?).

Named for Maromas quarries in town of Middletown, Middlesex County. Main body of gneiss occupies roughly elliptical area, 1 by 3 miles at first bend in Connecticut River east of Straits.

Maroon Formation[1]

Maroon Conglomerate[1]

Pennsylvanian and Permian: Western central Colorado.

Original reference: G. H. Eldridge, 1894, U.S. Geol. Survey Geol. Atlas, Folio 9.

D. B. Gould, 1935, Am. Assoc. Petroleum Geologists Bull., v. 19, no. 7, p. 971–1009. Subdivided to include Coffman conglomerate, Chubb siltstone, and Pony Spring siltstone members.

C. F. Bassett, 1939, Geol. Soc. America Bull., v. 50, no. 12, pt. 1, p. 1863–1864. Donner (1936, unpub. thesis) divided Maroon formation, in McCoy area, into Rock Creek conglomerate member below and State Bridge siltstone above. Overlies McCoy formation.

K. G. Brill, Jr., 1942, Am. Assoc. Petroleum Geologists Bull., v. 26, no. 8, p. 1375–1397. In Gore area, Eagle and Summit Counties, names Weber and Maroon are abandoned and term Battle Mountain proposed for the thick sequence of Pennsylvanian clastics.

K. G. Brill, Jr., 1944, Geol. Soc. America Bull., v. 55, no. 5, p. 627–632, measured sections. In west-central and northwestern Colorado, overlies Belden shale; rank raised to formation. Consists of red, yellow, and brown shale, sandstone, arkose, and conglomerate with intercalated beds of gypsum and thin limestone. Thickness as much as 7,000 feet. Contact with Belden shale gradational; contact arbitrarily drawn where coarse clastics predominate over dark shale and limestone. Underlies Weber quartzite or Chinle formation. Most, if not all, of unit is Des Moines in age.

Ogden Tweto and T. S. Lovering, 1947, Colorado Mining Resources Board [Bull.], p. 380 (chart). Formation in Gilman district, is 4,500 to 6,000 feet thick. Overlies Leadville limestone. Pennsylvanian and Permian(?).

Ogden Tweto, 1949, Colorado Sci. Soc. Proc., v. 15, no. 4, p. 152 (table 1), 229–235. Name Maroon formation applied to all Pennsylvanian or Permian redbeds overlying Minturn formation in Gore and Mosquito Ranges. As so used, Maroon corresponds to Wyoming formation of Emmons (1898, U.S. Geol. Survey Geol. Atlas, Folio 48), to "upper unit" of Pennsylvanian and Permian(?) of Koschmann and Wells (1946, Colorado Sci. Proc., v. 15, no. 2), to upper half to three-fourths of Maroon as recognized by U.S. Geological Survey in recent years, and, in part, to uppermost part of Maroon as used by Brill (1944). Upper part probably includes beds equivalent to part of State Bridge formation of Brill (1944), but siltstone facies typical of State Bridge is poorly developed in Pando-Kokomo region. Formation in Pando-Kokomo region consists of unfossiliferous redbeds which, on Jacque Peak, on north edge of district, reach thickness of almost 2,000 feet. Overlies Jacque Mountain limestone member of Minturn; top of formation not preserved and original thickness unknown; unconformably underlies rocks.

J. T. Stark and others, 1949, Geol. Soc. America Mem. 33, p. 42–47, pl. 1. Formation, in South Park area, crops out over wide belt across western part of Park, from Mount Silverheels on north to beyond Antero reservoir on south; forms floor of valley west of Dakota hogback; south of reservoir, it continues along west side of Park, but outcrops are irregular as result of faulting. In southwestern area, includes Chubb siltstone member below and Pony Spring siltstone member above; thickness about 7,700 feet; undifferentiated in northern area where it is about 8,500 feet thick and consists essentially of red beds. Overlies Weber(?) formation, which contains Coffman conglomerate at top. Separated from overlying deposits by erosional unconformity; underlies Garo sandstone. Pennsylvanian and Permian.

N. W. Bass and S. A. Northrop, 1950, Am. Assoc. Petroleum Geologists Bull., v. 34, no. 7, p. 1540–1551. In Glenwood Springs area, includes South Canyon Creek dolomite member (new) near top of formation. Underlies Chinle formation.

R. L. Langenheim, Jr., 1952, Am. Assoc. Petroleum Geologists Bull., v. 36, no. 4, p. 552 (fig. 3), 553. Described in Crested Butte quadrangle where it overlies Gothic formation (new) and unconformably underlies Entrada sandstone. Thickness 1,189 feet at type section of Gothic formation; probable maximum thickness 3,500 feet within area.

K. G. Brill, Jr., 1952, Geol. Soc. America Bull., v. 63, no. 8, p. 822–823. Described in paper on Permo-Pennsylvanian zeugogeosyncline, Colorado and New Mexico, where it crops out in northern part of trough and is equivalent to Sangre de Cristo formation. Division between these two formations is placed arbitrarily at Fremont-Park County line. In this paper, Maroon formation includes those strata which overlie Jacque Mountain limestone or its equivalent and underlies Weber sandstone or younger strata. In middle of trough where Jacque Mountain limestone is absent or greatly altered in appearance, it is difficult to distinguish between Maroon and Minturn formation. Either Wolfcampian or late Pennsylvanian.

R. L. Langenheim, Jr., 1954, Am. Assoc. Petroleum Geologists Bull., v. 38, no. 8, p. 1748–1779. Detailed description and discussion of correlation of formation in Crystal River valley, Gunnison, Pitkin, and Garfield Counties. Maroon formation as employed here includes all dominantly coarse clastic sediments above Gothic formation and below State Bridge siltstone. In Crystal River valley, three marine limestones are included in formation. Top of Maroon not well understood. In this area, State Bridge has been removed and Maroon is disconformably overlain by Jurassic rocks; hence, it is not difficult to select boundary. At Glenwood Springs, situation is complicated by Schoolhouse tongue of Weber sandstone and by South Canyon Creek dolomite. Other workers have recognized the Chinle, Shinarump, and other Triassic formations. If Schoolhouse tongue and South Canyon Creek dolomite were absent, all redbeds in that area could be referred to Maroon formation. Dry Park Ranch, Marion Creek, Thompson Creek, and Coal Creek sections of this report probably include lateral equivalents of these rocks [Schoolhouse tongue and South Canyon Creek dolomite].

H. F. Murray, 1958, Rocky Mountain Assoc. Geologists Symposium on Pennsylvanian rocks of Colorado and adjacent areas, p. 55. Described in Maroon trough. Because top of Maroon is eroded in Gore and Mosquito Ranges, Tweto's definition must be modified to make term more applicable. About 18 miles west of Minturn, red sandstones and conglomerates of Tweto's Maroon are overlain by Weber sandstone which marks upper limit of red sandstones and conglomerates everywhere north and west from this point. South and east of Wolcott, the sandstones and conglomerates of the Maroon contrast with overlying red siltstones of State Bridge. In section along Eagle River between Wolcott and Minturn, typical siltstones of State Bridge are well developed above the Maroon near town of Minturn. Therefore, Tweto's Maroon probably does not contain State Bridge beds. As used in this report, the Maroon consists of sandstones and conglomerates between the top of Jacque Mountain limestone and the base of Weber sandstone, where it is present. Where Weber is absent, top is defined by siltstones and mudstones of State Bridge formation. Thus defined the Maroon is mappable unit throughout central and northwestern part of Maroon trough in both surface and subsurface.

John Chronic, 1958, Rocky Mountain Assoc. Geologists Symposium on Pennsylvanian rocks of Colorado and adjacent regions, p. 62 (fig. 2), 63. In past, term Maroon has been used in north-central Colorado, while equivalent Sangre de Cristo formation has been restricted to mountain range of that name. Because lithologies and ages of the two formations are essentially the same, it is here proposed that name Sangre de Cristo be dropped and that prior name Maroon be applied to equivalent coarse redbeds, at least as far south as La Veta Pass.

Named for typical development on Maroon Creek in Aspen quadrangle.

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Marquam limestone (deposit)

Oligocene: Eastern Oregon.

J. E. Allen, 1946, Oregon Dept. Geology and Mineral Industries G.M.I. Short Paper 15, p. 4 (pl. 2), 5–7. Limestone occurs as lenses in sandy tuffs, grits, and conglomerates, both massive and well bedded, which have low dips to south and southeast. Conglomeratic phases overlie lime lenses in two localities. Fossils, both foraminifera and megafossils, indicate Vaqueros age, correlative with Illahe-Mehama formation of Thayer (1939) and Butte Creek beds of Harper (1941, unpub. map of Molalla quad.). Marine sediments interfinger with and are overlain by continental Molalla formation to east.

Occurs in sec. 2, T. 6 S., R. 1 E., Clackamas County, 1 mile northeast of Marquam. Extensively quarried.

Marquette Granite[1]

Precambrian: Northwestern Michigan and Wisconsin.

Original reference: C. C. Wang, 1932, Geol. Soc. China Bull., v. 11, no, 4, p. 426–428.

W. A. Seaman, 1944, Michigan Dept. Conserv. Geol. Survey Div. Prog. Rept. 10, p. 11, 12 (table 1). Shown on geologic column of Marquette Iron Range as Marquette granite, rhyolite, quartz porphyry, and so on. Older than Kitchi sediments.

Name first applied to granite in Wisconsin; area not stated.

Marquette Member[1] (of Belvidere Formation)

Lower Cretaceous (Comanche Series): Central Kansas.

Original reference: W. H. Twenhofel, 1924, Kansas Geol. Survey Bull. 9, p. 31–32.

R. C. Moore, 1935, Rock formations of Kansas *in* Kansas Geol. Soc.: Wichita, [Am. Assoc. Petroleum Geologists 20th Ann. Mtg., Mar. 21–23]. Shown on correlation chart as member of Belvidere formation. Overlies Kiowa shale member; underlies Mentor sandstone members.

R. C. Moore, J. C. Frye, and J. M. Jewett, 1944, Kansas Geol. Survey Bull. 52, pt. 4, p. 153. Dakota formation, as herein defined, includes stratigraphic units formerly called "Rocktown channel sandstone," "Ellsworth formation," "Solomon formation," "Reeder sandstone," "Marquette sandstone," "Spring Creek clay," and others.

Apparently named for exposures near Marquette, McPherson County.

Marquette Quartz Porphyry[1]

Precambrian (pre-Huronian?): Central southern Wisconsin.

Original reference: R. D. Irving, 1877, Geology Wisconsin, v. 2, p. 520.

Occurs near village of Marquette, Green Lake County.

Marquette Rhyolite[1]

Precambrian: Southeastern Wisconsin.

Original reference: C. C. Wang, 1932, Geol. Soc. China Bull., v. 11, no. 4, p. 426–428.

Occurs 1 mile southwest of village of Marquette, Green Lake County.

†Marquettian System[1]

Precambrian: Northeastern Minnesota.

Original reference: A. Winchell, 1888, Minnesota Geol. Nat. History Survey 16th Ann. Rept., p. 365.

Marquez Shale Member (of Reklaw Formation)

Eocene, middle: Eastern Texas.

H. B. Stenzel, 1938, Texas Univ. Bur. Econ. Geology Pub. 3818, p. 20 (table), 71–78. Chiefly even-bedded chocolate-colored shales; glauconitic sands or sandstones common in lower part. Thickness 50 to 60 feet. Overlies Newby sand member (new); boundary transitional and interfingering; underlies Queen City sand, contact transitional.

H. B. Stenzel, 1953, Texas Univ. Bur. Econ. Geology Pub. 5305, p. 78–83, 88, pl. 1. Described in Henrys Chapel quadrangle, Cherokee County, where it is 85 to 105 feet thick and gradationally underlies Arp member of Queen City formation.

Named for occurrences near Marquez, Leon County.

Marrowstone Shale

Oligocene: Northwestern Washington.

J. W. Durham, 1944, California Univ. Dept. Geol. Sci. Bull., v. 27, no. 5, p. 104 (fig. 2), 106. Name applied to the moderately well-bedded fossiliferous sandy shales that overlie Quimper sandstone on Marrowstone Islands.

Well exposed along eastern shore of Kilisut Harbor and on south side of Mystery Bay [Jefferson County]. Here outcrops are at water's edge, and any later Tertiary beds are concealed by glacial drift.

Marseilles Drift

Pleistocene (Wisconsin): Northern Illinois.

H. B. Willman and others, 1942, Illinois Geol. Survey Bull. 66, p. 145 (fig. 85), 146 (fig. 86), 162–165. Largely till; gravel and sand present in kames and eskers, as deposits in subglacial channels, as outwash plains in front of moraine, as deltas in Lake Illinois and Lake Lisbon, and as deposits of the Fox River torrent. Till is gray to dark gray, with greenish cast; usually more clayey than other till in area. Thickness about 200 feet beneath the higher parts of the moraine north of Marseilles; in large part of moraine thickness is at least 100 feet; variations in thickness result from irregular top of drift. Overlies Bloomington and Chatsworth drifts. [Report lists six drifts in the Tazewell; for sequence see under Shelbyville.]

Named for town of Marseilles, La Salle County, which is situated at place where Illinois River cuts through moraine.

Marsh Formation (in Missoula Group)

Marsh Shale[1]

Precambrian (Belt Series): South-central Montana.

Original reference: C. D. Walcott, 1899, Geol. Soc. America Bull., v. 10, p. 199–215.

D. A. Andrews, G. S. Lambert, and G. W. Stose, 1944, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 25, sheet 1. Shale shown on map legend as part of Siyeh group.

C. P. Ross, 1949, (abs.) Washington Acad. Sci. Jour., v. 39, no. 3, p. 113. In parts of region around Helena, Marsh shale is sole representative of Missoula group.

Adolph Knopf, 1950, Am. Mineralogist, v. 35, nos. 9–10, p. 838–839. Marsh formation overlies Helena dolomite conformably, as shown in exposures on South Park Street in town of Helena. Here, it consists of maroon mud-cracked shale (or argillite) and thin interbeds of mud-flake breccia and quartzite. It is 250 feet thick here and is overlain disconformably by Middle Cambrian Flathead quartzite. Type section is at mouth of Marsh Creek, just outside Marysville [this report] map area. Stratigraphic relations not well shown there. Barrell (1907, U.S. Geol Survey Prof. Paper 57) ignored type section in his report on Marysville district. According to Walcott (1899), Marsh formation is 300 feet at type locality and constitutes topmost formation of Belt terrane, and this characterization, though inadequate, has now done duty for 50 years. Formation thickens from Helena northwestward to 3,000 feet at Marysville. Here it underlies Greenhorn Mountain quartzite (new). Top of Marsh on north flank of Greenhorn Mountain is deep-maroon argillite, ripple marked and mud cracked and interbedded with thin quartzites 1 to 2 inches thick.

Type section: At mouth of Marsh Creek, north of Marysville, Lewis and Clark County. Town of Marysville is 20 miles northwest of Helena.

Marshall Diorite

Precambrian(?): Northeastern Washington and western Idaho.

M. C. Schroeder, 1952, Washington Div. Mines and Geology Bull. 40, p. 7 (table), 21–23, pl. 1. Medium-gray to almost black diorite that occurs mainly in sills which vary in thickness from 3 to 1,200 feet. Intrudes Bead Lake and Skookum formations (both new).

Named from Marshall Creek, Pend Oreille County, Wash.

Marshall Formation

Marshall Sandstone[1] or Group

Mississippian: Southern Michigan.

Original reference: A. Winchell, 1861, Michigan Geol. Survey 1st Bien. Rept. Prog., p. 80, 139.

G. V. Cohee, 1944, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 11. Sandstone consists of upper member, Napoleon sandstone, and lower unnamed member which consists in part of sandy shale. In some areas of Calhoun, Jackson, and Hillsdale Counties, lower member is separated from overlying Napoleon by shale, but where shale is absent, it is difficult to draw line between the two units. Thickness 200 to 250 feet north of outcrop area. Overlies Coldwater shale, and in many places grades down into it.

J. M. Weller and others, 1948, Geol. Soc. America Bull., v. 59, no. 2, chart 5 (columns 80, 81). Shown on correlation chart as Marshall group below Michigan formation and above Coldwater shale. Kinderhookian-Osagean.

G. J. Stramel, C. O. Wisler, and L. B. Laird, 1954, U.S. Geol. Survey Circ. 323, p. 21, 23 (fig. 20). Referred to as Marshall formation.

Named from exposures in vicinity of Marshall, Calhoun County.

†Marshall Granite[1] or Formation

Marshall Gneiss (in Virginia Blue Ridge Complex)

Precambrian: Western central and northern Virginia.

Original reference: A. I. Jonas, 1928, Virginia Geol. Survey Prelim. ed. geol. map of Virginia.

L. R. Thiesmeyer, 1938, (abs.) Geol. Soc. America Bull., v. 49, no. 12, pt. 2, p. 1963. Four major Precambrian granitic bodies representing extensive batholiths of western Piedmont in Virginia have been delineated; in order of intrusion these are: Lovingston gneiss, hypersthene granodiorite, Crest Hill granite (new), and Marshall granite. [Author states Marshall granite is redefined. However, redefinition is not clear in this abstract and compiler was unable to locate any subsequent paper on this area by Thiesmeyer.]

R. O. Bloomer and H. J. Werner, 1955, Geol. Soc. America Bull., v. 66, no. 5, p. 582. Marshall formation comprises most of basement complex in the Piedmont. Formation is gray or green uniformly medium-grained gneiss consisting of quartz, potash feldspar, oligoclase-andesite, and biotite; quartzo-feldspathic bands that average about an eighth inch thick are separated by filmlike folia of bleached chloritized biotite. Grades into basement complex gneiss, Lovingston formation, and Pedlar formation (new).

W. R. Brown, 1958, Virginia Div. Mineral Resources Bull. 74, p. 8 (fig. 2), 9, 11–12, pl. 1. Rocks of Lynchburg area, previously mapped as Lovingston gneiss, are generally without prominent augen and are called Marshall gneiss in this report. Gneiss occupies belt 3½ miles wide in northwest corner of quadrangle. grades into Pedlar formation on northwest, and, with modifications, is intertongued with darker gneisses to form Reusens migmatite on southwest. Included in Virginia Blue Ridge complex (new). Precambrian.

Named for exposures around Marshall, Fauquier County.

Marshall Limestone (in McLeansboro Formation)[1]

Pennsylvanian: Southeastern Illinois.

Original reference: J. E. Lamar and H. B. Willman, 1934, Illinois Geol. Survey Bull. 61, p. 129–138.

C. O. Dunbar and L. G. Henbest, 1938, (abs.) Geol. Soc. America Proc. 1937, p. 320. Should be considered as of Lansing age (Kansas and Nebraska) according to fusulinid evidence.

Occurs in Clark County.

†Marshall Shale[1]

Mississippian: Northwestern Arkansas and northeastern Oklahoma.

Original reference: J. C. Branner and F. W. Simonds, 1891, Arkansas Geol. Survey Ann. Rept. 1888, v. 4, p. xiii, 26, 53–54.

Named for Marshall Mountain, just east of Marshall, Searcy County, Ark.

Marshall Creek Breccia

Upper Cretaceous(?): Southwestern Utah.

J. H. Mackin, 1947, Utah Geol. Soc. Guidebook 2, p. 9–12. Fanglomerate mudflow breccia. Occurs at disconformable contact between "Entrada" and quartzite conglomerate at base of Iron Springs formation (new). Breccia lenses irregularly, varying from 0 to more than 50 feet within short distances.

Occurs along western and southeastern parts of border zone of Three Peaks intrusion in Iron Springs district.

Marshall Hill Conglomerate[1]

Precambrian (upper Huronian): Central northern Wisconsin.

Original reference: S. Weidman, 1907, Wisconsin Geol. Nat. History Survey Bull. 16, p. 357.

Forms large part of broad upland known as Marshall Hill, about 6 miles north of Wausau, Marathon County.

Marshalltown Formation (in Matawan Group)[1]

Marshalltown Member (of Matawan Formation)

Upper Cretaceous: New Jersey and Delaware.

Original reference: G. N. Knapp, as reported by R. D. Salisbury, 1899, New Jersey Geol. Survey Ann. Report. State Geologist, 1898, p. 35, 36.

C. W. Carter, 1937, Maryland Geol. Survey, v. 13, pt. 6, p. 243 (fig. 32), 258–261, pl. 57. Formation extends from Sandy Hook Bay southwestward to Delaware River. Can be traced in banks of Chesapeake and Delaware Canal a distance of approximately 5 miles from 2,100 feet west of Summit Bridge to one-quarter mile east of St. Georges Bridge where it disappears beneath water level.

W. B. Spangler and J. J. Peterson, 1950, Am. Assoc. Petroleum Geologists Bull., v. 34, no. 1, p. 30–32. Member of Matawan which is here reduced to formational rank. Underlies Wenonah member and overlies Englishtown member; both contacts conformable. Thickness 30 to 40 feet; dips about 25 feet to the mile southeast. Probably present in Chesapeake and Delaware Canal where it cannot be differentiated from Crosswicks clay. Beds in Canal called Marshalltown by Carter are believed to be Navesink and Mount Laurel.

M. E. Johnson and H. G. Richards, 1952, Am. Assoc. Petroleum Geologists Bull., v. 36, no. 11, p. 2151 (table 1), 2156. Here considered of formational rank. Excellent exposure occurs in cut along New Jersey Turnpike at Fellowship, 2 miles south of Moorestown, Burlington County. Thickness about 14 feet. Here formation contains so little clay that it is water bearing.

J. P. Minard and J. P. Owens, 1960, U.S. Geol. Survey Prof. Paper 400–B, p. B184, B185. Formation in Matawan group. Overlies Englishtown formation; underlies Wenonah sand. Average dip is southeast 35 feet per mile.

Named for occurrence near Marshalltown, Salem County, N.J.

†Marshalltown Shale[1]

Mississippian: Central northern Iowa.

Original reference: S. W. Beyer, 1897, Iowa Geol. Survey, v. 7, p. 211, 226–227.

Exposed near Marshalltown Flouring Mills, Marshall County.

Marshburg Clay

Marshburg Shale or Slates (in Pottsville Formation)[1]

Pennsylvanian (Pottsville Series): Northwestern and central northern Pennsylvania.

Original reference: C. A. Ashburner, 1885, Pennsylvania 2d Geol. Survey Rept. R_2, p. 307, 325.

Henry Leighton, 1941, Pennsylvania Geol. Survey, 4th ser., Bull. M–23, p. 57, 103. Marshburg clay (Pottsville series) underlies Kinzua Creek (Kinzua) sandstone and overlies Olean conglomerate.

First described in Forest, Elk, and McKean Counties.

Marsh Creek Group[1]

Pliocene(?): Southeastern Idaho.

Original reference: A. C. Peale, 1879. U.S. Geol. and Geog. Survey Terr. 11th Ann. Rept., p. 612, 641, 642.

Exposed on Marsh Creek above Red Rock Gap, Bannock County.

Marshfield Sandstone[1]

Lower Ordovician (Beekmantown): Southwestern Missouri.

Original reference: E. M. Shepard, 1904, Bradley Geol. Field Sta. Drury Coll. Bull. 1, pt. 1, p. 8, 42.

Mars Hill Conglomerate[1]

Silurian: Northeastern Maine.

Original reference: H. E. Gregory, 1900, U.S. Geol. Survey Bull. 165, p. 119, 134–136.

R. A. Bither, 1947, Maine State Geologist Rept. 1945–1946, p. 84. Mentioned in report on Aroostook limestone locations.

Named for development on Mars Hill, Aroostook County, on Maine-New Brunswick boundary.

Mars Hill Diabase[1]

Age(?): Northeastern Maine.

Original reference: H. E. Gregory, 1900, U.S. Geol. Survey Bull. 165, p. 115, 177–179.

Named for occurrence on Mars Hill, Aroostook County.

Marsh Valley Group[1]

Pliocene(?): Southeastern Idaho.

Original reference: A. C. Peale, 1879, U.S. Geol. and Geog. Survey Terr. 11th Ann. Rept., p. 612, 641, 642.

Exposed on Marsh Creek above Red Rock Gap, Bannock County.

Marsland Formation

Marsland Formation (in Hemingford Group)

Miocene: Nebraska, Colorado, South Dakota, and southeastern Wyoming.

C. B. Schultz, 1938, Am. Jour. Sci., 5th ser., v. 35, p. 443, 444. Name applied to deposits which immedately overlie Arikaree group and which are faunally and lithologically distinct from typical Arikaree. Overlies Harrison formation (as defined by Hatcher); underlies Sheep Creek formation. Where best exposed, in region around Marsland, includes some 150 feet of buff and gray soft sandstones. Consists, in part, of valley fills and in some places mantles slopes of large valleys. On basis of fauna, should provisionally be considered as lower part of upper Miocene.

A. L. Lugn, 1938, Am. Jour. Sci., v. 36, 5th ser., no. 213, p. 226, 227; 1939, Geol. Soc. America Bull., v. 50, no. 8, p. 1253–1254, 1258, 1264 (table 1), 1266 (table 2). Included in Hemingford group (new). Thickness 125 to 200 feet. Separated from underlying Harrison formation by structural and erosional unconformity. Unit has been referred to as "Upper Harrison" but was not part of Harrison as defined by Hatcher; neither was it part of Scott's (1894) Nebraska beds as Hatcher believed, nor was it included in Darton's Arikaree.

R. C. Cady, 1940, Am. Jour. Sci., v. 238, no. 9, p. 663–667. Underlies Box Butte member (new) of Sheep Creek formation. [Lugn (1939) states that this unit has been included with and measured as part of Marsland formation on which it rests unconformably at most places, where no separating Sheep Creek valley fill deposits occur to reveal true relationship.]

H. J. Cook and J. T. Gregory, 1941, Jour. Paleontology, v. 15, no. 5, p. 549–552. Fauna described from "Upper Harrison" beds. These beds are distinct from overlying Marsland formation and contain fauna more closely related to Arikaree than to Marsland. Hence, Marsland as defined by Schultz includes two separable formations: the "Upper Harrison" beds and the higher previously unnamed deposits, exposed east of Marsland. Because of faunal distinctness of beds around Marsland from the "Upper Harrison", it seems desirable to restrict use of term Marsland to deposits at type locality described by Schultz. Restricted Marsland is equivalent to the "unnamed beds" between the "Upper Harrison" and Sheep Creek, shown in columnar section of region by Cook and Cook (1933, Nebraska Geol. Survey Paper 5, p. 44). Although acknowledging undesirability of term "Upper Harrison," authors do not propose name for these earliest deposits of Hemingford group which lie below restricted Marsland.

C. B. Schultz, 1941, (abs.) Geol. Soc. America Bull., v. 52, no. 12, pt. 2, p. 1990. Traced from type area into Colorado, South Dakota, and Wyoming. A distinct lithologic unit in Nebraska and Wyoming areas, and, although in Colorado and South Dakota these deposits are less typical, the faunas are equivalent.

R. C. Cady and O. J. Scherer, 1947, U.S. Geol. Survey Water-Supply Paper 969, p. 20, 26–32, pl. 1. Described in Box Butte County, Nebr., where it overlies Harrison sandstone and underlies Sheep Creek formation, in many areas the Box Butte member. Nebraska Geological Survey places Marsland and Sheep Creek formations in Hemingford group. This classification not used by U.S. Geological Survey.

Type area: Southwest of Marsland, along Niobrara River, in secs. 23 to 27, T. 28 N., R. 52 W., and secs. 19 and 30, T. 28 N., R. 51 W., Box Butte County, Nebr.

Marthaville Formation (in Wilcox Group)

Eocene, lower: Northwestern Louisiana and eastern Texas.

J. O. Barry, 1941, (abs.) Am. Assoc. Petroleum Geologists Bull., v. 25, no. 5, p. 941. Sabine (Wilcox) subdivided into three faunal units (ascending) : Marthaville beds and Pendleton and Sabinetown faunal units.

J. O. Barry and R. J. Le Blanc, 1942, Louisiana Dept. Conserv. Geol. Bull. 23, p. 20–23. Consists of basal sand member that passes transitionally upward into lignitic and calcareous clays; the characteristic fauna occurs in sparingly glauconitic silty calcareous concretionary layers in the clay and silts. Thickness about 250 feet. Overlies Midway formations; underlies a lithologic sequence referred to as the Pendleton faunal unit. The Marthaville has also been referred to as Marthaville faunal unit. Name Marthaville is credited to G. E. Murray (unpub. thesis).

Richard Wasem and L. J. Wilbert, Jr., 1943, Jour. Paleontology, v. 17, no. 2, p. 181–195. Underlies Pendleton formation (new).

G. E. Murray, Jr., and E. P. Thomas, 1945, Am. Assoc. Petroleum Geologists Bull., v. 29, no. 1, p. 50 (fig. 4), 60–61. Expanded to include all beds above Hall Summit formation and below Pendleton formation. As thus defined, consists of three unnamed units or members: a basal sand member, a middle lignitic shale member, and an upper calcareous silt and clay member. Maximum thickness 300 feet.

H. V. Andersen, 1960, Louisiana Dept. Conserv. Geol. Bull., 34, p. 66–71. As mapped in Sabine Parish, includes two lithologic units: basal sand member, 7 to 17 feet thick, and upper clay and argillaceous silt member, 15 to 30 feet thick. Members are separated by ½- to 4-foot fossiliferous zone characterized by *"Ostrea" thirsae* Gabb. Basal contact with underlying "Hall Summit" formation is mapped slightly lower in section than indicated by Murray (1948, Louisiana Dept. Conserv. Geol. Bull. 25). Underlies Pendleton formation. Upper contact as mapped herein is at least 50 feet lower in section than boundary established by Barry (1941). Type locality restricted and alternate reference section designated.

Type locality: Near railway depot at Marthaville, Natchitoches Parish, La. Units can be traced along strike from Red River-Bienville Parish line westward to vicinity of Mount Enterprise fault in Shelby County, Tex.

Type locality (restricted): Outcrop in Natchitoches Parish, 0.3 mile south of Marthaville, on State Highway 1217. Extends from road "Y" south along dirt road to top of hill in center of S½ sec. 28, T. 9 N., R. 10 W.

Reference locality: In Sabine Parish 3 miles south of Marthaville on State Highway. Extends from water level of unnamed tributary to Bayou Dupont southwestwardly to top of hill near Berry's Grocery Store (NE¼SW¼SW¼ sec. 5, T. 8 N., R. 10 W.)

†Martha Washington Sandstone[1]

Pennsylvanian: Southwestern Indiana.

Original reference: E. T. Cox, 1871, Indiana Geol. Survey 2d Ann. Rept., p. 169.

Forms the bluff at Rockport, Spencer County, known familiarly as "The Lady Washington."

Martin Limestone[1] or **Formation**

Middle and Upper Devonian: Central and eastern Arizona.

Original reference: F. L. Ransome, 1904, U.S. Geol. Survey Prof. Paper 21.

Charles Keyes, 1942, Pan-Am. Geologist v. 77, no. 3, p. 225–228. In Bisbee region, no less than four good and valid geological formations incorporated in Martin limestone, each distiguishable lithologically and faunally, three of which are: Escacado limestone, Patagonia limestone, and Espinal formation. Martin limestone represents entire periodic sedimentation, and is merely synonymic with Devonic itself.

M. N. Short and others, 1943, Arizona Bur. Mines Bull. 151, Geol. Ser. 16, p. 27. In Superior district, restricted at base to exclude beds herein named Crook formation.

J. W. Huddle, 1948, Tulsa Geol. Soc. Digest, v. 16, p. 76. In northeastern Arizona, formation composed of three unnamed members (ascending): conglomeratic sandstone and dolomitic limestone member; sandstone and limestone member; and calcareous sandstone, sandy limestone and shale member. As traced from southeastern Arizona toward central Arizona, formation becomes increasingly sandy. Upper Devonian.

N. P. Peterson, 1950, Arizona Bur. Mines Bull. 156, Geol. Ser. 18, p. 99, 100. Limestone disconformably overlies either Dripping Spring quartzite or small remnants of Troy quartzite and underlies Escabrosa limestone and Naco limestone in Globe-Miami district.

James Gilluly, 1956, U.S. Geol. Survey Prof. Paper 281, p. 26–29, pl. 5. Lithologically, the most variable formation of Paleozoic age of central Cochise County. In type section, in Bisbee quadrangle, formation dominantly limestone, with some pinkish shale in lower half; in Tombstone

Hills, shale with subordinate sandstone constitutes over half the formation; in Dragoon Mountains, sandstone still more conspicuous, and dolomite more abundant than limestone; and in Whetstone Mountains, more largely clastic than at Bisbee. Thickness ranges from 229½ to 340 feet, but variation in thickness not significant of regional thinning. Upper Devonian.

R. E. Lehner, 1958, U.S. Geol. Survey Bull. 1021–N, p. 523–528, pls. 45, 47. In Jerome area, limestone subdivided into four unnamed members which do not correspond to the three members farther east as recognized by Huddle. Middle(?) and Upper Devonian.

Type section: Bisbee quadrangle, southeastern Arizona. Named for Mount Martin, on Escabrosa Ridge, where formation is typically developed and well exposed.

Martin Bridge Formation[1] or Limestone

Upper Triassic: Northeastern Oregon.

Original reference: R. W. Chaney, 1932, 16th Internat. Geol. Cong. Guidebook 21, p. 4.

W. D. Smith and J. E. Allen, 1941, Oregon Dept. Geology and Mineral Industries Bull. 12, p. 6 (fig. 2), 8, 10–11, 13. Described in Wallowa Lake quadrangle. Unconformably overlies a unit termed the Lower Sedimentary Series, or where series is lacking, unconformably overlies Clover Creek greenstone. Grades upward into and is intercalated with Hurwal formation (new).

Named for locally well-known bridge on Eagle Creek, Wallowa Mountains region.

†Martin Canyon Beds[1]

Oligocene, upper, and Miocene, lower: Northeastern Colorado.

Original reference: W. D. Matthew, 1901, Am. Mus. Nat. History Mem., v. 1, pt. 7, p. 355–374, 444.

E. C. Galbreath, 1953, Kansas Univ. Paleont. Contr. 13, Vertebrata, art. 4, p. 18–20. Martin Canyon problem discussed. In this report, upper part of Matthew's Martin Canyon beds with its fauna is included in Pawnee Creek formation. It is difficult to determine whether or not Matthew's Pawnee Creek beds included upper Martin Canyon beds in other localities, but possibly they did at all points except in the Martin Canyon area. Term Martin Canyon should be abandoned as name for lithologic unit. Section did not exist as described; the lower part is assigned to White River formation, and lithologically the upper part cannot be distinguished from similar beds that grade into the Pawnee Creek. Fauna is Hemingfordian and not Arikareean in age.

Named for Martin Canyon of Cedar Creek, Logan County.

Martin Creek Limestone

Middle Ordovician: Northeastern Tennessee and southwestern Virginia.

R. L. Miller and W. P. Brosgé, 1950, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 104 (2 sheets). Dark-gray and brown limestone with abundant chert nodules in lower part; tan cryptocrystalline limestone with chert nodules in some zones in upper part; locally has zone of coarsely crystalline fragmental limestone near base. Thickness 40 to 182 feet. Overlies Rob Camp limestone (new); underlies Hurricane Bridge limestone (new). Same as Lenoir limestone on U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 76.

R. L. Miller and W. P. Brosgé, 1954, U.S. Geol. Survey Bull. 990, p. 32 (table 1), 33–34, 43–47. Unconformably overlies Rob Camp limestone, or where this is absent overlies Poteet limestone; conformably underlies Hurricane Bridge limestone. Equivalent to Lenoir limestone described by Butts (1940, Virginia Geol. Survey Bull. 52, pt. 1) in Lee County; relations to type Lenoir not established. Type section stated. Discussion of problems of correlation and summarizes nomenclature of Middle Ordovician formations in Lee and Tazewell Counties.

Type section: Along county road that climbs bluff west of bridge across Martin Creek at its junction with Powell River, northwestern corner Hancock County, Tenn.

Martinez Formation[1]

Martinez Stage

Paleocene: Western California.

Original reference: W. B. Gabb, 1869, California Geol. Survey Pal., v. 2, p. xiii, as reported by J. D. Whitney from unpublished paper by Gabb, and footnote by Gabb on p. 129.

J. A. Cushman and J. D. Barksdale, 1930, Stanford Univ. Dept. Geology Contr., v. 1, no. 2, p. 55–73. Study of Foraminifera from shale below so-called Domengine at Martinez, and therefore within limits of Martinez formation (as previously mapped), shows definite relationship with Claiborne Eocene of Gulf Coastal Plain. Known relationship of fauna would seem to place Martinez formation definitely in Eocene of Claiborne age, or would seem to suggest possibility that Martinez formation needs to be redefined and upper part assigned to Meganos.

B. L. Clark and H. E. Vokes, 1936, Geol. Soc. America Bull., v. 47, no. 6, p. 853 (fig. 1), 854–856. West Coast Eocene comprises (ascending) Martinez, Meganos, Capay, Domengine, transition, Tejon, and Gaviota stages. For the Martinez, Capay, and Domengine, there is fairly good faunal evidence for general correlation. Deposits of the Martinez ("Paleocene") have limited distribution as compared to those of middle Eocene. Best known sections are in San Francisco Bay, Mount Diablo, and Simi Valley areas. "Martinez" of Cushman and Barksdale included in Capay stage.

R. T. White, 1938, Geol. Soc. America Proc. 1937, p. 256–257; 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 10, p. 1735–1745. Lodo formation (new) in Tumey Hills on west side of San Joaquin Valley, Fresno County, includes "Martinez(?) formation" of Anderson and Pack (1915, U.S. Geol. Survey Bull. 603).

Boris Laiming, 1940, 6th Pacific Sci. Cong., v. 2, p. 535–568. Discussion of character and distribution of smaller foraminifera in marine Eocene deposits of California, and shows correlation of foraminiferal zones with faunal "stages" already established by paleontologists on basis of mollusca. Correlation chart shows 12 foraminiferal zones in Eocene as compared to six stages on basis of mollusca. Foraminiferal zone E correlates with Clark's and Vokes' (1936) molluscan Martinez stage, and zones C and D with "Martinez" of Cushman and Barksdale (1930).

E. A. Watson, 1942, Am. Midland Naturalist, v. 28, no. 2, p. 451–458. Formation, in Pacheco syncline, is 2,600 feet thick; overlies Chico formation and underlies "Tejon" formation. Lower part Paleocene; upper 1,000 feet of type Martinez are correlated with other California deposits of middle Eocene age.

A. M. Keen and Herdis Bentson, 1944, Geol. Soc. America Spec. Paper 56, p. 11, 21 (fig. 4). Cretaceous-Paleocene boundary discussed. In present report [California Tertiary marine mollusca], an arbitrary choice of boundary has been set, taking lower Martinez at its type area in Contra Costa County as representing base of Paleocene and, hence, base of Tertiary. Correlative formations are considered to be the lower glauconitic sands of the Lodo at its type section in Fresno County and the "Martinez marine member" mapped by Nelson (1925, California Univ. Pubs. Bull., Dept. Geol. Sci., v. 15, no. 11) in Simi area, Ventura County. Stratigraphers are urged to study this area and give formational name to this Martinez correlative for which the name "Martinez" is inappropriate because (1) at its type area the Martinez is both Paleocene and Eocene and (2) Paleocene faunule in Simi Hills contains relatively few species in common with that of type Martinez.

C. E. Weaver, 1949, Geol. Soc. America Mem. 35, p. 17 (table 3), 48–52, pls. Formation described and mapped in Coast Ranges immediately north of San Francisco Bay region. Footnote on page 47–48 states that geologic map of Carquinez quadrangle and report were prepared prior to 1936 and do not represent changes of Eocene classification in Martinez area resulting from later investigations. Early Tertiary deposits in east and west limbs of Martinez syncline are mapped in Carquinez quadrangle as Martinez formation and Domengine sandstone. Martinez as mapped in west limb of syncline includes three stratigraphic units which, from recent paleontologic evidence, include Paleocene "glauconitic" sandstone, lower Eocene silty shales equivalent to the Capay, and silty sandstones and shales of Domengine age. Massive and thick-bedded gritty sandstones and overlying shales which are mapped as Domengine in west limb of Martinez syncline contain no molluscan fossils, but recent studies have furnished evidence of foraminiferal faunas indicative of late Eocene age. These gritty sandstones differ lithologically from upper Eocene Markley formation exposed elsewhere in Carquinez and Antioch quadrangles. Martinez as mapped in east limb includes Paleocene "glauconitic" sandstones and silty shales of Capay and possibly Meganos stages.

Peter Dehlinger, 1952, California Div. Mines Spec. Rept. 26, p. 5. East and northeast of mapped area [southern Ridge Basin] Martinez formation underlies Modelo formation, angular unconformity.

C. E. Weaver, 1953, Washington [State] Univ. Pubs. in Geology, v. 7, p. 1–20. Strata which were mapped in San Francisco Folio (Lawson, 1930) in east limb of Pacheco syncline as Martinez formation are designated in this report as Vine Hill sandstone and Las Juntas shale, and beds on west limb are designated as Vine Hill sandstone, Las Juntas shale, and Muir sandstone. Fossiliferous beds now referred to as Muir sandstone were considered in earlier reports as Upper Martinez. Rocks in Concord quadrangle between west limb of Pacheco syncline and Franklin fault were mapped in San Francisco Folio as Chico and Martinez formations. Recent work has shown that rocks exposed in hills just north of mouth of Franklin Canyon near north border of Concord quadrangle which were mapped as Martinez in San Francisco Folio belong to Chico series. These strata have been offset to northeast along Muir fault. Strata mapped as Martinez southeastward toward Walnut Creek include rocks classified in this report as Vine, Las Juntas, and Muir.

J. C. Brice, 1953, California Div. Mines Bull. 166, p. 12 (fig. 2), 27–29, pl. 1. Formation, mapped and described in Lower Lake quadrangle in Lake and Sonoma Counties where it is 2,200 to 4,200 feet thick. Consists of shale at top; conglomerate and sandstone, yellow feldspathic sandstone; white feldspathic sandstone at base. Rests with angular unconformity upon Knoxville and Cretaceous rocks; underlies Tejon formation.

L. F. Noble, 1954, U.S. Geol. Survey Geol. Quad. Map GQ–95. Formation, in Valyermo quadrangle, Los Angeles County, comprises two members: an upper, more than 3,000 feet thick, and a lower, more than 2,600 feet thick. The two members are not in normal contact. Present south of San Andreas fault.

B. Y. Smith, 1957, California Univ. Pub. Geol. Sci., v. 32, no. 3, p. 127–242. Discussion on history of usage of term Martinez. Term may have a number of meanings depending on interpretation of significance of contained fossils. Some workers consider that Martinez was defined on basis of age significance of contained fossils and believe that term is valid only as stage name and that some other term should be applied to lithogenetic unit. Many workers use term Martinez for cartographic, lithogenetic unit (formation) and prefer some other term for name of a Paleocene stage. Magnitude of Martinez within the cartographic, lithogenetic sense may vary. Term Martinez formation was used by Cushman and Barksdale for strata of entire Martinez group of Merriam's (1897, Jour. Geology, v. 5, p. 767) usage. Many recent workers prefer to limit term Martinez formation to that part of strata in Merriam's Martinez group that contains fossils of Paleocene age. Not until 1949 (Stewart, U.S. Geol. Survey Oil and Gas Inv. Prelim. Chart 34; also Weaver, 1953) did any worker who accepted restriction of term Martinez to Paleocene strata attempt to assign formal designations to formational units stratigraphically overlying them and within the Martinez group of earliest usage. In present report [Foraminifera from Contra Costa County], Weaver's (1953) terminology is used with no attempt at modification. However, since Pacheco syncline is generally accepted as type area for Martinez, it is difficult to follow Weaver's omission of that term, and it seems desirable that Weaver's new units, Vine Hill, Las Juntas, and Muir, be included either as members within Martinez formation or as formations within Martinez group.

G. B. Oakeshott, 1958, California Div. Mines Bull. 172, p. 22 (fig. 2), 57–58, pl. 1. Martinez is stage name applied to rocks of Paleocene epoch in California. It is also commonly used, not quite properly, as formation name in many parts of state, where distinctive Martinez-stage fauna has been recognized. "Martinez formation" is generally understood to refer to a Paleocene sedimentary unit overlying Upper Cretaceous and underlying formations of lower Eocene Meganos stage. It is so used in this report [San Fernando quadrangle, Los Angeles County]. Formation crops out only in discontinuous narrow slivers along south side of San Gabriel fault for about 8 miles. Reaches maximum outcrop width of about 0.4 mile in southeastern quarter of quadrangle where exposed thickness is about 1,500 feet. Formation is faulted, sheared, and folded but determinable dips are, in most places, steep toward north. Predominantly coarse marine sediments, comprising dark-greenish-black sandstone, thin interbeds of shale, and thick massive well-cemented lenticular beds of pebble conglomerate.

Named for occurrences at Martinez and on north flank of Mount Diablo, Contra Costa County.

Martinez Marine Member[1] (of Martinez Group)

Eocene: Southern California.

Original reference: R. N. Nelson, 1925, California Univ. Pub., Dept. Geol. Sci. Bull., v. 15, no. 11.

South of Simi Valley, Ventura County.

Martinian series[1]

Devonian: New Mexico.

Original reference: C. R. Keyes, 1915, Conspectus of geologic formations of New Mexico: Des Moines, Robert Henderson, State Printer.

Martin Lake Limestone (in Palo Pinto Formation)[1]

Pennsylvanian: North-central Texas.

Original reference: G. Scott and J. M. Armstrong, 1932, Texas Univ. Bull. 3224, p. 22.

Crops out around south and west sides of Martin Lake, 2 miles south of Bridgeport, Wise County.

Martin Ridge Schist

Pre-Ordovician(?): North-central Washington.

E. A. Youngberg and T. L. Wilson, 1952, Econ. Geology, v. 47, no. 1, p. 2–4, 12. Composed of alternating bands of argillaceous amphibole schists and quartzites varying in thickness from 1/32 of an inch up to more than 1 inch, and a bed of marble that occurs 20 to 25 feet above contact with Buckskin schist (new). Age sequence not clear; it would appear that Fernow unit (new) is older than the less metamorphosed Buckskin and Martin Ridge schists; this would require that beds be overturned because Fernow gneisses lie stratigraphically above schists.

Named for occurrence in vicinity of Martin Peak, near Holden, Chelan County.

Martinsburg Limestone (in Washington Formation)[1]

Permian: Southwestern Pennsylvania and eastern Ohio.

Original reference: E. V. d'Invilliers, 1895, Pennsylvania 2d Geol. Survey Summ. Final Rept., v. 3, pt. 2, p. 2579.

Burned for lime on Bacon Street Run, Morgan Township, Washington County, Pa.

Martinsburg Shale[1]

Middle and Upper Ordovician: West Virginia, Maryland, New Jersey, southeastern Pennsylvania, Tennessee, and western Virginia.

Original references: H. R. Geiger and A. Keith, 1891, Geol. Soc. America Bull., v. 2, p. 156–163, pl. 4; A. Keith, 1894, U.S. Geol. Survey Geol. Atlas, Folio 10.

G. W. Stose, 1906, Jour. Geology, v. 14, p. 207 (table), 211. In South Mountain, Pa., and adjacent areas, calcareous strata of Chambersburg limestone (new) of Shenandoah group are followed by series of shales and soft sandstones previously called "Martinsburg shale" but herein called Martinsburg group. At the base are a few feet of dark calcareous shale and thin beds of carbonaceous limestone, transition beds, containing fauna regarded as Trenton in age. These are followed by dark to gray platy shale, with *Leptobulus insignia, Triarthus becki,* and other Utica forms, including numerous graptolites, and is therefore named "Utica shale". It is intricately folded but thickness is estimated to be 1,000 feet. Above it is greenish to buff sandstone which is named Eden because it contains fauna referred by Ulrich to the Eden. It is about 500 feet thick.

H. B. Kummel, 1908, U.S. Geol. Survey Geol. Atlas, Folio 161. Overlies Jacksonburg limestone in Franklin Furnace area.

G. W. Stose, 1909, U.S. Geol. Survey Geol. Atlas, Folio 170. In Mercersburg-Chambersburg district, Pennsylvania, Martinsburg shale is 2,000 feet thick. Overlies Chambersburg limestone; underlies Juniata formation.

E. O. Ulrich, 1911, Geol. Soc. America Bull., v. 22, no. 8, p. 328. *Sinuites* bed referred to Martinsburg formation.

R. S. Bassler, 1919, Cambrian and Ordovician deposits of Maryland: Maryland Geol. Survey, p. 154–173. Generalized section of Martinsburg shale in southern Pennsylvania and Maryland shows Martinsburg comprises (ascending) Trenton and ? Utica division, about 1,100 feet thick, with granoscrystalline fossiliferous limestone and shale 2 to 10 feet thick, carrying *Sinuites* fauna; Eden division, about 1,000 feet thick; Lower Maysville division, 300 feet thick; Upper Maysville division, 150 feet thick, consists of unfossiliferous sandstone (Oswego sandstone). Overlies Chambersburg limestone; underlies Juniata formation of earliest Silurian or highest Ordovician age. Section along west slope of Tuscarora Mountain, southeast of McConnellsburg, Pa., describes Martinsburg (ascending) Trenton and Utica? black fissile shale, Lower Eden shales (not exposed), Middle Eden fossiliferous shale, Upper Eden shale and calcareous sandstone 400 feet, Maysville (Fairview) fossiliferous gray sandstone (*Orthorhynchula* bed at top) 300 feet, Oswego gray sandstone member 150 feet.

G. W. Stose and A. I. Jonas, 1927, Geol. Soc. America Bull., v. 38, no. 3, p. 505–536. Overlies Leesport limestone in southeastern Pennsylvania.

R. R. Rosenkrans, 1933, Washington Acad. Sci. Jour., v. 23, no. 9, p. 413–419. Six bentonite beds (Nos. 0–5) have been identified in basal Salona formation (late Black River or early Trenton age) in central Pennsylvania. A section of basal Martinsburg is exposed southwest of Strasburg, Va. Here Martinsburg contains six bentonite beds that are tentatively correlated with bentonite beds of the Salona of Pennsylvania.

R. L. Bates, 1936, Virginia Geol. Survey Bull. 46–M, p. 184–185. Described in Big A Mountain area where it consists chiefly of thin beds of highly fossiliferous limestone alternating with thinner beds of calcareous shale; near the top is buff sandy shale. Thickness about 1,600 feet. Martinsburg is divided, on basis of paleontology and to some extent also on lithology, into three parts: the Trenton, Eden, and Maysville. Only where there is good exposure of entire formation is this subdivision possible, and it is not feasible in area of present report. Trenton member (Upper Mohawkian) recognized in this area. Remainder of Martinsburg is Cincinnatian. Hiatus between Martinsburg and overlying Juniata indicated by absence of Oswego sandstone elsewhere 200 to 500 feet thick. Overlies Moccasin (Lowville). Term Sevier shale has been applied to Martinsburg in southwestern Virginia.

R. L. Miller, 1937, Geol. Soc. America Bull., v. 48, no. 11, p. 1701–1702. In all published reports of the Jacksonburg both in New Jersey and Pennsylvania, it has been stated to pass upward into Martinsburg shales without disconformity. However, no continuous exposures from Jacksonburg into Martinsburg had been observed. One such exposure occurs in Hackettstown limestone lowland [New Jersey] where there is a disconformity between the two formations. Presence of hiatus raises question as to amount of time represented thereby and age of basal Martinsburg. Youngest fauna in Jacksonburg is of Sherman Fall age, so overlying Martinsburg cannot be older than later Sherman Fall.

Bradford Willard and A. B. Cleaves, 1938, Pennsylvania Geol. Survey, 4th ser., Bull. G–8, p. 5–7. Martinsburg shale described in south-central Pennsylvania. Passes gradually over into Chambersburg or older limestone or is faulted against even older beds. Above, it may intergrade with "Oswego" sandstone, the Juniata red beds, or be in unconformable contact with Tuscarora sandstone. Usually called "shale", the Martinsburg is variable lithologic group. Often contains heavy sandstone, principal body of which is herein named West Fairview member. Also contains pebbly unit herein named Paxton Creek conglomerate.

Bradford Willard and A. B. Cleaves, 1939, Geol. Soc. America Bull., v. 50, no. 7, p. 1165–1198. Term Bald Eagle (Grabau, 1909) revived and used to replace term Oswego which has been misapplied in Pennsylvania. Bald Eagle is used herein as member of Juniata. This use of Bald Eagle restricts Martinsburg at top; this usage differs from Stose (1909) and Bassler (1919) who included the Bald Eagle ("Oswego") in the Martinsburg. The Fairview is treated as upper member of Martinsburg. Relationships of the Martinsburg, Bald Eagle, Juniata, and Tuscarora are all transitional. In Schuylkill Gap area, massive sandstone at top of Martinsburg is herein named Shochary sandstone member. Lithologically, stratigraphically, and faunally, appears to be correlate of Bassler's Fairview sandstone in south-central sections but is not traceable through. Based upon interpretation of sedimentary cycle, the Ordovician-Silurian boundary in Pennsylvania separates the Tuscarora or Shawangunk from underlying strata, whether these are Juniata, Bald Eagle, or Martinsburg. Tectonic evidence indicates Ordovician-Silurian line is at top of Martinsburg (Eden shale or one of its sandstone members—the Fairview or Shochary). By this procedure, the Bald Eagle and Juniata become basal Silurian.

Bradford Willard, 1939, Pennsylvania Acad. Sci. Proc., v. 13, p. 126–133. In Pennsylvania, Martinsburg "formation" or "shale" (group would be better term) normally rests on Chambersburg limestone west of the Susquehanna, the Leesport limestone in Schuylkill Valley. Between, it may be in fault contact with older formations, as the Beekmantown east of Harrisburg. Cocalico shale of Lancaster County is known to rest upon limestone with Chambersburg fossils and is partly or wholly the correlate of the Martinsburg. Overlain normally by Bald Eagle sandstone or conglomerate ("Oswego" of some authors) from Lehigh Valley. westward. At the Schuylkill, this sequence is interrupted because Martinsburg is faulted against Tuscarora of Medinan age. Martinsburg "formation" comprises (ascending) Cocalico shale, unnamed and undifferentiated dark shales, Jonestown beds (new), Fairview or Shochary sandstones. In Berks County, interval from top of Leesport to top of Shochary is probably of order of 4,500 feet; in Susquehanna Valley above Harrisburg, 2,500 to 3,000 feet, estimated. Age from early Trenton at least through early, perhaps, middle Maysville.

Charles Butts, 1940, Virginia Geol. Survey Bull. 52, pt. 1, p. 201-213. At Martinsburg, W. Va., in Massanutten Mountain; at Strasburg, Shenandoah County; and just south of Draper Mountain, in Wythe and Pulaski Counties, the Martinsburg overlies Chambersburg limestone with no known break or hiatus between them. Where Chambersburg is absent, as northwest of Walker and Clinch Mountains in southwest Virginia, the Martinsburg overlies Lowville-Moccasin limestone. In some areas around south end of Massanutten syncline, the geologic map shows Martinsburg resting on Athens shale, but there is reason to believe that the Chambersburg limestone, or shale of equivalent age, is included in base of Martinsburg. In central Pennsylvania and for long distances, but not everywhere, along line of Little North Mountain in Virginia as far south as Brocks Gap, Rockingham County, and perhaps as far as Rawley Springs, *Orthorhynchula* zone in top of Martinsburg is Oswego sandstone. In Walker and Clinch Mountains and throughout entire northwest part of Appalachian Valley in Virginia, the *Orthorhynchula* zone is invariably overlain by Juniata formation. In Massanutten Mountain, both Oswego and Juniata are absent, and Martinsburg is succeeded by Massanutten sandstone, basal part of which is possibly Clinch or equivalent Tuscarora. Where Trenton limestone is clearly differentiated, it is treated as separate formation. Overlying shale, corresponding to Eden and Maysville parts of the Martinsburg, is likewise made a distinct formation, named Reedsville shale.

L. C. Craig, 1941, (abs.) Geol. Soc. America Bull., v. 52, no. 12, pt. 2, p. 1963–1964. In Chambersburg area, overlies Greencastle formation which includes *Sinuites* zone at top.

Bradford Willard, 1943, Geol. Soc. America Bull., v. 54, no. 8, p. 1069–1075. Martinsburg group, as here used, includes Fairview and Shochary and Jonestown beds and Dauphin shale (new). Locally the Jonestown red beds, Eden and younger, are continental equivalents of marine Martinsburg with which they intergrade. The marine Martinsburg is twofold (shale below sandstone) and not threefold (shale, sandstone, shale) as sometimes stated. In northern New Jersey and at Otisville, N.Y., the Martinsburg is unconformably overlain by Shawangunk formation. Reedsville shale is partial coordinate of the Martinsburg.

B. N. Cooper, 1944, Virginia Geol. Survey Bull. 60, p. 103–109, pl. 8. Formation described in Burkes Garden quadrangle. Roughly divisible into three parts, lowest, or Trenton, division composed of light-gray medium-grained shell limestones which are very dense and hard. Dark-gray shales occur as intercalations in the limestones and constitute about 25 percent of total thickness of division. Metabentonites occur in lowest 50 to 75 feet of formation. Thickness of Trenton division 650 to 750 feet. Eden division is composed of olive-drab and drab-gray fissile shales and slabby argillaceous limestones. Thickness as much as 500 feet. Maysville, or uppermost division, is 250 to 350 feet thick and except for uppermost 50 to 75 feet, closely resembles Eden division. Separation of upper Eden and lower Maysville made wholly on basis of fossils. Conformable with underlying Eggleston and overlying Juniata.

B. N. Cooper and G. A. Cooper, 1946, Geol. Soc. America Bull., v. 57, no. 1, p. 86–89. Discussion of lower Middle Ordovician stratigraphy of Shenandoah Valley, Va. Martinsburg formation, 183 feet thick, overlies Oranda formation (new) at type section of Oranda. Contains *Sinuites* beds at base. Overlies Collierstown limestone (new) at type section of Collierstown.

L. C. Craig, 1949, Geol. Soc. America Bull., v. 60, no. 4, p. 742–746. Martinsburg shale succeeds Oranda formation in south-central Pennsylvania [this report]. Only lower few hundred feet included in this study. *Sinuites* zone consists of black muddy, rubbly to slabby limestone and forms the thin basal unit of Martinsburg. Sharp lithologic change succeeds *Sinuites* zone throughout most of area. Eighteen separate bentonite beds present in lower 220 feet of formation at composite Africa section, 1½ miles west of Mercersburg. Some metabentonites are correlated with metabentonite beds in Salona formation; lower part of Martinsburg formation is equivalent in Blacklog Valley to the part of Salona limestone succeeding metabentonites 1 and 2 and including metabentonite 6. Lower part of Martinsburg is quite fossiliferous. Lowest beds characterized by *Sinuites cancellatus* (Hall), *Cryptolithus tesselatus* Green, and *Leptobolus*? *ovalis* Bassler. Succeeding, more argillaceous beds contain *Cryptolithus tesselatus* Green and *Climacograptus* sp., and *Brongniartella trentonensis* (Collie) is present in Path and Blacklog Valleys where it is apparently restricted to beds between metabentonites 4 and 6. Presence of *Sinuites cancellatus* (Hall) and *Ecculiomphalus trentonensis* (Conrad) in upper part of type Jacksonburg in New Jersey suggests that it may contain beds corresponding to *Sinuites* zone of south-central Pennsylvania. Whether Jacksonburg contains equivalents of beds younger than *Sinuites* zone is not known. Term Greencastle formation abandoned in this report.

J. M. Cattermole, 1955, U.S. Geol. Survey Geol. Quad. Map 76. Martinsburg shale newly recognized in Shooks Gap quadrangle, Tennessee. Only lower beds present; overlies Bays formation.

J. P. Hobson, Jr., 1957, Am. Assoc. Petroleum Geologists Bull., v. 41, no. 12, p. 2722. Overlies Ontelaunee formation (new) of Beekmantown group in Berks County, Pa.

C. E. Prouty, 1959, Pennsylvania Geol. Survey, 4th ser., Bull. G–31, p. 29–30. Interval between Beekmantown group and Martinsburg formation, embodying essentially the Leesport in east-central Pennsylvania and, in a restricted sense, the Jacksonburg of eastern Pennsylvania and western New Jersey, divided into (ascending) Annville, Myerstown, and Hershey limestones. Basal contact of Martinsburg has been interpreted differently in various areas of Pennsylvania. One of the difficulties lies in lithologic versus faunal interpretations. *Sinuites cancellatus* zone, used by Ulrich (1911) as guide to basal contact was used by Craig (1949) in separating Martinsburg from Oranda in central belts. *Sinuites* zone is followed by graptolite-bearing dark shale. Latter zone is thought to represent graptolite zone recognized at Steelton in basal Hershey. Thick metabentonite below could then fit Salona 2 metabentonite which Craig placed at top of Oranda. Martinsburg base in central belts then has been placed lower stratigraphically than in eastern belts, and contact is drawn to include dark shaly limestone of general Hershey type within the Martinsburg. Eastward from Harrisburg, increased metamorphism has obliterated most of faunal evidence, and contact is drawn lithologically where carbonaceous limestones (Hershey limestone) yield stratigraphically higher into noncalcareous olive to brownish buff-weathering shale. Thus, basal Martinsburg contact as generally drawn eastward from Susquehanna River differs from contact westward by approximate interval of Hershey limestone. This relationship extends eastward into New Jersey where contact is drawn at top of calcareous Jacksonburg. On basis of general lithologic comparisons with fossiliferous rocks in central Pennsylvania, it is likely that the Hershey-Martinsburg contact would represent roughly the upper Salona contact and therefore appoximates upper Sherman Fall-Trenton in age. Miller (1937) indicates that Jacksonburg deposition in western New Jersey must have continued well into Sherman Fall time, thereby inferring age of basal Martinsburg to be no older than late Sherman Fall. Basal Martinsburg could be younger than this, depending upon time represented by hiatus separating it from Jacksonburg.

Named for Martinsburg, W. Va.

Martinsville Formation

Pleistocene (Wisconsin) : South-central Indiana.

H. H. Gray, R. D. Jenkins, and R. M. Weidman, 1960, Indiana Geol. Survey Bull. 20, p. 18–19, pl. 1. Silt, sand, and gravel deposits on floodplains of present streams. Thickness less than 2 feet to 15 feet or more. Overlies every bedrock formation within Huron area at one place or another. Among unconsolidated materials, it probably overlies both facies of Atherton formation (new) and lower part of Prospect formation (new). Name credited to W. J. Wayne (in preparation).

Type locality and derivation of name not stated.

Martinville limestone[1]

Pennsylvanian: Illinois.

Original reference: C. R. Keyes, 1923, Pan-Am. Geologist, v. 39, no. 4, p. 320.

Martville Sandstone[1]

Silurian: Central New York.

Original reference: G. H. Chadwick, 1918, Geol. Soc. America Bull., v. 29, p. 327–368.

Type locality: Bentley's quarry between Martville, Cayuga County, and Hannibal, Oswego County.

Marvel Limestone[1]

Precambrian: Southeastern California.

Original references: F. M. Murphy, 1930, Econ. Geology, v. 25, p. 309–310; 1933, California Div. Mines Rept. 28 of State Mineralogist, July-Oct. 1932, p. 329–356.

B. K. Johnson, 1957, California Univ. Dept. Geol. Sci., v. 30, no. 5, p. 355, 378 (fig. 7). This study [Manly Peak quadrangle] has made possible the correlation of formations defined by Murphy (1930, 1932 [1933]) in Telescope Peak quadrangle with formations now commonly in use in Death Valley region. Marvel dolomitic limestone underlies Surprise formation, here redefined as member of Kingston Peak formation. Precambrian.

Exposed along Marvel Canyon, southern part of Panamint Range, Inyo County.

Marvin Beds

See Marvin Quarry Bed.

Marvin Creek Limestone[1]

Marvin Creek Limestone Member (of Oswayo Formation)

Devonian: Central northern Pennsylvania and southern New York.

Original reference: C. A. Ashburner, 1880, Pennsylvania 2d Geol. Survey Rept. R, p. 68–69.

C. R. Fettke, 1938, Pennsylvania Geol. Survey, 4th ser., Bull. M–21, p. 33, 34. Section of Oswayo formation near Knapp Creek, N.Y., shows Marvin Creek coquinite about 23 feet above base of section. This is probably the limestone which Ashburner called Marvin Creek. Caster (1934) renamed this limestone the Roystone, stating that Ashburner was not sufficiently exact in his definition of type locality and that limestone which Ashburner saw along Marvin Creek is one of the calcareous horizons in lower part of Knapp formation. Writer [Fettke] does not agree with this interpretation of Ashburner's use of the term and states reasons. Term Marvin Creek is used in this report [Bradford oil field, Pennsylvania and New York].

Well developed in Marvin Creek valley, McKean County, Pa.

Marvin Quarry Bed

Middle Devonian: Northeastern Michigan.

[G. M. Ehlers], 1938, Michigan Acad. Sci., Arts and Letters Sec. Geology and Mineralogy [Guidebook] 8th Ann. Field Excursion, [fig. 2] after p. 8. Shown on columnar section as overlying Afton bed (new); top of section.

W. A. Kelly, 1940, Michigan Acad. Sci., Arts and Letters Sec. Geology and Mineralogy [Guidebook] 10th Ann. Field Excursion, [p. 1, figs. 4, 6, and 7], map 1. Lower beds consist of black argillaceous limestone with irregular shale partings and massive granular limestone with scattered crinoid columnals; includes biostrome consisting principally of heads of stromatoporoids and two varieties of *Prismatophyllum*. Upper half of section at Afton cannot be definitely correlated with section near Lake Huron, and provisional names, Afton beds, Marvin beds, and Beebe beds, are used in place of Alpena, Norway Point, Potter Farm, Partridge Point, and Squaw Bay, employment of which would imply stricter correlation than is justified.

Present in Black Lake-Afton area.

Mary Lake Granite

[Precambrian]: Northern Michigan.

L. T. Aldrich, 1958, Geol. Soc. America Bull., v. 69, v. 12, pt. 2, p. 1528. All the Rb-Sr ages of mica samples from Dickinson County, except those of the pegmatites, agree within the errors of measurement at 1,380 million years, indicating that all the micas analyzed from the metamorphic zones were formed at the same time as that of the Mary Lake granite.

In vicinity of Iron Mountain, Dickinson County.

Marys Creek Marl Member (of Goodland Formation)

Lower Cretaceous (Comanche Series): Northeastern Texas.

B. F. Perkins, 1957, Dissert. Abs., v. 17, no. 6, p. 1310; 1960, Geol. Soc. America Mem. 83, p. 9 (fig. 3), 12 (fig. 4), 15–19, 20. Proposed for lower interstratified marls and marly limestones of formation. At type locality, consists of 51 feet of interstratified blue marls, marly limestones, and several hard fossiliferous limestones. Underlies Benbrook limestone member (new). Basal part of member is gradational from Walnut marl;

contact between the two arbitrarily placed at top of uppermost resistant shell bed of the Walnut. Upper limit of member placed at top of interstratified sequence of thin marls and limestones and at base of thick limestone and marly limestone sequence of upper member. Widespread hard shell bed of *Gryphaea mucronata* Gabb in limestone matrix present about 6 feet below top of member.

Type section: Along Marys Creek for distance of 1½ miles from U.S. Highway 80–180 bridge southeastward to bluffs, on Rowan Ranch, Tarrant County.

Marysville Claystone Member (of Meganos Formation)

Marysville Formation[1]

Eocene, lower: Northern California.

Original reference: Howel Williams, 1929, California Univ. Pub., Dept. Geol. Sci. Bull., v. 18, p. 112, 121–124.

Ralph Stewart, 1949, U.S. Geol. Survey Oil and Gas Inv. Prelim. Chart 34, sheet 2. Restricted to beds of fossiliferous green claystone and siltstone; designated as claystone member of Meganos formation. Type locality designated.

Type locality: On west side of Marysville Buttes in Fig Tree Gulch near center W½ sec. 28, T. 16 N., R. 1 E. [Yuba County].

Marysville Sand Member (of Vashon Drift)

Pleistocene: Northwestern Washington.

R. C. Newcomb, 1952, U.S. Geol. Survey Water-Supply Paper 1135, p. 26, 27–28, pl. 1. Sand and gravel valley-train material more than 40 feet thick. Overlies Arlington gravel member (new).

Area: Snohomish County; contains Tps. 26 and 32 N. of the Willamette base line.

Maryville Limestone[1] (in Conasauga Group)

Middle Cambrian: Northeastern Tennessee, southeastern Kentucky, western North Carolina, and southwestern Virginia.

Original reference: A. Keith, 1895, U.S. Geol. Survey Geol. Atlas, Folio 16, p. 3.

John Rodgers, 1953, Tennessee Div. Geology Bull. 58, pt. 1 (plates); pt. 2, p. 46 (fig. 3), 49–51. In eastern Tennessee, the Conasauga varies in lithology, and three phases are recognized; in central phase (between Knoxville and Morristown and north of Clinch Mountains), the Conasauga is considered a group consisting of six formations of which Maryville limestone is fourth in sequence (ascending). Underlies Nolichucky shale; overlies Rogersville shale. Thickness 250 to 650 feet.

J. M. Cattermole, 1955, U.S. Geol. Survey Geol. Quad. Map GQ–76. Described and mapped as limestone in Conasauga group in Shooks Gap quadrangle, Tennessee. Thickness 670 feet.

Named for Maryville, Blount County, Tenn.

Mascall Formation[1]

Miocene, upper: Central northern Oregon.

Original reference: J. C. Merriam, 1901, California Univ. Pub. Bull. Dept. Geology, v. 2, no. 9, p. 305.

Theodore Downs, 1956, California Univ. Pub. Geol. Sci., v. 31, no. 5, p. 199–354, pls. Particularly in type area, includes wind-blown and water-laid deposits of variable thickness. Believed to be transitional Hemingfordian (middle Miocene) and Barstovian (late Miocene) in age. No evidence for subdivision of formation or fauna. Fauna described.

T. P. Thayer, 1956, U.S. Geol. Survey Mineral Inv. Field Studies Maps MF–49 and MF–50. Mapped in Aldrich Mountain quadrangle and in Mount Vernon quadrangle. Conformable on Columbia River basalt; underlies Rattlesnake formation with angular unconformity. Upper Miocene.

Type exposure near Mascall ranch, 4 miles below Danville.

Mascoma Group

Middle or Upper Devonian(?): West-central New Hampshire.

C. A. Chapman and others, 1938, Geologic map and structure sections of the Mascoma quadrangle, New Hampshire (1:62,500): New Hampshire Highway Dept. Consists of fine- to medium-grained white, gray, and pink weakly foliated granitoid rocks. Includes quartz diorite, granodiorite, quartz monzonite, and granite, Belongs to Oliverian magma series. Probably Upper Devonian.

C. A. Chapman, 1939, Geol. Soc. America Bull., v. 50, no. 1, p. 143, pl. 6. Name given to plutonic rocks of Mascoma dome. Granodiorite is most abundant type.

R. J. Bean, 1953, Geol. Soc. America Bull., v. 64, no. 5, p. 534–545, pl. 2. Middle(?) Devonian.

Occupies central part of Mascoma quadrangle.

Mascot Dolomite (in Knox Group)

Lower Ordovician: Eastern Tennessee and Virginia.

John Rodgers, 1943, Geologic map of Copper Ridge district, Hancock and Grainger Counties, Tennessee (1:24,000): U.S. Geol. Survey Strategic Minerals Inv. Prelim. Map. Name appears on map legend. Occurs above Kingsport limestone (new).

C. R. L. Oder and H. W. Miller, 1945, Am. Inst. Mining Metall. Engineers Tech. Pub. 1818, p. 1, 2 (table 1). In Mascot-Jefferson City zinc district, consists of light- and dark-gray dolomite and limestone; moderately cherty; base marked by chert matrix sandstone; limestone most abundant in Jefferson City area. Thickness 500–700 feet. Overlies Kingsport formation. Name chosen jointly by Josiah Bridge and Oder.

John Rodgers and D. F. Kent, 1948, Tennessee Div. Geology Bull. 55, p. 27–32. Described in Hawkins County where it consists typically of light-gray finely crystalline to compact well-bedded dolomite with intercalated layers of compact blue limestone near top; these limestone layers are not present along Copper Ridge. Base of formation is marked by bed of chert-matrix sandstone which is prominent in Mascot area; top is taken at unconformity at top of Knox group. Along Copper Ridge, formation is divided into two members, lower characterized by massive ledge-making beds of white chert and upper by compact well-laminated silty dolomite that underlies sink holes. Thickness 510 feet. Overlies Kingsport formation.

R. L. Miller and W. P. Brosgé, 1954, U.S. Geol. Survey Bull. 990, p. 28–30, pl. 1. Described in Jonesville district, southwestern Virginia, where it underlies Dot limestone and disconformably overlies Kingsport dolomite. Consists predominantly of light-colored to nearly white dolomite. Thickness 169 to 462 feet; thinness may be due to erosion during hiatus between Mascot and Dot formations.

Josiah Bridge, 1956, Geol. Soc. America Bull., v. 66, no. 6, p. 727. In Douglas Lake area, underlies Douglas Lake member (new) of Lenoir limestone.

Josiah Bridge, 1956, U.S. Geol. Survey Prof. Paper 277, p. 23. Term Mascot replaces "Cotter-Powell beds" as used by Oder, 1934. Jefferson City, Cotter, and Powell are names of formations exposed in Arkansas and Missouri; there is no possibility that they can be traced into Appalachian Valley.

Named for Mascot, Knox County, Tenn., near which several partial sections of formation are exposed.

Masefau Dike Complex and Breccia

Masefau Volcanics

Pliocene(?): Samoa Islands (Tutuila).

H. T. Stearns, 1944, Geol. Soc. America Bull., v. 55, no. 11, p. 1286–1288, pl. 1. Hundreds of closely spaced dikes intruded into thin-bedded basalts. About 200 feet thick. Complex is truncated at top apparently by erosional unconformity and on northern side of fault(?) scarp. Above fault(?) plane is 20 to 100 feet of talus and firefountain debris and about 50 feet of Pago volcanic series.

G. A. Macdonald, 1944, Geol. Soc. America Bull., v. 55, no. 11, p. 1336–1337. Masefau volcanics include olivine basalts, olivine-poor basalts, and olivine-free basalts.

G. A. Macdonald *in* Jacques Avias and others, 1956, Lexique Strat. Internat., v. 6, Océanie, fasc. 2, p. 180. Pliocene(?). No fossils.

Complex and breccia crop out on east side of Afono Bay, in Bartlett Island off Masefau Bay, and in promontory opposite island. Complex is named from latter locality which is near Masefau village.

Maskerchugg Granite (in East Greenwich Group)

Mississippian(?): Central Rhode Island.

A. W. Quinn, 1952, Bedrock geology of the East Greenwich quadrangle, Rhode Island: U.S. Geol. Survey Geol. Quad. Map [GQ–17]. Gray to light-tan fine-grained granite. Contains inconspicuous small phenocrysts and has well-developed flow structure. Appears to include Spencer Hill volcanics (new); intruded by unnamed granite porphyry and Cowesett granite (new). Unconformably underlies Carboniferous beds. Included in East Greenwich group.

Named for ledges near Maskerchugg River which flows through outcrop area in Kent County. Most characteristic outcrop is at intersection of First Avenue and Middle Road, East Greenwich.

Masket Formation

Silurian: Central Nevada.

Marshall Kay, 1960, Internat. Geol. Cong., 21st, Copenhagen, pt, 12, p. 97 (fig. 3), 98 (fig. 4). Named on cross section and structure section in report on Paleozoic continental margin in central Nevada. Overlies Diana formation (new) or Gatecliff formation (new).

Toquima Range, Nye County.

Mason Clay (in Conemaugh Formation)[1]

Mason clay or underclay member

Pennsylvanian (Conemaugh Series): Eastern Ohio

[Original reference]: Wilber Stout and R. E. Lamborn, 1924, Ohio Geol. Survey, 4th ser., Bull. 28, p. 316, 317, 318.

N. K. Flint, 1951, Ohio Geol. Survey, 4th ser., Bull. 48, p. 60, 61, table 1. Included in Mason cyclothem, Perry County.

D. L. Norling, 1958, Ohio Geol. Survey Bull. 56, p. 30. Mason clay member (Conemaugh series) occurs below Mason coal and above Upper Mahoning sandstone and shale member. In many areas in Morgan County, interval of Mason clay is occupied by sandstone and shales, which extend to base of Brush Creek limestone.

M. T. Sturgeon and others, 1958, Ohio Geol. Survey Bull. 57, p. 95 (table 11), 106. Underclay member of Mason cyclothem in report on Athens County. Average thickness about 7 feet. Occurs with Mason coal above Upper Mahoning shale and sandstone member. Conemaugh series.

First mentioned in Columbiana County. Probably named for association with Mason coal.

Mason cyclothem

Pennsylvanian (Conemaugh Series): Southeastern Ohio.

N. K. Flint, 1949, Ohio Acad. Sci. [Guidebook] 24th Ann. Field Conf., p. 11, Incidental mention in road log.

N. K. Flint, 1951, Ohio Geol. Survey, 4th ser., Bull. 48, p. 60–61, table 1, geol. map. Includes (ascending) Upper Mahoning shale and (or) sandstone, 30 feet; Mason clay, 3 feet; and Mason coal. Occurs above Mahoning cyclothem and below Brush Creek cyclothem. In area of this report, the Conemaugh series is described on a cyclothemic basis; seven cyclothems are named. [For sequence see Mahoning cyclothem.]

M. T. Sturgeon and others, 1958, Ohio Geol. Survey Bull. 57, p. 95 (table 11), 102–107. Described in Athens County. Occurs above Mahoning cyclothem and below Lower Brush cyclothem. Includes Upper Mahoning shale and (or) sandstone, Upper Mahoning redbed member, Mason underclay, Mason coal, and Mason marine shale member. In this report, the Conemaugh series is described on a cyclothemic basis; 15 cyclothems are named. [For complete sequence see Mahoning cyclothem.]

Name Mason was applied by White (1903) to an underclay, a coal, and a marine shale from type area at Mason on Elk River, Kanawha County, W. Va.

†Mason Series[1]

Precambrian (Llano Series): Central Texas.

Original reference: T. B. Comstock and E. T. Dumble, 1890, Texas Geol. Survey 1st Ann. Rept., pl. 3, p. lvii, 276–281.

Probably named for Mason County.

Mason Shale (in Conemaugh Formation)[1]

Mason shale member

Pennsylvanian (Conemaugh Series): Southern West Virginia and eastern Ohio.

Original reference: I. C. White, 1903, West Virginia Geol. Survey, v. 2, p. 281.

R. E. Lamborn, C. R. Austin, and Downs Schaaf, 1938, Ohio Geol. Survey, 4th ser., Bull. 39, p. 182, 183, 185. In Ohio, Mason shale member (Conemaugh series) occurs below Brush Creek coal and above Mason coal. Commonly gray with some shaly sandstone. Thickness 10 to 32 feet.

M. T. Sturgeon and others, 1958, Ohio Geol. Survey Bull. 57, p. 95 (table 11), 107. Marine shale member of Mason cyclothem in report on Athens County. Thickness 10 to 12 feet. Overlies Mason coal and underlies Lower Brush Creek shale and (or) sandstone member of Lower Brush Creek cyclothem.

Named for Mason, on Elk River, Kanawha County, W. Va.

Mason City Dolomite Member (of Shellrock Formation)

Mason City Limestone or Dolomite[1]

Upper Devonian: Central northern Iowa.

Original reference: W. H. Norton, 1897, Iowa Geol. Survey, v. 6, p. 148.

A. H. McNair, 1942, Jour. Paleontology, v. 16, no. 3, p. 349–350. Referred to as Mason City dolomite member of Shellrock.

M. A. Stainbrook, 1944, Illinois Geol. Survey Bull. 68, p. 182 (table), 187. Shellrock consists of lithographic and dolomitic limestones and thin shales; includes (ascending) Mason City, Rock Grove, and Nora members.

Named for exposures at Mason City, Cerro Gordo County.

Mass Amygdaloid[1]

Precambrian (Keweenawan): Northern Michigan.

Original reference: B. S. Butler and W. S. Burbank, 1929, U.S. Geol. Survey Prof. Paper 144 (chart complied by M. G. Wilmarth).

Named for occurrence in Mass mine, Ontonagon County.

Mass Flow[1]

Precambrian (Keweenawan): Northern Michigan.

Original reference: B. S. Butler and W. S. Burbank, 1929, U.S. Geol. Survey Prof. Paper 144 (chart compiled by M. G. Wilmarth).

Probably named for occurrence in Mass mine, Ontonagon County.

Massacre Volcanics[1]

(?)Pliocene, lower: Southern Idaho.

Original references: H. T. Stearns, 1932, Correlation chart of Idaho compiled by M. G. Wilmarth, dated Sept. 1, 1932; 1936, Jour. Geology, v. 44, no. 4, p. 434–439.

H. T. Stearns, Lynn Crandall, and W. G. Steward, 1938, U.S. Geol. Survey Water-Supply Paper 774, p. 32, 46–47, pls. 4, 6. A group of knobs of dense basalt. Rocks represent denuded feeder of an ancient volcano. Shown on stratigraphic section above Eagle Rock tuff and below Rockland Valley basalt.

The feeder dikes form Massacre Rocks, a group of knobs of diabase, in sec. 6, T. 9 S., R. 30 E., Power County.

†Massanutten Sandstone[1]

Silurian: Northeastern Virginia and western Maryland.

Original reference: H. R. Geiger and A. Keith, 1891, Geol. Soc. America Bull., v. 2, p. 156–163, pl. 4.

C. K. Swartz and F. M. Swartz, 1940, (abs.) Geol. Soc. America Bull., v. 51, no. 12, pt. 2, p. 2008–2009. Proposed to restrict term Massanutten to the Silurian beds.

Charles Butts, 1940, Virginia Geol. Survey Bull. 52, pt. 1, p. 202. In Massanutten Mountain, overlies Martinsburg shale. Basal part of Massanutten is possibly the Clinch or equivalent Tuscarora.

W. B. Brent, 1960, Virginia Div. Mineral Resources Bull. 76, p. 11 (table 1), 46–47. Term Massanutten sandstone, as used here, applies to the thick series of sandstones, quartzites, and conglomerates of Massanutten Mountain area, overlying unfossiliferous or sparsely fossiliferous sandstone at top of Martinsburg and lying below Bloomsburg red beds. Original definition by Geiger and Keith (1891) invalid because of misidentification (corrected by Keith, 1894). Darton (1899, U.S. Geol. Survey Geol. Atlas, Folio 61) used Massanutten sandstone to include Juniata formation, Tuscarora quartzite, and Cacapon sandstone. Thornton (1953, unpub. thesis) designated type section and gave thickness of 700 feet. Thickness 500 to 700 feet in Rockingham County [this report].

Type locality: At Burners Gap, 3 miles N. 25° W. of Hamburg, Page County. Named for Massanutten Mountain, in Rockingham, Shenandoah, and Page Counties, northeastern Virginia. Occurs only in Massanutten Mountain area where it is principal ridge-forming rock.

Massie Clay[1]

Massie Member (of Alger Formation)

Silurian (Niagaran) : Southwestern Ohio.

Original reference: A. F. Foerste, 1929, Ohio Jour. Sci., v. 29, no. 4, p. 168.

Wilber Stout, 1941, Ohio Geol. Survey, 4th ser., Bull. 42, p. 35, chart facing p. 46. Shown on generalized section of western Ohio as uppermost member of Alger formation. Thickness 5 to 6 feet. Overlies Laurel member; underlies Euphemia formation.

Well exposed on Massie Creek, a short distance west of Cedarville, Greene County.

Massie Creek Sandstone

Upper Devonian: Central Missouri.

M. G. Mehl, 1960, Denison Univ. Jour. Sci. Lab., v. 45, art. 5, p. 73–75. Highly calcareous fossiliferous sandstone that varies from light gray, or almost white, to medium gray and light yellowish brown on fresh exposures. Thickness about 7 feet at type locality; probably does not exceed 10 to 12 feet; average may be as little as 5 feet. Unconformable below Mississippian Bachelor formation (new) ; unconformable on beds ranging from Plattin to Holts Summit (new), including Kimmswick, Callaway, Snyder Creek, and Glen Park. Stratigraphic relations of Massie Creek and Bushberg are similar, and later evidence may show they are time equivalents. Recommended that both names be used unless and until the two are proven synonymous.

Type locality: Outcrop in NE cor. SW¼SE¼NW¼ sec. 24, T. 47 N., R. 4 W., Warren County. Exposed along Massie Creek and some of its tributaries.

†Massillon Sandstone (in Pottsville Formation)[1]

Massillon sandstone and shale member

Pennsylvanian (Pottsville Series) : Eastern Ohio.

Original reference: J. S. Newberry, 1874, Ohio Geol. Survey, v. 2, p. 131.

N. K. Flint, 1951, Ohio Geol. Survey, 4th ser., Bull. 48, p. 24, 25–26, table 1. Included in Bear Run cyclothem. Name has been largely restricted to massive sandstone; in this report, shale occurring at the same stratigraphic position is also called Massillon. Thickness 5 to 65 feet. Member thins, thickens, and changes from massive sandstone to interbedded sandstone and shale within short distances.

R. E. Lamborn, 1954, Ohio Geol. Survey Bull. 53, p. 43–46, geol. map. Near Massillon, where thickness varies from 20 to 80 feet, Massillon sandstone (Connoquenessing) member (Pottsville series) closely overlies Massillon coal; locally replaces Quakertown coal. Eastward, sandstone is well developed on outcrop in Ohio and western Pennsylvania. In Beaver County, Pa., was described as Connoquenessing sandstone by White (1878), for exposures along Connoquenessing River. White (1878 [1879]) divided it into the Upper and Lower Connoquenessing sandstone with Quakertown coal between. Southwest from Massillon, sandstone is irregularly present but found close above Quakertown coal and thus corresponds in position to Connoquenessing sandstone of Pennsylvania. Locally the Massillon thickens replacing overlying and underlying units; at such localities, it extends from near base of Pennsylvanian to horizon of Lower Mercer limestone.

Named for Massillon, Stark County.

Mass Mountain[1] (Basalt)

Mississippian: Northern California.

Original reference: N. E. A. Hinds, 1930, Geol. Soc. America Bull., v. 41, p. 158.

Southern part of Klamath Mountains.

Masuk Member (of Mancos Shale)

†Masuk Shale (in Mancos Shale)[1]

Masuk Tongue (of Mancos Shale)

Upper Cretaceous: Central southern Utah.

Original reference: G. K. Gilbert, 1877, Geology of the Henry Mountains: U.S. Geog. and Geol. Survey of the Rocky Mountain region, p. 4 [2d. ed. 1880].

C. R. Longwell and others, 1923, U.S. Geol. Survey Prof. Paper 132–A, p. 3–4 (table), 15, 16, 21–22. Discussion of rock formations in Colorado Plateau of Utah and Arizona. To rocks above Dakota (?) sandstone in Henry Mountains, Gilbert (1877) applied local names (ascending) Tununk shale, Tununk sandstone, Blue Gate shale, Blue Gate sandstone, Masuk shale, and Masuk sandstone. Only Gilbert's names for the sandstones have been adopted by U.S. Geological Survey, and in the present report his names for the shales are used in quotation marks because of doubt regarding relations of this whole succession of sandstone and shale to named units to north and east. R. C. Moore tentatively correlates "Tununk shale," Tununk sandstone, and "Blue Gate shale" with Mancos shale of southwestern Colorado and east-central Utah; Blue Gate sandstone he tentatively correlates with Mesaverde formation, "Masuk shale" with Lewis shale, and Masuk sandstone with so-called Laramie sandstone of southwestern Colorado. Some geologists, however, believe that entire succession corresponds to Mancos shale. Thickness of "Masuk shale" 500 to 700 feet.

C. B. Hunt and R. L. Miller, 1946, Utah Geol. Soc. Guidebook 1, p. 8 (table). Generalized section of exposed sedimentary rocks in Henry Mountains shows Masuk shale member at top of Mancos shale. Thickness

700 feet. Overlies Emery sandstone member; underlies Mesaverde formation.

C. B. Hunt, Paul Averitt, and R. L. Miller, 1953, U.S. Geol. Survey Prof. Paper 228, p. 36 (table), 85. Thickness of Masuk member 787 feet at Bitter Creek Divide, Henry Mountains. Overlies Emery sandstone member; underlies Mesaverde formation (referred to as Masuk sandstone by Gilbert, 1877).

R. G. Young, 1955, Geol. Soc. America Bull., v. 66, no. 2, p. 180 (fig. 2). In central Utah where it is separated from lower members by Emery sandstone, upper part of Mancos is called Masuk member, but to east it is not easily separable and is herein referred to as Masuk tongue of Mancos. Present below Panther sandstone tongue of Star Point sandstone.

Named for occurrence in Masuk Plateau, Henry Mountains.

†Masuk Sandstone Member (of Mesaverde Formation)[1]

Upper Cretaceous: Central southern Utah.

Original reference: G. K. Gilbert, 1877, Geology of the Henry Mountains: U.S. Geog. and Geol. Survey of the Rocky Mountain region, p. 4 [2d ed. 1880].

C. R. Longwell and others, 1923, U.S. Geol. Survey Prof. Paper 132–A, p. 3–4 (table), 15, 21–22. Discussion of rock formations in Colorado Plateau of Utah and Arizona. To rocks above Dakota(?) sandstone in Henry Mountains, Gilbert (1877) applied local names (ascending) Tununk shale, Tununk sandstone, Blue Gate shale, Blue Gate sandstone, Masuk shale, and Masuk sandstone. Only Gilbert's names for the sandstones have been adopted by U.S. Geological Survey, and in the present report his names for the shales are used in quotation marks because of doubt regarding relations of this whole succession of sandstone and shale to named units to north and east. R. C. Moore tentatively correlates "Tununk shale," Tununk sandstone, and "Blue Gate shale" with Mancos shale of southwestern Colorado and east-central Utah; Blue Gate sandstone he tentatively correlates with Mesaverde formation, "Masuk shale" with Lewis shale, and Masuk sandstone with so-called Laramie sandstone of southwestern Colorado. Some geologists, however, believe that entire succession corresponds to Mancos shale. Thickness of Masuk sandstone about 300 feet. Unconformable below Wasatch(?) formation.

H. E. Gregory and R. C. Moore, 1931, U.S. Geol. Survey Prof. Paper 164, pl. 5. Shown on correlation chart as Masuk sandstone member of Mesaverde formation.

C. B. Hunt, Paul Averitt, and R. L. Miller, 1953, U.S. Geol. Survey Prof. Paper 228, p. 86. In Henry Mountains, Mesaverde formation is about 400 feet thick and consists entirely of sandstone. Gregory (1877) referred to the formation as Masuk sandstone.

In Masuk Plateau, Henry Mountains.

Masukian series[1]

Upper Cretaceous: Utah.

Original reference: C. R. Keyes, 1924, Pan-Am. Geologist, v. 41, p. 36, 64–65, 280, 303.

Mata Chin Formation

Quaternary(?): Panamá.

R. T. Hill, 1898, Harvard Coll. Mus. Comp. Zoology Bull., v. 28, no. 5, p. 187–189. Black basic rounded igneous boulders. Thickness 110 feet in face of hill at Juan Grande; 100 feet south of Bas Obispo. Believed to be contemporaneous with basic igneous eruptions of Cretaceous and Eocene time.

W. P. Woodring *in* R. Hoffstetter and others, 1960, Lexique Strat. Internat., v. 5, Amérique Latine, fasc. 2a, p. 339. Considered informal name. Quaternary(?). Boulders may have weathered from conglomerate of Bohio formation or may be exfoliated masses weathered out of basalt. Name should be Matachin.

Matachin was a pre-Canal village on Río Chagres. Site is now flooded by Gatún Lake.

Matafao Trachyte and Breccia

Pleistocene(?): Samoa Islands (Tutuila).

R. A. Daly, 1924, Carnegie Inst. Washington Pub. 340, p. 100, 105, 129–130. Trachyte plug penetrating massive basaltic breccia.

H. T. Stearns, 1944, Geol. Soc. America Bull., v. 55, no. 11, p. 1286 (table 1), 1302–1303. Matafao trachyte plug is associated with Pago volcanic series. Where well exposed in Fagaalu Valley, plug is bordered by 10 to 25 feet of brecciated trachyte which grades into band of friction breccia 50 to 150 feet wide composed of trachyte and basaltic fragments. Pliocene and lower Pleistocene(?).

G. A. Macdonald *in* Jacques Avias and others, 1956, Lexique Strat. Internat., v. 6, Océanie, fasc. 2, p. 181. Pleistocene(?).

Crops out on summit of Matafao Peak. Covers area of about 0.25 square mile.

Matalanim beds

See Metalanim Beds or Conglomerate.

Matansa Limestone

Eocene, upper: Mariana Islands (Saipan).

Risaburo Tayama, 1938, Geomorphology, geology, and coral reefs of Saipan Island: Tropical Industry Inst., Palau, South Sea Islands, Bull. 1 [English translation in library of U.S. Geol. Survey, p. 52–53]. Referred to as Matansya beds. Lower part is andesite boulder conglomerate; middle, a succession of tuff beds; upper, well-stratified pink limestone 3 to 5 meters thick.

Josiah Bridge *in* W. S. Cole and Josiah Bridge, 1953, U.S. Geol. Survey Prof. Paper 253, p. 11–12. Limestone unconformably overlies Sankakuyama rhyolite or Hagman andesite and underlies younger igneous and sedimentary formations of various ages. Upper Eocene.

P. E. Cloud, Jr., R. G. Schmidt, and H. W. Burke, 1956, U.S. Geol. Survey Prof. Paper 280–A, p. 56–60, pls. 2, 8B, 17A, chart 1. Tayama applied name Matansya beds to part of rocks here called Matansa limestone. Includes three principal facies: basal transitional facies of dull-yellowish to red-brown tuffaceous to marly limestone and calcareous conglomerate; pink, highly foraminiferal clastic limestones; and white, sparingly formainiferal clastic limestones. Thickness 200 to about 500 feet. Basal beds overlie or grade laterally to upper beds of Densinyama formation, contact transitional or locally unconformable. Beds that succeed Matansa in local column are the probably Oligocene volcanic rocks of Fina-sisu formation (new), but direct contact not observed. In local succession, Matansa beds are actually overlain by Miocene or Quaternary deposits. Type section designated.

Type section: Succession of Eocene strata that extends up southern part of west-facing Papua cliffs, in southeastern part of Matansa district, about 300 feet south of roadside quarry.

Matansya Beds

See **Matansa Limestone.**

Matanuska Formation[1]

Lower and Upper Cretaceous: Central southern Alaska.

Original reference: G. C. Martin, 1926, U.S. Geol. Survey Bull. 776, p. 317–327, table facing p. 474.

F. F. Barnes and T. G. Payne, 1956, U.S. Geol. Survey Bull. 1016, p. 12, pls. 1, 2. Most complete section of formation exposed in gorge of Granite Creek about 2 miles east of Eska, where it has aggregate thickness of at least 4,000 feet. Assumed to overlie Arkose Ridge formation (new). Upper Cretaceous.

Arthur Grantz and D. L. Jones, 1960, U.S. Geol. Survey Prof. Paper 400–B, p. B347–B350. Mollusks can be grouped into assemblages of Albian, Cenomanian, Turonian, Campanian and Upper Campanian and Maestrichtian(?) ages.

In Matanuska Valley.

†Matanuska Series[1]

Jurassic, Cretaceous, and Tertiary: Alaska.

Original reference: W. C. Mendenhall, 1900, U.S. Geol. Survey 20th Ann. Rept., pt. 7, p. 307–309.

Occurs near top of Limestone Gap and along upper course of Bubb Creek; also makes base of Castle Mountain. Matanuska River flows nearly along strike of series.

Matawan Group or **Formation**[1]

Upper Cretaceous: New Jersey, Delaware, and northeastern Maryland.

Original references: W. B. Clark, 1894, New Jersey Geol. Survey Ann. Rept. 1893, p. 335–336; Jour. Geology, v. 2, p. 161–177.

C. W. Carter, 1937, Maryland Geol. Survey, v. 13, p. 250–261. In New Jersey, group comprises (ascending) Merchantville clay, Woodbury clay, Englishtown sand, Marshalltown formation, and Wenonah sand. In Chesapeake and Delaware Canal area in Delaware and adjacent parts of Maryland, the Matawan has been mapped as an individual formation; previous investigators have not considered it practicable to subdivide it. Fresh exposures along canal have made it possible to subdivide the Matawan there, although it has not been deemed feasible to separate the Merchantville and Woodbury clay units, which are therefore treated as combined unit under old name Crosswicks clay; Wenonah sand is wanting.

R. A. Schmidt, 1948, Jour. Paleontology, v. 22, no. 4, p. 392 (table 1). Group in northern Delaware comprises (ascending) Crosswicks clay, Englishtown sand, and Marshalltown formation.

W. B. Spangler and J. J. Peterson, 1950, Am. Assoc. Petroleum Geologists Bull., v. 34, no. 1, p. 8 (fig. 4), 23-39. Rank reduced to formation. Defined as those beds above the Magothy and below the shell bed formed by *Exogyra*, *Gryphaea*, and *Belemnitella* in base of the Navesink. As thus defined, consists of six members (ascending): Merchantville, Woodbury, Englishtown, Wenonah, and Mount Laurel (previously included in Monmouth group). Overlies Magothy formation with slight disconformity; conformably underlies Monmouth formation.

M. E. Johnson and H. G. Richards, 1952, Am. Assoc. Petroleum Geologists Bull., v. 36, no. 11, p. 2150–2160. Here Matawan is considered a group with Wenonah sand at top. Report is a discussion of paper by Spangler and Peterson.

Typically exposed on shore of Raritan Bay in vicinity of Matawan Creek and along banks of the creek, Monmouth County, N.J.

Matewan Sandstone (in Kanawha Formation[1] or Group)

Pennsylvanian: Southern West Virginia.

Original reference: R. V. Hennen and D. B. Reger, 1914, West Virginia Geol. Survey Rept. Logan and Mingo Counties, p. 199.

H. R. Wanless, 1939, Geol. Soc. America Spec. Paper 17, p. 94. Massive sandstone in Kanawha group.

Named for town in Mingo County.

Matfield Shale (in Chase Group)[1]

Permian: Eastern Kansas, southeastern Nebraska, and northern Oklahoma.

Original reference: C. S. Prosser, 1902, Jour. Geology, v. 10, p. 714.

G. E. Condra and J. E. Upp, 1931, Nebraska Geol. Survey Bull. 6, 2d ser., p. 36. Includes (ascending) Wymore shale, Kinney limestone, and Blue Springs shale members (all new).

R. C. Moore, J. C. Frye, and J. M. Jewett, 1944, Kansas Geol. Survey Bull. 52, pt. 4, p. 164–165. Thickness 60 to 90 feet. Underlies Barneston limestone; overlies Wreford limestone.

P. B. Greig, 1959, Oklahoma Geol. Survey Bull. 83, p. 110–111. Matfield shale of this report extends upward from top of Wreford limestone to base of Fort Riley limestone. Prosser (1902) defined Matfield as 60 to 70 feet of shale and thin limestones overlying Wreford limestone and underlying Florence flint. This section has been divided into Blue Springs and Wymore shale members separated by Kinney limestone member. These members have been identified as far south as Kay County. South of this point, Kinney limestone is absent and shale members cannot be differentiated. Florence flint member of Barneston, which defines top of Matfield farther north, does not occur in Pawnee County. As used in this report, the Matfield is an undifferentiated section of red sandstones and shales and probably includes thin section in upper part that is equivalent to lower part of Barneston formation of Kansas. Thickness about 100 feet in Pawnee County.

Named for development in Matfield Township, Chase County, Kans.

Matilija Formation

Matilija Sandstone Member[1] (of Tejon Formation)

Eocene, or Eocene, upper: Southern California.

Original reference: P. F. Kerr and H. G. Schenck, 1928, Geol. Soc. America Bull., v. 39, p. 1090.

T. W. Dibblee, Jr., 1950, California Div. Mines Bull. 150, p. 26–27, 38 (fig. 2), pls. 1–6. Described in Santa Ynez Mountains, Santa Barbara County, as Matilija formation. Made up of a succession of beds, up to 25 feet thick, of massive medium-grained fairly hard bluish-white sandstone which weathers buff. Thickness as much as 2,000 feet. Underlies Cozy Dell shale; overlies Anita shale; where Anita shale buttresses out Matilija unconformably overlies the Cretaceous or Franciscan. Upper Eocene.

B. M. Page, J. G. Marks, and G. W. Walker, 1951, Am. Assoc. Petroleum Geologists Bull., v. 35, no. 8, p. 1756–1758. In Santa Barbara area, overlies Juncal formation (new).

Type locality: In canyon at Matilija Springs, Ventura County.

Matoaka Formation (in Pocono Group)

Lower Mississippian: Southern West Virginia.

J. L. Dally, 1956, Dissert. Abs., v. 16, no. 12, p. 2425. Named as uppermost unit in group in southern part of state. Overlies Sunbury shale.

Probably named for Matoaka, Mercer County.

Mattapan Volcanic Complex[1]

Devonian or Carboniferous: Eastern Massachusetts and northeastern Rhode Island.

Original reference: Laurence LaForge *in* B. K. Emerson, 1917, U.S. Geol. Survey Bull. 597, p. 200–201, map.

N. E. Chute, 1950, Bedrock geology of the Brockton quadrangle, Massachusetts (1:31,680): U.S. Geol. Survey Geol. Quad. Map [GQ–5]. Rhyolite dikes of Brockton quadrangle may be same age (Devonian or Carboniferous) as Mattapan volcanic complex exposed in Norwood quadrangle to northwest.

Named for exposures in Mattapan, Dorchester district of Boston, Mass.

Mattaponi Formation

Upper Cretaceous and Paleocene: Southeastern Virginia (subsurface).

D. J. Cederstrom, 1957, U.S. Geol. Survey Water-Supply Paper 1361, p. 17–22, pls. 1, 7. Name applied to 429 feet of sediments underlying Aquia formation in type well. Top 100 feet is glauconitic to some extent and remainder consists of brightly colored mottled clays, and gray, blue, red, and purple-brown clays. Overlies Potomac group. Occurs between depths of 235 and 654 feet in type well.

Type well: Municipality of Colonial Beach, Westmoreland County. Drilled by Virginia Machinery & Well Co., Inc.

Matteawan Granite[1]

Precambrian: Southeastern New York.

Original reference: W. W. Mather, 1843, Geology New York, v. 1, pl. 18.

Probably named for occurrence in town of Matteawan, Dutchess County.

†Matthews Landing Group or Series (in Midway Group)[1]

Eocene, lower: Southwestern Alabama.

Original reference: E. A. Smith and L. C. Johnson, 1887, U.S. Geol. Survey Bull. 43, p. 57–60.

Named for exposures at Matthews Landing, on Alabama River, in Wilcox County.

Matthews Landing Marl Member (of Porters Creek Clay)

Matthews Landing Marl (in Midway Group)[1]

Matthews Landing Member (of Naheola Formation)

Paleocene: Southwestern Alabama and Mississippi.

Original reference: E. A. Smith and L. C. Johnson, 1887, U.S. Geol. Survey Bull. 43, p. 57–60.

F. S. MacNeil, 1946, U.S. Geol. Survey Strat. Minerals Inv. Prelim. Rept. 3–195, p. 5, 11–12. Reallocated to member status in Porters Creek clay and emended to include upper marls and limestones of Graveyard Hill section of Smith, Johnson, and Langdon (1894, Report on geology of Coastal Plain of Alabama: Alabama Geol. Survey) which is generally referred to as Blacks Bluff interval or Porters Creek. These changes made because top of Matthews Landing member is sharply defined, whereas, especially in central Alabama where it attains maximum development, there seems to be no definite line to separate it from beds represented in Graveyard Hill section. In central Alabama, member consists of glauconitic sandy marl, sand, and limestone, but west of Alabama River it becomes sandy glauconitic clay that on weathering forms concretionary limonite. West of Tombigbee River, member is 3 to 8 feet thick; east of river, thickens to about 100 feet in Wilcox County, Ala. If there are equivalent beds to the east, they are included in Clayton formation. Underlies Naheola formation.

L. D. Toulmin, P. E. LaMoreaux, and C. R. Lanphere, 1951, Alabama Geol. Survey Spec. Rept. 21, p. 37, 42, pl. 3. Underlies Oak Hill member (new) of Naheola formation in Choctaw County, Ala.

R. J. Hughes, Jr., 1958, Mississippi Geol. Survey Bull. 84, p. 107–118, pls. 1, 5, 7, 9, 10. Described in Kemper County, Miss., as member of Porters Creek. Thickness 5 to 8 feet. Underlies Naheola formation and in some areas Fearn Springs member of Nanafalia formation. Historical summary of usage of name.

W. L. Roux, Jr., 1958, Dissert. Abs., v. 19, no. 5, p. 1056. Referred to as member of Naheola formation.

Named from old Matthews Landing on Alabama River, in northern part of sec. 12, T. 12 N., R. 6 E., Wilcox County, Ala. Extends from Winston County, Miss., to eastern Butler County, Ala.

Mattoon Formation (in McLeansboro Group)

Pennsylvanian: Illinois.

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 8 (fig. 1), 26 (fig. 4), 27, 39–41, 51 (table 1), pl. 1, geol. sections. Proposed for all Pennsylvanian strata above top of Millersville limestone member of Bond formation (new). Predominantly shale and sandstone. Maximum thickness 500 to 600 feet; more than 750 feet of Mattoon strata present in Union County, Ky. Members (ascending): central and southeastern Illinois—Friendsville coal, McClearys Bluff coal, Shelbyville coal, Opdyke coal, Trowbridge coal, Calhoun coal (new), Bonpas coal (new), Omega limestone, Shumway limestone, Effingham limestone (new), Bogota limestone (new), Greenup limestone (new), Gila limestone, Woodbury limestone (new), and Reisner limestone (new); and eastern Illinois—Cohn coal (new) and Merom sandstone. Presentation of new rock-stratigraphic classification of Pennsylvanian of Illinois. Cyclical classification is retained but is independent of rock-stratificatic classification.

Type locality: Outcrops in counties of deeper Illinois basin area of southeastern Illinois. Named for city of Mattoon which lies in general outcrop belt of formation.

Mauch Chunk Shale[1] or Formation

Mauch Chunk Group, Red Beds, or Series

Upper Mississippian: Pennsylvania, western Maryland, and northern West Virginia.

Original reference: J. P. Lesley, 1876, Pennsylvania 2d Geol. Survey Rept. L, App. E, p. 221, 222, chart.

P. H. Price and E. T. Heck, 1939, West Virginia Geol. Survey [Rept.] Greenbrier County, p. 252, 254–266, measured sections. Mauch Chunk series, upper division of Mississippian, underlies Pottsville series and overlies Greenbrier series. Maximum thickness about 2,800 feet. Includes (ascending) Bluefield, Hinton, Princeton, and Bluestone groups.

W. O. Hickok 4th and F. T. Moyer, 1940, Pennsylvania Geol. Survey, 4th ser., Bull. C–26, p. 46 (fig. 14), 49–53. Series, in Fayette County, divided into three parts: lower, red and green shale and buff to olive micaceous sandstone that lies directly on Loyalhanna limestone; middle, dark fossiliferous limestone and interbedded gray shale; upper, predominantly bright-red shale with lesser amounts of green shale and buff micaceous sandstone. Includes Greenbrier limestone, 5 to 40 feet thick, in middle part. Thickness about 200 feet. Underlies Connoquenessing sandstone, Pottsville series. Age not well known, commonly thought to be Chester.

Ernst Cloos and C. H. Broedel, 1943, Geol. Soc. America Bull., v. 54, no. 9, p. 1379 (table 1). Referred to as Mauch Chunk red beds in discussion of reverse faulting north of Harrisburg, Pa. Thickness 2,000 to 3,000 feet.

M. N. Shaffner, 1952, Pennsylvania Geol. Survey, 4th ser., Prog. Rept. 141. Group, in Donegal quadrangle, composed of about 160 feet of alternating red and green argillaceous shales with interbedded greenish fine-grained thin to massive sandstones. Fossiliferous Greenbrier limestone, about 24 feet thick, present in lower part. Overlies Loyalhanna limestone; underlies Pottsville series, Connoquenessing sandstone.

T. W. Amsden, 1954, Maryland Dept. Geology, Mines and Water Resources Bull. 13, p. 44–45, 48 (fig. 7). Formation described in Garrett County where it crops out on both flanks of Deer Park anticline and on flanks of Accident anticline. Consists of interbedded fine-grained sandstones, siltstones, and shales; shales are typically noncalcareous and red or green; sandstones are brown to green, micaceous, and thin bedded. Sections based on geologic map indicated thickness of 500 to 700 feet. Overlies Greenbrier formation; underlies Pottsville formation. Assigned to Chester series, though not believed to be everywhere the same age.

G. H. Wood, Jr., and others, 1956, Am. Assoc. Petroleum Geologists Bull., v. 40, no. 11, p. 2671, 2674 (fig. 3), 2683. Formation underlies Tumbling Run member (new) of Pottsville formation at type section and reference section of Pottsville. Thickness about 1,000 feet.

H. H. Arndt and others, 1959, Geol. Soc. America Guidebook Field Trips Pittsburgh Mtg., p. 1–2, 37, 39, fig. 9. Formation, of Late Mississippian and Pennsylvanian(?) age, rests conformably on Pocono formation and consists of from 2,000 to more than 8,000 feet of rock in southern and western parts of anthracite region. Absent in extreme northeastern part of region, and only a few feet thick in extreme northern part. Typically consists of red-brown and light-gray fine- to coarse-grained quartzose and impure quartz sandstone, red and olive-green siltstone and shale beds, and gray-olive-green and red-brown conglomerate beds. The light-gray quartzose and impure quartz sandstone is concentrated in the basal 500 to 600 feet of formation. The basal light-gray beds appear to be genetically related to underlying strata of the Pocono, and conglomerates in upper part are apparently tongues of Early Pennsylvanian Pottsville formation. Progressively younger red beds occur to north and west.

Carlyle Gray, 1960, Geologic map of Pennsylvania (1:250,000): Pennsylvania Geol. Survey, 4th ser. Formation includes Greenbrier limestone in Fayette, Westmoreland, and Somerset Counties; Loyalhanna limestone at base in southwestern Pennsylvania.

Type locality not stated but commonly assumed to be at Mauch Chunk, Carbon County, Pa.

Maud Chert Conglomerate Member (of Konawa Formation)

Permian: East-central Oklahoma.

W. F. Tanner, 1956, Oklahoma Geol. Survey Bull. 74, p. 110–111. Name applied to the dark cherts occurring in the upper three-fourths of formation.

Well exposed at Dripping Springs School, in Pottawatomie County, northwest of Maud, sec. 29, T. 8 N., R. 5 E.

Maudlow Conglomerate Lentil (in Livingston Formation)

Paleocene: Southwestern Montana.

W. J. McMannis, 1955, Geol. Soc. America Bull., v. 66, no. 11, p. 1410, pl. 7. Consists of andesitic volcanic conglomerate and conglomeratic, crystal-lithic tuff. Thickness 688 feet. Occurs about 300 feet above Eagle sandstone. Paleocene plant remains in upper part of lentil and 300 feet above it. Name credited to Klemme (unpub. thesis).

Occurs in vicinity of Maudlow, Gallatin County.

Maunawili Volcanics[1] (in Honolulu Volcanic Series)

Pleistocene, upper: Oahu Island, Hawaii.

Original reference: H. T. Stearns, 1935, Hawaii Div. Hydrography Bull. 1.

G. A. Macdonald and D. A. Davis *in* Jacques Avias and others, 1956, Lexique Strat. Internat., v. 6, Océanie, fasc. 2, p. 115. Nepheline basalt lava flow and remnants of associated cinder cone. Thickness at flow about 100 feet. Flow rests on soil which in turn rests on conglomerates in terrace graded to plus 95-foot (Kaena) stand of sea.

Named for Maunawili Ranch, on which it is exposed. Covers area of about 0.3 square mile on northeast side of Koolou Range, 7.5 miles northwest of Makapuu Head.

Maurice Formation

Maurice Member (of Boysen Formation and Gros Ventre Formation)

Upper Cambrian: Southern Montana and northwestern Wyoming.

Erling Dorf and Christina Lochman, 1938, (abs.) Geol. Soc. America Proc. 1937, p. 276; 1940, Geol. Soc. America Bull., v. 51, no. 4, p. 547–550. Consists of lower member of intercalated gray-green fissile shales and glauconitic limestone edgewise conglomerates with local development of lenses of dense gray algal(?) limestone (average 60 feet thick); upper member of massive-bedded oolitic limestone, mottled buff, gray, and pink, with a few flat pebble conglomerates and sandy limestones (average 100 feet thick). Thickness at type locality 150 feet. Underlies Snowy Range formation (new); overlies Park shale. Dresbach equivalent. Term Gallatin formation not applicable in this area [southern Montana].

Charles Deiss, 1938, Geol. Soc. America Bull., v. 49, no. 7, p. 1094–1096, 1101 (fig. 3), 1104–1105. Rank reduced to member status in Boysen formation (new) in Wind River area, Wyoming. Thickness 182 feet in type section of Boysen. Underlies Snowy Range member; overlies Gros Ventre member of Depass formation.

V. E. Nelson and Victor Church, 1943, Jour. Geology, v. 51, no. 3, p. 145. Stratigraphic chart of Gros Ventre and Hoback Ranges shows member at top of Gros Ventre formation. Middle Cambrian.

A. M. Hanson, 1952, Montana Bur. Mines and Geology Mem. 33, p. 16. Dorf and Lochman introduced term Maurice for Pilgrim equivalent in Yellowstone Park area, and term has been applied in Logan area. Distinction between Maurice and Pilgrim is presence of mottled oolitic limestone in Maurice. Term Maurice considered unnecessary.

P. W. Richards, 1957, U.S. Geol. Survey Bull. 1021–L, p. 399. In the area east and southeast of Livingston, Mont., name Pilgrim limestone is used in preference to Maurice because separation of the two units is difficult especially where they interfinger in basins between the outcrops where the formations are named.

Type locality: South side of valley of North Fork of Grove Creek, 5 miles south of Red Lodge, Carbon County, Mont. Named from Mount Maurice, prominent elevation on Beartooth front.

Maury Formation

Maury Glauconitic Member (of Ridgetop Shale)[1]

Maury Green Shale Member (of Chattanooga Shale)

Maury Shale

Lower Mississippian: Western and central Tennessee, Alabama, and Georgia.

Original reference: J. M. Safford and J. B. Killebrew, 1900, Elements of geology of Tennessee, p. 104, 141, 143.

K. E. Born and H. B. Burwell, 1939, Tennessee Div. Geology Bull. 47, p. 48. Maury green shale is top member of Chattanooga shale.

Guy Campbell, 1946, Geol. Soc. America Bull., v. 57, no. 9, p. 895–900. Maury shale, with its conspicuous phosphatic nodules, has been prominent in black-shale literature as a connecting link between the black shale and overlying strata. Its status as member of one or the other has been crucial to some of theories relating to the Mississippian succession. Proposed here to restrict term Maury to bed of shale containing phosphatic nodules, commonly less than 1 foot thick, Osage in age, which overlies Chattanooga. This definition excludes the Falling Run, and Eulie (both new) and the undifferentiated overlying beds, and limits the Maury to the time and conditions of formation of its most characteristic feature, phosphatic nodules. This restriction will necessitate restudy and differentiation of excessive thicknesses of shale [as much as 20 feet] usually assigned to Maury. Chattanooga shale is overlain disconformably by Maury, and Maury is shoreward facies, not seaward facies, or Chattanooga or any other formation to which it is related. Summary of usage.

W. H. Hass, 1956, U.S. Geol. Survey Prof. Paper 286, p. 23–26, pl. 5. Maury formation of this report is "Maury green shale" of Safford and Killebrew, who proposed the term for beds between the "Black shale (Chattanooga shale)" and their Tullahoma formation. Lithologic characteristics, stratigraphic position, and fauna of Glendale shale of Swartz (1924) are similar to those of Maury formation, and it is believed that these names refer to same lithologic unit. Name Maury is used in preference to Glendale in this report. Maury is well-defined lithologic unit wherever it is overlain by Ridgetop shale or New Providence shale. Generally 1½ to 3 feet thick and consists mostly of grayish-yellow, green, and greenish-gray glauconitic mudstones. In north-central Tennessee, nodule bed contains Late Devonian conodonts like those of Gassaway member of Chattanooga shale; elsewhere in central Tennessee, it contains early Mississippian (Kinderhook) conodonts. On basis of conodonts, Maury is considered biostratigraphic equivalent of lower part of New Providence shale. Beds identified as Big Stone Gap member and Olinger member of Chattanooga by Swartz (1927) are included in Maury as herein defined. No adequate exposure of formation was found in Maury County [where named by Safford and Killebrew] therefore standard exposure is designated.

Standard section: Along south side of road near top of west slope of Pull Tight Hill, 13½ miles southeast of Franklin and 1.2 miles east of Cross Key, Williamston County, Tenn.

Mauumae Volcanics[1] (in Honolulu Volcanic Series)

Pleistocene, upper: Oahu Island, Hawaii.

Original reference: C. K. Wentworth, 1926, Bernice P. Bishop Mus. Bull. 30, p. 42, 45.

G. A. Macdonald and D. A. Davis *in* Jacques Avias and others, 1956, Lexique Strat. Internat., v. 6, Océanie, fasc. 2, p. 115–116. Pyroclastic material ranging from cinder and spatter to medium-textured black ash and associated lava flow of nepheline basalt. Thickness in drill hole more than 151 feet. Unconformably overlies Koolau volcanic series; underlies Diamond Head tuff and Kaimuki basalt.

Erupted from Mauumae. Exposed over about one-half square mile on south side of Koolau Range, 10 miles west of Makapuu Head.

Maverick Shale

Precambrian: Central Arizona.

E. D. Wilson, 1938, *in* Arizona Bur. Mines Bull. 145, Geol. Ser. 12, pl. 3; 1939, Geol. Soc. America Bull., v. 50, no. 7, p. 1118, 1123–1124. In type section, consists of thin-bedded locally rippled-marked fine-grained dense gray shale containing alternating thin sandy to quartzitic beds in upper part. In vicinity of North Peak, shale ranges from gray and dark gray to maroon with light-gray diffusion spots; south of North Peak, shale is prevailingly gray to pale greenish gray on fresh fracture, weathering dull gray or pale yellowish. Thickness 800 feet at Maverick Basin; thins to about 500 feet at North Peak; apparently thins greatly northward. Overlies Deadman quartzite (new) and underlies Mazatzal quartzite with conformable contacts.

Named from typical occurrence in Maverick Basin, in northwestern part of Mazatzal Mountains.

Maxfield Limestone[1]

Middle Cambrian: Central northern Utah.

Original reference: F. F. Hintze, Jr., 1913, New York Acad. Sci. Annals, v. 23, p. 107.

F. C. Calkins and B. S. Butler, 1943, U.S. Geol. Survey Prof. Paper 201, p. 14–18, pl. 5. Gray and white dolomite and gray- to buff-mottled limestone interbedded with shale. Thickness 570 feet. Overlies Ophir shale; underlies Jefferson(?) dolomite. Probably Middle Cambrian. Plate 5 shows Upper Cambrian.

A. E. Granger, 1953, U.S. Geol. Survey Circ. 296, p. 2. Crops out in City Creek Canyon (near Salt Lake City) where it is 1,039 feet thick, conformably overlies Ophir shale and conformably underlies Swan Peak(?) formation.

U.S. Geological Survey currently designates the age of the Maxfield Limestone as Middle Cambrian on the basis of a study now in progress.

Named for Maxfield mine at Argenta, near Salt Lake City.

Max Meadows (fault) Breccia

Upper Paleozoic: Southwestern Virginia.

B. N. Cooper and J. C. Haff, 1940, Jour. Geology, v. 48, no. 8, pt. 2, p. 945–974. Fault breccia, separating the sole and tread of Max Meadows overthrust, consists of three cataclastic zones: upper autoclastic breccia composed of large angular blocks and smaller tabular fragments of quartz sericite phyllite; lower autoclastic zone consisting of angular blocks and fractured masses of Elbrook limestone and dolomite; and intervening zone of crush conglomerate composed chiefly of rounded fragments of limestone, dolomite, and phyllite. Combined thickness of three zones about 75 feet; all fundamental relations of the breccia are seldom seen in a single exposure. Rome and Elbrook formations have been thrust over younger formations along two closely spaced low-angle overthrusts which are nearly parallel; lower and older of these faults is the Pulaski and the upper Max Meadows.

Occurs in Draper Mountain area situated in west-central Pulaski County and adjacent parts of Wythe County. All three zones are exposed along east bank of Cove Creek about 3 miles west of Max Meadows, Pulaski County.

Maxon Sandstone (in Trinity Group)[1]

Lower Cretaceous: Western Texas.

Original reference: P. B. King, 1930, Texas Univ. Bull. 3038, p. 91–93, map.

G. A. Kiersch and P. W. Hughes, 1952, Econ. Geology, v. 47, no. 8, p. 798 (fig. 2). Shown on geologic column of outcropping units, Reagan Canyon to Del Rio, Tex., as below the Walnut-Comanche Peak and above the Glen Rose limestone. Consists of buff- to reddish-brown medium-bedded sand and siltstone and gray-black medium- to thin-bedded argillaceous limestone. Thickness about 200 feet.

Type locality: Maxon Station, near point where Southern Pacific [Railroad] leaves Marathon basin, Brewster County.

Max Patch Granite[1]

Max Patch Granite Gneiss

Precambrian: Western North Carolina and eastern Tennessee.

Original reference: A. Keith, 1904, U.S. Geol. Survey Geol. Atlas, Folio 116.

J. L. Stuckey and S. G. Conrad, 1958, North Carolina Div. Mineral Resources Bull. 71, p. 18–19; J. L. Stuckey, 1958, Geologic map of North Carolina (1:500,000): North Carolina Div. Mineral Resources. Max Patch granite gneiss consists entirely of Max Patch granite as mapped by

Keith. Unit has been so completely metamorphosed that most of it has a gneissic to schistose structure, and little, if any, true granite remains unaltered; porphyritic variety of unit has been altered to augen gneiss, whereas the even-grained variety has been altered to gneiss or schist. Precambrian(?).

Named for Max Patch Mountain in Madison County, N.C. [This may be considered the type locality.].

Maxville Limestone[1]

Mississippian: Ohio and northeastern Kentucky.

Original reference: E. B. Andrews, 1870, Ohio Geol. Survey Rept. Prog. 1869, p. 80, 84.

Wilber Stout, 1945, Ohio Geol. Survey, 4th ser., Bull. 45, p. 8 (table), 34. Maxville limestones were laid down on sandstones and shales of Logan formation, and then were cut away during a long cycle of erosion which left only small isolated areas. Such deposits are present at surface in Scioto, Jackson, Vinton, Hocking, Perry, and Muskingum Counties. Underlies Pottsville rocks.

Named for village of Maxville, Perry County, Ohio.

Maxwell Limestone (in McLeansboro Formation)[1]

Pennsylvanian: Central western Illinois.

Original reference: E. F. Lines, 1912, Illinois Geol. Survey Bull. 17, p. 89, 90.

Probably named for occurrence at or near Maxwell, Peoria County.

Maya conglomerate[1]

Tertiary: New Mexico.

Original references: C. R. Keyes, 1915, Iowa Acad. Sci. Proc., v. 22, p. 257; 1915, Conspectus of geologic formations of New Mexico: Des Moines, Robert Henderson, State Printer, p. 2, 9.

Derivation of name not stated.

Mayagüez Group

Cretaceous: Southwestern Puerto Rico.

P. H. Mattson, 1958, Dissert. Abs., v. 18, no. 1, p. 197; 1960, Geol. Soc. America Bull., v. 71, no. 3, p. 329–340, pl. 1. Composed of bedded and massive fragmental limestone; thin- to medium-bedded foraminiferal tuffaceous mudstone, siltstone, and tuff, and andesitic and basaltic volcanic rock including massive tuff, lava, and breccia. Thickness about 780 meters near south and southwest coasts and as much as 3,800 meters near northeastern corner of area. Conformably overlies Río Loco formation, and, where Río Loco is absent, unconformably overlies Bermeja complex (new). Comprises seven lithofacies units of formational rank: Parguera, Brujo, and Melones limestones, Yauco mudstone, Maricao basalt, Sabana Grande andesite, and El Rayo volcanic rocks. In this classification, the Mayagüez group and Melones limestone are litologic units which correspond to time-stratigraphic units within Mayagüez area, whereas the other six formations are regarded as lithologic units or lithofacies, with no implications of position relative to one another. Youngest rocks are Maestrichtian; oldest are Turonian to Santonian.

E. A. Pessagno, Jr., 1960, Geology of the Ponce-Coamo area, Puerto Rico: Puerto Rico Econ. Devel. Adm. and Princeton Univ. Dept. Geology, p.

55–56. Mattson included rocks assignable to Río Yauco formation in his Mayagüez group. Inasmuch as the Río Yauco and Río Blanco formations interfinger, the Río Blanco should be included in Mayagüez group.

Named for Mayagüez map area. Comprises most of rocks in southwestern Puerto Rico.

Mayagüez Shales[1]

Tertiary: Puerto Rico.

Original reference: C. P. Berkey, 1915, New York Acad. Sci. Annals, v. 26, p. 61.

J. D. Weaver, 1956, *in* R. Hoffstetter and others, Lexique Strat. Internat., v. 5, Amérique Latine, fasc. 2b, p. 334. Berkey suggested this name for shales outcropping near Mayagüez. Name has not been used since but Meyerhoff and Smith (1931, New York Acad. Sci. Scientific Survey of Porto Rico and the Virgin Islands, no 2, pt. 3) suggested similarity between them and Fajardo shales.

Maybelle Formation (in Lueders Group)

Maybelle Limestone[1] Member (of Lueders Formation)

Permian (Leonard Series): Central northern Texas.

Original reference: A. S. Romer, 1928, Texas Univ. Bull. 2801, p. 74.

M. G. Cheney, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 1, p. 66 (fig. 1). Given formational status in the Lueders herein designated as a group. Underlies Lake Kemp formation; overlies Paint Rock limestone.

R. C. Moore, 1949, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 80, sheet 2. Examination of type outcrops of Maybelle and Lake Kemp beds affords no satisfactory ground for classing the limestones as parts of the Lueders. No basis was found for recognizing any limestone beds of the Lueders in the Colorado River area [mapped in this report] as corresponding to Maybelle and Lake Kemp beds, respectively.

Derivation of name unknown.

May Creek Formation[1] or Schist

Devonian (?): Southwestern Oregon.

Original reference: J. S. Diller and G. F. Kay, 1924, U.S. Geol. Survey Geol. Atlas, Folio 218.

C. N. Schuette, 1938, Oregon Dept. Geology and Mineral Industries Bull. 4, p. 112. In Meadows mining district, unconformably underlies Umpqua formation.

Exposed for 3 miles along May Creek and beyond mouth of May Creek, Riddle quadrangle, Jackson County.

Mayes Formation[1]

Mayes Group

Mayes Limestone Member (of Fayetteville Shale)

Mississippian: Northeastern and central eastern Oklahoma and northwestern Arkansas.

Original reference: C. W. Shannon and L. E. Trout, 1915, Oklahoma Geol. Survey Bull. 19, pt. 1, p. 127–130.

W. H. Easton, 1942, Arkansas Geol. Survey Bull. 8, p. 17 (table), 19–20. Mayes limestone member of Fayetteville is recognizable lithologic unit in Arkansas.

E. L. Selk, 1948, Jour. Geology, v. 56, no. 4, p. 303–307. Mayes formation consists of those beds of Mississippian age underlain by Boone (Osagian) and overlain by Fayetteville (Chesterian) in outcrops in Mayes County, Okla., and is commonly considered to be equivalent in age to Moorefield and Batesville formations. Name was proposed by Snider (1915) and correlated as lower Chester. Buchanan (1927) applied name to dark argillaceous silty limestone of subsurface Mississippian and correlated lower part at least with Meramec series. Cram (1930) presented evidence that subsurface "Mayes" was facies of Boone and, therefore, of Osage age. Since that time, the name has persisted, as has the confusion and controversy. New evidence, by deep drilling in western and northwestern Oklahoma, supports general opinion of subsurface geologists that the "Mayes" of subsurface is of Osage age and is not a correlative of Mayes formation of outcrop in northeastern Oklahoma.

J. C. Barker, 1951, Tulsa Soc. Digest, v. 19, p. 173–176. Caney formation of Lawrence uplift has two characteristically developed facies, a lower calcareous siltstone phase and an upper black shale unit. Subsurface stratigraphers have referred to calcareous phase of lower Caney as the "Mayes". This calcareous phase is exposed in three localities and could not be mapped as separate unit. It is herein referred to as "Ada Mayes." The "Ada Mayes" unconformably overlies Welden limestone and grades into overlying shale of upper Caney.

M. K. Elias, 1956, *in* Petroleum geology of southern Oklahoma, v. 1: Tulsa, Okla., Am. Assoc. Petroleum Geologists, p. 60. Name Ahloso [Ahlosa] member is introduced for basal unit of Caney shale, commonly referred to as "Mayes" or "Ada Mayes". These terms reflect attempts of geologists to connect these rocks with lithologically similar "Mayes" of subsurface of east-central Oklahoma. This is shown by Selk (1948) to be largely Osage in age and, therefore, older than Snider's (1915) Mayes of northeastern Oklahoma outcrops. Term is inappropriate for formal nomenclature of Mississippian rocks of Arbuckle Mountains; hence, name Ahloso [Ahlosa] is proposed.

G. G. Huffman and others, 1958, Oklahoma Geol. Survey Bull. 77, p. 47–65. Raised to group rank for surface units in northeastern Oklahoma. Includes Moorefield formation below and Hindsville above. Meramec and Chester.

K. C. Jackson, 1959, Fort Smith Geol. Soc. Guidebook 1st Field Conf., p. 56. Member occurs near base of Fayetteville. Consists of dark-gray to blue-black massive crystalline limestone. Throughout much of southwest Washington County, Ark., member is represented by large septarian-type concretions.

U.S. Geological Survey uses the term Mayes formation only in subsurface.

Named for Mayes County, Okla.

Mayfield Member (of Mount Simon Formation)

Upper Cambrian: Northern Illinois (subsurface).

J. S. Templeton, Jr., 1950, Illinois Acad. Sci. Trans., v. 43, p. 153 (fig. 2), 154 (fig. 3), 155. Name proposed for a thick sequence of interbedded conglomeratic and nonconglomeratic sandstones overlying Lovell member (new). Type section extends from depths of 2,495 to 2,850 feet. Thickness 145 to 390 feet. Underlies Lacey member (new).

Type well: Wyman No. 1 (well 7), in NE¼NE¼SE¼ sec. 35, T. 41 N., R. 5 E., De Kalb County. Name derived from Mayfield Township, 5 miles west of type well.

Mayfield Hills Plagioclase Syenite

Tertiary: Western Texas.

Hugh Hay-Roe, 1957, Texas Univ. Bur. Econ. Geology Geol. Quad. Map 21. Name applied to the plagioclase syenite occurring in Mayfield Hills stock.

Occurs in Wylie Mountain vicinity, Jeff Davis County.

Mayflower Amygdaloids[1]

Precambrian (Keweenawan): Northern Michigan.

Original reference: B. S. Butler and W. S. Burbank, 1929, U.S. Geol. Survey Prof. Paper 144 (chart compiled by M. G. Wilmarth).

Named for occurrence in Mayflower mine, Houghton County.

Mayflower Flows[1]

Precambrian (Keweenawan): Northern Michigan.

Original reference: B. S. Butler and W. S. Burbank, 1929, U.S. Geol. Survey Prof. Paper 144 (chart compiled by M. G. Wilmarth).

Probably named for occurrence in Mayflower mine, Houghton County.

Mayflower Schist[1]

Ordovician(?): Central Nevada.

Original reference: H. G. Ferguson, 1924, U.S. Geol. Survey Bull. 723.

Exposed in Mayflower Gulch, Manhattan district.

Maynardville Limestone[1] or **Formation** (in Conasauga Group)

Maynardville Limestone Member (of Conasauga Shale)

Maynardville Limestone Member (of Nolichucky Shale)

Upper Cambrian: Eastern Tennessee and southwestern Virginia.

Original reference: C. R. L. Oder, 1934, Jour. Geology, v. 42, no. 5, p. 474–475, 494, 497.

C. E. Resser, 1938, Geol. Soc. America Spec. Paper 15, p. 4. Name considered invalid.

John Rodgers, 1943, Geologic map of Copper district, Hancock and Grainger Counties, Tennessee (1:24,000): U.S. Geol. Survey Strategic Minerals Inv. Prelim. Map; John Rodgers and D. F. Kent, 1948, Tennessee Div. Geology Bull. 55, p. 11–12. Removed from Rome formation, and rank reduced to member in upper part of Nolichucky shale. Thickness 181 feet in Hawkins County. New standard section designated as old section is now covered by Norris Reservoir.

R. L. Miller and J. O. Fuller, 1947, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 76 (2 sheets); R. L. Miller and W. P. Brosgé, 1954, U.S. Geol. Survey Bull. 990, p. 14, 15–17 geol. sections. In Jonesville district, Lee County, Va., Maynardville limestone is subdivided into two members. Low Hollow limestone below and Chances Branch dolomite. Thickness 250 to 350 feet. Underlies Copper Ridge dolomite. Maynardville is oldest formation exposed in district; present in discontinuous belts partially rimming Fleenortown and Town Branch fensters and in discontinuous belts on south side of Wallen Valley fault.

John Rodgers, 1953, Tennessee Div. Geology Bull. 58, pt. 1 (pl.); pt. 2, p. 46 (fig. 3), 48, 49–53. In eastern Tennessee, the Conasauga varies in lithology, and three phases are recognized. In northwestern phase, Maynardville limestone is considered member of Conasauga shale. In central phase, the Conasauga is considered a group consisting of six formations of which the Maynardville is the uppermost; thickness 150 to 350 feet;

overlies Nolichucky shale. In southeastern phase, sequence is Honaker dolomite, Nolichucky shale, and Maynardville limestone.

L. D. Harris and R. L. Miller, 1958, U.S. Geol. Survey Geol. Survey Geol. Quad. Map GQ–111. Referred to as formation in Duffield quadrangle, Virginia; more than one-half of unit is dolomite. Contains Chances Branch limestone member and Low Hollow limestone member which total about 200 feet in thickness. Overlies Nolichucky shale; underlies Copper Ridge dolomite.

J. M. Cattermole, 1960, U.S. Geol. Survey Geol. Quad. Map GQ–126. Maynardville limestone mapped in Bearden quadrangle, Tennessee, where it is uppermost unit of Conasauga group. Thickness about 250 feet. Overlies Nolichucky shale; underlies Copper Ridge dolomite of Knox group.

New type section: Along State Highway 33, 7 miles northeast of Maynardville, between bridge over Cox Branch and south end of bridge across Norris Reservoir. Old and new type sections are about 3 miles apart along same belt of outcrop. Name taken from village of Maynardville, Union County, Tenn.

Mayne Creek Formation[1]

Mayne Creek Member (of Hampton Formation)

Mississippian (Kinderhookian) : Central northern Iowa.

Original reference: F. M. Van Tuyl, 1925, Iowa Geol. Survey, v. 30, p. 52,92, 105, 108.

L. R. Laudon and B. H. Beane, 1937, Iowa Univ. Studies, v. 17, no. 6, p. 236, 237. Member of Hampton formation. Overlies Chapin member; underlies Eagle City member. [Spelled Maynes Creek.]

Named for exposures in north bluff of Mayne Creek, NE¼ sec. 21, Reeve Township, Franklin County.

May Pond Member (of Littleton Formation)

Lower Devonian: Southwestern New Hampshire.

M. T. Heald, 1950, Geol. Soc. America Bull., v. 61, no. 1, p. 45, 50–51, 55, pl. 1; 1950, The geology of the Lovewell Mountain quadrangle, New Hampshire: New Hampshire State Plan. Devel. Comm., p. 9, 14. Composed predominately of banded gneiss with some beds of well-stratified schist. In Lovewell Mountain quadrangle, the May Pond lies stratigraphically above and to east of Hubbard Hill member (new). In northern part of quadrangle, the two members are separated by a sill of Kinsman quartz monzonite. Underlies Dakin Hill member (new). Probable total thickness 5,000 feet.

Typical outcrops: Along roads leading to village of Marlow and on Route 31 in Washington, 600 feet south of bridge over Ashuelot River.

Maysville Group[1]

Maysville Formation (in Cincinnati Group)

Maysville or Maysvillian Stage

Upper Ordovician: Northern Kentucky, northwestern Georgia, southern Indiana, southwestern Ohio, and Tennessee.

Original reference: A. F. Foerste, 1905, Science, new ser., v. 22, p. 150.

R. H. Flower, 1946, Bulls. Am. Paleonotology, v. 29, no. 116, p. 108–112. Discussion of Cincinnatian cephalopods of Cincinnati region. Maysville group includes Fairview beds below and McMillan formation above. Occurs above Eden group and below Richmond subseries. In Covington subseries of Cincinnatian series.

Charles Butts and Benjamin Gildersleeve, 1948, Georgia Geol. Survey Bull. 54, p. 32–33. In full sequence, as at Cincinnati, Maysville formation is separated from the Trenton by Fulton and Eden shales. In Georgia, so far as is known, the Fulton and Eden are absent, and, where Maysville is present, the Trenton is also absent and the Maysville succeeds the Moccasin.

C. W. Wilson, Jr., 1948, Tennessee Div. Geology Bull. 53, p. 10, 11, 44–45; 1949, Tennessee Div. Geology Bull. 56, p. 179–192. Group in central Tennessee includes Leipers formation. Overlies Nashville group (redefined and used to replace term Trenton group in Tennessee); underlies Richmond group. Eden group present locally between Nashville and Maysville groups.

Duff Kerr, 1951, Compass, v. 28, no. 2, p. 98 (fig. 3), 100–102. Group, in Cincinnati area, comprises Fairview and McMillan formations. Conformably overlies Eden group. Top of Mount Auburn member of McMillan formation marks top of Covington subseries, the lower half of the Cincinnatian series. Mount Auburn underlies Sunset member of Arnheim formation which is base of Richmond subseries of the Cincinnatian.

J. B. Patton, T. G. Perry, and W. J. Wayne, 1953, Indiana Geol. Survey Field Conf. Guidebook 6, pl. 1. Generalized stratigraphic column of Ordovician and Silurian rocks exposed in Jefferson and Switzerland Counties shows Maysville group comprises (ascending) Mount Hope, Fairmount, Bellevue, Corryville, Mount Auburn, and Arnheim formations. Overlies Eden group; underlies Richmond group. Cincinnatian.

W. H. Twenhofel and others, 1954, Geol. Soc. America Bull., v. 65, no. 3, chart 2. Correlation chart shows Maysvillian stage in Cincinnatian series above Edenian and below Richmondian stage. Maysville group comprises (ascending) Mount Hope shale and limestone, Fairmount shale and limestone, Bellevue shale and limestone, Corryville shale and limestone, and Mount Auburn shale and limestone. Above Eden group and below Richmond group.

A. M. Gutstadt, 1958, Am. Assoc. Petroleum Geologists Bull., v. 42, no. 3, pt. 1, p. 518–521. Formation included in Cincinnati group, are of Cincinnati arch (subsurface).

W. C. Sweet and others, 1959, Jour. Paleontology, v. 33, no. 6, p. 1031. Fairview and McMillan formations constitute the standard for a medial Cincinnatian Maysville stage.

Named for exposures along railroad south of Maysville, Mason County, Ky.

Mayville Limestone[1]

Silurian: Southeastern Wisconsin.

Original reference: T. C. Chamberlin, 1877, Geology Wisconsin, v. 2, p. 336–345.

C. K. Swartz and others, 1942, Geol. Soc. America Bull., v. 53, no. 4, chart 3. Mayville dolomite shown on correlation chart in Michigan and Wisconsin. Occurs below Burnt Bluff group. In Michigan, occurs above Manitoulin dolomite; in Wisconsin, is oldest Silurian. Albion series.

G. V. Cohee, 1948, U.S. Geol. Survey Oil and Gas Inv. Prelim. Chart 33, sheet 2. Gray-buff to light-browish-gray dolomite and limestone; locally pink and red dolomite. More than 100 feet thick at type locality.

G. M. Ehlers and R. V. Kesling, 1957, Michigan Geol. Soc. [Guidebook] Ann. Geol. Excursion, p. 3, 9. Name Mayville, which as been used for strata occupying position between Middle Silurian Burnt Bluff group and Richmond strata of Upper Ordovician age, is not used in this report. Highest *Virgiana decussata*-bearing strata of Mayville are here named Lime Island dolomite and placed in Burnt Bluff group.

Type locality: About 2 miles south of Mayville, Dodge County. Extends throughout eastern part of Wisconsin from Illinois border to Green Bay Peninsula; forms series of low cuestas at many places.

Maywood Formation[1]

Upper Devonian: Central western Montana.

Original reference: F. C. Calkins and W. H. Emmons, 1913, U.S. Geol. Survey Prof. Paper 78.

Christina Lochman and Donald Duncan, 1944, Geol. Soc. America Spec. paper 54, p. 16. In discussion of early Cambrian faunas of central Montana, Maywood formation tentatively assigned to Silurian by Calkins and Emmons is here regarded as highest Upper Cambrian.

Christina Lochman, 1950, Am. Assoc. Petroleum Geologists Bull., v. 34, no. 11, p. 2202 (fig. 1), 2213. As used in this report, Maywood overlies Sage pebble conglomerate member (new) of Dry Creek shale (redefined). Consists of buff-orange dolomite, maroon-green dolomite, and mudstones 65 to 85 feet thick. Underlies Jefferson dolomite. Devonian. Most of the beds referred to in literature by Weed (1900, U.S. Geol. Survey 20th Ann. Rept. for 1898–1899, pt. 3), Deiss (1936, Geol. Soc. America Bull., v. 47, no. 8), and Lochman and Duncan (1944) as Dry Creek shale are actually the basal Devonian unit and beds of undetermined age of Sloss and Laird (1947, Am. Assoc. Petroleum Geologists Bull., v. 31, no. 8) and should be known as Maywood formation.

V. L. Freeman, E. T. Ruppel, M. R. Klepper, 1958, U.S. Geol. Survey Bull. 1042–N, p. 495–496, pl. 42. In area of this report [Townsend Valley, Mont.], Red Lion formation of Cambrian age and Maywood formation of Upper Devonian age are mapped as a unit although the two formations are separated by erosional unconformity.

Named for exposures on Maywood Ridge, west of Princeton, Philipsburg quadrangle.

Mazama Andesites, Lavas. Flows

See Mount Mazama Andesite, Dacites, Lavas, Flows.

Mazarn Shale[1]

Lower Ordovician: Southwestern Arkansas and southeastern Oklahoma.

Original reference: H. D. Miser, 1917, U.S. Geol. Survey Bull. 660, p. 68.

W. D. Pitt, 1955, Oklahoma Geol. Survey Circ. 34, p. 11 (fig. 2), 22–23, pl. 1. Described in Ouachita Mountains of Oklahoma where it has an estimated thickness of 600 feet. Lithologically resembles the older Collier shale. The locally interbedded limestones of the Mazarn are distinctive, but, in spite of this distinctive limestone, the position of Mazarn shale in sequence, above Crystal Mountain sandstone and below Womble shale, is only sure method of its identification. As defined here, the Mazarn underlies Womble shale although it is separated from it by a thin sandstone referred to as "Blakely" sandstone; this sandstone could be designated as a separate unit, but if so designated it should not be called "Blakely" because of the findings of current fieldwork in the Blakely sandstone type area in Arkansas. Ordovician.

Named for Mazarn Creek, eastern Montogomery County, Ark.

Mazatzal Granite

Precambrian: Central Arizona and southwestern Colorado.

N. E. A. Hinds, 1936, Carnegie Inst. Washington Pub. 463, pt. 2, p. 101. While Archean deformation was going on, granitoid magmas invaded crust in central Arizona and southwestern Colorado. Exposures show stocks and small batholiths of various sizes and composition. Since most of the rock is granite, it is all referred to as Mazatzal granite. Mazatzal orogeny discussed.

Mazatzal Quartzite[1]

Precambrian: Central Arizona.

Original reference: E. D. Wilson, 1922, Pan-Am Geologist, v. 38, p. 299–312.

Alexander Stoyanow, 1942, Geol. Soc. America Bull., v. 53, no. 9, p. 1259–1261. Mentioned in detailed succession of Paleozoic paleogeography of Arizona. Theories on age relationships reviewed.

E. D. Wilson, 1938, *in* Arizona Bur. Mines Bull. 145, Geol. Ser. 12, pl. 3; 1939, Geol. Soc. America Bull., v. 50, no. 7, p. 1118 (table 1), 1124–1126, pl. 10. Crops out in four different areas in central Arizona. Resting with apparent conformity on Maverick shale (new) and intruded in places by granite, it makes up the high main ridge of the northern half and the crest of Four Peaks at the southern end of Mazatzal Range. Along Pine Creek, lies unconformably on Red Rock rhyolite and is unconformably overlapped by Paleozoic and Tertiary beds. In northeastern Tonto Basin and in Christopher Mountain and vicinity, occurs faulted against Red Rock rhyolite and is unconformably overlapped by Apache, Paleozoic and Tertiary formations. Near Del Rio, in fault contact with metamorphosed shale of Alder series and unconformably overlapped by Cambrian, Devonain, and Tertiary beds. Thicknesses. 1,300 feet in Mazatzal Mountains; 3,800 feet on Pine Creek, 1,780 feet near Del Rio.

Named for development in Mazatzal Range.

Mazomanie Sandstone[1]

Mazomanie Sandstone Member (of Franconia Formation)

Upper Cambrian: Central Wisconsin and southern Minnesota.

Original reference: E. O. Ulrich, 1920, Washington Acad. Sci. Jour., v. 10, p. 73–78.

R. R. Berg, 1951, Minnesota Geologist, v. 8, no. 4, p. 1, 2; 1953 Jour. Paleontology, v. 27, no. 4, p. 555. Rank reduced to member status in Franconia formation which is herein subdivided into five formations. Ulrich (1920) used term Mazomanie formation for nonglauconitic dolomitic sandstone in central Wisconsin that contains *Prosaukia* fauna; he believed Mazomanie was younger than Franconia. This sandstone represents a facies to the north and east of the more highly glauconitic Franconia sandstone, and name Mazomanie member is applied here to this nonglauconitic facies. Interfingers with and replaces glauconitic sandstones to north and east. Overlies Tomah member (new), interfingers with Reno member (new).

R. R. Berg, 1954, Geol. Soc. America Bull., v. 65, no. 9, p. 866–869, measured sections. Twenhofel, Raasch, and Thwaites (1935, Geol. Soc. America Bull., v. 46, no. 11) rejected name Mazomanie. From Mississippi River eastward in Wisconsin, interbedded nonglauconitic sandstone in Franconia greensands thicken until in central Wisconsin entire Franconia above Tomah member is composed of nonglauconitic and dolomitic sandstone; revived name Mazonmanie is applied to facies that intertongues with Reno member. Member consists of two rock types: a crossbedded dolomitic sandstone dominant in type area, and a thin-bedded sandstone well exposed only in St. Croix Valley. The thin-bedded Mazomanie is a distinct type distinguished from the Tomah by absence of interbedded shale, but regional relationships between the two Mazomanie rock types cannot be distinguished in detail. Term Mazomanie has been expanded to include all sandstones that constitute nonglauconitic facies to north and east. In some areas, the Mazomanie overlies Birkmose member of Franconia. At type area, the Mazomanie constitutes more than three-fourths of Franconia thickness. Thickness at type locality 116½ feet. Measured sections show Mazomanie present in Minnesota.

Type area: At Ferry Bluff, SW¼ sec. 20, T. N., 9 R. 6 E., Sauk County, Wis. This is a locality mentioned by Ulrich (1920) and is situated across Wisconsin River from town of Mazomanie.

Mazourka Group

Mazourka Formation[1] (in Pogonip Group)

Lower and Middle Ordovician: East-central California.

Original reference: F. B. Phleger, Jr., 1933, Southern California Acad. Sci. Bull., v. 32, pt. 1, p. 1–6.

R. L. Langenheim, Jr., and others, 1956, Am. Assoc. Petroleum Geologists Bull., v. 40, no. 9, p. 2085–2091. Described in Mazourka Canyon area, Independence quadrangle. Consists of approximately 500 feet of limestone and shale. Overlies Pogonip dolomite; underlies Barrel Spring formation of Eureka group. In Pogonip group. Chazyan.

U.S. Geological Survey currently classifies the Mazourka as a group and designates its age as Lower and Middle Ordovician on the basis of a study now in progress.

Typically exposed in Mazourka Canyon between Barrel Spring Canyon and Lead Canyon Trial, Inyo Range.

Mead Limestone

Middle(?) Cambrian: Northwestern Arizona.

E. T. Schenk and H. E. Wheeler, 1942, Jour. Geology, v. 50, no. 7, p. 894–896, fig. 3, table 1. Light-gray to pink, fine-grained to dense laminated to thin-bedded (outcrops massive), somewhat mottled limestone. Thickness quite variable, 110 feet at type locality. Disconformably overlies Peasley limestone. Variation in thickness due to post-Mead disconformity which has completely removed formation short distance eastward.

Type locality: South wall of western Grand Canyon about 1½ miles east of Grand Wash Cliffs.

Meade Group

Meade Formation

Meade Gravel[1]

Pleistocene: Southwestern Kansas and northern Oklahoma.

Original reference: F. W. Cragin, 1896, Colorado College Studies, v. 6, p. 53–54.

H. T. U. Smith, 1940, Kansas Geol. Survey Bull. 34, p. 108. Meade gravels of Cragin (1896) should be abandoned unless future work leads to an adequate understanding or nature of the beds.

J. C. Frye and C. W. Hibbard, 1941, Kansas Geol. Survey Bull. 38, p. 399 (table), 411–419. Formation as herein redefined includes Meade gravels of Cragin (1896) at base; Cragin's (1896) Pearlette ash; Smith's 1940 Odee formation, *Equus niobrarensis* beds, Jones Ranch beds; and all other beds of Pleistocene age above Rexroad member of Ogallala formation and below Kingsdown silt. Thickness 50 to 150 feet. Type locality designated because original Meade type locality cannot be located accurately.

T. G. McLaughlin, 1946, Kansas Geol. Survey Bull. 61, p. 123–130. Term Meade formation is used in this report as defined by Frye and Hibbard except that Jones Ranch beds are considered a part of Kingsdown silt.

J. C. Frye, Ada Swineford, and A. B. Leonard, 1948, Jour. Geology, v. 56, no. 6, p. 520 (fig. 6), 521–523. Proposed to restrict Meade formation (Frye and Hibbard, 1941) to sediments at its type section, NW¼ sec. 21, T. 33 S., R. 28 W., Meade County, Kans., and equivalent deposits elsewhere, which signifies that this term should be used throughout Kansas to include the sediments of the Kansan cycle of fluvial sedimentation. Two members recognized: Grand Island below and Sappa above; latter includes Pearlette volcanic ash lentil.

C. W. Hibbard, 1949, Michigan Univ. Mus. Paleonotology Contr., v. 7, no. 4, p. 63–70. Formation redefined to include original deposits designated by Cragin as Meade gravels in area of old Vanhem post office. Formation is also defined to include the overlying silts and caliche exposed in section on tributary of Spring Creek, west of Crooked Creek. These upper beds are not present near Vanhem post office but occur below another gravel here included with Pearlette ash in Crooked Creek formation (new). Basal sands and gravels are herein designated Meade gravels member of Meade formation, thus retaining name and type locality given by Cragin in vicinity of old Vanhem post office. Type exposures are in Clark County in sec. 12, T. 30 S., R. 23 W., and secs. 7 and 18, T. 30 S., R. 22 S., on north side of Bluff Creek; Vanhem post office, in NW¼ sec. 13, T. 30 S., R. 23 W., was just to southwest of these exposures. Beds overlying the Meade gravels and below Crooked Creek formation are here named Missler member of Meade formation. Overlies Rexroad formation. Type locality of Meade redesignated to conform with new definition of formation proposed in this paper. Type locality of formation designated by Frye and Hibbard (1941) does not include Meade gravels as defined by Cragin. Thickness 29 feet at type locality.

J. C. Frye and A. B. Leonard, 1952, Kansas Geol. Survey Bull. 99, p. 84–106. Report discusses conflicts in usage of term Meade and presents classification as currently used by Kansas Geological Survey. Type locality of Frye and Hibbard restudied; type locality (measured section) given as SE¼NE¼NE¼ sec. 21, T. 33 S., R. 28 W., Meade County. Here formation is 62 1/3 feet thick and includes Grand Island member below and Sappa member above. Sappa member includes Pearlette ash bed. Overlies Ogallala formation. Underlies Sanborn formation. Pleistocene (Kansan stage).

C. W. Hibbard, 1958, Am. Jour. Sci., v. 256, no. 1, p. 55 (fig. 1), 56. Group in northern Kansas, includes all Pleistocene deposits above base of David City formation and below Crete formation. In Meade County, group includes all deposits above the Rexroad formation and below Kingsdown formation. In southwestern Kansas, group comprises Ballard formation (new) below and Crooked Creek formation above. Elsewhere divided into two unnamed formations and underlies Crete formation of Sanborn group. Classification used in this report is in accord with agreement at Pleistocene conference held at Lawrence, Kans., June 1956.

A. J. Myers, 1959, Oklahoma Geol. Survey Bull. 80, p. 54–58. Discussion of history of usage of name. In Harper County, Meade group includes fluvial gravels, sands, and silts, and volcanic ash that lie above Pliocene Ogallala formation or above Permian Rush Springs, or Whitehosre group where Ogallala is missing. Thickness 0 to 70 feet. Ballard formation not recognized in Harper County, but Crooked Creek formation with Pearlette ash lentil is present.

Type locality (Frye and Hibbard) : Exposures along Crooked Creek valley in Meade Center Township south of city of Meade, and particularly Pleistocene beds exposed in sec. 21, T. 33 S., R. 28 W., Meade County, Kans.

Type locality (Hibbard, 1949) : Includes exposures along tributary of Spring Creek in SW¼ sec. 6, and in sec. 7, T. 32 S., R. 28 W., Meade County.

Type section (Frye, Swineford, and Leonard) : NW¼ sec. 21, T. 33 S., R. 28 W., Meade County.

Meade Peak Phosphatic Shale Member or Tongue (of Phosphoria Formation)

Permian: Eastern Idaho, southwestern Montana, eastern Utah, and western Wyoming.

V. E. McKelvey *in* V. E. McKelvey and others, 1956 , Am. Assoc. Petroleum Geologist Bull., v. 40, no. 12, p. 2832 (fig. 3), 2836 (fig. 4), 2845–2847. Phosphatic shale member of Richards and Mansfield (1912), formerly known also as B unit or member of Phosphoria in Montana and northwestern Wyoming and as middle shale member of Park City in Utah, is here named Meade Peak phosphatic shale member of Phosphoria formation. In its typical area, consists of about 200 feet of dark carbonaceous phosphatic and argillaceous rocks; mudstone and phosphorite are chief end-member rock types, and dark dolomite and limestone are subordinate types. In southeastern Idaho 125 to 225 feet thick; thickens southward to about 300 feet in central Wasatch Mountains, where it is split by tongue of Franson member (new) of Park City formation; thins toward the north, east, and southeast, and pinches out in southwestern Montana, western Wyoming, and eastern Utah; thins westward; in Cassia County, Idaho, about 80 feet thick; westernmost extent unknown. Overlies lower chert member (unnamed) ; underlies Rex chert member. In typical area, lower and upper contacts are defined, respectively, as base and top of sequence of dark carbonaceous or phosphatic beds.

V. E. McKelvey and others, 1959, U.S. Geol. Survey Prof. Paper 313–A, p. 12–17, 36–37, pls. 2, 3. Overlies Grandeur member or tongue (new) of Park City formation.

Name derived from Meade Peak, about 2½ miles south of Phosphoria Gulch, Bear Lake County, Idaho.

†Meadow Limestone[1]

Pennsylvanian (Missouri Series) : Southeastern Nebraska, eastern Kansas, and northwestern Missouri.

Original reference: G. E. Condra and N. A. Bengston, 1915, Nebraska Acad. Sci. Pub., v. 9, no. 2, p. 7, 13, 22, 37.

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G. E. Condra, 1949, Nebraska Geol. Survey Bull. 16, p. 33–34. Although unit was properly defined with relation to its position and sequence in the section its age and correlation has proved to be in error. Name has been in use for more than 30 years but is now dropped and name Merriam accepted by Nebraska Survey.

Type locality: In Keiwitz Quarry west of Meadow Station, Sarpy County, Nebr.

Meadow Marble Member (of Sevier Shale)[1]

Middle Ordovician: Central Tennessee.

Original reference: C. H. Gordon, 1924, Tennessee Dept. Ed., Div. Geology Bull. 28, p. 39–40, 63–65, map.

G. A. Cooper, 1956, Smithsonian Misc. Colln., v. 127, pt. 1, p. 78. Name applied to calcarenite lens near base of Sevier southwest Friendsville.

Named for exposures near Meadow Station, Loudon County.

Meadow Rhyolitic Tuff

Tertiary: Northwestern Wyoming.

R. E. Wilcox, 1944, Geol. Soc. America Bull., v. 55, no. 9, p. 1052, 1059, pls. 1, 2. Crumbly rhyolitc tuff older than rocks of Gardiner River rhyolite-basalt complex (new). Underlies Cataract basalt (new); overlies Castle rhyolite (new).

Present in meadow near east end of First Cataract in Gardiner River, Yellowstone Park.

Meadow Canyon Member (of Oquirrh Formation)

Pennsylvanian (Derryan): Northwestern Utah.

H. J. Bissell, 1959, Utah Geol. Soc. Guidebook 14, p. 100–108, pls. 1, 2. Typically interbedded orthoquartzite, calcareous sandstones, arenaceous limestones and crystalline to bioclastic limestones. Thickness 945 feet. Conformably overlies Hall Canyon member and conformably underlies Cedar Fort member (both new).

Type locality: Meadow Canyon west of Lewiston Peak, in secs. 29 and 32. T. 5 S., R. 3 W., Tooele County. Measured section on spur directly north of Meadow Canyon.

Meadow Creek Sandstone Member (of Frontier Formation)

Upper Cretaceous: Northeastern Utah.

L. A. Hale, 1960, Wyoming Geol. Assoc. Guidebook 15th Ann. Field Conf., p. 141. Incidental mention in discussion of Grass Creek member (new) of Frontier formation. Name credited to D. W. Trexler (unpub. thesis).

Coalville area, Summit County.

Meadow Creek Trachyte[1]

Tertiary, middle or upper: Northwestern Arizona.

Original reference: F. L. Ransome, 1923, U.S. Geol. Survey Bull. 743.

Occurs on north side of Meadow Creek, Oatman district.

†Meadville Group (in Pocono Group)[1]

Mississippian: Northwestern Pennsylvania and northeastern Ohio.

Original reference: I. C. White, 1881, Pennsylvania 2d Geol. Survey Rept. Q_4, p. 83–90.

Named for Meadville, Crawford County, Pa.

†Meadville (lower) Limestone (in Cuyahoga Formation)[1]

Mississippian: Northwestern Pennsylvania and northeastern Ohio.

Original reference: I. C. White, 1881, Pennsylvania 2d Geol. Survey Rept. Q_4, p. 83–90.

Named for Meadville, Crawford County, Pa.

†Meadville (upper) Limestone (in Cuyahoga Formation)[1]

Mississippian: Northwestern Pennsylvania.

Original reference: I. C. White, 1880, Pennsylvania 2d Geol. Survey Rept. Q_3.

Named for Meadville, Crawford County, Pa.

†Meadville (lower) Shale (in Cuyahoga Formation)[1]

Mississippian: Northwestern Pennsylvania and northeastern Ohio.

Original reference: I. C. White, 1881, Pennsylvania 2d Geol. Survey Rept. Q_4, p. 83–90.

Named for Meadville, Crawford County, Pa.

†Meadville (upper) Shale (in Cuyahoga Formation)[1]

Mississippian: Northwestern Pennsylvania and northeastern Ohio.

Original reference: I. C. White, 1881, Pennsylvania 2d Geol. Survey Rept. Q_4, p. 83–90.

Named for Meadville, Crawford County, Pa.

Meadville Shale or **Formation** (in Cuyahoga Group)

Meadville Shale Member (of Cuyahoga Formation)[1]

Mississippian: Northwestern Pennsylvania and northeastern Ohio.

Original reference: I. C. White, 1881, Pennsylvania 2d Geol. Survey Rept. Q_4, p. 83–90.

H. P. Cushing, Frank Leverett, and F. R. Van Horn, 1931, U.S. Geol. Survey Bull. 818, p. 52–54, 56. Cuyahoga, in its typical area, is elevated to group rank, and subdivisions (ascending) Orangeville shale, Sharpsville sandstone, and Meadville shale are treated as formations. Meadville in Cleveland area [this report] is 30 to 250 feet thick and consists of alternating blue shale, thin sandstone, and sandy limestone. Unconformably underlies Sharon conglomerate.

F. T. Holden, 1942, Jour. Geology, v. 50, no. 1, p. 52–53. Included in Tinker Creek facies of formation in Ohio. Lower part of member consists largely of blue-black argillaceous fissile shales and blue-gray thin-laminated arenaceous shales with some interbedded micaceous fine-grained sandstones; number and thickness of sandstones increase in upper part and make up as much of deposit as the shales. Thickness 100 to 200 feet. Overlies Sharpsville sandstone member; contact gradational. Lower Mississippian.

E. J. Szmuc, 1958, Dissert. Abs., v. 18, no. 6, p. 2109. Eight members recognized in Cuyahoga formation (ascending): Orangeville, Sharpsville, Strongsville (new), Meadville, Rittman, Armstong, Wooster (new), and Black Hand. Field evidence indicates that Shenango sandstone and overlying Hempfield shale (new) are stratigraphic equivalents of upper part of Meadville member in Cuyahoga and Medina Counties. Meadville contains a mixed late Kinderhook-early Osage fauna.

Named for exposures near Meadville, Crawford County, Pa. Well exposed in Cuyahoga, Medina, and Summit Counties, Ohio.

Meadville Stage[1] or monothem[1]

Mississippian: New York, Ohio, and Pennsylvania.

Original reference: K. E. Caster, 1934, Bulls. Am. Paleontology, v. 21, no. 71, p. 129, table facing p. 61.

Hugo Greener, 1957, Yale Univ. Peabody Mus. Nat. History Bull. 11, p. 9, 59–60, fig. 1. Discussion of "*Spirifer disjunctus*": its evolution and paleoecology in Catskill delta. Collections were made from Meadville stage which (according to chart) includes Orangeville shale, Sharpsville sandstone, and Harvest Home shale.

Meagher facies (of Belt Series)

Precambrian: Western Montana.

C. L. Fenton and M. A. Fenton, 1937, Geol. Soc. America Bull., v. 48, no. 12, p. 1877. Within its northern basin, Belt series is divisible into facies that differ in lithology, stratigraphic sequence, thickness, recorded conditions of deposition, fauna, and flora. Meagher facies includes the standard section of the series in the Belt Mountains and probably the Little Belt section; extends westward to Prickly Pear Creek. Distinguished by great thickness of Spokane and presence of Greyson member at its base.

In Belt and Little Belt Mountains.

Meagher Limestone[1]

Middle Cambrian: Central and southwestern Montana.

Original references: W. H. Weed, 1899, U.S. Geol. Survey Geol. Atlas, Folio 55; 1900, U.S. Geol. Survey 20th Ann. Rept., pt. 3, p. 285–286.

Charles Deiss, 1936, Geol. Soc. America Bull., v. 47, no. 8, p. 1276, 1277, 1314, 1330–1332. Weed designated the cap of Keegan Butte as principal locality for Meagher; because that cap is Dry Creek and Pilgrim, the Meagher technically has no status; however, name has been used consistently to designate limestone between Wolsey and Park shales and for this reason should be retained. At type locality, herein designated, and on Checkerboard Creek, Meagher limestone (emended) consists of three lithologic subdivisions: basal thin-bedded gray to green-gray limestone containing flakes and nodules of tan and buff sandy clay; middle, green to green-gray fissile micaceous shale, interbedded with a few gray and tan-gray thin-bedded banded fine-grained limestone; upper, mixed beds of fine- and coarse-grained thick- and thin-bedded limestone, which weathers gray and, in some sections, buff. Thickness at type locality 127 feet; maximum thickness 416 feet on Beaver Creek; 50 feet on Half Moon Pass; thickens from Big Snowy Mountains westward and southward and averages approximately 258 feet. Best exposed, most completely developed, and most fossiliferous section is in vicinity Nixon Gulch, Three Forks quadrangle. This is in area of Peale's (1893) section for Flathead and Gallatin formations. Here Meagher is 347 feet thick and is correlated with Peale's "Trilobite limestone" (at base of Gallatin), for which he gave thickness of 120 feet. [See Flathead Quartzite.]

L. L. Sloss and C. A. Moritz, 1951, Am. Assoc. Petroleum Geologists Bull., v. 35, no. 10, p. 2142–2143. Present in southwestern Montana where it is as much as 550 feet thick. Overlies Wolsey shale and underlies Park shale.

M. R. Klepper, R. A. Weeks, and E. T. Ruppel, 1957, U.S. Geol. Survey Prof. Paper 292, p. 8–10, pls. 1, 2, 3. Five lowest natural Cambrian map units in southern Elkhorn Mountains are lithologically similar to Flathead sandstone, Wolsey shale, Meagher limestone, Park shale, and Pilgrim dolomite of nearby areas, as redefined by Deiss (1936), and these formational names have been adopted. Meagher limestone comprises three units. Middle unit consists of medium-gray or medium-bluish-gray, indistinctly thick-bedded limestone. Upper and lower units are more thinly and more distinctly bedded carbonate rocks that are characterized by "black and tan" or "blue and gold" banding and mottling on weathered surfaces. Thickness 490 to 570 feet; typically intermediate unit accounts for about half the thickness of the formation and upper and lower units share the rest about equally.

Type locality: On south side and top of South Hill in Belt Park, center sec. 15, T. 14 N., R. 7 E., Little Belt Mountains quadrangle.

Means Trachyte (in Garren Group)

Tertiary: Western Texas.

Hugh Hay-Roe, 1957, Texas Univ. Bur. Econ. Geology, Geol. Quad. Map 21. Name proposed for dark-gray to black alkali-feldspar trachyte which forms most of outcrops on C. C. Means Ranch. Thickness at type locality 530 feet. Contains a breccia lentil 140 feet thick and a felsite lentil 115 feet thick. Overlies Fairbury trachyte (new); underlies Zopilote breccia (new).

R. K. DeFord and others, 1958, Soc. Econ. Paleontologists and Mineralogists Permian Basin Sec. Guidebook, Apr. 10, 11, 12, p. 31 (fig. 14). Generalized columnar section shows Means trachyte below Bell Valley andesite.

Type section: Adjacent to Bell ranch, Wylie Mountain area, Culberson County.

Mecca Formation

Miocene: Southern California.

T. W. Dibblee, Jr., 1954, California Div. Mines Bull. 170, chap. 2, p. 24, 25 (fig. 2), pl. 2. Essentially a basal conglomerate of granitic and metamorphic debris that lies upon "basement" rocks and is overlain by Palm Spring formation in Mecca and Indio Hills; northwest of Painted Canyon, upper part of formation contains reddish sands and clays and in one exposure contains cobbles of sandstone with marine Eocene fossils; 3 miles southeast of Painted Canyon, Mecca consists of 600 feet of hard pinkish-gray sandstone and reddish clays; base not exposed. Thickness as much as 1,000 feet.

Type section: On Mecca Hills anticline at Painted Canyon, 5 miles northwest of Mecca, Imperial County.

Mechum River metasedimentary rocks

Late Precambrian and Lower Cambrian: North-central Virginia.

E. O. Gooch, 1958, Geol. Soc. America Bull., v. 69, no. 5, p. 569–674. Name applied to an infolded belt of rocks that includes metamorphosed conglomerates, sandstones, and siltstones that are intruded by metagabbro and diabase. Unconformably overlie Precambrian basement complex.

Named for exposures along Mechum River, Albemarle County. Belt is about 60 miles long and from one-half mile to 2 miles wide in northwestern Piedmont. Lies along or near axis of Catoctin Mountain-Blue Ridge anticlinorium about midway between the Late Precambrian-Early Cambrian formations in the Blue Ridge and Late Precambrian and possibly younger formations in the Piedmont. Belt is locally faulted, and infold is overturned toward northwest in southwestern end but is open to the northeast.

Mechunck Limestone[1]

Cambrian: Central Virginia.

Original reference: W. A. Lambeth, 1901, Thesis presented to University of Virginia, p. 14.

Occurs in Monticello area, Albemarle County.

Meda Rhyolite[1]

Tertiary: Southwestern Nevada.

Original reference: F. L. Ransome, 1909, U.S. Geol. Survey Prof. Paper 66, p. 28, 65.

Exposed in vicinity of Meda Pass and near to road south of Myers Mountain, Goldfield district.

Medford Diabase[1]

Upper Triassic: Northeastern Massachusetts.

Original reference: A. W. G. Wilson, 1901, Boston Soc. Nat. History Proc., v. 30, no. 2, p. 353–374, map.

W. H. Drennen, 1951, Geol. Soc. America Bull., v. 62, no. 1, p. 552, 553. Incidental mention in report on variations in chemical composition across igneous contacts.

Named for occurrence in Medford, Middlesex County.

Media Shale[1] Member (of Temblor Formation)

Miocene, lower: Central California.

Original reference: G. M. Cunningham and W. F. Barbat, 1932, Am. Assoc. Petroleum Geologists Bull., v. 16, no. 4, p. 419–421.

H. H. Heikkila and G. M. MacLeod, 1951, California Div. Mines Spec. Rept. 6, p. 5 (table 2), 9–10, pl. 1. Described in Bitter Creek area, Kern County, as the Media shale member of Temblor formation. Lithologically ranges from tan platy silty shale to light-colored hard porcelaneous and siliceous shale. Thickness varies from 500 to 800 feet along McDonald anticline to as much as 2,300 feet on flank of Cedar Canyon syncline. Conformably overlies Carneros sandstone member; conformably overlain by "Button bed" sandstone.

Occurs in San Joaquin Valley.

†Medicine Beds[1]

Lower and Upper Cretaceous: Central southern Kansas.

Original reference: C. N. Gould, 1898, Am. Jour. Sci., 4th ser., v. 5, p. 169–174.

R. C. Moore, J. C. Frye, and J. M. Jewett, 1944, Kansas Geol. Survey Bull. 52, pt. 4, p. 154. Kiowa shale as herein defined probably contains stratigraphic units formerly called "Greenleaf sandstone," "Mentor beds," and others, and is in part equivalent to "Belvidere formation," "Medicine bed," "Elk River [Creek?] beds", and others.

Named for upper Medicine River, west of Belvidere, Kiowa County.

Medicine Flow

Recent: Northern California.

H. A. Powers, 1932, Am. Mineralogist, v. 17, no. 7, p. 276, 288, pl. 1. Composed of dacite lava. Thickness 100 feet at margins to 250 feet in center. Probably younger than Hoffman flow.

C. A. Anderson, 1941, California Univ. Dept. Geol. Sci. Bull., v. 25, no. 7, p. 373. Stony to glassy black dacite. Rests upon platy andesite, morainic deposits, Lake basalt, and lake deposits from former extension of Medicine Lake.

Occurs in Modoc Lava-Bed quadrangle.

Medicine Bow Formation[1]

Upper Cretaceous: Southern Wyoming and northwestern Colorado.

Original reference: C. F. Bowen, 1918, U.S. Geol. Survey Prof. Paper 108, p. 228, 229.

Erling Dorf, 1942, Carnegie Inst. Washington Pub. 508, p. 4–21 [preprint 1938]. Redefined and stratigraphically restricted below to exclude approximately 400 feet of sediments which are termed Fox Hills. Base is considered to be lowest coal beds which separate underlying marine faunas from overlying fresh- and brackish-water faunas, and which also separates massive more persistent sandstones below from the thinner lenticular sandstones above. Thickness of restricted Medicine Bow in Wyoming 4,000 to 6,000 feet. Geographically extended into northwestern Colorado.

S. H. Knight, 1951, Wyoming Geol. Assoc. Guidebook 6th Ann. Field Conf., p. 45–50. Thickness 3,200 to 4,000 feet in northern part of Hanna basin. Overlies Lewis formation; underlies conglomeratic sequence aggregating 13,500+ feet in thickness referred to as Ferris-Hanna formations. Upper Cretaceous (Lancian).

Well exposed along both sides of North Platte River at mouth of Medicine Bow River, Carbon County, Wyo.

Medicine Bow Peak Quartzite

Precambrian: Wyoming.

W. J. Kivi and R. W. Mallory, 1940, *in* Kansas Geol. Soc. Guidebook 14th Ann. Field Conf., p. 107. Incidental mention.

Medicine Bow Peak and high ridge to left are formed of the quartzite.

Medicine Lake Basalt

See Lake Basalt.

†Medicine Lodge Beds (in Cimarron Group)[1]

Permian: Kansas.

Original reference: L. C. Wooster, 1905, The Carboniferous rock system of Kansas.

Medicine Lodge Beds or Volcanics

Miocene(?): East-central Idaho and southwestern Montana.

Robert Scholten, K. A. Keenmon, and W. O. Kupsch, 1955, Geol. Soc. America Bull., v. 66, no. 4, p. 369–370, table 1, pl. 1. Consist of shales, bentonitic clays, sandstones, pebble conglomerates, fanglomerates, rhyolites, and some lignite; thick vuggy fresh-water limestone at top. Thin to medium bedded, crossbedded, and jointed. White, gray, yellow, violet brown, and brown. Maximum thickness exceeds 5,000 feet. Overlie basaltic and andesitic lavas.

Occupy intermontane basin between Beaverhead and Tendoy Ranges, and a small plateau in Tendoy Range, Clark County, Idaho, and Beaverhead County, Mont.

Medicine Lodge Gypsum Member (of Blaine Formation)[1]

Medicine Lodge Gypsum (in Cimarron Group)[1]

Permian: Southern Kansas and western Oklahoma.

Original reference: F. W. Cragin, 1896, Colorado Coll. Studies, v. 6, p. 3, 27–39.

D. A. Green, 1936, Am. Assoc. Petroleum Geologists Bull., v. 20, no. 11, p. 1468. In Canadian County, Okla., Medicine Lodge gypsum bed, 4 to 7 feet thick, is separated from overlying Shimer gypsum bed by Alabaster gypsum bed (new). All in Blaine formation.

G. H. Norton, 1939, Am. Assoc. Petroleum Geologists Bull., v. 23, no. 12, p. 1784, 1795, 1796 (fig. 6). Underlies Nescatunga member (new).

A. J. Myers, 1959, Oklahoma Geol. Survey Bull. 80, p. 24 (fig. 6), 28–29. Overlies Flowerpot shale. Guadalupe series.

U.S. Geological Survey has abandoned the term Cimarron Group.

Named for Medicine Lodge River and town of Medicine Lodge, Barber County, Kans.

Medicine Peak Metaquartzite[1] (in Snowy Range Series)

Precambrian: Southeastern Wyoming.

Original reference: E. Blackwelder, 1926, Geol. Soc. America Bull., v. 37, p. 620, 623, 632.

J. J. Runner, 1928, (abs.) Geol. Soc. America Bull., v. 39, no. 1, p. 202. Included in Snowy Range series (new).

Forms south end of Medicine Bow Peak Ridge, Medicine Bow Mountains.

Medill Sand

Pleistocene, upper: Southern California.

P. U. Rodda, 1957, Am. Assoc. Petroleum Geologists Bull., v. 41, no. 11, p. 2481, 2487–2488, 2490–2491. Loosely consolidated fine to coarse sand and gravel. Maximum thickness 60 feet. Unconformably overlies Anchor sand (new).

Area is near hilltop on Overland Avenue, about 1,000 feet south of National Boulevard, and 1 mile southwest of Castle Heights area, in Cheviot Hills, Los Angeles. Named for exposures along and adjacent to Medill Place.

Medill volcanic zone (in Eagleford Formation)

Cretaceous: Northeastern Texas.

R. T. Hazzard, 1939, Shreveport Geol. Soc. Guidebook 14th Ann. Field Trip, p. 138, 139, 143. A zone of crossbedded tuffaceous sand 11 to 20 feet thick that occurs near the top of the Eagleford. Top of zone is approximately 15 feet below base of Austin conglomerate in Medill-Woodland area. Separated from underlying Kanawha volcanic zone by interval of 80 to 90 feet of bluish-gray bedded clay shales.

Well exposed at Medill, Lamar County.

†Medina Group[1]

Lower Silurian: New York and Michigan.

Original reference: L. Vanuxem, 1840, New York Geol. Survey 4th Rept., p. 374, on 3d district.

Wilber Stout, 1941, Ohio Geol. Survey, 4th ser., Bull. 42, p. 31–34. Confusion prevails in literature with reference to term Medina. In this report, no attempt is made to revise or modify classification; term Medina group simply includes two members, Elkhorn shale and Clinton sandstone, which are correlative respectively with Queenston shale and Whirlpool sandstone of the New York (Niagara Falls) section.

G. B. Richardson, 1941, U.S. Geol. Survey Bull. 899–B, p. 70–91. Medina group as used in this report [southwestern New York] is assigned entirely to Silurian. Strata here designated Oswego and Queenston in lower part of group have been correlated with formations elsewhere that are assigned an Ordovician age in other U.S. Geological Survey reports. Group crops out in belt about 10 miles wide south of Lake Ontario, and Albion sandstone, at top of group, is exposed in gorge of Niagara River. Dipping southward, in conformity with regional structure, the group extends underground far beyond State boundary, and in southern Allegany County the gas sand lies more than 4,000 feet below sea level. Underlies Clinton group.

C. K. Swartz and others, 1942, Geol. Soc. America Bull., v. 53, no. 4, p. 533–534, chart 3. Medinan of Vanuxem and Hall was shown by Grabau and others to include, at its base, Queenston shale of Richmond age, here referred to Upper Devonian. Ulrich, Bassler, and New York Geological Survey use term in its original sense to include Queenston shale, which they consider to be Silurian. Many, following Grabau, restrict the Medinan to beds above the Queenston and below the Clinton. Clarke (in Ulrich, 1913) proposed the term Albion for Medinan beds lying above Queenston shale. This usage has been adopted by U.S. Geological Survey and is followed in this report. [Term Medina not used and terms Albion group and Albion series used instead.]

J. B. Patton, T. G. Perry, and W. J. Wayne, 1953, Indiana Geol. Survey Field Conf. Guidebook 6, pl. 1. Chart shows Medina group in Albion series. Brassfield is only unit listed in group.

D. W. Fisher, 1954, Am. Assoc. Petroleum Geologists Bull., v. 38, no. 9, p. 1979–1996. Standardization of Silurian stratigraphic terminology (exclusive of the Cayugan) in southern Ontario and western New York, including type section in Niagara Gorge, shows that strata are suited to tripartite divisions, both faunal and physical. Hence, Silurian system is divided into Medina, Clinton, and Niagara groups, the three comprising Ontarian series. Medinan time includes an early short transgressive history represented by deposition of Whirlpool sandstone, Fish Creek shale (new), and Manitoulin dolomite, followed by longer regressive history represented by deposition of Cabot Head shale and Grimsby sandstone. Change from transgressive to regressive tendencies is marked by phosphatic zone in upper Manitoulin dolomite of Niagara Gorge; the Manitoulin-Cabot Head contact is essentially a time-line. Suggested that, for purposes of mapping, Grimsby-Thorold contact be retained as Medina-Clinton boundary. Recommended that names Albion, Alexandrian, Anticostian, Cataract, and Power Glen be suppressed and discontinued.

D. W. Fisher, 1959, New York State Mus. Sci. Service Geol. Survey Map and Chart Ser. 1. Group included in Lewistonian stage (new), Niagaran series. Includes Rumsy Ridge shale above Whirlpool sandstone and below Cabot Head shale. Name Rumsy Ridge replaces preoccupied name Fish Creek.

Named for occurrence in vicinity of Medina, Orleans County, N.Y.

Medinilla (Lower and Upper) Limestone

Aquitanian: Mariana Islands (Medinilla).

Risaburo Tayama, 1952, Japan Hydrog. Office Bull., v. 11, table 4. [In English translation (p. 65), limestone on Medinilla Island is described but formal name is not used.] Named on correlation chart. Consists of lower and upper limestone. Oligocene.

S. Hanzawa *in* Jacques Avias and others, 1956, Lexique Strat. Internat., v. 6, Océanie, fasc. 2, p. 46. Tayama referred name Medinilla limestone to the whole limestone mass of Medinilla Island which he subdivided as pink-colored massive limestone, thin sandy limestone, and well-bedded limestone in descending order. He correlated the massive limestone, sandy limestone, and bedded limestone with his Tagpochau, Donni, and Laulau formations respectively. Aquitanian.

Medora Amygdaloid[1] (in Portage Lake Lava Series)

Precambrian (Keweenanwa): Northern Michigan.

Original reference: B. S. Butler and W. S. Burbank, 1929, U.S. Geol. Survey Prof. Paper 144 (chart compiled by M. G. Wilmarth).

H. R. Cornwall, 1954, U.S. Geol. Survey Geol. Quad. Map GQ–51. Included in Portage Lake lava series.

Named for occurrence in Medora mine, Keweenaw County.

Medora Flow[1]

Precambrian (Keweenawan): Northern Michigan.

Original reference: B. S. Butler and W. S. Burbank, 1929, U.S. Geol. Survey Prof. Paper 144 (chart compiled by M. G. Wilmarth).

Probably named for occurrence in Medora mine, Keweenaw County.

Medora Knob facies[1] (of Edwardsville Formation)

Lower Mississippian: Southern Indiana.

Original reference: P. B. Stockdale, 1931, Indiana Dept. Conserv., Div. Geology Pub. 98, p. 76, 237–239.

P. B. Stockdale, 1939, Geol. Soc. America Spec. Paper 22, p. 74. Includes Dry Creek sandstone and Brownstown Hills sandstone members of Edwardsville.

Name derived from Medora Knob of the Knobstone escarpment, crossed by U.S. Highway 50, 1 mile west of Medora, Jackson County.

Medorm Member (of Ngeremlengui Formation)

Eocene, upper, or Oligocene: Caroline Islands (Palau).

U.S. Army Corps of Engineers, 1956, Military geology of Palau Islands, Caroline Islands: U.S. Army Corps of Engineers, Far East, p. 45, 47–48, pl. 8. Volcanic breccia and lapilli tuff and highly altered and poorly exposed rocks of Karamado Bay complex. At type locality, ranges from coarse volcanic breccia near base to lapilli tuff near top, and varieties and relative proportion of fragments likewise change. Thickness at type locality about 700 feet. Thickness of the part of Medorm that composes Karamado Bay complex not estimated; if bay is caldera, as structure suggests; total thickness may exceed 1,000 feet. Middle member of formation; overlies Nghemesed number; underlies Arakabesan member.

Name derived from village of Medorm in central part of west coast of Babelthuap. Occurs in vicinity of Karamado Bay and region to south.

Medusa Member (of Pecatonica Formation)

Middle Ordovician: Northern Illinois.

J. S. Templeton and H. B. Willman, 1952, Tri-State Geol. Soc. Guidebook 16th Ann. Field Conf., figs. 3, 10, 15A, 16. Limestone, dolomite; thickness as much as 11 feet. Shown on columnar section as underlying Oglesby member (new) and overlying New Glarus member (new). Where Oglesby member is absent, underlies Boarman member (new) of Mifflin formation.

Occurs in Dixon-Oregon area.

Meduxnekeag Granite

Age not stated: Northwestern Maine.

R. S. Houston, 1956, Maine Geol. Survey Bull. [7], p. 106, 107. Incidental mention.

Occurs in southern Aroostook County west of Houlton.

Meek Group

Pennsylvanian: Eastern Wyoming and southwestern South Dakota.

G. E. Condra, E. C. Reed, and O. J. Scherer, 1940, Nebraska Geol. Survey Bull. 13, p. 2 (fig. 2), 22 (fig. 7), 28 (fig. 10). Consists mostly of limestones and silty limestones with some sandstone. Comprises lower 130 feet of Division II of Hartville "formation" (Condra and Reed, 1935). Thickness 119 to 130 feet. Underlies Wendover group (new); overlies Hayden group (new).

Type locality: Meek Cliff, sec. 22, T. 27 N., R. 66 W., Platte County, Wyo.

Meek Bend Limestone (in Millsap Lake Formation)[1]

Meek Bend Limestone Bed (in Hill Creek Member of Lazy Bend Formation)

Pennsylvanian: North-central Texas.

Original reference: E. H. Sellards, 1933, Texas Univ. Bull. 3232, p. 106, 107.

Leo Hendricks, 1957, Texas Univ. Bur. Econ. Geology Pub. 5724, p. 15, fig. 3, pl. 1. Reallocated and rank reduced to status of bed in Hill Creek member of Lazy Bend formation. Fine- to medium-crystalline limestone. Commonly gray with some beds light mottled brown. Thin, flaggy to massive. Maximum thickness 12 feet. Separated from Dennis Bridge limestone bed (at base of Hill Creek) by unnamed interval of shale and sandstone. Underlies Steussy shale member. Type section established.

Type section: In scarp northwest of Hill Creek about 1½ miles southwest of mouth of Hill Creek. Limestone forms top of irregular scarp extending from Brazos River southwestward to Cretaceous rocks near southwest corner of Parker County. Limestones that crop out near Meek Bend are Brannon Bridge limestones higher in section. Named for Meek Bend of Brazos River.

Meeker Sandstone Member (of Mancos Shale)

Upper Cretaceous: Northwestern Colorado.

Kenji Konishi, 1959, Rocky Mountain Assoc. Geologists 11th Ann. Field Conf., Symposium, p. 67. Consists of sandstone, gray to brownish gray, very fine grained, and well sorted; very thin bedded with ill-defined undulatory bedding planes; strongly calcareous. Occurs about 700 feet below Morapos sandstone member. Term has been used by subsurface geologists working in northwestern Colorado.

Traceable on surface northward from Meeker, Rio Blanco County, into Yellowjacket area along western flank of Yellowjacket anticline and continues northward as steep hogback.

Meers Quartzite[1]

Precambrian: Southwestern Oklahoma.

Original reference: M. G. Hoffman, 1930, Oklahoma Geol. Survey Bull. 52, p. 26, 31, 45.

G. W. Chase, 1952, Oklahoma Geol. Survey Circ. 30, p. 11, 12 (table 3). Oldest rock in region [Wichita Mountains]. Black to nearly white medium-grained quartzite occurring as xenoliths in gabbro and Lugert granite.

Named for occurrence south of Meers townsite, Comanche County.

Meeteetse Formation[1]

Upper Cretaceous: Northern Wyoming.

Original reference: D. F. Hewett, 1914, U.S. Geol. Survey Bull. 541, p. 91, 102.

J. D. Love, 1956, Wyoming Geol. Assoc. Guidebook 11th Ann. Field Conf., p. 81–82. In type area consists of light-colored tuffaceous sandstone, thin coal and carbonaceous shale beds, and yellowish to greenish bentonite beds. These overlie sandstone of Mesaverde formation. In Spread Creek Canyon, an exposure in center of syncline includes 166 feet of strata consisting of gray to chalky gray siltstone with large biotite flakes, white granular biotite tuff, carbonaceous claystone and shale, thin impure coal beds, and yellow to green bentonite beds. About 675 feet exposed on west limb of Spread Creek anticline. Younger Cretaceous rocks not observed in contact with Meeteetse. Stratigraphically below Harebell formation; contact not observed. Plant remains suggest Upper Cretaceous age.

E. I. Rich, 1958, Am. Assoc. Petroleum Geologists Bull., v. 42, no. 10, p. 2436–2437. Described in parts of Powder River, Wind River, and Big Horn basins. Consists of alternating thin beds of sandstone, siltstone, shale, tuffaceous siltstone or mudstone, carbonaceous shale, and lenticular coal beds. Maximum thickness 1,300 feet in western part of Big Horn basin; thins eastward, intertongues with Lewis shale, and is absent along southwestern part of Wind River basin; in southeastern part of Wind River basin, ranges in thickness from 700 feet in Rattlesnake Hills surface section to about 400 feet in Canal surface section. Underlies Lance formation, apparently conformable.

Named for town of Meeteetse on Greybull River, Park County.

Meetinghouse Slate

Meetinghouse Slate (in St. Francis Group)

Meetinghouse Slate Member (of Gile Mountain Formation)

Upper Silurian: East-central Vermont and west-central New Hampshire.

C. G. Doll, [1944], Vermont State Geologist 24th Rept. 1943–1944, p. 19. Described as gray and black micaceous slates often showing brownish stains. Very thin quartzite layers often interbedded. Excellent cleavage. Estimated thickness about 1,100 feet. Upper member of Gile Mountain schists. Devonian.

J. B. Hadley, 1950, Vermont Geol. Survey Bull. 1, p. 17–19, pl. 1. Described as slate. Devonian(?).

M. P. Billings, 1955, Geologic map of New Hampshire (1:250,000): U.S. Geol. Survey. Geographically extended to New Hampshire. Middle Ordovician(?).

J. B. Lyons, 1955, Geol. Soc. America Bull., v. 66, no. 1, p. 108, 111, 112, pl. 1. Member of Gile Mountain formation.

J. H. Eric and J. G. Dennis, 1958, Vermont Geol. Survey Bull. 11, p. 24–25. Included in St. Francis group. The Meetinghouse may either overlie Gile Mountain formation and thus be at top of St. Francis group (thrust hypothesis of Monroe contact) and Devonian in age or correlate with Northfield slate, which is at base of St. Francis group (unconformity hypothesis of Monroe contact), and thus be Devonian or Silurian in age.

L. M. Hall, 1959, Vermont Geol. Survey Bull. 13, p. 34–36. Estimated thickness 0 to 2,700 feet in St. Johnsbury quadrangle. Overlies Gile Mountain formation. Most agree that age is Silurian and (or) Devonian but age is still open to question. Of the three possible sequences discussed, the author [Hall] prefers (ascending) Northfield slate, Waits River formation, Gile Mountain formation, and Meetinghouse slate.

W. M. Cady, 1960, Geol. Soc. America Bull., v. 71, no. 5, pls. 1, 3. Assigned to Upper Silurian.

Named for Meetinghouse Hill in Stafford quadrangle, Vermont.

Meganos Formation[1]

Meganos Stage

Eocene, lower: Western California.

Original reference: B. L. Clark, 1918, Geol. Soc. America Bull., v. 29, p. 94, 281–296.

B. L. Clark and H. E. Vokes, 1936, Geol. Soc. America Bull., v. 47, no. 6, p. 853 (fig. 1), 856–858. Referred to as Meganos stage intermediate between Martinez stage below and Capay stage above. Clark (1921, Jour. Geology, v. 29, no. 2) described type section of Meganos formation, dividing it into ascending divisions A, B, C, D, and E. Molluscan fauna of this series as listed by Clark and Woodford (1927, California Univ. Pubs. Bull., Dept. Geol. Sci., v. 17, no. 2) comes from division D. This is important because it is possible that upper member, or division E, should be referred to Capay stage. Thus in discussing fauna of Meganos stage, present writers include only species from Division D, or lower. Fauna of stage incompletely known at present, only approximately 70 species described.

H. E. Vokes, 1939, New York Acad. Sci. Annals, v. 38, p. 13 (table 1), 27–32. Strata north of Coalinga have been referred by various writers to the Martinez, Meganos, and Tejon stages, but no formational name has been formally assigned them. Name Arroyo Hondo formation has been suggested for them by E. R. Atwill and is here applied to these strata. Formation, which includes Meganos horizon, is included in Capay stage.

I. F. Wilson, 1943, California Jour. Mines and Geology, v. 39, no. 2, p. 205–206. In San Benito quadrangle, unit defined as Los Muertos Creek formation has been assigned to Meganos formation by Kerr and Schenck (1925, Geol. Soc. America Bull., v. 36, no. 9), but that was before Capay stage had been separated in California. Eocene.

Ralph Stewart, 1949, U.S. Geol. Survey Oil and Gas Inv. Prelim. Chart 4, sheet 2. Includes Marysville claystone member.

Type section: Strip beginning about 1½ miles east and a little north of Clayton and ending in vicinity of Byron Hot Springs, Contra Costa County. Named for exposures on Meganos Ranch or land grant, southeast of Martinez.

Mehama Volcanics[1]

Oligocene: Northwestern Oregon.

Original reference: T. P. Thayer, 1933, Pan-Am. Geologist, v. 59, no. 4, p. 317.

T. P. Thayer, 1939, Oregon Dept. Geology and Mineral Industries Bull., v. 15, fig. 1. Described as terrestrial tuffs, lavas, and breccias which for most part were water laid. Contains fossil wood. Thickness as much as 600 feet. Underlies Stayton lavas. Comparable in age to Warrendale or Eagle Creek formation in Columbia River Gorge.

I. S. Allison and W. M. Felts, 1956, Geology of Lebanon quadrangle, Oregon (1:62,500): Oregon Dept. Geology and Mineral Industries. Geographically extended into Lebanon quadrangle. Tentative names Scio beds and Berlin volcanics used by Felts (1936, unpub. thesis) are abandoned. About 500 vertical feet of Mehama volcanics are exposed on sides of Prospect Mountain, Franklin Butte, and Hungry Hill. Formation in this part of quadrangle strikes N. 50° W. and dips about 6° NE. By projecting outcrop at Hungry Hill northeastward in direction of Prospect Mountain, total thickness exposed is estimated about 1,500 to 2,500 feet. Maximum thickness not known. The 500-foot section on Franklin Butte shows about 250 feet of sandstone, siltstone, and tuffs at top. Below this is Scio floral zone in about 100 feet of white bedded tuffaceous shale. At base of section are about 150 feet of micaceous sandstones in which fragment of marine fossil was found. Relation of Mehama volcanics to Eugene formation uncertain; Mehama volcanics may be in part terrestrial equivalent of marine beds to west. Upper part presumably overlies Eugene formation. Both are overlain unconformably by Stayton lavas. Oligocene or partly older.

Well exposed near crest of Mehama anticline, north and east of Mehama, Marion County.

Mehrten Formation[1]

Miocene and Pliocene: Northern California and western Nevada.

Original reference: A. M. Piper and others, 1939, U.S. Geol. Survey Water-Supply Paper 780, p. 34 (table), 61–71, pl. 1.

G. H. Curtis, 1954, California Univ. Pub. Geol. Sci., v. 29, no. 9, p. 453–502. Piper and others (1939) proposed name Mehrten formation for fluviatile sediments of predominantly andesitic material occurring in area of Mokelumne River drainage, the type section being near Mehrten dam site. The authors did not make clear just what they intended the limits of the formation to be. It would appear that they restricted its limits to area of their geologic map, plate 1, which covers relatively small tract in lower part of Sierran foothills between Plymouth and Salt Springs. However, they stated (page 69) that "east of the Mokelumne area andesitic breccia and detritus that are equivalent to the Mehrten formation and that are similar to it in texture, bedding, and composition are widespread over the entire west slope of the Sierra Nevada and extend far to the north and south. In that area the andesitic rocks exceed 1,000 feet in thickness at many places and attain a maximum thickness of 2,000 feet on the northeast side of Silver Lake, 40 miles northeast of Jackson. All these are the products of one epoch of volcanism." This being true, it seems reasonable to extend name Mehrten to these "equivalent" and "similar" deposits which are connected by more or less continuous outcrops with type section. Since deposits extend eastward beyond Silver Lake for many miles even beyond border of California into Nevada north of Topaz Lake, name "Mehrten formation" is used in present paper to apply to all deposits of clastic and pyroclastic material of predominantly andesitic composition deposited on the Sierra Nevada and contiguous terrain during this volcanic epoch. Extension of name will probably cause problems, especially in western Nevada, where similar deposits of earlier age have been identified (Gianella, 1936, Nevada Univ. Bull., v. 30, no. 9) and possibly in northern Sierra, where source andesites of Oligocene Wheatland formation may occur. Deposition occurred in late Miocene(?) and early Pliocene.

J. H. Eric, A. A. Stromquist, and C. M. Swinney, 1955, California Div. Mines Spec. Rept. 41, p. 18, pls. 1, 3. Described in Angels Camp and Sonora quadrangles as essentially andesitic or basaltic throughout and consisting of conglomerate, mudflows, agglomerate, breccia, and tuff. Composed chiefly of hornblende andesite. Maximum thickness about 300 feet (northeast part of Angels Camp quadrangle). Unconformably overlies Valley Springs formation. Miocene and Pliocene.

S. N. Davis and F. R. Hall, 1959, Stanford Univ. Pub. Geol. Sci., v. 6, no. 1, p. 9–10, 14–15. In eastern Stanislaus and northern Merced Counties, conformably underlies Turlock Lake formation (new); overlies Valley Springs formation. Maximum thickness 1,200 feet. Early to middle Pliocene.

Type section: Along Clements-Camanche Road about 1¼ miles east of the Mehrten dam site, in NE¼SW¼ sec. 5, T. 4 N., R. 9 E., San Joaquin County. Named for exposures in bluffs along Mokelumne River near Mehrten dam site, which is about 3½ miles upstream from Clements bridge.

Meigs Creek Clay Shale

Pennsylvanian (Monongahela): Southeastern Ohio.

D. L. Norling, 1958, Ohio Geol. Survey Bull. 56, p. 10 (fig. 3), 74. Meigs Creek clay and clay shale member (Monongahela series) is present between Lower Sewickley sandstone and Meigs Creek coal in many localities; in others, it is either absent or not recognized in the underlying shale sections of Lower Sewickley sandstone and (or) Fishpot limestone members. Consists of 1 to 5 feet of gray to tan semiplastic clay or clay shale.

Occurs in Morgan County.

†Meigs Creek White Limestone (in Monongahela Formation)[1]

Pennsylvanian: Western Pennsylvania.

Original reference: W. T. Griswold, 1902, U.S. Geol. Survey Bull. 198, p. 17–19.

Probably named for association with Meigs Creek coal.

Meister Member (of Devils Gate Limestone)

Middle Devonian: Central Nevada.

T. B. Nolan, C. W. Merriam, and J. S. Williams, 1956, U.S. Geol. Survey Prof. Paper 276, p. 49, 50–51. Greater part of member is thick-bedded gray fine-grained limestone. Many beds are crowded with rounded algal growths or stromatoliths, and others are filled with colonies of coral. A few dolomites occur sporadically throughout member, most significant being those in 30-foot zone at top of unit. These are white-weathering dense dolomites or dolomitic limestones in beds 6 inches or so thick interbedded with darker limestone beds of same thickness. Thickness 410 feet on Newark Mountain. Contact with underlying Nevada formation gradational. In general, base of member was placed at lowest bed of dark-gray thick-bedded limestone. Upper contact marked by diagnostic bed of dark-gray oolitic ostracod-bearing limestone at base of overlying Hayes Canyon member (new).

Named from exposures in vicinity of Meister mine in Newark Mountain, near Eureka, White Pine County.

Melbourne bone bed[1] facies (of Pamlico Sand)

Melbourne Formation

Pleistocene: Florida.

Original reference: C. W. Cooke and S. Mossom, 1929, Florida Geol. Survey 20th Ann. Rept.

E. H. Sellards, 1940, Geol. Soc. America Bull., v. 51, no. 3, p. 381. Melbourne beds underlie Van Valkenburg beds (new).

H. E. Wood 2d and others, 1941, Geol. Soc. America Bull., v. 52, no. 1, p. 25, pl. 1. Late Pleistocene formation.

C. W. Cooke, 1945, Florida Geol. Survey Bull. 29, p. 299–300. Regarded as facies of Pamlico sand.

Named for occurrence at Melbourne, Brevard County. Widespread—east coast, west coast, and interior.

Melette facies (of Arikaree Formation)

Melette Formation

Miocene: South-central South Dakota.

A. F. Agnew, 1957, Geology of the White River quadrangle (1:62,500): South Dakota Geol. Survey. Formation consists typically of three zones of fine-grained thin-bedded pinkish dense limestone, white-weathering and fossiliferous; lower two limestones, each 2 feet thick, are separated by 38 feet of red and grayish-pink uncemented tuffaceous sand; upper limestone, 7 feet thick, is separated from middle one by 19 feet of similar sand; above upper limestone, several feet of similar sand is exposed beneath cap of Pleistocene upland gravel. Thickness in mapped area at least 78 feet; 9 miles to south more than 150 feet thick. Conformably overlies Arikaree formation.

W. D. Sevon, 1959, Geology of the Okreek quadrangle (1:62,500): South Dakota Geol. Survey. Redefined as facies of Arikaree formation. Limestones vary from 1 to 3 feet in thickness and occur at about 150, 165, and 175 feet above base of formation.

Named for exposures near center of line between secs. 14 and 23, T. 41 N., R. 28 W., in small mesa containing Mellette triangulation station.

Mellen or High Bridge Granite[1]

Precambrian: Wisconsin.

Original reference: C. C. Wang, 1932, Geol. Soc. China Bull., v. 11, no. 4, p. 426–428.

Melmont[1]

Eocene: Western Washington.

Original reference: W. F. Jones, 1914, Geol. Soc. America Bull., v. 25, p. 122.

Probably named for town of Melmont in northern part of Pierce County.

Melones Limestone (in Mayagüez Group)

Upper Cretaceous: Southwestern Puerto Rico.

P. H. Mattson, 1958, Dissert. Abs., v. 18, no. 1, p. 197; Geol. Soc. America Bull., v. 71, no. 3, p. 329, 335–337, pls. 1, 6. Name applied to dark argillaceous lenticular limestone with banded tuff or volcanic wacke and mudstone exposed in center of the Sierra Melones. Lowest part of unit is massive or thick-bedded dark argillaceous limestone or, where this is absent, thin fossiliferous medium-bedded mudstone. This grades upward into medium-bedded fossiliferous calcareous mudstone. Above are banded volcanic wacke, conglomeratic tuff or wacke, fragmental calcilutite, and more argillaceous limestone. Top of formation not exposed in this area; approximate minimum thickness 175 meters. In Teo syncline, occurs as lenses in El Rayo volcanic rocks. In Melones syncline, overlies Parguera limestone (new). Microfauna indicates a Campanian to Maestrichtian or possibly Maestrichtian age.

Named for exposures in the Sierra Melones, Mayagüez area.

Melozi Formation[1] (in Shaktolik Group)

Lower Cretaceous: Central western and central Alaska.

Original reference: G. C. Martin, 1926, U.S. Geol. Survey Bull. 776, p. 395–412, chart opp. p. 474.

R. W. Imlay and J. B. Reeside, Jr., 1954, Geol. Soc. America Bull., v. 65, no. 3, pl. 1 (facing p. 246). Age given as Lower Cretaceous on correlation chart.

T. G. Payne, 1955, U.S. Geol. Survey Misc. Geol. Inv. Map I–84. Marine formation included in Shaktolik group in Koyukuk geosyncline and Hogatza uplift areas.

Named for exposures on north bank of Yukon River from 8 to 20 miles below Melozi telegraph station. In Nulato-Norton Bay district, and Lower Yukon River and Koyukuk River regions.

Melrose Granite

Melrose granite facies (of Columbia Granite)[1]

Precambrian: Central Virginia.

Original reference: A. I. Jonas, 1932, Virginia Geol. Survey Bull. 38, p. 22–23, map.

H. E. LeGrand, 1960, Virginia Div. Mineral Resources Bull. 75, p. 13, pl. 1. Melrose granite described in report on Pittsylvania and Halifax Counties. Paleozoic or Precambrian.

Named for exposures around Melrose, Campbell County.

Melrose[1] (quartzite)

Carboniferous: Montana.

Original reference: C. R. Keyes, 1926, Pan-Am. Geologist, v. 46.

Derivation of name not stated.

Melville Formation (in Fort Union Group)

Paleocene: Central Montana.

G. G. Simpson, 1937, U.S. Natl. Mus. Bull. 169, p. 15 (table), 25, 55, pl. 1. Dark, greenish or gray, shales with numerous gray to yellow sandstones. Thickness at least 4,000 feet and possibly as much as 6,000 feet. Uppermost unit of group in Crazy Mountains. Overlies Lebo formation.

Named from town of Melville, Sweetgrass County, which is situated on these beds and is surrounded, within a few miles, by excellent and typical exposures of them.

Memorial Shale[1] (in Marmaton Group)

Pennsylvanian (Des Moines Series): Northeastern Oklahoma, eastern Kansas, and western Missouri.

Original reference: R. H. Dott *in* R. C. Moore, 1936, Kansas Geol. Survey Bull. 22, p. 58, 67.

R. H. Dott, 1941, Am. Assoc. Petroleum Geologists Bull., v. 25, no. 8, p. 1591–1597. Formal proposal of name. Term is applied to strata above top of Lenapah (Eleventh Street) limestone and below base of Seminole formation. In latitude of Tulsa, it consists principally of clay shale with silty streaks and contains, near the middle, about 10 feet of sandstone in thin fine-grained to silty beds a few inches thick interspersed with sandy, silty shale and locally in the upper part, one or more fossiliferous limestone beds a few inches thick. Thickness at type locality 80 feet. Equivalent to upper part of Holdenville shale and to strata formerly mapped as upper Nowata in vicinity of Tulsa. Type locality stated.

J. M. Jewett, 1941, Kansas Geol. Survey Bull. 38, pt. 11, p. 340–341. At top of Marmaton group. Overlies Idenbro limestone member (new) of Lenapah limestone; underlies Hepler sandstone. Thickness as much as 40 feet in Kansas.

F. C. Greene and W. V. Searight, 1949, Missouri Geol. Survey and Water Resources Rept. Inv. 11, p. v (fig. 1), 9. Marmaton shale above the Lenapah has been named Memorial shale, and the name is applied to shale at this position in Missouri. Underlies Hepler sandstone.

M. C. Oakes, 1952, Oklahoma Geol. Survey Bull. 69, p. 42. Memorial shale, by definition, extends upward from top of Lenapah limestone to base of Seminole formation; likewise Holdenville shale extends upward from top of Wewoka formation to base of Seminole formation. Lenapah has been traced into uppermost Wewoka; hence, Memorial and Holdenville lie between same stratigraphic limits and are equivalent. Holdenville, the older and more commonly used term, takes precedence.

C. C. Branson, 1957, Oklahoma Geology Notes, v. 17, no. 11, p. 101. Abandoned by Oklahoma Geological Survey.

Type locality: Near cemetery along west line of SW sec. 36, T. 19 N., R. 13 E., and in SE sec. 35, vicinity of Tulsa, Okla. Name derived from Memorial Park cemetery.

Memphis Loess[1]

Pleistocene: Southwestern Tennessee.

Original reference: J. M. Safford and J. B. Killebrew, 1900, Elements of geology of Tennessee, p. 104, 162.

Named for occurrence at Memphis, Shelby County.

†Memphis Sandstone (in Peacock Formation)[1]

Permian : Central northern Texas.

Original reference: A. M. Lloyd and W. C. Thompson, 1929, Am. Assoc. Petroleum Geologists Bull., v. 13, p. 953, pl. 10.

Crops out near town of Northfield, in northern Motley County. Named from occurrence near Memphis, Hall County.

Memphremagog Formation

Memphremagog Slate[1]

Silurian or Devonian : East-central and northeastern Vermont.

Original reference: C. H. Richardson, 1906, Vermont State Geologist 5th Rept., p. 115, footnote.

L. W. Currier and R. H. Jahns, 1941, Geol. Soc. America Bull., v. 52, no. 9, p. 1491, 1501, 1505. Beds mapped in central Vermont as "Memphremagog slates" by Richardson (1906) are, in general, represented by redefined Northfield slate. Stratigraphic relations of the former had not been clearly described. Lower Trenton age of "Memphremagog slates" is open to question.

C. G. Doll, 1941, (abs.) Geol. Soc. America Bull., v. 52, no. 12, pt. 2, p. 2014. Memphremagog quadrangle touching upon international boundary in northeastern Vermont is in large part underlain by relatively thin-bedded, metamorphosed sedimentary rocks of probable Ordovician age. These rocks compose Memphremagog formation and consist chiefly of slates, phyllites, impure limestones, and quartzites.

C. G. Doll, 1943, Am. Jour. Sci., v. 241, no. 1, p. 57. Memphremagog formation contains Waits River limestone as key member. Recent discovery of determinable fossil crinoid and cystoid calyces, and two gastropods in Waits River limestone at Westmore, shows Waits River limestone and intercalated rocks to be at least as young as Middle Silurian, and very possibly of Lower Devonian age.

C. G. Doll, [1945], Vermont State Geologist 24th Rept., p. 16–18, pls. 3, 4. Formation includes a great variety of rock types, arenaceous and micaceous dolomitic limestones and intercalated mica schists. Contains Waits River limestone member, also Standing Pond amphibolite member (new). Latter occurs either entirely in the limestones of the formation or along their contact with the mica schists. Coarse garnet schist is associated with this member. Thickness estimated about 8,000 feet. Age designated Middle Silurian ; plate 4 shows age as probably Lower Devonian also.

Named for Lake Memphremagog located in northern part of Memphremagog quadrangle on Vermont-Quebec border.

Menan Tuff

Pleistocene : Southeastern Idaho.

H. T. Stearns, Lynn Crandall, and W. G. Steward, 1938, U.S. Geol. Survey Water-Supply Paper 774, p. 28 (table), pl. 4 (geol. map). Named on map. Described as tuff and unconsolidated lapilli interbedded with basalt.

J. C. Bayless, 1950, Michigan Acad. Sci., Arts and Letters, Papers, v. 34, p. 218. Menan Buttes cover 8 square miles and rise 500 feet above plain. They contain craters about one-half mile in diameter and 100 to 150 feet deep. Lower slopes are covered with weathered tuff and loess, beyond which black volcanic sand predominates. Snake River lava laps on west and north sides of Menan Buttes and entirely surrounds tuff cone to north.

Mapped only in and near Menan Buttes, western Madison County.

Menard Limestone[1]

Menard Limestone (in Elvira Group)

Upper Mississippian (Chester Series) : Southern Illinois, southern Indiana, and western Kentucky.

Original reference: S. Weller, 1913, Illinois Acad. Sci. Trans., v. 6, p. 120, 128.

J. M. Weller, 1939, Kansas Geol. Soc. Guidebook 13th Ann. Field Conf., p. 131, 136, 137; J. M. Weller and A. H. Sutton, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 5, p. 766 (fig. 1), 838. Assigned to Elvira group (new). In standard Mississippian section, underlies Palestine sandstone and overlies Waltersburg sandstone. In southwestern Indiana, may be represented by Siberia limestone and the underlying and overlying shale intervals.

C. A. Malott, 1952, Stratigraphy of the Ste. Genevieve and Chester formations of southern Indiana: Ann Arbor, Mich., The Edwards Letter Shop, p. 7. Name Menard limestone extended into southern Indiana where it replaces term Siberia limestone. Local Indiana names of upper Chester are dropped, and formations given names of standard Chester column.

T. G. Perry and N. M. Smith, 1958, Indiana Geol. Survey Bull. 12, pl. 1. Menard limestone shown on stratigraphic column of upper Chester in Indiana as 25 to 50 feet of blue-gray thin-bedded lithographic to fine-grained oolitic arenaceous limestone. Term Elvira group not used in Indiana.

Named for Menard, Randolph County, Ill., where it is well exposed southeast of State Hospital.

Mendenhall Gneiss

Precambrian : Southern California.

G. B. Oakeshott, 1958, California Div. Mines Bull. 172, p. 21–29, pls. 1, 2, 3. Dark gneiss consisting of high percentage of blue quartz, thoroughly altered plagioclase, potash feldspars, and various proportions of ferromagnesian minerals. Main body of gneiss, oriented in west-northwest direction approximately parallel to San Gabriel fault, is overlapped by upper Miocene Mint Canyon formation which lies in depositional contact on gneiss at its west end; elsewhere gneiss is in contact with rocks of Precambrian anorthosite group, pre-Cretaceous diorite gneiss, and Cretaceous(?) granitic rocks; in some places contact is a clear-cut fault. Intruded by anorthosite-gabbro rocks and also by Upper Jurassic(?)-Lower Cretaceous(?) granitic rocks. Age of rocks of anorthosite group, determined by leadalpha measurements, is about 900 million years.

Type locality: Mendenhall Peak, San Fernando quadrangle, Los Angeles County. Crops out north of San Gabriel fault; underlies area of 9 square miles in belt 10 miles long and less than 2 miles wide.

Mendha Formation

Mendha Limestone[1]

Upper Cambrian and Lower Ordovician : Eastern Nevada.

Original references: L. G. Westgate and A. Knopf, 1927, Am. Inst. Mining Metall. Engineers Trans. 1647, p. 7; 1932, U.S. Geol. Survey Prof. Paper 171.

H. E. Wheeler, 1940, Nevada Univ. Bull., Geology and Mining Ser., No. 34, p. 12 (fig. 2), 13. Interbedded limestone and dolomite with a few thin beds of intercalated shale. Composite thickness about 2,125 feet. Overlies Highland limestone (restricted).

Named for Mendha mine on west side of Arizona Peak, Pioche region, Lincoln County.

Mendon Schist[1]

Mendon Dolomite[1]

Mendon Formation

Precambrian: Northwestern and southwestern Vermont.

Original reference: C. L. Whittle, 1894, Am. Jour. Sci., 3d, v. 47, p. 347–355.

L. M. Prindle and E. B. Knopf, 1932, Am. Jour. Sci., 5th, v. 24, no. 142, p. 265. Over Mount Holly gneiss lies succession of mica schist and quartzite, including some limestone or dolomite with a prominent structure that strikes nearly due north. This assemblage was called by Whittle the Mendon "series". Because assemblage is chiefly schists, it is herein called Mendon schist. Dolomite belonging to Mendon schist unconformably underlies Paleozoic quartzite.

G. W. Bain, 1938, New England Intercollegiate Geol. Assoc. Guidebook 34th Field Mtg., p. 8, 12. Mendon series includes lower graywacke, Mendon dolomite, and Nickwackett graywacke.

Phillip Fowler, 1950, Vermont Geol. Survey Bull. 2, p. 12 (fig. 2), 13 (table 1), 14–16, pl. 1. Oldest rocks in autochthonous sequence of Castleton area belong to provisional Mendon series. Until true relations of these rocks to those above and below are understood, name Mendon series should be retained. Thickness about 2,000 feet. Underlies Cheshire quartzite.

P. H. Osberg, 1952, Vermont Geol. Survey Bull. 5, p. 22 (table 2), 26–36, geol. map. Rocks immediately overlying Mount Holly complex at Mendon were named Mendon series by Whittle (1894). Under present stratigraphic usage application of term "series" to these rocks should be abandoned. Proposed here that Mendon series be emended to Mendon formation. Whittle described the "series" as including (ascending) "conglomerate-schist" member, "pebbly crystalline limestone" member, and "mica schist" member. The "pebbly crystalline limestone" will be referred to as Forestdale member (Keith, 1932) of Mendon, and the "mica schist" member will be referred to as Moosalamoo member (Keith, 1932) of Mendon. Forestdale member is about 600 feet above base of formation; Moosalamoo member is lenticular body of schist in upper part of formation. Thickness 800 to 1,800 feet. Underlies Cheshire quartzite. Lower Cambrian.

W. F. Brace, 1953, Vermont Geol. Survey Bull. 6, p. 29 (table 1), 30–34. Formation in Rutland area comprises (ascending) Nickwacket, Forestdale, and Moosalomoo members. Thickness as much as 1,750 feet. Underlies Cheshire quartzite; overlies Precambrian Wilcox formation (new), unconformity.

P. H. Osberg, 1959, New England Intercollegiate Geol. Assoc. Guidebook 51st Ann. Mtg., p. 47. In Coxe Mountain area, Vermont, Pinnacle formation underlies Forestdale dolomite. Names Mendon and Nickwacket have been used for rocks included in Pinnacle formation. However, name Mendon is not sufficiently definitive.

Well exposed in town of Mendon, 1 mile south of Mendon village, Rutland County. Formation crops out along upper part of western escarpment of Green Mountains and underlies summit and eastern slopes of Mount Moosalamoo. To the south, width of outcrop expands and includes area between Chandler Ridge and Romance Mountain.

Mendota Dolomite Member (of St. Lawrence Formation)[1]

Upper Cambrian: Southern Wisconsin.

Original reference: R. D. Irving, 1875, Am. Jour. Sci., 3d, v. 9, p. 441–442.

Josiah Bridge, 1937, U.S. Geol. Survey Prof. Paper 186–L, p. 236 (table 2). Chart shows Mendota dolomite as middle member of St. Lawrence formation. Overlies unnamed shale and underlies Lodi shale member.

Named for occurrence on Lake Mendota, near Madison.

Menefee Formation (in Mesaverde Group)[1]

Upper Cretaceous: Southwestern Colorado and northwestern New Mexico.

Original reference: A. J. Collier, 1919, U.S. Geol. Survey Bull. 691–K.

J. E. Allen and Robert Balk, 1954, New Mexico Bur. Mines Mineral Resources Bull. 36, p. 92, 95, pls. 1, 11. Described in Fort Defiance-Tohatchi quadrangles where it underlies Tohatchi [Tohachi] formation and overlies Point Lookout sandstone. Thickness 1,200 to 2,290 feet. Lower 500 feet contain carbonaceous shales and thin coals and are equivalent environmentally of upper Gibson coal member of Sears (1934, U.S. Geol. Survey Bull. 860–A), and rest of section above is equivalent to Allison barren member of Sears (1925).

E. C. Beaumont, C. H. Dane, and J. D. Sears, 1956. Am. Assoc. Petroleum Geologists Bull., v. 40, no. 9, p. 2156, 2157. Nomenclature of Mesaverde group, in San Juan basin, revised. Menefee formation includes, in southern part of basin, coal-bearing zone formerly called upper Gibson coal member, and above that zone bed formerly called Allison barren member. Unit formerly called upper Gibson coal member is here named Cleary coal member of Menefee.

Named for Menefee Mountain, Montezuma County, Colo.

Menominee Group

†Menominee Series[1]

Precambrian (Animikie Series): Northern Michigan.

W. S. Balyey, 1904, U.S. Geol. Survey Mon. 46, p. 38, 39, 175–488. The rocks of the Algonkian system in the Menominee district are divided into Lower Menominee and Upper Menominee series, equivalent to Lower Huronian and Upper Huronian elsewhere in Lake Superior region. Unconformity separates Lower Menominee from Upper Menominee. Lower Menominee includes (ascending) Sturgeon quartzite. Randville dolomite, and Negaunee formation; Upper Menominee includes (ascending) Vulcan formation (subdivided into ore-bearing Curry member, Brier slate, and ore-bearing Traders member), and Hanbury slate. Menominee is unconformable below Cambrian rocks and above Archean granites, gneisses and schists.

H. L. James, 1958, U.S. Geol. Survey Prof. Paper 314–C, p. 30 (table 1), 35. Reinstated and redefined as group in Animikie series. As redefined, covers only middle part of series as originally defined. In type locality, group consists of two formations: basal Felch formation, and Vulcan formation made up of (ascending) Traders iron-bearing member, Brier slate member, Curry iron-bearing member, and Loretto slate member. Unconformably underlies Baraga group (new); unconformably overlies Chocolay group (new).

Group is named for Menominee district of southern Dickinson County.

Mentasta Schist[1]

Pre-Devonian: Southeastern Alaska.

Original reference: W. C. Mendenhall, 1905, U.S. Geol. Survey Prof. Paper 41, p. 26.

Upper Copper River region.

Menteth Limestone Member (of Moscow Shale)[1]

Menteth Formation

Middle Devonian: West-central New York.

Original reference: J. M. Clarke and D. D. Luther, 1904, New York State Mus. Bull. 63, p. 22.

R. G. Sutton, 1951, Rochester Acad. Sci. Proc., v. 9, nos. 5–6, p. 374–375, pl. 1. Discussion of stratigraphy of Batavia quadrangle. Menteth limestone, basal member of Moscow formation, has stratigraphic position 55 feet above Tichenor member of Ludlowville at Canandaigua Lake, but when traced westward, it approaches Tichenor horizon due to rapid thinning of Deep Run member of Ludlowville. May terminate in eastern part of quadrangle. Underlies Kashong shale member of Moscow.

T. B. Coley, 1954, Jour. Paleontology, v. 28, no. 4, p. 453, 454. Referred to as Menteth formation. Thickness 1 foot at Jacox Run near Geneseo. Overlies Deep Run formation.

Forms first falls at Tichenor Point and Menteth Point, on Canandaigua Lake, Ontario County.

†Mentor Formation[1]

Mentor Sandstone Member (of Belvidere Formation)

Lower Cretaceous (Comanche Series): Central Kansas.

Original reference: F. W. Cragin, 1895, Am. Geologist, v. 16, p. 162.

R. C. Moore, 1935, Rock formations of Kansas *in* Kansas Geol. Soc.: Wichita [Am. Assoc. Petroleum Geologists 20th Ann. Mtg., Mar. 21–23]. Shown on chart as sandstone member of Belvidere formation. Overlies Marquette sandstone member; underlies Terra Cotta shale member (new) of Ellsworth formation (new).

R. C. Moore, J. C. Frye, and J. M. Jewett, 1944, Kansas Geol. Survey Bull. 52, pt. 4, p. 154. Kiowa shale as herein defined probably contains stratigraphic units formerly called "Greenleaf sandstone," "Mentor beds," and others, and is in part equivalent to "Belvidere formation," "Medicine bed," "Elk River beds," and others.

Type exposure (Mentor beds): On east side of Smoky Hill River about 3 miles east of Mentor, Saline County.

Meramec Series

Meramec Group[1]

Upper Mississippian : Mississippi Valley region.

Original reference: E. O. Ulrich, 1904, Missouri Bur. Geology and Mines, v. 2, 2d ser., p. 110.

R. C. Moore, 1933, Historical Geology: New York, McGraw-Hill Book Co., Inc., p. 262–264. Valmeyer series (new) includes Osage group below and Meramec group above.

J. M. Weller, 1939, Kansas Geol. Soc. Guidebook 13th Ann. Field Conf., p. 131, 132–134. Meramec group, Valmeyer series, includes (ascending) Warsaw, Salem (Spergen), St. Louis, and Ste. Genevieve limestones. Overlies Osage group; underlies New Design group (new) in Chester series. Interpretations in this report are not necessarily in accord with current classifications recognized by Illinois and Missouri Geological Surveys.

J. M. Weller and A. H. Sutton, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 5, p. 766 (fig. 1), 771, 777–778. Iowa series includes (ascending) Kinderhook, Osage, and Meramec groups. This is classification used by Illinois Geological Survey; however, present authors [Weller and Sutton] believe that the Kinderhook should be raised to rank of series and the Valmeyer series, consisting of Osage and Meramec groups, should be recognized. Meramec group includes (ascending) Salem, St. Louis, and Ste. Genevieve limestones. Underlies New Design group of Chester series.

J. M. Weller and others, 1948, Geol. Soc. America Bull., v. 59, no. 2, p. 98 (fig. 1), 99–100, chart 5. In this report, the Mississippian is subdivided into (ascending) Kinderhookian, Osagean, Meramecian, and Chesterian series. In standard section, Meramecian series comprises (ascending) Warsaw, Salem, St. Louis, and Ste. Genevieve limestones. Disagreement exists regarding boundary between Meramecian and Osagean series and current usage is not consistent. U.S. Geological Survey classes Warsaw formation in the Meramecian, and this practice is followed by Missouri Geological Survey. Indiana, Iowa, and Illinois Geological Surveys classify the Warsaw with the Osagean.

L. R. Laudon, 1948, Jour. Geology, v. 56, no. 4, p. 288–302. Discussion of Osage-Meramec contact. Problems concerning contact cannot be solved at type sections of either Osage or Meramec series because both sections are incomplete. At type section of Osage, the upper Burlington, Keokuk, Salem, and St. Louis formations are all missing. Upper Burlington and Keokuk beds are exposed at other places in west-central Missouri, Warsaw and Salem formations are not represented at all, and St. Louis formation is known from only one small area. At type section of Meramec series, beds of Osage age are not exposed. In vicinity, beds of Keokuk, Burlington, Reeds Spring, and Fern Glen age are exposed, but Warsaw formation is not represented. Evidence indicates major break at end of Osage epoch. Evidence also indicates desirability of retaining standard terms Kinderhook, Osage, Meramec, and Chester, and militates against any usage whereby Osage and Meramec rocks are classed together as unit.

H. R. Wanless, 1957, Illinois Geol. Survey Bull. 82, p. 47–49. In Beardstown, Glasford, Havana, and Vermont quadrangles, Meramec group, Valmeyer series, includes Salem and St. Louis formations and unconformably underlies Pennsylvanian strata.

Named for Meramec Highlands and Meramec River, west of St. Louis, Mo.

Merced Formation[1]

Pliocene, upper, and Pleistocene (?): Western California.

Original references: A. C. Lawson, 1893, California Univ. Pub. Dept. Geol. Bull., v. 1, p. 142–151; 1895, U.S. Geol. Survey 15th Ann. Rept., p. 459–463.

F. A. Johnson, 1943, California Div. Mines Bull. 118, p. 622–627. In Petaluma region, upper Pliocene Merced is represented by both marine and fresh-water sediments. Former consists chiefly of fine-grained generally massive quartz-feldspathic sandstone, conglomerate, and clay shale. Latter consists of fluvatile conglomerates and sandstones of varying coarseness accompanied in many places by siltstones and clays. Marine Merced, about 1,500 feet thick, rests unconformably upon the Franciscan over entire area, except in southeastern corner, where west of Penngrove and Petaluma it is apparently conformable upon Sonoma volcanics which, in turn, are unconformable upon Franciscan group and Petaluma formation. Fresh-water deposits occur north of Santa Rosa and rest in conformable depositional contact upon Sonoma volcanics represented here by basalt.

C. E. Weaver, 1949, Geol. Soc. America Mem. 35, p. 16 (table 3), 92–94. In area of this report [Coast Ranges north of San Francisco Bay], the Merced is composed of marine sandstones and sandy shales usually less than 300 feet thick and probably equivalent to lower Merced of type section. South of Petaluma on west side of Burdell Mountain, Merced is interbedded with Sonoma volcanics. Pliocene.

W. K. Gealey, 1951, California Div. Mines Bull. 161, p. 11 (fig. 2), 23–25, pl. 1. In Healdsburg quadrangle, the limited exposures of Merced are light-gray massive- to thick-bedded uniformly medium-grained sandstone that weathers pale buff; not cemented. Grades upward into nonmarine Sonoma sands and gravels, contact not precisely located. Minimum thickness of 500 feet estimated for Wilson Grove area. In Wilson Grove area, Merced strata conformably overlie 200 feet of Sonoma tuff; they are in turn overlain conformably by Sonoma sandstone and conglomerate; thus Merced here is marine wedge interbedded with Sonoma group. Northeast of Rio Dell, overlies Franciscan with profound unconformity. Merced blankets Franciscan terrane west of Llano de Santa Rosa south of Russian River, and is preserved in structural lows along San Andreas rift at various points southward to Golden Gate. In Healdsburg quadrangle and adjacent areas to south, its eastern extent has been controlled by western flanks of coeval Sonoma volcanics.

G. T. Cardwell, 1958, U.S. Geol. Survey Water-Supply Paper 1427, p. 26 (table 6), 38–47, pls. 1, 3, 4. Described in Santa Rosa and Petaluma Valley areas where it consists of medium- to fine-grained fossiliferous marine sand, sandstone, and silty clay, with minor interbedded gravel and pebbly beds; tuffaceous in part. Thickness 0 to about 2,000 feet. Interbedded with Sonoma volcanics and Glen Ellen formation. Includes part of Sonoma group of Gealey (1950 [1951]). In much of the area, unconformably overlies Franciscan and Knoxville, but, in western part of the area, is in fault contact with them. In some places, overlies Petaluma formation with marked angular unconformity. Pleistocene(?) and late Pliocene. In general, Merced time is believed to span time interval occupied by Sonoma volcanics of Pliocene age and Glen Ellen formation of Pliocene(?) and Pleistocene age.

William Glen, 1959, California Univ. Pubs. Geol. Sci., v. 36, no. 2, p. 147–198. Type Merced, approximately 5,000 feet thick, is mostly gray and brown, soft, friable sandstone; largely deposited in a marine shallow water coastal embayment environment. Molluscan and crustacean species indicate deposition from middle Pliocene through early Pleistocene time. Fossils and lithology indicate that "Merced" formation of Pillar Point is of middle Pliocene age and part of Purisima formation. Only a small part may be correlative with type Merced.

Named from Lake Merced, which lies in structural or synclinal depression of Pliocene terrane, south of San Francisco. Exposed in sea-cliff which extends from Lake Merced, near San Francisco, to Mussel Rock about 8 miles south of Point Lobos at entrance to the gate. Thickness in cliff section, 5,834 feet.

Mercedita Lentil (in Ponce Limestone)

Oligocene, middle: Puerto Rico.

R. C. Mitchell-Thome, 1960, Caribbean 2d Geol. Conf. Trans., Mayagüez, Puerto Rico, p. 138, 139 (table 1). Clastic fraction in lower Ponce. Maximum thickness about 75 meters.

Occurs between Quebrada and del Agua and central Mercedita.

Mercer coal group[1]

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

Original references: J. P. Lesley, 1879, Pennsylvania 2d Geol. Survey Rept. Q_2, p. xxi–xxxvi; H. M. Chance, 1880 Pennsylvania 2d Geol. Survey Rept. G_4.

Mercer Formation (in Pottsville Group)

Mercer Member (of Pottsville Formation)

Mercer Shale Member (of Pottsville Formation)[1]

Pennsylvanian: Western Pennsylvania, Maryland, eastern Ohio, and northern West Virginia.

Original references: J. P. Lesley (Mercer group), 1879, Pennsylvania 2d Geol. Survey Rept. Q_2, p. xxi-xxxvi, 319–333; H. M. Chance (Mercer coal group), 1880, Pennsylvania 2d Geol. Survey Rept. G_4

Charles Butts, 1904, U.S. Geol. Survey Geol. Atlas, Folio 115. Pottsville formation, in Kittanning quadrangle, is composed of two sandy members, the Connoquenessing and Homewood sandstones, separated near the middle by stratum of shale 20 feet or more in thickness, bearing one or more thin seams of coal (the Mercer coal and shale).

Charles Butts, 1905, U.S. Geol. Survey Geol. Atlas, Folio 133. In the Ebensburg quadrangle, Pottsville formation is about 130 feet thick and is composed of two sandstone members separated by shale and fire clay. These are (ascending) Connoquenessing sandstone, Mercer shale and clay, and Homewood sandstone members. Mercer member consists of 6 feet of shale overlain by 9 feet of clay, at top of which, partly included in the Homewood, are small pockets of coal 2 inches thick. Small specimens of plants present in shale.

F. G. Clapp, 1907, U.S. Geol. Survey Geol. Atlas, Folio 146. In parts of Pennsylvania where it is exposed, the Pottsville consists of two massive members, Homewood and Connoquenessing sandstones, separated by thin bed of shale, which generally carries fire clay and coal beds. This shale is known as Mercer member.

W. C. Phalen, 1910, U.S. Geol. Survey Geol. Atlas, Folio 174. Pottsville formation, in Johnstown quadrangle, consists of (ascending) Connoquenessing sandstone, Mercer shale, and Homewood sandstone members. The Mercer consists of shale and clay, with which locally a coal bed is associated. Thickness and character of member vary. Thickness 8 to 13 feet.

M. R. Campbell, F. G. Clapp, and Charles Butts, 1913, U.S. Geol. Survey Geol. Atlas, Folio 189. In Barnesboro-Patton quadrangles, the Pottsville formation consists of a lower sandstone, the Connoquenessing, and an upper, the Homewood. These massive members are separated by shale of somewhat irregular thickness, which commonly contains bed of fire clay and in some places thin beds of coal. To this member, which has been recognized throughout most of western Pennsylvania and which contains fossil flora, name Mercer shale member has been applied from Mercer County where the coal beds and limestones are particularly well developed. The fire clay is known as Mount Savage fire clay in western Maryland. It seems to be persistent throughout most of western Pennsylvania, but it has not been observed in Barnesboro and Patton quadrangles.

R. C. Moore and others, 1944, Geol. Soc. America Bull., v. 55, no. 6, chart 6 (column 9). Correlation chart shows Mercer shale in Pottsville series.

R. M. Foose, 1953, Econ. Geology, v. 39, p. 563. Mercer shale member of Pottsville group consists mainly of thin-bedded shale and sandy shale, containing one, and in some places two or three coal beds which range from 3 to 30 inches in thickness. Uusually directly underlying lowest main coal bed there are 5 to 20 feet of clay. Clay commonly rests directly on Connoquenessing sandstone. Underlies Homewood sandstone. Thickness including clay, coals, and shale, as much as 53 feet.

R. C. Bolger and H. V. Gouse, 1953, Pennsylvania Geol. Survey, 4th ser., Bull. M–36, p. 4. In the Driftwood quadrangle, Mercer formation (Pottsville series) consists of shale, coal, sandstone, and claystone. Overlies Connoquenessing sandstone; underlies Homewood sandstone.

R. R. Dutcher and others, 1959, Geol. Soc. America Guidebook Pittsburgh Mtg., p. 68, 70 (fig. 5), 71, figs. 10, 18. Mercer formation contains Mercer coals, Mercer clay, and Homewood sandstone. Overlies Connoquenessing formation; in some areas, overlies Mississippian Mauch Chunk formation.

E. G. Williams, 1960, Jour. Paleontology, v. 34, no. 5, p. 909, 910, (fig. 2). Throughout most of western Pennsylvania, the lower two-thirds of Pottsville group consists of massive sandstone (Connoquenessing formation) and upper one-third of highly variable sequence of clays, coals, shales. and sandstones (Mercer formation). As shown on generalized section, Mercer formation includes Mercer clay at base, Mercer coals and shales in middle part, and Homewood sandstone and shale at top. Underlies Clarion formation of Allegheny group.

Named for Mercer, Mercer County, Pa.

Mercer Limestone (in Pottsville Formation)[1]

Pennsylvanian: Western Pennsylvania.

Original reference: H. D. Rogers, 1858, Geology Pennsylvania, v. 2, pt. 1, p. 474–477.

See Lower Mercer Limestone and Upper Mercer Limestone.

Named for Mercer, Mercer County.

Mercersburg Formation

Middle Ordovician (Trentonian) : South-central Pennsylvania.

L. C. Craig, 1941, (abs.) Geol. Soc. America Bull., v. 52, no. 12, pt. 2, p. 1964. Name proposed for beds formerly included in middle part of Chambersburg limestone. Dark-gray thin irregular and thick even-bedded limestone with base at bottom of drab cuneiform siltstone zone containing metabentonite. Thickness 500 feet. Underlies Greencastle formation; overlies Shippensburg formation (new). In western belts of outcrop in Cumberland Valley, converges with Greencastle formation; in that area it is separated from Shippensburg by Hatter limestone and Snyder member of Benner limestone.

L. C. Craig, 1949, Geol. Soc. America Bull., v. 60, no. 4, p. 715 (fig. 1), 731–732. Redefined and subdivided. Stratigraphically extended by lowering of base to include beds from top of Shippensburg formation. Consists of dark-gray fine-grained, thin crinkly and thick evenly bedded, blue-gray-weathering limestone with an interval of tan to medium-gray, slabby, buff-weathering limestone at base. Five metabentonites recognized; not all present in a single section. In eastern belts, divided into Housum member below and Kauffman member above. Thickness 235 feet at type locality; thins uniformly to northeast. Disconformably underlies Oranda formation; contact marked by prominent basal calcarenite of the Oranda. Contact with underlying Shippensburg formation marked at type section by prominent irregular, partly silicified bedding surface. Type locality further described. Derivation of name given.

Carlyle Gray and others, 1960, Geologic map of Pennsylvania (1:250,000) : Pennsylvania Geol. Survey, 4th ser. As mapped, Chambersburg formation includes dark-gray thin-bedded limestone (Oranda) at top; gray argillaceous limestone (Mercersburg) in the middle; and dark-gray cobbly and thin irregularly bedded limestone (Shippensburg) below. Occurs southwest of Susquehanna River only.

Type section: Along Cumberland Valley Railroad 2 miles southwest of Marion. Franklin County. Named for exposure along West Branch of Conococheague Creek 2.5 miles southeast of Mercersburg, Franklin County.

Merchants Amygdaloid[1]

Precambrian (Keweenawan) : Northern Michigan.

Original reference: B. S. Butler and W. S. Burbank, 1929, U.S. Geol. Survey Prof. Paper 144 (chart compiled by M. G. Wilmarth).

Named for occurrence in old Merchants mine, Ontonagon County.

Merchants Flow[1]

Precambrian (Keweenawan) : Northern Michigan.

Original reference: B. S. Butler and W. S. Burbank, 1929, U.S. Geol. Survey Prof. Paper 144 (chart compiled by M. G. Wilmarth).

Named for occurrence in old Merchants mine, Ontonagon County.

Merchantville Formation (in Matawan Group)

Merchantville Clay (in Matawan Group)[1]

Merchantville Member (of Matawan Formation)

Upper Cretaceous: New Jersey.

Original reference: G. N. Knapp, as reported by R. D. Salisbury, 1899, New Jersey Geol. Survey Ann. Rept. State Geologist 1898, p. 35.

W. B. Spangler and J. J. Peterson, 1950, Am. Assoc. Petroleum Geologists Bull., v. 34, no. 1, p. 8 (fig. 4), 24–26. Member of the Matawan which is here reduced to formational rank. Gradational into overlying Woodbury member; overlies Magothy formation. Thickness about 35 feet in Monmouth County; 60 feet in Salem County; decreases in thickness southeastward toward Chesapeake and Delaware Canal. Exposed in cuts in Chesapeake and Delaware Canal where lithologically it can not be differentiated from the Marshalltown and Woodbury.

M. E. Johnson and H. G. Richards, 1952, Am. Assoc. Petroleum Geologists Bull., v. 36, no. 11, p. 2150–2160. Here considered of formational rank. Report is discussion of paper by Spangler and Peterson (1950).

J. P. Minard and J. P. Owens, 1960, U.S. Geol. Survey Prof. Paper 400–B, p. B184, B185. Basal formation in Matawan group. Underlies Woodbury clay; overlies Magothy formation. Average dip southeast 40 feet per mile. Thickness 48 to 60 feet; thickens in outcrop to northeast.

Named for Merchantville, Camden County.

Mercury Limestone

Lower Mississippian: Southern Nevada.

M. S. Johnson and D. E. Hibbard, 1957, U.S. Geol. Survey Bull. 1021–K, p. 356–357, pls. 32, 33. Consists of dark-gray buff-weathering cherty crinoidal limestone. Generally poorly bedded and forms resistant ledges. Thickness of incomplete section 115 feet. Overlies Narrow Canyon limestone (new); contact gradational. Upper contact not exposed owing to faulting.

Named from exposures on Mercury Ridge about 5 miles east of Camp Mercury, southeast margin of the Atomic Energy Commission Nevada proving grounds area, Nye and Clark Counties. Traceable northeastward for about a mile as prominent gray ledge but terminated in both directions by reverse fault.

Mercy Sandstone Lentil (in Tierra Loma Shale Member of Moreno Formation)

Upper Cretaceous: Southern California.

M. B. Payne, 1941, (abs.) Geol. Soc. America Bull., v. 52, no. 12, pt. 2, p. 1954; 1951, California Div. Mines Spec. Rept. 9, p. 6 (fig. 2), 8 (fig. 14), 9, 24. Occurs 70 feet below top of Tierra Loma shale (new). Thickness about 190 feet. On basis of this mapping, it is concluded that Anderson and Pack (1915) show base of Moreno formation in Ortigalita Creek some 1,800 feet stratigraphically lower than their type Moreno in Moreno Gulch.

Type locality: Mercy Canyon, sec. 15, T. 16 S., R. 12 E., Panoche Hills, Fresno County. Named for Mercy Hot Springs.

Meredith Granite[1] (in New Hampshire Plutonic Series)

Meredith Porphyritic Granite (in New Hampshire Magma Series)

Upper Devonian(?): East-central New Hampshire.

Original reference: M. P. Billings, 1928, Am. Acad. Arts and Sci. Proc., v. 63, p. 83, map.

David Modell, 1936, Geol. Soc. America Bull., v. 47, no. 12, p. 1892, 1893–1894. Porphyritic granite assigned to New Hampshire magma series in Belknap Mountains.

Alonzo Quinn, 1944, Geol. Soc. America Bull., v. 55, no. 4, p. 476–478, pl. 1. Porphyritic granite further described.

M. P. Billings, 1955, Geologic map of New Hampshire (1:250,000): U.S. Geol. Survey. Granite included in Kinsman quartz monzonite of New Hampshire plutonic series in Lake Winnipesaukee region.

Named for typical exposures in Meredith Township, Belknap County.

Meriden Ash Bed[1]

Meriden type[1]

Upper Triassic: Central Connecticut.

Original reference: B. K. Emerson, 1897, Geol. Soc. America Bull., v. 8, p. 66–67, 72–77.

Occurs 1 mile north of Meriden, New Haven County.

Meriden Formation (in Newark Group)

Triassic: Central Connecticut.

P. D. Krynine, 1941, (abs.) Geol. Soc. America Bull., v. 52, no. 12, pt. 2, p. 1919. Fine-grained lacustrine and paludal variegated and dark siltstone, shales, limestones, light feldspathic sandstones, subordinate coarse clastics, and three basaltic lava flows. Maximum thickness 2,800 feet. Underlies Portland formation (new): overlies New Haven arkose (new).

P. D. Krynine, 1950, Connecticut Geol. Nat. History Survey Bull. 73, p. 30–31, 32, 57–69. Subdivided from base upward: lower lava flow, lower sedimentary division, middle lava flow, upper sedimentary division, and upper lava flow. Thickness of sedimentary members varies from 1,150 feet near Meriden to 2,000 feet east of New Haven; lava sheets are from 450 to 850 feet thick. Sedimentary units occur in two facies: normal sedimentary, the most widespread, and Great Fault fanglomeratic facies, confined to eastern margin of outcrop area. Normal sedimentary facies is divided into two geographic facies. In south-central Connecticut, lower division includes coarse pink arkose, limestone, dark shales, and coarse pink or gray micaceous arkose with shaly lenses. Upper division contains fine-grained grayish arkose with a little sandy shale, red siltstones and fissile shales interbedded with black shales and gray feldspathic sandstones, dark shales with arkose and conglomerate lenses, and red fissile shales. In central Connecticut, lower division includes maroon fissile shales, dark laminated shales with limestone layers, and red fissile shales and siltstones. Upper division includes red fissile shales, siltstones and sandy siliceous shales; dark shales with arkose and limestone lenses; and red siliceous sandy shales. Assigned to Newark group. Two type localities designated: the lacustrine environment prototype for the lower division and the swamp prototype for the upper division.

John Rodgers and others, 1956. Preliminary geological map of Connecticut (1:253,440): Connecticut Geol. Nat. History Survey. Lava flows named: Talcott lava member at base, Holyoke lava member in middle, and Hampden lava member at top.

E. P. Lehmann, 1959, Connecticut Geol. Nat. History Survey Quad. Rept. 8, p. 6–7, 8 (table 1). Term Meriden formation not used in this report [Middletown quadrangle]. Rock units involved are here given formational status as follows: Talcott basalt, Shuttle Meadow formation (new), Holyoke basalt, East Berlin formation (new), and Hampden basalt.

Type localities: For lower sedimentary division, outcrop on southern shore of Shuttle Meadow reservoir between Meriden and New Britain; for upper sedimentary division, quarry on a country road in Kensington, 1½ miles south of Berlin.

†Meridian Formation[1] or Buhrstone[1]

Eocene, middle: Southeastern Mississippi and southern Alabama

Original reference: W. J. McGee, 1891, U.S. Geol. Survey 12th Ann. Rept., pt. 1, p. 413–415, 491.

James Turner, 1952, Mississippi Geol. Survey Bull. 76, p. 14–18. Formation described in Yalobusha County, Miss., where it is 40 to 125 feet thick. Unconformably overlies Ackerman formation; contact with overlying Tallahatta not well defined as Meridian sand is interlensed with Tallahatta sand and shale. In basal part of Claiborne.

Named for exposures in vicinity of Meridian, Lauderdale County, Miss.

Meridian Sand Member[1] (of Tallahatta Formation)

Meridian Formation (in Claiborne Group)

Eocene, middle: Southeastern Mississippi and western Alabama.

Original reference: E. N. Lowe, 1933, Mississippi Geol. Survey Bull. 25.

R. E. Grim, 1936, Mississippi Geol. Survey Bull. 30, p. 20. Basal member of Tallahatta formation; underlies Basic member.

F. S. Mellen, 1939, Mississippi Geol. Survey Bull. 38, p. 46–47. Thickness of member 61 feet in Winston County. Underlies Basic member; overlies Hatchetigbee formation.

V. M. Foster, 1940, Mississippi Geol. Survey Bull. 41, p. 63–64, 68–72. Rank raised to formation. Lowe recognized probability of unconformity at top of [Meridian] sand and, in uncompleted manuscript, separated basal Claiborne sands as a distinct formation. Since it is now established that stratigraphic relations are disconformable both above and below and that sands constitute a stratigraphic unit which is different lithologically from overlying and underlying beds, the Meridian is now generally considered to be of formational rank. Thickness 70 to 100 feet in Lauderdale County. Overlies Hatchetigbee formation; underlies Tallahatta formation.

E. P. Thomas, 1942, Mississippi Geol. Survey Bull. 48, p. 16. Meridian is uppermost Wilcox. Reasons presented for this age designation.

L. D. Toulmin, P. E. LaMoreaux, and C. R. Lanphere, 1951, Alabama Geol. Survey Spec. Rept. 21, pl. 3. Correlation chart shows Meridian sand member present in Choctaw County and western Alabama.

T. W. Lusk, 1956, Mississippi Geol. Survey Bull. 80, p. 43–54. Formation described in Benton County about 100 to 150 feet thick. Commonly a very coarse to medium sand. On outcrop, usually reddish brown, but, where fresh and a few feet above its lower contact, characteristically banded light and dark brown. Disconformity at base of formation well exhibited; upper contact not so clear. As result of lateral change of Tallahatta formation from shale to sand, exact Meridian-Tallahatta contact can be determined at only few locations. Overlap of Meridian formation has added to confusion of age determination of Meridian as well as overlying Wilcox strata. Claiborne group.

R. J. Hughes, Jr., 1958, Mississippi Geol. Survey Bull. 84, p. 189, pls. 1, 5. Meridian sand member probably present at surface in southeastern corner of Kemper County. Sand might be included in either Wilcox or Claiborne group. Mississippi Geological Survey includes Meridian sand member in the Claiborne.

Named for exposures at and near Meridian, Lauderdale County, Miss.

Meriwitica Member (of Bright Angel Shale and of Lyndon Limestone)

Meriwitica Tongue [in Bright Angel Shale]

Lower and (or) Middle Cambrian: Northwestern Arizona.

E. D. McKee, 1945, Carnegie Inst. Washington Pub. 563, p. 14 (fig. 1), 29, 80–82. Tongue is rusty-brown-dolomite unit in Bright Angel shale of western Grand Canyon. Composed of crystalline dolomite. Thickness at Meriwitica Canyon 16 feet. Separated from base of Muav formation by member of Bright Angel shale about 100 feet thick composed of shales and limestone. Lateral equivalent of certain limestone beds found in area west of Grand Canyon that probably constitute a member of the Muav, which is lower than any member within the Grand Canyon. Younger than Tincanebits tongue (new); older than Elves Chasm tongue (new).

H. E. Wheeler and V. W. Mallory, 1953, Am. Assoc. Petroleum Geologist Bull., v. 37, no. 10, p. 2413 (fig. 2), 2414. In generalized paper on designation of stratigraphic units, mentioned that Meriwitica would be treated as member of Lyndon westward and as member of Bright Angel eastward in accordance with procedure recommended by present stratigraphic code.

In western Grand Canyon. Traced along walls of canyon for many miles and extends eastward at least as far as Meriwitica Canyon.

Merizo Limestone

Recent: Mariana Islands (Guam).

Risaburo Tayama, 1952, Coral reefs in the South Seas: Japan Hydrog. Office Bull., v. 11, p. 58–59, table 4 [English translation in library of U.S. Geol. Survey, p. 69]; S. Hanzawa, 1956, *in* Jacques Avias and others, Lexique Strat. Internat., v. 6, Océanie, fasc. 2, p. 46–47. A raised coral reef. Consists of two members separated by unconformity. Upper member is limestone consisting of erect corals; lower member is conglomerate consisting of coral gravels deposited horizontally. Merizo and Barrigada (Mariana) limestones are unconformable. Correlated with Tanapag limestone.

Typically exposed at Merizo, Guam.

Merkel Dolomite Member (of Choza Formation)

Merkel Dolomite Member (of Clear Fork Formation)[1]

Permian: North-central Texas.

Original reference: W. E. Wrather, 1917, Southwestern Assoc. Petroleum Geologists Bull., v. 1, p. 95, 96, 97, pl.

M. G. Cheney, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 1, p. 66 (fig. 1). Shown on chart as member of Choza formation. Occurs above Bullwagon dolomite member of Arroyo formation and below San Angelo sandstone.

Named for exposures just west of Merkel, Taylor County.

Mermentau Member (of Le Moyen Formation)

Recent: Southeastern Louisiana (subsurface and surface).

P. H. Jones *in* P. H. Jones, A. N. Turcan, Jr., and H. E. Skibitzke, 1954, Louisiana Dept. Conserv. Geol. Bull. 30, p. 90–94. Consists of dark-colored marine muds, beach deposits of sand and shell, organic clays of the coastal marsh, and sediments formed in lakes and bays—all complexly interlaminated; deposition of member continues today. Thickness increases gulfward and eastward and thins out landward against emergent Pleistocene deposits. Upper surface is modern land surface. Base lies on eroded gulf-marginal surface of Prairie formation. Essentially contemporaneous with and merges into deltaic deposits of Lebeau member.

Named for deposits penetrated by water wells and bore holes in vicinity of Cameron, in T. 14 S., R. 9 W., in Cameron Parish.

Merom cyclothem (in McLeansboro formation)

Pennsylvanian: Central and southern Illinois.

J. M. Weller and W. A. Newton, 1938, (abs.) Geol. Soc. America Proc. 1937, p. 329. Upper part of McLeansboro formation from Shoal Creek limestone up to highest Pennsylvanian strata, is divided into following cyclothems (descending): Merom, Shumway, Woodbury, Gila, Greenup, Newton, Upper Bogota, Lower Bogota, Cohn, LaSalle, Macoupin, Flannigan, and Shoal Creek.

Type locality not given, but type for Merom sandstone is in sec. 7, T. 7 N., R. 10 W., Sullivan County, Ind.

†Merom Group[1]

Pennsylvanian: Southwestern Indiana.

Original reference: G. H. Ashley, 1902, U.S. Geol. Survey 22d Ann. Rept., pt. 3, p. 273–277.

Named for Merom, Sullivan County.

Merom Sandstone[1]

Merom Sandstone Member (of Mattoon Formation)

Upper Pennsylvanian: Southwestern Indiana and eastern Illinois.

Original reference: J. Collett, 1871, Indiana Geol Survey 2d Rept., p. 199.

C. A. Malott, 1948, Indiana Acad. Sci. Proc., v. 57, p. 126 (fig. 1), 129–130. In Dicksburg Hills, Knox County, Ind., overlies Ditney formation (restored) and underlies Hazelton Bridge formation (new). Thickness about 40 feet in Hazelton locality.

H. R. Wanless and Raymond Siever, 1956, Illinois Geol. Survey Circ. 217, p. 12. Type locality stated.

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 41, 51 (table 1). Rank reduced to member status in Mattoon formation (new).

Type locality: Sec. 7, T. 7 N., R. 10 W. Named from exposures in Wabash River bluff at Merom, Sullivan County, Ind.

Merriam Limestone[1] **Member** (of Plattsburg Limestone)

Pennsylvanian (Missouri Series): Eastern Kansas, northwestern Missouri, and southeastern Nebraska.

Original reference: R. C. Moore, 1932, Kansas Geol. Soc. 6th Ann. Field Conf. Guidebook, p. 93, 97.

G. E. Condra, 1949, Nebraska Geol. Survey Bull. 16, p. 33–34. This is "Meadow" limestone named by Condra and Bengston (1915). Its type locality is in Kiewitz quarry west of Meadow Station, Sarpy County, Nebr. Although member was properly defined with relation to its position and sequence in the section, its age correlation has proven to be in error; although name has been in use for more than 30 years, it is now dropped, and name Merriam accepted by Nebraska Survey.

R. C. Moore and others, 1951, Kansas Geol. Survey Bull. 89, p. 81. Basal member of Plattsburg. Underlies Hickory Creek shale member; overlies Bonner Springs shale.

Named for exposures in town of Merriam, Johnson County, Kans.

Merrimac granodiorite

Late Jurassic(?): Northern California.

Anna Hietanen, 1951, Geol. Soc. America Bull., v. 62, no. 6, p. 583, 584, pl. 1. Shown on map and named in a petrographic discussion of rocks in the area.

Occurs in Merrimac area, Plumas National Forest, Butte and Plumas Counties.

Merrimac Rhyolite[1]

Precambrian (pre-middle Huronian): South-central Wisconsin.

Original reference: J. T. Stark, 1932, Jour. Geology, v. 40, no. 2, p. 120, 121, 130.

In Merrimac Township, on south flank of syncline near Merrimac, sec. 32, T. 11 N., R. 7 E., Baraboo district.

Merrimack Quartzite[1] **or Group**

Probably Ordovician and Silurian: Southeastern New Hampshire and northeastern Massachusetts.

Original reference: C. H. Hitchcock, 1870, New Hampshire 2d Ann. Rept. on Geology and Mineralogy, p. 34, geol. map.

L. W. Currier, 1952, *in* L. W. Currier and R. H. Jahns, Geol. Soc. America Guidebook for Field Trips in New England, p. 107. Age of quartzite is Devonian(?) or Carboniferous(?).

M. P. Billings, 1955, Geologic map of New Hampshire (1:250,000): U.S. Geol. Survey. Group term used in New Hampshire. Subdivided to include (ascending) Kittery quartzite, Eliot formation, and Berwick formation. Probably Ordovician and Silurian.

M. P. Billings, 1956, Geology of New Hampshire, pt. 2, bedrock geology: Concord, New Hampshire State Plan. Devel. Comm., p. 43–44, 99–105. Merrimack group of present report is used in much the same sense as by Hitchcock except that Rye formation is excluded. That part of Hitchcock's Rockingham mica schist lying southeast of Fitchburg pluton is included in Merrimack group. Group is equivalent of Eliot and Berwick formations. Thickness probably about 16,500 feet. Term Merrimack group as used in present report is more inclusive than Merrimack quartzite of Massachusetts (Emerson, 1917, U.S. Geol. Survey Bull. 597). Group includes following formations on Emerson's map: Merrimack quartzite, Oakdale quartzite, and gneisses of unknown age and origin. Tentatively assigned to Silurian.

Named for exposures on both sides of Merrimack River and near town of Merrimack, N.H.

Merriman Limestone Member (of Graford Formation)[1]

Upper Pennsylvanian: Central northern Texas.

Original reference: F. Reeves, 1922, U.S. Geol. Survey Bull. 736–E, p. 120.

C. O. Nickell *in* Wallace Lee and others, 1938, Texas Univ. Bur. Econ. Geology Pub. 3801, p. 97. Name Merriman abandoned. Unit included in Winchell member (new) of Graford formation.

Crops out near Merriman Church, south of Ranger, Eastland County.

Merritt Sand[1]

Pleistocene: Western California.

Original reference: A. C. Lawson, 1914, U.S. Geol. Survey Geol. Atlas, Folio 193.

P. D. Trask and J. W. Rolston, 1951, Geol. Soc. America Bull., v. 62, no. 9, p. 1082, 1103–1105. Thickness as much as 60 feet. Underlies Bay Mud formation (new); overlies Posey formation (new).

D. H. Radbruch, 1957, U.S. Geol. Survey Misc. Geol. Inv. Map I–239. In Oakland West quadrangle, Merritt sand varies in thickness from a few inches to known maximum of 65 feet. Overlies Alameda formation; grades laterally into Temescal formation; underlies Bay Mud. Where exposed at surface forms low, rounded hills.

Named for occurrence on Lake Merritt, in city of Oakland.

Mesa Basalt[1]

Tertiary, upper: Northwestern Nevada and southeastern Oregon.

Original reference: J. C. Merriam, 1910, California Univ. Dept. Geology Bull., v. 6, no. 2, p. 21–53.

D. O. Cochran, 1959, Oregon Dept. Geology and Mineral Industries Bull. 50, p. 10 (chart), 12. Mesa basalt listed with Cenozoic formations of Oregon. Overlies Thousand Creek formation.

Widespread over region of Virgin Valley and Thousand Creek, west of Denio, Humboldt County, Nev.

Mesa Formation[1]

Age(?): Arizona.

Original reference: W. P. Blake, 1899, Rept. Governor Arizona to Secretary Interior of U.S., p. 143.

Forms mesa on which University of Arizona at Tucson is located.

†Mesabi Gabbro[1]

Precambrian: Minnesota.

Original reference: N. H. Winchell, 1895, Am. Geologist, v. 16, p. 333.

In Mesabi district.

†Mesabi Series[1]

Pre-Cambrian (Huronian): Northeastern Minnesota.

Original reference: C. R. Van Hise and C. K. Leith, 1901, U.S. Geol. Survey 21st Ann. Rept., pt. 3, p. 351–361.

Mesabi district.

Mesa Redondo Member (of Chinle Formation)

Upper Triassic: Northeastern Arizona.

M. E. Cooley, 1958, Plateau, v. 31, no. 1, p. 7–14. Comprises lower reddish-brown mudstone-siltstone slope-forming unit, medial conglomeratic ledge-forming unit, and upper mudstone-siltstone slope-forming unit. Thickness ranges from 95 to 160 feet. Maximum thickness on Cedar Ridge 5 miles southeast of St. Johns; 98 feet thick, 6 miles north of Concho, and 121 feet at type area. Grades upward or intertongues with lower part of Petrified Forest member; either lies unconformably on Moenkopi formation or overlies and intertongues laterally with Shinarump member of Chinle formation.

Type section: Along north side of Little Colorado River, 1 to 3 miles east of State Highway 260, and about 16 miles northwest of Concho, Ariz. Named from exposures, lying at base of Mesa Redondo, a prominent landmark 20 miles east of Snowflake, about 10 miles southwest of type section.

Mesa Rica Sandstone

Mesa Rica Sandstone Member (of Purgatoire Formation)

Lower Cretaceous: Northeastern New Mexico.

Ernest Dobrovolny and C. H. Summerson, 1946, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 62. White or brownish-buff crossbedded medium- or coarse-grained sandstone that is massive or cliff forming; locally lenses of quartz-pebble conglomerate at base. Overlies Tucumcari shale member; underlies Pajarito shale member (new). Originally included in Tucumcari beds.

R. L. Griggs and C. B. Read, 1959, Am. Assoc. Petroleum Geologists Bull., v. 43, no. 8, p. 2005 (fig. 2), 2007. Rank raised to formation; term Purgatoire abandoned in Tucumcari-Sabinoso area. Thickness 50 to 100 feet.

Type locality and derivation of name not stated. First described in northwestern Quay County.

Mesaverde Group[1] or Formation[1]

Upper Cretaceous: Western Colorado, Arizona, northwestern New Mexico, eastern Utah, and Wyoming.

Original reference: W. H. Holmes, 1877, U.S. Geol. and Geog. Survey Terr. 9th Ann. Rept. for 1875, p. 245, 248, pl. 35.

N. M. Fenneman and H. S. Gale, 1906, U.S. Geol. Survey Bull. 297, p. 22–28, pl. 11. Formation, in Yampa coal field, Routt County, Colo., comprises (ascending) barren sandstone series, lower coal group, Trout Creek sandstone, middle coal group, Twentymile sandstone, and upper coal group. Thickness about 3,500 feet. Overlies Mancos formation; underlies Lewis shale.

W. T. Lee, 1909, U.S. Geol. Survey Bull. 341, p. 320 (table), 322–323. Formation, in Grand Mesa coal field, Colorado, comprises (ascending) Rollins sandstone, Bowie shale, and Paonia shale. Thickness 925 feet. Overlis Mancos shale. Montana group.

C. H. Wegemann, 1918, U.S. Geol. Survey Bull. 670, p. 20–23. Formation, in Salt Creek oil field, Wyoming, divided into (ascending) Parkman sandstone, unnamed member, and Teapot sandstone. Thickness about 845 feet. Represents in whole or in part the Mesaverde formation of Colorado and southern Wyoming. Overlies Steele shale; underlies Lewis shale.

A. J. Collier, 1919, U.S. Geol. Survey Bull. 691–K, p. 296–297, pl. 34. Group, in Montezuma County, Colo., comprises (ascending) Point Lookout sandstone, Menefee and Cliff House sandstone. Overlies Mancos shale.

E. T. Hancock, 1925, U.S. Geol. Survey Bull. 757, p. 7 (table), 13–20. Group, in Axial and Monument Butte quadrangles, Colorado, comprises (ascending) Iles and Williams Fork formations. Overlies Mancos shale; underlies Lewis shale.

J. D. Sears, 1925, U.S. Geol. Survey Bull. 767, p. 15–18. Formation, as exposed in Gallup-Zuni basin, comprises about 1,800 feet of alternating gray sandstone, drab clay shale, and coal beds. Subdivided into (ascending) Gallup sandstone, Dilco coal, Bartlett barren, Gibson coal, and Allison barren members. Overlies Mancos shale.

E. M. Spieker and J. B. Reeside, Jr., 1925, Geol. Soc. America Bull., v. 36, no. 3, p. 440 (fig. 2), 441–448. In Wasatch Plateau, rocks designated as Mesaverde group are subdivided into (ascending) Star Point sandstone, Blackhawk formation, and Price River formation. Upper shale member of Mancos passes by gradual transition into basal formation of Mesaverde group; underlies Wasatch formation.

J. D. Sears, 1926, U.S. Geol. Survey Bull. 781, p. 16 (chart). Group, in Baxter Basin, Wyo., comprises (ascending) Blair formation, Rock Springs formation, Ericson sandstone, and Almond formation. Overlies Baxter shale; underlies Lewis shale.

C. E. Dobbin and others, 1929, U.S. Geol. Survey Bull. 806–D, p. 134 (table), 140–141. Formation, in Rock Creek oil field, Wyoming, is about 1,250 feet thick. Top is marked by Pine Ridge sandstone member which contains several beds of coal. Overlies Steele shale; underlies Lewis shale.

C. E. Erdmann, 1934, U.S. Geol. Survey Bull. 851, p. 22–23 (table), 31–53. In Book Cliffs coal field, Colorado, Mesaverde group comprises (ascending) Castlegate sandstone, Sego sandstone, Mount Garfield formation, and Hunter Canyon formation. Overlies Mancos shale; unconformable below Tertiary(?).

J. D. Sears, 1934, U.S. Geol. Survey Bull. 860–A, p. 14–19. Formation, in coal field from Gallup eastward to Mount Taylor, comprises (ascending) Gallup sandstone, Dilco coal, Dalton sandstone (new), Bartlett barren, Gibson coal, Hosta sandstone (new), and Allison barren members. Overlies Mancos shale.

C. B. Hunt, 1936, U.S. Geol. Survey Bull. 860–B, p. 45–50. Formation, in Mount Taylor coal field, comprises (ascending) Gallup sandstone, Dalton sandstone, Gibson coal, and Hosta sandstone members. Mulatto tongue of Mancos lies between Dilco coal and Dalton sandstone members. Satan tongue of Mancos splits Hosta sandstone member into a lower and an upper part. Gibson coal member is split by Hosta sandstone into a lower and an upper part. Higher formations of Upper Cretaceous absent in area.

C. H. Dane, 1936, U.S. Geol. Survey Bull. 860–C, p. 93–108, pl. 41. Formation, in La Ventana-Chacra Mesa coal field, New Mexico, comprises (ascending) Hosta sandstone, Gibson coal, Allison, La Ventana, and Chacra sandstone members. Overlies Mancos shale; underlies and interfingers with Lewis shale.

D. J. Fisher, 1936, U.S. Geol. Survey Bull. 852, p. 9–10 (table), 12–20. Group, in Book Cliffs coal field, Emery and Grand Counties, Utah, comprises (ascending) Blackhawk formation and Price River formation which is subdivided into (ascending) Castlegate sandstone, Sego sandstone, Neslen coal-bearing, and Farrer non-coal-bearing members. Buck tongue of Mancos shale separates the Castlegate and Sego sandstone members. Overlies Mancos shale; underlies Tuscher formation.

E. C. Dapples, 1939, Econ. Geology, v. 34, no. 4, p. 371. In Anthracite-Crested Butte coal district, Colorado, formation includes Rollins sandstone member below and Baldwin sandstone member (new) above. Name Baldwin replaces term Bowie as used in area by Lee.

P. J. Walton, 1944, Geol. Soc. America Bull., v. 55, no. 1, p. 93–130. Tabby Mountain region in western part of Uinta basin, Mesaverde group undifferentiated is 0 to 3,000 feet; overlies Mancos shale and unconformably underlies Current Creek formation (new). In eastern part of Uinta basin, group is subdivided into (ascending) Asphalt Ridge sandstone (new), Rim Rock sandstone (new), and Williams Fork formation (contains more than type Williams Fork). Overlies Mancos shale; unconformably underlies Wasatch formation.

W. S. Pike, Jr., 1947, Geol. Soc. America Mem. 24, p. 9–11, 71. Discussion of large-scale intertonguing between marine Mancos and nonmarine Mesaverde strata in New Mexico, Arizona, and southwestern Colorado. At type locality, the Mesaverde is usually referred to as a group because of the three distinct lithologic subdivisions. To the south, it is usually considered a formation, and the less distinct subdivisions are treated as members. In Gallup area, base of Gallup sandstone, although conformable with underlying Mancos shale, marks abrupt change in lithology which Sears considered indicated Mancos-Mesaverde contact. At that time, he believed Gallup sandstone to be homogenetic equivalent of Point Lookout sandstone but recognized that it was much older. It is now known that all or most of Mesaverde near Gallup is older than any of Mesaverde of type locality. Several tongues of Mancos shale project into and wedge out between rocks of Mesaverde character. Southward from Gallup, the Gallup member thickens at expense of underlying Mancos shale to about 400 feet and becomes more nonmarine, and in Zuni Indian Reservation is divided into upper and lower parts by Pescado tongue (new) of Mancos shale. Still farther south near southern limit of Mesa Verde-Atarque area, rocks of Mesaverde facies come into section below Gallup member and are separated from it by Horsehead tongue (new) of Mancos shale. This unit is herein named Atarque member of Mesaverde. Winchester's (1920) Chamiso formation reduced to rank of member of Mesaverde.

L. B. Leopold and C. T. Snyder, 1951, U.S. Geol. Survey Water-Supply Paper 1110–A, p. 8, 9. In vicinity of Gallup, N. Mex., Gibson coal member of Mesaverde disconformably underlies Gamerco formation (new).

C. E. Stearns, 1953, Geol. Soc. America Bull., v. 64, no. 4, p. 463 (fig. 2), 466–467. Formation, in Galisteo-Tonque area, New Mexico, includes Cano sandstone member (new) embedded in upper part of Mancos shale.

J. E. Allen and Robert Balk, 1954, New Mexico Bur. Mines Mineral Resources Bull. 36, p. 87–96. Mesaverde group, in Fort Defiance-Tohatchi quadrangles divided into five formations with several members as follows: Gallup sandstone, 100 to 400 feet; Crevasse Canyon formation (new), 252 to 410 feet, which includes Dilco, Dalton sandstone, and lower Gibson members; Point Lookout sandstone, 0 to 365 feet, which includes Satan tongue of Mancos shale and Hosta sandstone tongue; Menefee formation, 2,300 feet; and Tohatchi formation, about 1,350 feet. Overlies Mancos shale; underlies Chuska sandstone.

H. E. Wright, Jr., 1954, Am. Assoc. Petroleum Geologists Bull., v. 38, no. 8, p. 1831–1833. Group, in Chuska Mountains, unconformably underlies Deza formation (new).

M. W. Bodine, Jr., 1956, New Mexico Bur. Mines Mineral Resources Circ. 35, p. 4 (fig. 2), 5 (fig. 3), 6–8. In Capitan coal field, Lincoln County, Mesaverde group, undifferentiated, is about 400 feet thick, overlies Mancos shale and underlies Cub Mountain formation (new).

C. A. Repenning and H. G. Page, 1956, Am. Assoc. Petroleum Geologists Bull., v. 40, no. 2, p. 271–281. Mesaverde group in Black Mesa area, Arizona, comprises three formations (ascending): Toreva, Wepo, and Yale Point sandstone (all new). Group of Black Mesa, in its entirety, is older than Mesaverde at type locality in southwestern Colorado. Overlies Mancos shale; no younger sediments overlie Yale Point sandstone.

E. C. Beaumont, C. H. Dane, and J. D. Sears, 1956, Am. Assoc. Petroleum Geologists Bull., v. 40, no. 9, 2149–2162. Mesaverde group substituted for Mesaverde formation, throughout San Juan basin, and formations of the type locality, Point Lookout sandstone, Menefee formation, and Cliff House sandstone, are also extended throughout the basin. Several names for units formerly called members of Mesaverde formation in southern part of basin are retained as names of tongues or members of the formations of Mesaverde group. Name Gallup sandstone replaces Tocito sandstone lentil of Mancos shale. Crevasse Canyon formation of Allen and Balk (1954) is accepted for that part of Mesaverde group between Gallup sandstone and Point Lookout sandstone with Gibson coal member restricted at its top. Name Cleary coal member of Menefee formation is proposed for beds formerly included in upper part of Gibson coal member of Mesaverde. Beds included in Chacra sandstone member by Dane (1936) appear to be about equivalent to combined upper two southward-extending tongues of Cliff House sandstone northeast of Newcomb. Name Cliff House sandstone will replace Chacra sandstone member.

C. H. Dane, A. A. Wanek, and J. B. Reeside, Jr., 1957, Am. Assoc. Petroleum Geologists Bull., v. 41, no. 2, p. 191, Chamiso member of Mesaverde abandoned in favor of Crevasse Canyon formation.

W. H. Tonking, 1957, New Mexico Bur. Mines Mineral Resources Bull. 41, p. 6 (table 1), 7 (fig. 2), 18–22. Group described in Puertecito quadrangle. Includes La Cruz Peak and Crevasse Canyon formations as well as unit termed Tres Hermanos(?) sandstone at base. Thickness about 1,765 feet including Tres Hermanos(?) sandstone. Overlies Mancos shale; underlies Baca formation.

E. I. Rich, 1958, Am. Assoc. Petroleum Geologists Bull., v. 42, no. 10, p. 2426–2436. In Powder River basin, Mesaverde formation is divided into three members (ascending): Parkman sandstone, unnamed member, and Teapot sandstone. Parkman sandstone, as defined by Darton (1906), was treated as a formation and included all sandy strata correlative with what is herein referred to as Mesaverde formation. Within framework of regressive and transgressive deposition, as it is used in this report, the marine part of unnamed middle member in Power River basin appears to be a tongue of Pierre shale. Mesaverde is not subdivided in Big Horn Basin. Overlies Cody shale or Steele shale. Underlies Meeteetse formation or Lewis shale.

C. W. Brown, 1958, Dissert. Abs., v. 18, no. 1, p. 194. Mesa Verde group, in Yellowstone Park area, includes Bacon Ridge formation, "coaly sequence," "lenticular sandstone and shale sequence," "white sandstone sequence," and Harebell formation. Group is overturned southwest of Gardiner thrust fault and is in fault contact with Precambrian, Paleozoic, and Jurassic rocks.

J. M. Parker, 1958, Wyoming Geol. Assoc. Guidebook 13th Ann. Field Conf., p. 90, 98. As formation names Bearpaw and Claggett are used in part of basin [Powder River, Wyoming-Montana] and as age relationships of these formations are rather well defined, it is preferable to use those names throughout basin. By using formation names Bearpaw, Parkman, Claggett, Eagle, Telegraph Creek, and Niobrara, it is possible to do away with names Lewis, Cody, Steele, and Mesaverde in this area. Lewis, Cody, Steele, and Mesaverde formations, as defined in their respective type localities, do not relate exactly in time or as continuous rock units with rocks that have been designated by those names in Powder River basin.

J. R. Donnell, 1959, Rocky Mountain Assoc. Geologists [Guidebook] 11th Ann. Field Conf., Symposium, p. 76–77. Formation, in Carbondale area, northwestern Colorado, is more than 5,000 feet thick in Thompson Creek area. Thins southward to about 2,800 feet. Overlies Mancos shale. Underlies Ohio Creek conglomerate.

J. A. Barlow, Jr., 1959, Rocky Mountain Assoc. Geologists [Guidebook] 11th Ann. Field Conf., Symposium, p. 111–113. Total thickness of Mesaverde formation 2,644 feet on west flank of Rawlins uplift, Carbon County, Wyo. Overlies Steele formation; underlies Lewis formation.

J. R. Bergstrom, 1959, Rocky Mountain Assoc. Geologists [Guidebook] 11th Ann. Field Conf., Symposium, p. 114. Informally named Mesaverde group in southeastern Wyoming is composed of Allen Ridge formation (new) and Pine Ridge sandstone. Overlies Steele formation; underlies Lewis formation.

D. J. Fisher, C. E. Erdmann, and J. B. Reeside, Jr., 1960, U.S. Geol. Survey Prof. Paper 332, p. 9–22, measured sections. Area of report, Book Cliffs in Carbon, Emery, and Grand Counties, Utah, and Garfield and Mesa Counties, Colo. Mesaverde group, because of its lateral changes in character and composition, is divided into three sets of units. In western cliffs, the Star Point formation is not present as such, and Blackhawk formation at base of group is overlain by Castlegate sandstone and Price River formation (restricted by removal of the Castlegate). In central cliffs, the much-thinned Blackhawk formation is overlain in succession by Castlegate sandstone, Buck tongue of Mancos shale, Sego sandstone, Neslen formation, Farrer formation, and Tuscher formation. In early reports, the Sego, Neslen, and Farrer formations have been considered members of Price River formation, and Tuscher formation was not included in Mesaverde group. In eastern cliffs, the Sego sandstone is basal unit, containing Anchor Mine tongue of Mancos shale; the Sego is overlain by Mount Garfield formation, containing in lower part "coal measures" with Rollins sandstone member and upper part "barren measures"; at top is Hunter Canyon formation. Relations between Mancos shale and overlying Mesaverde are not simple, for there is successive loss of sandstone along the outcrop from west to east by change into shale, such that in their larger aspects the two units overlap considerably—higher parts of Mancos shale were formed contemporaneously with lower parts of Mesaverde to west.

Names Haybro, Holderness, Milner, and Mount Harris Formations, all in Mesaverde Group, appeared in bold face in the Wilmarth Lexicon on the basis of Wilmarth's correlation chart. The names had been approved for use by M. R. Campbell. Cobban and Reeside (1952, Geol. Soc. America Bull., v. 63, no. 10) used the names on the Cretaceous correlation chart and cited the Wilmarth Lexicon. However, Campbell's report was not published. U.S. Geological Survey has abandoned the names.

Named from Mesa Verde, Colo.

Mescal Limestone (in Apache Group)[1]

Precambrian : Central Arizona.

Original reference: F. L. Ransome, 1915, Washington Acad. Sci. Jour., v. 5, p. 380–385.

N. P. Peterson, 1954, U.S. Geol. Survey Geol. Quad. Map GQ–41. Composed of distinct beds ranging from a few inches to 2 feet in thickness that have great diversity in character and composition, A few beds are relatively pure crystalline limestone, but most are cherty and dolomitic. Thickness in Globe quadrangle about 250 feet. Overlies Dripping Spring quartzite. Wherever top of Mescal is exposed, it is overlain by basalt of Apache group. Stratigraphically below Troy quartzite.

Named for exposures in Mescal Range, Ray quadrangle.

Mescaleran series

Paleozoic (Late Carbonic) : New Mexico.

Charles Keyes, 1940, Pan-Am. Geologist, v. 74, no. 2, p. 106 (chart). Comprises (ascending) Cornudas, Leonard, Limpia; and Eddy terranes.

Meseta Blanca Sandstone Member (of Yeso Formation)

Permian : Northwestern New Mexico.

G. H. Wood and S. A. Northrop, 1946, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 57. Light orange or red tangentially crossbedded sandstone. Weathers to rounded and overhanging cliffs. Underlies San Ysidro member (new) ; overlies Abo formation in the south, tongues with Abo to the north, and then tongues into Cutler formation in vicinity of Senorito Canyon. In area from San Miguel Canyon north to Senorito Canyon, Meseta Blanca tongues with overlying San Ysidro member.

V. C. Kelley and G. H. Wood, 1946, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 47. In Lucero uplift, Valencia, Socorro, and Bernalillo Counties, underlies Los Vallos member (new). Thickness 0 to 250 feet. Coextensive with underlying Abo formation.

Type section: Near Canon, in sec. 3, T. 16 N., R. 2 E., Sandoval County, and area immediately north of this section in Canon de San Diego Grant.

Meshik Formation[1]

Miocene: Southwestern Alaska.

Original reference: R. S. Knappen, 1929, U.S. Geol. Survey Bull. 797, p. 198–201, map.

U.S. Geological Survey currently designates the age of the Meshik Formation as Oligocene or Miocene on the basis of a study now in progress.

Well exposed along sides of valley of Meshik River and Meshik Lake, Alaska Peninsula.

Mesillan series

Paleozoic (Mid-Siluric) : Southern New Mexico.

[C. R.] Keyes, 1942, Pan-Am. Geologist, v. 77, no. 4, p. 319. Name applied to Mid-Siluric rocks. Includes Fusselmann limestone.

Name taken from valley at foot of Franklin-Organ Mountains, north of El Paso.

†Mesnard Epidote[1]

Precambrian (Keweenawan) : Northern Michigan.

Original reference: A. C. Lane and A. E. Seaman, 1907, Jour. Geology, v. 15, p. 680.

Named for fact it occurs in old Mesnard mine, Houghton County.

†Mesnard Formation[1]

Precambrian : Northwestern Michigan.

Original reference: M. E. Wadsworth, 1893, Michigan Geol. Survey Rept. 1891 and 1892, p. 63–66.

S. A. Tyler and W. H. Twenhofel, 1952, Am. Jour. Sci., v. 250, nos. 1–2, p. 11 (table 1), 12–16. Lithology at type locality and adjacent areas, consists of basal conglomerate succeeded by clean quartzite followed upward by shaly quartzite which passes into shale; east of Teal Lake, basal quartzite is succeeded by interbedded shales and quartzites which pass upward into relatively clean white and pink quartzites. Van Hise and Bayley (1897, U.S. Geol. Survey Mon. 28) divided formation into four members: basal conglomerate, slate and quartzite, quartzite, and slate; Van Hise and Leith (1911, U.S. Geol. Survey Mon. 52) concluded there were three members: basal conglomerate, central quartzite, and upper slate. It is doubtful if any division as simple as either of these can be made because lithic sequence varies greatly from place to place. Total thickness cannot be determined. Underlies Kona formation; separated from underlying granites by unconformity.

Type section: Exposed on slopes and summit of Mount Mesnard south of Marquette.

Mesnard Quartzite[1]

Precambrian : Northwestern Michigan.

Original reference: C. R. Van Hise and W. S. Bayley, 1895, U.S. Geol. Survey 15th Ann. Rept., p. 517.

S. A. Tyler and others, 1940, Geol. Soc. America Bull., v. 51, no. 10, p. 1436 (table 1), 1455 (table 4), 1461. Palmer gneiss, previously considered pre-Huronian, consists of metamorphic Mesnard quartzite, Kona dolomite, Wewe slate, and Ajibik quartzite. Table 1 shows lower Huronian sequence in Marquette area (ascending) Mesnard, Kona, Wewe. Palmer gneiss not listed on this table.

Composes larger part of mass of Mount Mesnard, south of Marquette, Marquette County.

Mesquite Schist

Precambrian (?) : Southern California.

T. W. Dibblee, Jr., 1952, California Div. Mines Bull. 160, p. 12 (fig. 1). 14–15, pls. 1–3. Chlorite-quartiz-albite-sericite schist; dark steel gray when fresh, weathers to light silvery gray; prominently and thinly bedded; uppermost 500 feet contains many interbeds of fine crystalline limestone, some as much as 10 feet thick. Total thickness about 4,500 feet. Schist dips east under Garlock series (new) ; contact sharp, concordant; probably a disconformity. Columnar section shows Mesquite schist younger than Rand schist.

Exposed in Mesquite Canyon in El Paso Mountains, Saltdale quadrangle, Kern County.

Metacom Granite Gneiss

Devonian(?) or older: Eastern Rhode Island.

A. W. Quinn and G. H. Springer, 1954, U.S. Geol. Survey Geol. Quad. Map GQ–42. Gray to pink medium-grained locally porphyritic granite. Characteristically lineated and locally foliated. Contains inclusions or relics of quartz muscovite schist and darker schists; in places is in gradational contact with the quartz-muscovite schist. Small dikes and irregular intrusive bodies of aplite also present.

Named for exposures along Metacom Avenue one-half mile south of summit of Jupiter Hill and eastward for one-quarter mile at eastern border of Bristol village, Bristol County.

Metalanim (Matalanin) Beds or Conglomerate

Miocene: Caroline Islands (Ponape).

Risaburo Tayama, 1939, Correlation of the strata of the South Sea Islands: Geol. Soc. Japan Jour., v. 46, no. 549, p. 347 (correlation chart) [English translation in library of U.S. Geol. Survey]. Matalanim conglomerate named on correlation chart. Oligocene.

Risaburo Tayama, 1952, Coral reefs in the South Seas: Japan Hydrog. Office Bull., v. 11, p. 69, table 5 [English translation in library of U.S. Geol. Survey, p. 84]. Matalanim beds belong to East Caroline group, considered to be Miocene.

Metaline Limestone or **Formation**

Middle Cambrian: Northeastern Washington.

C. F. Park, Jr., 1938, Econ. Geology, v. 33, no. 7, p. 713 (chart), 714 (fig. 2). Named on map and stratigraphic chart. Thickness 3,000 feet. Underlies Ledbetter slate and overlies Maitlen phyllite (both new).

C. F. Park, Jr., and R. S. Cannon, Jr., 1943, U.S. Geol. Survey Prof. Paper 202, p. 6 (table), 17–19, pl. 1. Described as limestone and dolomites with phyllite near base. Grades into Maitlen phyllite below. Derivation of name given.

C. D. Campbell, 1947, Geol. Soc. America Bull., v. 58, no. 7, p. 606–612, pl. 1. Remapping of northeastern Stevens County and discovery of Cambrian and Ordovician fossils are thought to justify adoption there of formation names established by Park and Cannon (1943) for Metaline quadrangle. The new names replace those given by Weaver (1920). Correlative with Metaline limestone are most of Weaver's Northport limestone, Republican Creek limestone, Red Top limestone, and Deep Lake argillite, and part of Boundary argillite.

Named from cliffs near Metaline Falls, Pend Oreille County. Exposed in Pend Oreille Valley from Ione north to Canadian border.

Metamora Drift

Pleistocene (Wisconsin): Northern Illinois.

Leland Horberg, 1950, Illinois Geol. Survey Bull. 75, pt. 1, p. 29. In Peoria area, Metamora drift is listed as older than Normal drift and younger than Bloomington drift.

Probably named for occurrence near Metamora, Woodford County.

Metcalf Phyllite (in Snowbird Group)

Precambrian (Ocoee Series) : Southeastern Tennessee.

P. B. King and others, 1958, Geol. Soc. America Bull., v. 69, no. 8, p. 955 (table 1), 957. Represents Snowbird group in western part of Great Smoky Mountains. Characteristic rock of formation is lustrous thinly fissile gray-green or gray phyllite, but almost half the unit is more silty and resembles siltstone of the Pigeon except for its stronger cleavage; carbonate-bearing laminae uncommon; sandstone beds resembling those in the Pigeon and Roaring Fork are widely spaced and generally thin, but northwest of Schoolhouse Gap they constitute much of exposed section. In most places, Metcalf is faulted against other rocks and is highly foliated, contorted, and sheared; thickness indeterminable but may be thousands of feet. Relations to remainder of group uncertain; joins Pigeon siltstone at northeast end of its outcrop, but contact relations are obscure.

Named for Metcalf Bottoms on Little River, [Sevier County], where it is typically exposed along Tennessee Highway 73. Crops out between high ridges of Great Smoky Mountains and the cove areas on the northwest in belt extending from near meridian of Gatlinburg southwestward to Cades Cove.

Metchosin Volcanics[1]

Metchosin Volcanic Series

Eocene, lower(?) and middle: British Columbia, Canada, western Oregon and western Washington.

Original reference: C. H. Clapp, 1910, Canada Geol. Survey Summ. Rept. 1909, p. 89.

C. E. Weaver, 1937, Washington [State] Univ. Pubs. in Geology, v. 4, p. 26–40. Basaltic lavas, tuffs, and agglomerates with pillow structure and intercalated shales and cherts. Form basement Eocene rocks from Vancouver Island southwest to southern Oregon. On Olympic Peninsula, the volcanics overlie the Solduc (Soleduck) formation with angular unconformity.

C. E. Weaver, 1945, Am. Assoc. Petroleum Geologists Bull., v. 29, no. 10, p. 1406 (table 6). Paleocene.

D. A. Henriksen, 1956, Washington Div. Mines and Geology Bull. 43, p. 16 (fig. 5), 22–34, 70–79, pl. 1. In Cowlitz River-Willapa Hills area, series comprises central mass of Willapa Hills anticlinal uplift. Minimum exposed thickness 6,000 to 8,000 feet; total thickness probably exceeds 10,000 feet. Base of series not exposed in southwestern Washington; around borders of Olympic Peninsula, the series rests upon basal Tertiary or pre-Tertiary complex of closely folded sedimentary and metamorphic rocks. Along northern and eastern borders of Willapa Hills, upper flows of series are overlain conformably by Stillwater Creek member of Cowlitz formation; along southern boundary of mapped area, series is overlain with marked angular unconformity by basalt flows and sandstones of middle Miocene Astoria formation. Lower part of Metchosin is of unknown age, although volcanism may have been initiated in early Eocene time; upper part of formation is of upper middle Eocene. In recent years, several new names—Tillamook volcanic series, Siletz River volcanic series, and Coffin Butte volcanics—have been proposed for middle and lower(?) Eocene volcanic units in parts of northwestern Oregon; these units are correlative at least in part with each other, and all three may be correlated with Metchosin volcanic series. Herein suggested that these formational names are unnecessary and that name Metchosin volcanic series be used for lower(?) and middle Eocene volcanics which constitute Tertiary "basement rocks" of western Oregon and Washington.

Type area: Southern Vancouver Island, British Columbia. Volcanics underlie area approximately 37 miles in an east-west direction and 5 to 7 miles in a north-south direction.

Meteor Granodiorite[1]

Upper Jurassic: Northeastern Washington.

Original reference: C. E. Weaver, 1913, Washington Geol. Survey Bull. 16, p. 20–30.

J. L. Marlow, 1958, U.S. Atomic Engery Comm. [Pub.] RME–2068, p. 9. Incidental mention in report on uranium occurrences in northern Ferry County. Late Jurassic.

Named for Meteor, Ferry County.

Methow Gneiss

Age uncertain (pre-Chelan batholith). Northwestern Washington.

J. D. Barksdale, 1948, Northwest Sci., v. 22, no. 4, p. 165, 166–167. Distinctive "biotite-granite" gneiss. Has marked foliation emphasized in outcrop and hand specimen by clots of biotite some of which are as large as half dollar. Clots may be irregularly drawn-out ovoid areas of paper thinness or single ragged books of black biotite up to 2 millimeters in thickness. Outcrops paralleling schistosity have leopard-spot appearance. Gneiss shows concordance in structure with overlying Leecher metamorphics (new) north and east of Methow River.

Type locality: In narrow valley of Methow River from Carlton south through town of Methow, Methow quadrangle.

Metralla Sandstone Member (of Tejon Formation)

Eocene, upper: Southern California.

J. G. Marks, 1941, (abs.) Geol. Soc. America Bull., v. 52, no. 12, pt. 2, p. 1922. Listed as member of Tejon formation in type area of Tejon. Thickness 1,300 feet. Shown as underlying Reed Canyon siltstone member (new) and overlying Liveoak member (new).

J. G. Marks, 1943, California Div. Mines Bull. 118, pt. 3, p. 535, 536 (fig. 232), 537 (fig. 233). Consists of fine- to medium-grained sandstones uniformly gray in color, massive, and well indurated by calcareous cement; many spherical concretions up to 10 feet in diameter. Upper Eocene.

Type locality: Reed Canyon, Tehachapi Mountains, Kern County.

Mettawee Slate[1]

Mettawee Member (of Bull Formation)

Lower Cambrian: Southwestern Vermont and eastern New York.

Original reference: R. Ruedemann, 1914, New York State Mus. Bull. 169, p. 67–70.

E. P. Kaiser, 1945, Geol. Soc. America Bull., v. 56, no. 12, p. 1084 (table 1), 1085–1086, 1091. In northern Taconic area, Mettawee slate overlies Bomoseen grit and underlies Eddy Hill grit. Keith's (1932) sequence is incompatible with sequence used in present report. Keith's Stilles phyllite, Hubbardton slate, and Bull slate are here included in Mettawee.

Phillip Fowler, 1950, Vermont Geol. Survey Bull. 2, p. 47–49, pl. 2. Mettawee slate is widespread formation in western part of Castleton quadrangle. Several bands of Mettawee crop out in Poultney, Castleton, and Hubbardton quadrangles. In southern half of quadrangle, the Mettawee is confined to slate belt and does not crop out in Taconic Range. Kaiser (1945) mapped Mettawee in Taconic Range north of Castleton River. It is probable that the rock here mapped as Nassau contains some undifferentiated Mettawee. Thickness in Castleton area 100 to 300 feet. Top of Mettawee is fixed either at bottom of Eddy Hill grit or at lowest black slate or limestone of Schodack formation. Rests on Bomoseen grit, in many places a gradational contact between the two requires arbitrary definition.

D. W. Fisher, 1956, Internat. Geol. Cong., 20th, Mexico, Cambrian Symposium, pt. 2, p. 336–338. "Cambrian roofing slates" of Dale (1898, U.S. Geol. Survey 19th Ann. Rept., pt. 3B) were formally named Mettawee by Ruedemann (1914), although Dale had previously (1904) casually used name Greenwich slate for same beds. Keith (1932) subsequently proposed Bull slate for same interval. Mettawee slates occur in narrow synclinal belts, overturned westward, surrounding infolded Ordovician slates and shales. Bomoseen grit, which conformably and gradationally underlies the Mettawee, encloses these synclinal belts. Average thickness probably 125 feet.

E–an Zen, 1959, New England Intercollegiate Geol. Conf. Guidebook 51st Ann. Mtg., p. 2. Rank reduced to member status in Bull formation. Constitutes bulk of formation. Distinguished from underlying Biddie Knob formation by lack of chloritoid, which reflects primary compositional differences. In some areas, overlies Bomoseen greywacke member; in other areas the Bomoseen is within the Mettawee.

Named for Mettawee River, which drains region, rising in Pawlet quadrangle in southwestern part of Rutland County, Vt., and flowing northwest into New York.

Mexia Member (of Wills Point Formation)[1]

Paleocene: Northeastern Texas.

Original reference: F. B. Plummer, 1933, Texas Univ. Bull. 3232, p. 530, 535, 559, 562.

Mackenzie Gordon, Jr., J. I. Tracey, Jr., and M. W. Ellis, 1958, U.S. Geol. Survey Prof. Paper 299, p. 25. Lower member of Wills Point. Consists of dark thinly laminated or compact fossiliferous clay of fairly deep water marine facies. Constitutes about one-third of formation. Underlies Kerens member.

G. R. Kellough, 1959, Gulf Coast Assoc. Geol. Soc. Trans., v. 9, p. 153–155, 160. Thickness 85 feet in Tehuacana Creek section. Lower 36 feet contains abundant microfauna. Underlies Kerens member; overlies Tehuacana member of Kincaid formation.

Type locality: Clay pit at brickyard in west edge of Mexia, Limestone County.

Mexican sandstone[1]

Lower Cretaceous: Southeastern Arizona.

Original reference: C. R. Keyes, 1935, Pan-Am. Geologist, v. 64, no. 2, p. 129, 138, 139.

Named for Mexican Gulch, east of Bisbee, Cochise County.

Mexico Sandstone Member[1] (of Marcellus Formation)

Middle Devonian: Central Pennsylvania.

Original reference: Bradford Willard, 1935, Geol. Soc. America Bull., v. 46, Proc. Pal. Soc. Feb. 28, p. 202–203.

Bradford Willard, 1939, Pennsylvania Geol. Survey, 4th ser., Bull. C–19, p. 173, 174. Overlies Turkey ridge sandstone member; underlies Mahoney black shale member.

Well exposed in hill east of Mexico, Juniata County, and also at Blue Spring southwest of Mexico.

Meyersdale Limestone (in Conemaugh Formation)[1]

Pennsylvanian: Western Maryland.

Original reference: Maryland Geol. Survey, v. 11, p. 59, 95, 110.

In Lower Youghiogheny Basin, Garrett County.

Meyersdale Red Shale (in Conemaugh Formation)[1]

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

Original reference: C. K. Swartz, W. H. Price, and H. Bassler, 1919, Geol. Soc. America Bull., v. 30, p. 574.

M. T. Sturgeon and others, 1958, Ohio Div. Geology Bull. 57, p. 114–116. Swartz and others (1919) proposed name Meyersdale for redbeds above Buffalo sandstone and below Lower Bakerstown (Anderson or Thomas) coal. Flint's (1951) description of Buffalo shale in Perry County fits that of Meyersdale redbed rather than that of Buffalo member. Meyersdale is included in Wilgus cyclothem although it is not present in area of this report [Athens County]. It has been noted locally in Ohio. Conemaugh series.

Well exposed in cut of Western Maryland Railway east of Meyersdale, Pa.

Miami Oolite[1]

Pleistocene: Southern Florida.

Original reference: S. Sanford, 1909, Florida Geol. Survey 2d Ann. Rept., p. 209, 211–214, table.

C. W. Cooke, 1945, Florida Geol. Survey Bull. 29, p. 256–260. Base of oolite is exposed only in Everglades and in southeastern part of Big Cypress Swamp. There it rests unconformably on Tamiami formation, of Pliocene age; locally limestone breccia or conglomerate, perhaps of early Pleistocene age, separates the Miami from the Tamiami. Presumably equivalent to Key Largo limestone; probably merges northwestward into Coffee Mill Hammock marl member of Fort Thompson formation.

Named for occurrence in vicinity of Miami.

†Michigamme Jasper[1]

Precambrian (upper Huronian): Northwestern Michigan.

Original reference: H. L. Smyth, 1894, Am. Jour. Sci., 3d, v. 47, p. 219–223.

Crops out in vicinity of Michigamme Mountain, in sec. 33, T. 44 N., R. 31 W. and sec. 3, T. 43 N., R. 31 W.

Michigamme Slate[1] (in Baraga Group)

Precambrian (Animikie Series): Northwestern Michigan and northeastern Wisconsin.

Original reference: C. R. Van Hise and W. S. Bayley, 1895, U.S. Geol. Survey 15th Ann. Rept., p. 598.

W. A. Seaman *in* A. K. Snellgrove, W. A. Seaman, and V. L. Ayres, 1944, Michigan Dept. Conserv. Geol. Survey Div. Prog. Rept. 10, p. 12. Chart shows Michigamme slate (or series) as underlying Sibley formation.

J. E. Gair and K. L. Wier, 1956, U.S. Geol. Survey Bull. 1044, p. 14 (table 2), 59, pl. 1. Described in Kiernan quadrangle, Michigan, where it is about 10,000 feet thick and unconformably overlies newly defined Fence River formation.

H. L. James, 1958, U.S. Geol. Survey Prof. Paper 314–C, p. 30, (table 1), 36, 37. Assigned to newly defined Baraga group. In Marquette district, Michigan, includes in the lower part Bijiki iron-formation member, Clarksburg volcanics member, and Greenwood iron-formation member; in Iron and Dickinson Counties, Mich., overlies Fence River formation and underlies Badwater greenstone (new).

Named for exposures on islands of Lake Michigamme, Marquette district, Michigan.

Michigan Conglomerate[1]

Precambrian (Keweenawan): Northern Michigan.

Original reference: B. S. Butler and W. S. Burbank, 1929, U.S. Geol. Survey Prof. Paper 144 (chart compiled by M. G. Wilmarth).

Named for occurrence in old Michigan mine, in Ontonagon County.

Michigan Formation[1] (in Grand Rapids Group)

Mississippian: Michigan.

Original reference: W. H. Taylor, chm., 1839, Michigan Geol. Survey Rept. State Geologist in re improvement of State salt springs, Michigan Leg. H. R. Doc. 2, p. 3.

G. M. Ehlers and W. E. Humphrey, 1944, Michigan Univ. Contr. Mus. Paleontology, v. 6, no. 6, p. 114–117. Discussion of history of nomenclature of Point au Gres limestone, Bayport limestone, and Grand Rapids limestone [group]. Reference is made to work of Lane (1893, 1895, 1899, 1900, 1909). Concluded that Point au Gres should be used instead of "Grand Rapids" or "Bayport".

J. M. Weller and others, 1948, Geol. Soc. America Bull., v. 59, no. 2, chart 5 (columns 80, 81). Shown on correlation chart as underlying Bayport limestone and overlying Napoleon sandstone of Marshall group. Osagean-Meramecian series.

Type locality and derivation of name not stated.

Midco Member (of Wellington Formation)

Permian: North-central Oklahoma.

G. O. Raasch, 1941, (abs.) Geol. Soc. America Bull., v. 52, no. 12, pt. 2, p. 1928. Thickness 255 feet. Overlies Otoe (redbed) member (new); underlies Billings member (new). Cyclic deposition is recognized in the Midco. Contains insect and crustacean fauna.

Type locality and derivation of name not stated.

†Middendorf Formation[1]

Middendorf Member (of Black Creek Formation)

Upper Cretaceous: Coastal Plain of South Carolina and Georgia.

Original reference: E. Sloan, 1904, South Carolina Geol. Survey, ser. 4, Bull. 1, p. 68, 72, 75–81.

C. W. Cooke, 1936, U.S. Geol. Survey Bull. 867, p. 17. Local names Hamburg and Middendorf were applied by Sloan (1904) to clays and sands in South Carolina that were supposed to be of Lower Cretaceous age. Berry (1916, U.S. Geol. Survey Prof. Paper 84), on basis of fossil plants, transferred Middendorf beds to Upper Cretaceous under name Middendorf arkose member of Black Creek formation. Cooke (1926, U.S. Geol. Survey Prof. Paper 140–E) proposed to restore Middendorf to formation rank and to include in it the Hamburg beds. At that time, [Cooke] correlated the Middendorf with Tuscaloosa formation of Alabama but deemed local designation necessary, because beds having Middendorf aspect in Georgia might represent a period of time somewhat longer than that of the Tuscaloosa and might include all or part of Eutaw time. Recent work shows that Middendorf in Georgia is quite different from Eutaw formation but apparently identical with the Tuscaloosa. As local name for the beds in South Carolina and Georgia is unnecessary, older name Tuscaloosa is here substituted for name Middendorf formation.

Erling Dorf, 1952, Am. Assoc. Petroleum Geologists Bull., v. 36, no. 11, p. 2181–2184. In South Carolina, Middendorf member of Black Creek formation (herein revived as equivalent of upper part of Cooke's 1936 Tuscaloosa formation) has been shown to contain plant remains essentially equivalent to those of the lower Black Creek formation of North Carolina; lower part of Cooke's Tuscaloosa is herein referred to as Lower Cretaceous? (undifferentiated).

Named for exposures near Middendorf, Chesterfield County, S.C.

Middleburg Limestone Member (of Bader Limestone)

Middleburg Limestone (in Council Grove Group)[1]

Permian: Southeastern Nebraska and eastern Kansas.

Original reference: G. E. Condra and J. E. Upp, 1931, Nebraska Geol. Survey Bull. 6, 2d ser., p. 20, 25.

R. C. Moore, M. K. Elias, and N. D. Newell, 1934, Stratigraphic sections of Pennsylvanian and "Permian" rocks of Kansas River Valley: Kansas Geol. Survey, issued Dec.; R. C. Moore, 1935, Rock formations of Kansas *in* Kansas Geol. Soc.: Wichita [Am. Assoc. Petroleum Geologists 20th Ann. Mtg., Mar. 21–23]; G. E. Condra, 1935, Nebraska Geol. Survey Paper 8, p. 4, 7. Reallocated to member status in Bader limestone (new).

J. M. Jewett, 1941, Kansas Geol. Survey Bull. 39, p. 61; R. C. Moore and others, 1951, Kansas Geol. Survey Bull. 89, p. 46. Uppermost member of Bader limestone. Overlies Hooser shale member; underlies Easly Creek shale. Wolfcamp series.

Type locality: On Easly Creek, 1½ miles south of Middleburg School, in E¼ sec. 36, T. 1 N., R. 13 E., in southwestern part of Richardson County, Nebr.

Middlebury Limestone

Middlebury Limestone (in Chazy Group)

Middle Ordovician: West-central Vermont.

W. M. Cady, 1945, Geol. Soc. America Bull., v. 56, no. 5, p. 524, 552–553, 554. Buff-streaked dark-blue-gray partly dolomitic limestone which is somewhat nodular and granular, thin bedded and incompetent. Maximum thickness 600 feet. Underlies Orwell limestone (new); overlies Beldens formation (new) with gradational contact. Assigned Chazyan age, but may be partly Black River.

W. M. Cady and E-an Zen, 1960, Am. Jour. Sci., v. 258, no. 10, p. 728-739. Discussion of stratigraphic relationships of Lower Ordovician Chipman formation in west-central Vermont. Some of Cady's (1945) interpretations revised. Chipman formation comprises Beldens, Weybridge, and Burchards members in Cornwall village area and Bridport member in Bascoms Ledge area. All members of the Chipman underlie the Middlebury. The Bridport is as mapped by Cady at Bascoms Ledge, but Middlebury limestone is expanded westward and downward stratigraphically to top of Bridport and includes rocks that have been interpreted as "Crown Point limestone" and Beldens formation. Underlies Orwell formation.

Crops out over wide area west of Otter Creek at Middlebury village, Addison County. Well exposed in ledges on Middlebury College campus.

Middle Creek Conglomerate

Pleistocene: Northern Kentucky.

R. H. Durrell, 1956, (abs.) Geol. Soc. America Bull., v. 67, no. 12, pt. 2, p. 1751. Incidental usage only.

Occurs just to south of Commissary Corners, Kentucky.

Middle Creek limestone ledge (in Graneros Formation)

Cretaceous: Western South Dakota.

M. E. Wing, 1940, South Dakota Geol. Survey Rept. Inv. 35, p. 6, chart facing p. 10. Thin persistent limestone ledge in upper part of Graneros; approximately 200 feet below top of Greenhorn limestone.

B. C. Petsch, 1949, South Dakota Geol. Survey Rept. Inv. 65, p. 9. Preoccupied name Middle Creek abandoned; unit renamed Orman Lake limestone.

Caps escarpment trending northwest from Belle Fourche along northeast side of Middle Creek valley, Butte County.

Middle Creek Limestone[1] Member (of Swope Limestone)

Pennsylvanian (Missouri Series): Eastern Kansas, southwestern Iowa, northwestern Missouri, and southeastern Nebraska.

Original reference: R. C. Moore, 1932, Kansas Geol. Soc. Guidebook 6th Ann. Field Conf., p. 85, 90, 97.

R. C. Moore, 1948, Am. Assoc. Petroleum Geologists Bull., v. 32, no. 11, p. 2031 (fig. 4); 1949, Kansas Geol. Survey Bull. 83, p. 68 (fig. 14), 88; F. C. Greene and W. V. Searight, 1949, Missouri Geol. Survey and Water Resources Rept. Inv. 11, p. 11. Middle Creek limestone member of Swope formation; underlies Hushpuckney limestone member; overlies Ladore formation. This is classification agreed upon by State Geological Surveys of Iowa, Kansas, Missouri, Nebraska, and Oklahoma, May 1947.

H. G. Hershey and others, 1960, Iowa Highway Research Board Bull. 15, p. 28, fig. 5. Thin blue-gray to black dense fine-grained limestone. Not more than 1 foot thick. Basal member of formation; underlies Hushpuckney shale member; overlies Ladore shale.

Type locality: SW sec. 22, T. 18 S., R. 24 E., on Middle Creek at crossing of main highway 3 miles east of LaCygne, Linn County, Kans.

Middlefield Granite[1]

Carboniferous or post-Carboniferous : Western Massachusetts.

Original references: B. K. Emerson, 1898. U.S. Geol. Survy Geol. Atlas, Folio 50 ; 1898, U.S. Geol. Survey Mon. 29, pl. 34.

A small north-south mass in Middlefield Township, western part of Hampshire County.

Middle Freeport Limestone[1]

Pennsylvanian : Western Pennsylvania, Maryland, eastern Ohio, and northern West Virginia.

Original reference: F. Platt, 1877, Pennsylvania Geol. Survey Rept. H_2, p. xxviii.

Name derived from town of Freeport, Armstrong County, Pa.

Middlegate Formation

Pliocene, lower : Western Nevada.

D. I. Axelrod, 1956, California Univ. Pubs. Geol. Sci., v. 33, p. 183–186, figs. 10, 11. Consists of three unnamed members (ascending) : volcanics, conglomerates, and sedimentary breccias, with associated sandstones, clays, silts, and tuffs, white dacite tuff lense near Middlegate—thickness from a few feet to maximum of 300 feet; tan siliceous shale with interbedded clays and silts—thickness up to approximately 400 feet; sandstone, rhyolite breccias, silts, diatomite, conglomerate, grading northward to lake beds with siliceous sandstone and siliceous shale—thickness approximately 600 feet over most of area. Maximum aggregate thickness about 1,300 feet. Underlies Monarch Mill formation (new) with gradational contact; unconformably overlies Clan Alpine volcanics (new).

Named for exposures in southeastern foothills of Clan Alpine Range immediately east, north, and south of Middlegate, Churchill County.

Middle Kittanning Clay (in Allegheny Formation)[1]

Middle Kittanning underclay member

Pennsylvanian (Allegheny Series) : Western Pennsylvania and eastern Ohio.

Wilber Stout and others, 1923, Ohio Geol. Survey, 4th ser., Bull. 26, p. 393–417. Middle Kittanning clay lies directly below Middle Kittanning coal. Position is nearly 31 feet above Lower Kittanning coal, 47 feet below Lower Freeport member and 95 feet below Upper Freeport stratum. Intervals vary from place to place. In many localities, separated from underlying Oak Hill clay by only a few feet of shale. Average thickness Middle Kittanning clay about 5 feet. Allegheny formation.

J. B. McCue and others, 1948, West Virginia Geol. Survey, v. 18, p. 16. Middle Kittanning underclay mentioned in report on clays of West Virginia.

N. K. Flint, 1951, Ohio Geol. Survey, 4th ser., Bull. 48, p. 49, table 1. Included in Middle Kittanning cyclothem in report on Perry County. Average thickness 4 feet. Overlain by Middle Kittanning (No. 6) coal; at many places, underlain by sandstone or shale. Locally directly overlies Strasburg coal.

M. T. Sturgeon and others, 1958, Ohio Geol. Survey Bull. 57, p. 48 (table 7), 70–72. Middle Kittanning underclay member of Middle Kittanning cyclothem in report on Athens County. Average thickness 1 or 2 inches. Allegheny series.

Name derived from Kittanning, Armstrong County, Pa.

Middle Kittanning complex

See Kittanning Formation.

Middle Kittanning cyclothem

Pennsylvanian (Allegheny Series): Western Pennsylvania and southeastern Ohio.

N. K. Flint, 1949, Ohio Acad. Sci. [Guidebook] 24th Ann. Field Conf., p. 12. Incidental mention in road log.

N. K. Flint, 1951, Ohio Geol. Survey, 4th ser., Bull. 48, p. 48–51, table 1, geol. map. Includes (ascending) unnamed shale, Salem limestone, Middle Kittanning clay, Middle Kittanning (No. 6) coal, and Washingtonville shale. Occurs below Lower Freeport cyclothem and above Strasburg cyclothem. In area of this report [Perry County], the Allegheny series is described on a cyclothemic basis; nine cyclothems are named. [For sequence see Brookville cyclothem.]

M. T. Sturgeon and others, 1958, Ohio Geol. Survey Bull. 57, p. 48 (table 7), 68–76. Embraces interval between Strasburg cyclothem below and Upper Kittanning cyclothem above. Includes (ascending) Middle Kittanning shale and (or) sandstone, Snow Fork ironstone (Salem limestone), Middle Kittanning underclay, Middle Kittanning (No. 6) coal, and Washingtonville shale members. Thickness about 27 feet. In area of this report [Athens County], Allegheny series is discussed on a cyclothemic basis; 13 cyclothems are named. [For sequence see Brookville cyclothem.]

Named from Kittanning, Pa. Members outcrop in belt extending from Columbiana, Jefferson, and Mahoning Counties in eastern Ohio to Gallia and Lawrence Counties in southern Ohio. Outcrop extends across northwestern part of Athens County where exposures mostly occur in Waterloo and York Townships.

Middle Kittanning shale and (or) sandstone member

Pennsylvanian: Eastern Ohio.

M. T. Sturgeon and others, 1958, Ohio Geol. Survey Bull. 57, p. 48 (table 7), 69. Middle Kittanning shale and sandstone member included in Middle Kittanning cyclothem in report on Athens County. Interval between Strasburg-Oak Hill member of Strasburg cyclothem and Middle Kittanning coal or, in absence of Strasburg cyclothem, the interval between Lower and Middle Kittanning coals is largely occupied by shale and sandstone. Average thickness of shale and sandstone about 14 feet. Shale normally exceeds sandstone. Occurs below Snow Fork (Salem) limestone member. Allegheny series.

†Middle Mahoning Sandstone (in Conemaugh Formation)[1]

Pennsylvanian: Southwestern Pennsylvania.

Original reference: W. G. Platt, 1878, Pennsylvania 2d Geol. Survey Rept. H_4.

In Indiana County.

Middle Mercer clay member

See Middle Mercer cyclothem.

Middle Mercer cyclothem

Pennsylvanian (Pottsville Series) : Southeastern Ohio.

N. K. Flint, 1949, Ohio Acad. Sci. [Guidebook] 24th Ann. Field Conf., p. 7. Incidental mention in road log.

N. K. Flint, 1951, Ohio Geol. Survey, 4th ser., Bull. 48, p. 32–33, table 1, geol. map. Includes (ascending) Middle Mercer shale and (or) sandstone, 4 to 13 feet; Middle Mercer clay, 3 to 5 feet; Middle Mercer coal; and Lower Mercer limestone, 2 feet. Occurs below Bedford cyclothem and above Flint Ridge cyclothem. In area of this report, Pottsville series is described on a cyclothemic basis; 10 cyclothems are named. [For sequence see Anthony cyclothem.]

Exposed in Perry County.

Middle Mercer shale and (or) sandstone member

See Middle Mercer cyclothem.

†Middle Mercer Shales (in Pottsville Formation)[1]

Pennsylvanian: Western Pennsylvania.

Original reference: J. P. Lesley, 1879, Pennsylvania 2d Geol. Survey Rept. Q_2.

Middle Park Formation[1]

Upper Cretaceous and Paleocene: Northwestern Colorado.

Original reference: W. B. Clark, 1891, U.S. Geol. Survey Bull. 83, p. 137.

T. S. Lovering and E. N. Goddard, 1950, U.S. Geol. Survey Prof. Paper 223, p. 40, 42. Discussed under formations of Upper Cretaceous and Paleocene age. Equivalent to Arapahoe and Denver formations. Thickness exceeds 5,000 feet.

Occurs in Middle Park.

Middle Park Formation[1] (in Telescope Group)

Precambrian: Southeastern California.

Original references: F. M. Murphy, 1930, Econ. Geology, v. 25, p. 311, map; 1933, California Div. Mines Rept. 28 of State Mineralogist, July-Oct. 1932, p. 329–356.

B. K. Johnson, 1957, California Univ. Dept. Geol. Sci., v. 30, no. 5, p. 355, 365, 378 (fig. 7). This study [Manly Peak quadrangle] has made possible the correlation of formations defined by Murphy (1930, 1932, [1933]) in Telescope Peak quadrangle with formations now commonly used in Death Valley region. Murphy tentatively assigned all rocks above Panamint metamorphic complex to the Lower Paleozoic. South Park member (new) of Kingston Peak formation is a correlative of the Middle Park formation, Mountain Girl conglomerate-quartzite, and Wildrose formation of Telescope group. Precambrian.

Probably named for Middle Park Canyon in southern part of Panamint Range, Inyo County.

Middlesex Shale Member (of Sonyea Formation)

Middlesex Shale[1] (in Naples Group)

Upper Devonian: Western and west-central New York.

Original reference: J. M. Clarke, 1903, New York State Mus. Handb. 19, p. 23, chart.

W. H. Bradley and J. F. Pepper, 1938, U.S. Geol. Survey Bull. 899–A, p. 11–12, pl. 3. Middlesex is unit of jet-black shale through greater part of area [Steuben, Yates, and parts of adjacent counties]. Sharply defined at base, where it overlies flagstones of the Standish, and at top where it underlies Cashaqua shale. Eastward and southward from southwestern part of Ovid quadrangle lithology of Middlesex changes abruptly. Massive flagstones come into upper half and virtually displace the shale; lower half, though it persists as exclusive shale unit changes to gray silvery shale.

G. W. Colton and Wallace de Witt, Jr., 1958, U.S. Geol. Survey Oil and Gas Inv. Chart OC–54; Wallace de Witt, Jr., and G. W. Colton, 1959, Am. Assoc. Petroleum Geologists Bull., v. 43, no. 12, p. 2819. Clarke (1903) gave name Middlesex to black shale underlying his Cashaqua shale in vicinity of Middlesex, Yates County. This black shale is herein redesignated Middlesex shale member of Sonyea formation. Basal member of formation from Lake Erie eastward to Seneca Lake. Underlies Cashaqua shale member; in some areas, underlies Pulteney shale member (new); overlies West River shale. Standard reference section designated. Thicknesses: about 6 feet at mouth of Pike Creek on shore of Lake Erie; 63 feet at reference section; 75 feet on stream west of Chidsey Point on west shore of Keuka Lake and less than 5 feet in Watkins Glen, central Schuyler County.

R. G. Sutton, 1960, New York State Mus. Bull. 380, p. 11, 12–13. Basal formation in Naples group. Underlies Sawmill Creek member (new) of Cashaqua formation. [Name Pulteney has priority over Sawmill Creek.]

Reference section: Gully on east side of West River valley, 0.8 mile southwest of center of Middlesex, Yates County. Named for exposures in town of Middlesex and in Middlesex Valley.

†Middleton Formation[1]

Eocene, lower: Western Tennessee, southern Alabama, and Mississippi.

Original references: J. M. Safford, 1892, Geol. Soc. America Bull., v. 3, p. 511–512; 1892, Am. Geologist, v. 9, p. 63–64.

Named for exposures at and near Middleton, Hardeman County, Tenn.

Middletown Clay[1]

Pleistocene, upper: Connecticut.

Original reference: R. F. Flint, 1933, Geol. Soc. America Bull., v. 44, no. 5, p. 965–987.

Underlies parts of northern Middletown Township, Middlesex County.

Middletown Gneiss[1]

Paleozoic(?): South-central Connecticut.

Original reference: H. E. Gregory, 1906, Connecticut Geol. Nat. History Survey Bull. 6, p. 115, 143, map.

E. N. Cameron and others, 1954, U.S. Geol. Survey Prof. Paper 255, p. 20, 21. Paleozoic(?).

John Rodgers and others, 1956, Preliminary geological map of Connecticut (1:253,440): Connecticut Geol. Nat. History Survey. Includes variety of rock types interbanded, generally with sharp contacts. Especially characterized by amphibolite and amphibole gneiss; also includes hornblendite, biotite gneiss and schist, feldspathic gneiss and granulite, quartzite and garnet granulite. Pre-Triassic.

H. M. Mikami and R. E. Digman, 1957, Connecticut Geol. Nat. History Survey Bull. 86, p. 26, 34–46, 51–52, pls. 1, 2. Throughout most of area [Guilford and part of New Haven quadrangle] Middletown gneiss is in contact with Haddam tonalite, apparently grades stratigraphically upward into Bolton schist, but part grades along strike into lower Bolton schist. Pre-Triassic.

John Rodgers, R. M. Gates, and J. L. Rosenfeld, 1959, Connecticut Geol. Survey Nat. History Bull. 84, p. 19, 21, fig. 3. Unconformably underlies Collins Hill formation (new). Ordovician(?).

Crops out in southeastern part of Middletown Township, Middlesex County.

Middle Washington Limestone Member (of Washington Formation)[1]

Middle Washington Limestone

Permian: Southwestern Pennsylvania, eastern Ohio, and West Virginia.

Original reference: J. J. Stevenson, 1876, Pennsylvania 2d Geol. Survey Rept. K, p. 44, 48–50.

R. E. Lamborn, 1951, Ohio Geol. Survey, 4th ser., Bull. 49, p. 39, 40. Middle Washington limestone is confined in its known distribution on the outcrop chiefly to Belmont County where it varies in thickness from 5 to 20 feet. Stratigraphic position is about 27 feet above Lower Washington limestone and about 54 feet above top of persistent Washington coal. Included in Washington series which, in Ohio, consists of the following limestones (ascending): Elm Grove, Mount Morris, Lower Washington, Middle Washington, and Upper Washington.

R. L. Nace and P. P. Bieber, 1958, West Virginia Geol. Survey Bull. 14, p. 18 (table 2). Middle Washington limestone in Washington formation shown on table of summary of stratigraphic sections of Dunkard group in Harrison County. Thickness 0 to about 30 feet. Occurs above middle Marietta sandstone and below Creston shale.

Named for exposures near Washington, Washington County, Pa.

Midland Sand[1]

Pleistocene (Wisconsin): Western Washington.

Original reference: B. Willis and G. O. Smith, 1899, U.S. Geol. Survey Geol. Atlas, Folio 54.

Occurs in village of Midland, Puget Sound region.

Midnight Peak Formation

Upper Cretaceous: Northwestern Washington.

J. D. Barksdale, 1948, Northwest Sci., v. 22, no. 4, p. 165, 173–174. Thick series of andesitic tuffs, breccias, and flows. Approximately 500 feet of red siltstone, tuffaceous sandstone, and pebble conglomerate form lowest member which is exposed in Bridge Creek. Breccias and flows above basal tuffs and sandstones are dark gray to green. Red tuffaceous sandstones and shales at base of formation named Ventura by Russell (1900). Unconformably underlies Pipestone Canyon formation (new) and overlies Winthrop sandstone. Thickness over 8,000 feet.

Occurs at Midnight Peak, the highest point on a northwest trending ridge lying between Twisp River and Canyon Creek, Methow quadrangle.

Midridge Limestone

Lower Mississippian (Kinderhook): West-central Utah.

C. S. Bacon, Jr., 1948, Geol. Soc. America Bull., v. 59, no. 10, p. 1032 (fig. 2), 1037. Crinoidal bed of upper Kinderhook age.

Lawrence Ogden, 1951, Am. Assoc. Petroleum Geologists Bull., v. 35, no. 1, p. 64 (fig. 2), 67, 70 (fig. 5). Massive cliff-forming dense medium- to dark-gray petroliferous calcitic limestone; basal bed is pink quartzite 1 foot thick; above is a 9-inch shale bed containing reworked material from underlying Devonian; another thin quartzite above shale grades upward into fossiliferous nodular limestone; rest of formation is mostly massive dark-gray limestone. Thickness 260 feet. Overlies unnamed Devonian rocks with angular unconformity; unconformably below Pennsylvanian rocks.

Present in Confusion Range. Forms prominent north-trending hogback which terminates southeast of Cowboy Pass, T. 17 S., R. 16 W., Millard County.

†Midway andesite[1]

Tertiary: Central Nevada.

Original references: J. E. Spurr, 1911, Min. and Sci. Press, v. 102, p. 560–561; 1911, Report on geology of property of Montana-Tonopah Mining Co.: Tonopah, Nev., published privately.

Named for Midway mine, Tonopah district.

Midway Group[1]

Midway Formation[1]

Midway Stage

Paleocene: Western Georgia to southern Texas, Arkansas, southwestern Illinois, Kentucky, southeastern Missouri, and western Tennessee.

Original references: G. D. Harris, 1894, Am. Jour. Sci., 3d, v. 47, p. 303–304 1896, Bulls. Am. Paleontology, v. 1, no. 4, p. 10–38.

C. W. Cooke, 1925, U.S. Geol. Survey Prof. Paper 140–E, p. 133–134. Group comprises Clayton formation, Sucarnochee clay, Porters Creek clay, and Naheola formation. Clayton is thickest in eastern Alabama and thins toward west; in western Alabama and in Mississippi, reduced to thin beds of limestone and, over considerable area of both states, overlapped by the Porters Creek or Sucarnochee clay. Porters Creek clay is thickest in Tennessee or Mississippi and pinches out entirely or is overlapped about midway across Alabama. Naheola extends across Alabama into Mississippi at least as far north as DeKalb. Underlies Wilcox group; overlies Cretaceous.

Julia Gardner, 1933, Am. Assoc. Petroleum Geologists Bull., v. 17, no. 6, p. 744. In eastern Texas, includes Kincaid formation in lower part.

H. J. Plummer, 1933, Texas Univ. Bull. 3232, p. 555. Upper Midway named Wills Point formation.

R. H. Cuyler and A. W. Weeks, 1940, *in* Geol. Soc. America [Guidebook] 53d Ann. Mtg., p. 24. Near Mendoza, Texas, Midway formation contains Rosette bed (new), a mappable horizon as far northeast as Mexia region and beyond.

R. J. Le Blanc, 1941, (abs.) Am. Assoc. Petroleum Geologists Bull., v. 25, no. 5, p. 941. Lower Eocene sediments below basal Sabine (Wilcox) *Ostrea thirsae* zone have surface thickness of about 800 feet in Sabine uplift of northwestern Louisiana. Upper 300 feet of sediments contain limited fauna. Lower 500 feet carry varied fauna which is older than Solomon Creek fauna of Texas (basal Wilcox or upper Midway in age) and correlated with upper Midway faunas of Alabama Naheola formation and Kerens member of Wills Point formation of Texas. This correlation based on study of over 90 species from 15 previously undescribed localities in Sabine, Natchitoches, and De Soto Parishes.

Grover Murray, Jr., 1941, (abs.) Am. Assoc. Petroleum Geologists Bull., v. 25, no. 5, p. 941–942. Midway sediments which crop out in northwestern Louisiana outline highest structural part of Sabine uplift. They are divisible on surface into three formations (ascending): Naborton, Logansport, and Hall Summit.

D. P. Meagher and L. C. Aycock, 1942, Louisiana Dept. Conserv., Geol. Pamph. 3, p. 13. Group includes (ascending) Naborton formation with Chemard Lake lignite lentil at top, Logansport formation with Dolet Hills, Cow Bayou, and Lime Hill members, and Hall Summit formation with Loggy Bayou, Grand Bayou, and Bisteneau members. Underlies Wilcox group.

M. W. Beckwith and F. E. Turner, 1943, Am. Assoc. Petroleum Geologists Bull., v. 27, no. 5, p. 608–621. Seguin formation, as originally defined, straddles boundary between Midway and Wilcox groups. Members of Seguin formation, Solomon Creek clays, and Caldwell Knob sands, are redefined so that base of Wilcox group is placed at disconformity marking top of Solomon Creek clays and base of Caldwell Knob sands. Solomon Creek member as defined herein apparently corresponds to upper part of Hall Summit unit of Barry and LeBlanc whereas Caldwell Knob member may be correlated with basal sand member of Marthaville unit and beds containing *Ostrea thirsae* in association with *O. multilirata*.

Lyman Toulmin, Jr., 1944, Alabama Acad. Sci. Jour., v. 16, p. 41–42. Discussion of Midway-Wilcox contact in Alabama. Contact easily located in exposures on Chattahoochee River at Fort Gaines, Ga., where fossiliferous Wilcox (Nanafalia) beds lie on irregular surface of Midway limstone. Stratigraphic position of Midway-Wilcox contact in central and western Alabama has heretofore been indefinite. Stratigraphic interval consisting of 200 feet or more of beds of uncertain age separates uppermost fossiliferous Midway bed and lowermost fossiliferous Wilcox bed. These beds consist of laminated clay and sand, lignite, greensand, and crossbedded coarse sand. Heretofore, paleontological evidence has been insufficient for determining whether these beds should be assigned to Midway or Wilcox group. A fossiliferous greensand marl within this sequence has been discovered in Wilcox County. Microfossils, including diagnostic Midway species, occur in this bed and it has been assigned to Midway group. Midway-Wilcox contact has been placed above sequence of greensand beds at erosional unconformity beneath crossbedded coarse sand that underlies fossiliferous Nanafalia beds of Wilcox group. The crossbedded sand is absent in places, and fossiliferous Nanafalia beds lie directly on irregular surface of the Midway. Midway group comprises (ascending) Clayton formation Porters Creek formation (Sucarnooche), Naheola formation (with "Matthews Landing marl," "Oak Hill beds," and "Coal Bluff beds").

G. E. Murray, Jr., and E. P. Thomas, 1945, Am. Assoc. Petroleum Geologists Bull., v. 29, no. 1, p. 45–70. Group, in southern half of Sabine uplift, comprises (ascending) Naborton formation (with Chemard Lake lignite lentil at top), Logansport formation (with Dolet Hills, Cow Bayou, and Lime Hill members), and Hall Summit formation (with Loggy Bayou, Grand Bayou, and Bisteneau members). In northern half of uplift, comprises Logansport formation and Hall Summit(?) sand; Naborton formation not exposed. Underlies Marthaville formation of Wilcox group. Paleocene.

F. S. MacNeil, 1946, U.S. Geol. Survey Strategic Minerals Inv. Prelim. Rept. 3-195, p. 6-17. Group includes (ascending) Clayton formation with McBryde limestone, Pine Barren, and Chalybeate limestone members, Porters Creek clay with Tippah sand lentil and Matthews Landing marl member, and Naheola formation with Coal Bluff marl member, and Betheden formation.

G. E. Murray, 1947, Am. Assoc. Petroleum Geologists Bull., v. 31, no. 10, p. 1829-1833. Midway deposits (group) crop out in central Gulf Coast in crescentic belt across southern Alabama, northeastern Mississippi, and western Tennessee. Isolated exposures flank west side of Mississippi alluvial valley in Arkansas. Midway formations are (ascending) Clayton, Porters Creek clay (with Matthews Landing marl member), and Naheola. In western Alabama, the Naheola contains Coal Bluff marl. Naheola replaced by Betheden formation in northern Mississippi and southern Tennessee. Transitional between underlying Cretaceous Gulf series and overlying Eocene Wilcox group. Paleocene.

G. E. Murray, 1948, Louisiana Dept. Conserv., Geol. Bull. 25, p. 88-135. Group in Louisiana redefined to include all sediments stratigraphically below Marthaville formation of Wilcox group and above Arkadelphia formation of Gulf series. In this sense, it includes Mansfield subgroup of Howe and Garrett (1934), lower part of Wilcox group of Moody (1930, Pan-Am. Geologist, v. 54, no. 2), Midway black shale unit of numerous authors, and Kincaid formation. In De Soto and Red River Parishes, divided into (ascending) Kincaid, Porters Creek, Naborton, Logansport, and Hall Summit formations. Paleocene.

G. E. Murray, 1953, Mississippi Geol. Soc. [Guidebook] 10th Field Trip, p. 48-60; 1955, Am. Assoc. Petroleum Geologists Bull., v. 39, no. 5, p. 671-696. Controversy concerning term Wilcox, as well as term Midway, stems from usage of both terms in dual sense as (1) rock terms and as (2) time and time-rock terms. Proposed to use Wilcox strictly as rock unit term. Such usage of Wilcox permits retention of Midway as a time and time-rock term for all the time and rocks deposited during fluctuations of Paleocene sea in Coastal Plain province. Midway age (time) and stage (time-rock), therefore contain, respectively, all of the time, or rocks deposited in Coastal Plain province after Cretaceous and before early Eocene invasion as recorded by glauconitic fossiliferous sands of Nanafalia and Marthaville formations. Midway stage is used to include those deposits in Gulf and Atlantic Coastal Plain province formed during stand of early Tertiary sea prior to deposition of wide-spread *Ostrea thirsae*, *Ostrea multilirata* beds of east Texas, Louisiana, Mississippi, and Alabama and their equivalents. Type exposures of Clayton, Porters Creek, and Naheola formations are considered exemplary of the stage. Midway age embraces all time involved in deposition of these deposits. This is essentially the original usage of Midway as defined by Harris (1896). Sabine stage is suggested as time-rock term for post-Midwayan and pre-Claibornian deposits of Coastal Plain province. Wilcox group contains delineatable and mappable lithologic rock units, some of Midway age and some of Sabine age.

C. O. Durham, Jr., and C. R. Smith, 1958, Louisiana Dept. Conserv., Geol. Pamph. 5, p. 1-17. Discussion of Louisiana Midway-Wilcox correlation problems. Evidence reviewed to show that Midway and Wilcox cannot be used in both a faunal and lithologic sense. Lithologic boundary drawn between Midway and Wilcox groups in Louisiana. [See Wilcox group, this reference.]

G. R. Kellough, 1959, Gulf Coast Assoc. Geol. Soc. Trans., v. 9, p. 147–160. Midway group of Texas, a predominantly shale, sandy shale, and sandy limestone section of Paleocene age, was deposited in open sea whose depth fluctuated between very shallow and deep. This concept based on study of samples from Tehuacama Creek, Limestone County. Sampled interval extends upward for 278 feet from Cretaceous-Paleocene contact. Foraminiferal content indicates that very lowest beds of Midway (Littig member of Kincaid) are marine, not littoral, probably mid- to outer neritic. Group includes Kincaid and Wills Point formations. Unconformably overlies Upper Cretaceous Navarro formation.

Named for exposures at Midway Landing and plantation, on west side of Alabama River, about 5 miles below Prairie Bluff, in Wilcox County, Ala.

†Midway Series[1] or Limestone[1]

Eocene, lower: Southern Alabama.

Original reference: E. A. Smith, 1886, Alabama Geol. Survey Bull. 1, p. 14.

Named for exposures at Midway Landing and plantation, on west side of Alabama River, about 5 miles below Prairie Bluff, in Wilcox County.

Midway Volcanic Group[1]

Oligocene and Miocene: Northeastern Washington, and southern British Columbia, Canada.

Original reference: R. A. Daly, 1912, Canada Geol. Survey Dept. Mines Mem. 38, map.

Probably named for Midway, British Columbia near international boundary.

Mier Sandstone Member (of Yegua formation)[1]

Mier Sandstone Tongue (of Yegua Formation)

Eocene, middle: Northeastern Mexico, and southwestern Texas.

Original reference: W. G. Kane and G. B. Gierhart, 1935, Am. Assoc. Petroleum Geologists Bull., v. 19, no. 9, p. 1374, 1384.

J. M. Patterson, 1942, Am. Assoc. Petroleum Geologists Bull., v. 26, no. 2, p. 264–265. Tongue overlies La Perla shale member and underlies Jose shale member (both new). About 150 feet thick where it crosses into Starr County from Mexico; thins northward and wedges out before latitude of Laredo is reached.

Typically exposed Ciudad Mier, Tamaulipas, Mex.

Mifflin Formation

Silurian: Central Pennsylvania.

H. H. Arndt and others, 1959, Geol. Soc. America Guidebook Pittsburgh Mtg., p. 5–6, 23, 29–30. New name introduced to include McKenzie, Rochester, and Keefer formations of earlier authors. Older names are retained as members as they are locally separable. Thickness about 304 feet at Mifflinton [Mifflintown] section. Underlies Bloomsburg formation; overlies Rose Hill formation. Name credited to Miller (unpub. ms.).

Type locality and derivation of name not stated.

Mifflin Limestone (in Platteville Group)

Mifflin Limestone Member (of Platteville Formation)

Middle Ordovician: Southwestern Wisconsin, northern Illinois, and southeastern Minnesota.

C. A. Bays, 1938, (abs.) Geol. Soc. America Proc. 1937, p. 269. Thinly bedded limestones which pass laterally to dolomitic limestones and dolomites. Thickness 17½ feet. Overlies Pecatonica dolomite member; underlies Magnolia member.

J. S. Templeton and H. B. Willman, 1952, Tri-State Geol. Soc. Guidebook 16th Ann. Field Conf., p. 6, 10 (fig. 3). Geographically extended into Dixon-Oregon area, Illinois, where it is considered a formation in Platteville group. Consists of limestone or dolomite, alternately pure and argillaceous, noncherty, thin- to thick-bedded, with gray-green shale partings. Thickness about 25 feet. Includes (ascending) Brickeys, Boarman, Establishment, Hazelwood, and Briton members (all new). Underlies Grand Detour formation (new); overlies Pecatonica formation.

M. P. Weiss and W. C. Bell, 1956, Geol. Soc. America Guidebook for Field Trips Minneapolis Mtg., Field Trip 2, p. 58 (table 1), 59, 60. Rocks of McGregor member have at some times and places been classified as Magnolia and Mifflin members of the Platteville (Bays and Raasch, 1935; Bays, 1938). In region south from Rochester, Minn., to McGregor, Iowa, there is virtually no evidence of Magnolia and Mifflin members. However, in Twin City area, where interval is somewhat dolomitic Majewske (1953, unpub. ms.) has shown that what in past has been lumped together as the McGregor is the Mifflin and Magnolia separated by an hitherto unnamed member, Hidden Falls. McGregor is used where special characteristics of Mifflin, Hidden Falls, or Magnolia are absent or insufficiently distinct. In Minnesota, Mifflin member is developed only from Twin City area eastward to Wisconsin and southward to Goodhue and Rice Counties. Thickness in Twin Cities about 11 to 13 feet; 7 feet at Afton; less than 4 feet at Faribault.

Named for exposures in roadcuts and stream banks of Pecatonica River at Mifflin, Iowa County, Wis., NE¼ sec. 34, T. 5 N., R. 1 E.

Mifflintown Limestone[1]

Silurian: Central Pennsylvania.

Original reference: J. P. Lesley, 1878, Pennsylvania 2d Geol. Survey Rept. F., p. xxv–xxvi.

Crops out on west bank of Juniata River, near Mifflintown, Juniata County.

†Miguel Formation[1]

Upper Cretaceous: Southwestern New Mexico.

Original reference: D. E. Winchester, 1920, U.S. Geol. Survey Bull. 716–A.

C. H. Dane, A. A. Wanek, and J. B. Reeside, Jr., 1957, Am. Assoc. Petroleum Geologists Bull., v. 41, no. 2, p. 187. Abandoned because of its originally incorrect definition, and because of substantial duplication of beds as measured and mapped in the type area.

Named for Miguel Creek, which crosses beds in northwest part of area (Alamosa Creek valley), Socorro County.

Milam Chalk Member (of Anacacho Limestone)

Upper Cretaceous: Southwestern Texas.

R. T. Hazzard, 1956, San Angelo Geol. Soc. Guidebook March 16–17, p. 45 (chart), 58 (strat. section), 61 (strat. section), 121–122. Name applied to middle Anacacho member. Grayish-white chalk and marl. Basal 10 feet characterized by profusion of *Exogyra costata* var *spinosa* Stephenson. Numerous species of unidentified ammonites present in chalk above zone of *Exogyra costata* var *spinosa*. Large *Pachydiscus* numerous. *Exogyra ponderosa* present in yellowish-weathering marly zone above the grayish-white chalk; *Pcynodonta* (*Gryphaea*) *vesicularis* abundant in this marly zone and with it the ammonite *Bostrychoceras*. Pelecypod shells, which may be *Diploschiza cretacea*, present in marly zones. Thickness about 40 feet. Unconformably overlies an interval (of varying thickness) of thin-bedded brown limestones and brownish marly limestones without *Exogyra ponderosa*. Based upon field relationships and provisional interpretation of fossil sequences, Taylor-Austin contact is placed at base of Milam chalk with first appearance of *Exogyra costata* var *spinosa*, and some feet above, the ammonite *Bostrychoceras*.

Exposed on Turner and Milam Ranches at northeast end of Anacacho Mountains, Kinney County. Not recognized as lithologic unit on Anacacho Ranch in western part of Anacacho Mountains.

Milams Member (of Cook Mountain Formation)[1]

Eocene (Claiborne) : Northwestern Louisiana and eastern Texas.

Original reference: A. C. Ellisor, 1929, Am. Assoc. Petroleum Geologists Bull., v. 13, p. 1339–1346.

J. Huner, Jr., 1939, Louisiana Dept. Conserv. Geol. Bull. 15, p. 87, 91–95, pl. 3. Stratigraphically restricted below to exclude lower 17 feet which are placed in newly defined Dodson member. As redefined, the Milams consists of about 50 feet of calcareous glauconitic shales, lignitic shales, and marl which occur above glauconitic fossiliferous sands of Dodson member and below fossiliferous ironstone zones of Saline Bayou member.

Type locality: NE¼ sec. 17, T. 13 N., R. 3 W., Winn Parish, La., which is one-half to three-quarter mile southwest of Milams, on Arkansas Southern Railway.

Milan Limestone Member (of Wellington Formation)

Permian: Southern Kansas.

G. H. Norton, 1937, Am. Assoc. Petroleum Geologists Bull., v. 21, no. 12, p. 1557. Milan limestone member at top of Wellington shale; conformably underlies Harper sandstone.

G. H. Norton, 1939, Am. Assoc. Petroleum Geologists Bull., v. 23, no. 12, p. 1757–1758. In following Wellington gray beds up section from type locality toward west and north, the break between gray beds below and redbeds above is so clear as to leave no doubt as to what Cragin (See Wellington formation) considered the contact. This is marked by a 1-foot bed of greenish to gray shaly platy dense limestone, strong enough to afford good outcrops, which are expressed in scarps and benches, characterized by an abundance of green copper carbonate. This bed is named the Milan limestone member. Three calcareous beds occur in top 8 feet of the Wellington, with the upper one ordinarily the most prominent as well as most cupriferous. Locally, there is thinning and weakening of topmost bed, together with corresponding strengthening and thickening of one of the lower beds, the 3-foot bed or the 8-foot bed below, with increase of copper content of these beds. Name Milan limestone member is intended to include all three thin limestones. A thin bed of maroon shale commonly underlies the topmost bed, separated by a foot of gray shale, the color being typical of the Wellington rather than the brick red of over lying Cimarron redbeds.

R. C. Moore and others, 1951, Kansas Geol. Survey Bull. 89, p. 40. Milan limestone member, consisting of 1 foot of greenish-gray shaly limestone that on outcrop is characterized by bright-green copper carbonate, marks top of Wellington in comparatively large area.

Named for typical exposures on the 1-foot bed near SE cor. sec. 30, T. 32 S., R. 3 W., 2 miles north of Milan, and along south bank of Chikaskia River, Sumner County.

Milburn Shale (in Canyon Group)[1]

Pennsylvanian: Central Texas.

Original reference: E. T. Dumble, 1890, Texas Geol. Survey 1st Ann. Rept., p. lxvi, pl. 3.

Named for Milburn, McCulloch County.

Miles Limestone Member[1] (of Falls City Limestone)

Pennsylvanian: Southeastern Nebraska.

Original reference: G. E. Condra, 1935, Nebraska Geol. Survey Paper 8, p. 5, 9.

Type locality: In high hill west of Miles Ranch, 2 miles southwest of Falls City, Richardson County.

Milesburg Formation[1]

Lower Devonian: Central Pennsylvania.

Original reference: C. Schuchert, 1916, Geol. Soc. America Bull., v. 27, p. 552.

In Tyrone Gap, Bald Eagle Mountain, Blair County.

†Milford Chlorite Schist[1]

Pre-Triassic: Southwestern Connecticut.

Original reference: H. E. Gregory, 1906, Connecticut Geol. Nat. History Survey Bull. 6, p. 100, map.

John Rodgers and others, 1956, Preliminary geological map of Connecticut (1:253,440): Connecticut Geol. Nat. History Survey. Includes local bands of serpentine and limestone. Pre-Triassic.

Mapped over large area in Milford Township, New Haven County.

Milford Granite[1]

Devonian(?): Eastern Massachusetts and northeastern Rhode Island.

Original reference: B. K. Emerson and J. H. Perry, 1907, U.S. Geol. Survey Bull. 311, p. 26–33, 45–47, 66, map.

A. W. Quinn, R. G. Ray, and W. L. Seymour, 1948, *in* A. W. Quinn and others, Rhode Island Port and Indus. Devel. Comm. Geol. Bull. 3, p. 15. Locally abandoned. Replaced by Esmond granite (new) in Pawtucket quadrangle, Rhode Island, where it is dissimilar to its type area.

Named for quarries in Milford, Mass.

Milford Silts

Pleistocene (Nebraskan): Western West Virginia.

D. P. Stewart, 1952, West Virginia Acad. Sci. Proc., v. 23, p. 113. Incidental mention in discussion of Barboursville silts (new). Deposited when preglacial Teays River was blocked by Nebraskan glacial ice.

Type locality and derivation of name not given.

Milk Creek Beds

Pliocene, lower: Central Arizona.

C. A. Reed, 1950, Plateau, v. 22, no. 4, p. 75–77. Has yielded numerous mammalian remains. Lower or middle Pliocene age.

C. S. St. Clair, 1957, Plateau, v. 30, no. 2, p. 36, 37, fig. 2. About 2,500 feet of fluviatile and lacustrine sediments containing siltstones, sandstones, conglomerates, and interbedded tuffs. Includes three members: lowest chiefly of conglomerate and conglomeratic sandstone, about 500 feet thick; middle of siltstone and sandstone with interbedded tuff, about 1,000 feet thick and uppermost of siltstone and sandstone with interbedded tuff, differing from middle member mainly by being locally crossbedded, about 700 feet thick. Upper 300 to 400 feet dated as lower Pliocene and underlying 2,000 feet or so of sediments assumed to be lower Pliocene, although it is possible that beds may in part span Miocene-Pliocene boundary.

On Milk Creek, a tributary of Hassayampa River, south of Prescott and within Prescott National Forest, Yavapai County. In Walnut Grove basin, west of Bradshaw Mountains.

Millard Formation (in Ophir Group)

Millard Limestone

Millard Member (of Howell Limestone)

Middle Cambrian: Western Utah.

H. E. Wheeler, 1948, Nevada Univ. Bull., Geology and Mining Ser., no. 47, p. 35–36, fig. 5. Eastward thinning and disappearance of Chisholm shale between Wah Wah and House Ranges bring the similar Lyndon and Peasley limetones into contact. In House Range, these two combined formations constitute valid lithologic unit, herein designated Millard limestone. As herein defined, consists of predominantly dark-gray fine- to medium-grained limestones that make up basal 281 feet of Howell limestone (Deiss, 1938, Geol. Soc. America Bull., v. 49, no. 7). Overlies Busby quartzite; underlies Burrows dolomite.

J. K. Rigby, 1958, Utah Geol. Soc. Guidebook 13, p. 11, 12, 14 (fig. 3). Included in Ophir group in Stansbury Mountains where it overlies Busby quartzite and underlies undivided shale and limestone sequence correlated with Dome, Burrows, and Burnt Canyon formations of Sheeprock and House Ranges. Thickness 190 to 280 feet. Base of formation placed at base of consistently pisolitic algal? limestone and top mapped at top of similar limestone. A few *Glossopleura* occur in shales of the formation.

R. E. Cohenour, 1959, Utah Geol. and Mineralog. Survey Bull. 63, p. 12, (table 1), 35, 41–44, pl. 1, measured sections. In Sheeprock Mountains, name Millard formation substituted for Millard limestone of House Range. Divisible into three members: basal, 150 to 207 feet, pisolitic blue-gray medium-bedded limestone; middle, 50 to 120 feet, green shale, the *Glossopleura* zone of the Sheeprock Cambrian; upper, pisolitic limestone averaging 40 feet in thickness. Conformably overlies Busby quartzite; underlies Burrows limestone. Included in Ophir group.

R. O. Robison, 1960, Intermountain Assoc. Petroleum Geologists Guidebook 11th Ann. Field Conf., p. 50–51. Rank reduced to member status of Howell limestone (restricted). Proposed that Millard include *Girvanella* limestone facies of the Howell when other carbonate lithofacies are also represented. Upper member of Howell in House Range left unnamed at this time. Overlies Tatow formation. Name Burrows discontinued in House Range and Wah Wah Range.

Type section: In Marjum Canyon, House Range, Millard County.

Millbach Formation (in Conococheague Group)

Millbach Member (of Conococheague Formation)

Upper Cambrian: Southeastern Pennsylvania.

Carlyle Gray, A. R. Geyer, and D. B. McLaughlin, 1958, Geologic map of the Richland quadrangle, Pennsylvania (1:24,000): Pennsylvania Geol. Survey, 4th ser., Atlas 167–D. Limestone sequence that stratigraphically overlies Schaefferstown member (new); top is drawn at base of first medium-gray siliceous dolomite bed of overlying Richland member (new). Distinguished from Schafferstown member by presence of white to pinkish-gray crystalline limestone beds and less distinct shaly partings and bands in the medium-light-gray to medium-gray limestone beds; lithologically similar to Buffalo Springs member (new) and is distinguished principally by stratigraphic position; a few thin sandstones and sandy limestones or dolomites present; *Cryptozoon* reefs common. Width of outcrops suggests that thickness is in order of 500 to 550 feet; partial section (type) 112 feet; neither top nor base exposed, but good exposures of *Cryptozoon* present.

Carlyle Gray and D. M. Lapham, 1959, Geol. Soc. America Guidebook Pittsburgh Mtg., p. 148–150. Upper Cambrian.

Carlyle Gray and others, 1960, Geologic map of Pennsylvania (1:250,000): Pennsylvania Geol. Survey, 4th ser. Mapped as formation in Conococheague group.

Type section: Partial section measured in quarry about one-half mile southwest of Sheridan on south side of Mill Creek and 0.8 mile northeast of village of Millbach, Lebanon County. No satisfactory type section available in Lebanon County, but best partial section measured and used as type section.

Millboro Shale

Millboro Shale Member (of Romney Shale)

Middle and Upper Devonian: Western Virginia.

B. N. Cooper, 1939, Virginia Geol. Survey Bull. 55, p. 42–44, pls. 1, 3. Proposed by C. Butts (unpub. ms. to replace term "Black shale of Devonian age" which was tentatively used to distinguish a Devonian black shale, composed of Marcellus and early Naples age, from Romney shale which includes beds of Onondaga and Hamilton age. In belts where name Millboro applies, the "black shale" contains no Onondaga and no beds of Hamilton, Tully, or Genesee age. Thickness 750 feet. Comprises two members, Marcellus below and Naples above. Underlies Brallier formation; overlies Onondaga formation.

Charles Butts, 1940, Virginia Geol. Survey Bull. 52, pt. 1, p. 308–314. Term is applicable only in areas where the Hamilton is absent, as southwest of

Shenandoah County, Va. Shale is constant in its occurrence between the Onondaga and Brallier from Highland and Augusta Counties southwest to Tennessee. Thickness 200 to 1,000 feet. Type locality designated.

G. A. Cooper and others, 1942, Geol. Soc. America Bull., v. 53, no. 12, pt. 1, chart 4, p. 1736–1737. Millboro may represent not only Marcellus but entire Hamilton.

F. G. Lesure, 1957, Virginia Polytech. Inst. Engineering Expt. Sta. Ser. 118, p. 19 (table 1), 20 (table 2), 55–57, pl. 1. Rank reduced to member status in Romney shale. In Clifton Forge district, conformably overlies and grades into Needmore shale member. Middle and Upper Devonian.

Type locality : Millboro Springs, Bath County.

Millbury Limestone[1]

Upper Carboniferous or post-Carboniferous : Eastern Massachusetts.

Original reference: B. K. Emerson and J. H. Perry, 1903, Geology of Worcester, with map.

Occurs at Millbury, Worcester County.

Mill City Glacial Stage

Mill City Till

Pleistocene : Northwestern Oregon.

T. P. Thayer, 1939, Oregon Dept. Geology and Mineral Industries Bull. 15, p. 20, 21–23. Stage defined as time during which Mill City till was deposited. Thickness of till 25 to 30 feet.

Deposits exposed about 7½ miles along North Santiam River from Gates to a point almost 3 miles west of Mill City, Marion County.

Mill Creek beds

See **McIntosh Formation** and **Yamhill Formation.**

Mill Creek Limestone[1]

Pennsylvanian : Northeastern Pennsylvania.

Original reference: C. A. Ashburner, 1886, 2d Pennsylvania Geol. Survey Ann. Rept. 1885, p. 443.

M. M. Chow, 1951, Pennsylvania Geol. Survey, 4th ser., Bull. G–26, p. 1–17. Summary discussion.

Crops out along north side of Mill Creek near Wilkes-Barre, Luzerne County, near breast of old Hallenback Dam, and about midway between River Street bridge and a bridge of Lehigh Valley Railroad which crosses creek at its mouth.

Miller Fire Clay[1]

Pennsylvanian : Northern Missouri.

Original reference: H. A. Wheeler, 1893, Missouri Geol. Survey Sheet Rept. 2, v. 9, p. 60–65.

Named for Miller Farm, 2½ miles south of Bevier, Macon County.

Miller Lava Flow

Recent : Southwestern Oregon.

E. T. Hodge, 1925, Oregon Univ. Pub., v. 2, no. 10, p. 14 (fig. 10), 60 (fig. 44), 80. Discussion of Mount Multnomah, ancient ancestor of the Three Sisters. Name applied to lava flow that issued from base of South Sister and flowed toward but did not entirely reach Devils Hill. Lava came to surface, soaked through glacial moraine and debouched over glaciated surface. Covers about one-third square mile.

South Sister Mountain is on border of Lane and Deschutes Counties. Flow was named for Morrison Miller, a member of Hodge's party.

Miller Mountain Formation

Lower Cambrian: Southwestern Nevada.

H. G. Ferguson, S. W. Muller, and S. H. Cathcart, 1954, U.S. Geol. Survey Geol. Quad. Map GQ-45. Lower part dominantly massive argillite with minor quartzite; upper part, alternation of thin-bedded slate, quartzite, and limstone, partly altered to diopside-garnet rock. Near top of exposed section is a bed of massive white crystalline dolomitic limestone about 500 feet thick. Thickness about 3,000 feet; neither top nor base exposed.

Type locality: South flank of Miller Mountain.

Miller Peak Argillite
Miller Peak Formation[1] (in Missoula Group)

Precambrian (Belt Series): Central western Montana, and southwestern Alberta, Canada.

Original reference: C. H. Clapp and C. F. Deiss, 1931, Geol. Soc. America Bull., v. 42, p. 677-678, figs. 2, 3.

C. L. Fenton and M. A. Fenton, 1937, Geol. Soc. America Bull., v. 48, no. 12, p. 1901-1903. Basal formation of Missoula group. Comprises three members (ascending): Kintla, Roosville, and Mount Rowe (new). Underlies undifferentiated rocks of group; overlies Sheppard formation. Geographically extended into Alberta.

Charles Deiss, 1943, Geol. Soc. America Bulll., v. 54, no. 2, p. 211-215. Miller Peak argillite, in Saypo quadrangle, conformably underlies Cayuse limestone (new). Thickness 1,000 feet; base cut out by Lewis overthurst.

D. A. Andrews, G. S. Lambert, and G. W. Stose, 1944, U.S. Geol. Survey Oil and Gas Inv. Prelim Map 25. Mapped as basal formation of Missoula group. Underlies Hellgate formation.

W. H. Nelson and J. P. Dobell, 1959, U.S. Geol. Survey Misc. Geol. Inv. Map I-296. Miller Peak argillite mapped in Bonner quadrangle, Montana, where it includes Hellgate quartzite member. Underlies Bonner quartzite (new); overlies Newland limestone of Piegan group.

Type locality: Upper part of south flank of Miller Peak, Bonner quadrangle, Montana.

Millers Sandstone[1]

Upper Devonian: Northwestern Pennsylvania.

Original reference: G. H. Chadwick, 1925, Geol. Soc. America Bull., v. 36, p. 457-464.

G. A. Cooper and others, 1942, Geol. Soc. America Bull., v. 53, no. 12, pt. 1, p. 1752. Referred to as Millers Hollow member of Salamanca [apparently a lapsus for Millers sandstone (Caster, 1934)]. Upper Devonian.

First described in Erie County. Derivation of name not stated.

Millersburg Formation[1] or Group

Pennsylvanian: Southwestern Indiana.

Original reference: M. L. Fuller and G. H. Ashley, 1902, U.S. Geol. Survey Geol. Atlas, Folio 84.

H. R. Wanless 1939, Geol. Soc. America Spec. Paper 17, p. 95. Millersburg group includes beds from base of Inglefield sandstone above to Millersburg coal. Name Millersburg formation was used to include strata from Somerville limestone above to Millersburg coal, about the lower half of Millersburg group.

Named for Millersburg, Elkhart County.

Millersburg Limestone Member (of Cynthiana Formation)[1]

Middle Ordovician: Central Kentucky.

Original reference: A. F. Foerste, 1914, Cincinnati Soc. Nat. History Jour., v. 21, no. 4, p. 112.

A. C. McFarlan and W. H. White, 1948, Am. Assoc. Petroleum Geologists Bull., v. 32, no. 8, p. 1641. Division of Cynthiana. Very fossiliferous, argillaceous, and characteristically rubbly limestone on eastern and northeastern flank of the dome. Marked at base by abundance of *Alonychia flanaganensis* in zone 6 to 8 feet thick. Underlies Nicholas limestone. More or less equivalent to Greendale limestone and similarly constitutes body of formation as Nicholas wedges out southward. Pre-Cincinnatian.

D. K. Hamilton, 1950, Kentucky Geol. Survey, ser. 9, Bull. 5, p. 18. All subdivisions of interval between top of Benson limestone and base of Eden formation should be referred to as members of Cynthiana. This includes lithologic and paleontologic units heretofore defined as Brannon, Woodburn, Greendale, Millersburg, Nicholas, Rogers Gap, Bromley, and Gratz.

Named for Millersburg, Bourbon County.

Millers Cliff Conglomerate[1]

Devonian or Carboniferous: Northwestern Pennsylvania.

Original reference: J. P. Lesley, 1892, Pennsylvania 2d Geol. Survey Summ. Final Rept., v. 2, p. 1489–1536.

Miller's Cliff is halfway between Lottsville and Wrightsville, Warren County.

Millers Hollow member (of Salamanca [formational suite])

See Millers Sandstone.

†Millers River Conglomerate[1]

Carboniferous: Northeastern Rhode Island.

Original reference: J. B. Woodworth, 1899, U.S. Geol. Survey Mon. 33, p. 134, 140, 156.

Occurs in valley of Millers River, in Cumberland, Providence County.

Millersview Limestone Member (of Grape Creek Formation)[1]

Permian: Central Texas.

Original reference: W. Kramer, 1934, Am. Assoc. Petroleum Geologists Bull., v. 18, no. 12, p. 1579, 1581.

Crops out 4½ miles south-southwest of Millersview, Concho County.

Millersville cyclothem (in McLeansboro Group)

Pennsylvanian: Southern Illinois.

H. R. Wanless, 1955, Am. Assoc. Petroleum Geologists Bull., v. 39, no. 9, p. 1764 (table 2); H. R. Wanless and Raymond Siever, 1956, Illinois

Geol. Suvery Circ. 217, p. 12, pl. 1. Listed as cyclothem at top of McLeansboro group.

Type locality: Secs. 28 and 34, T. 12 N., R. 1 W., Christian County.

Millersville Limestone Member (of Bond Formation)

Millersville Limestone (in McLeansboro Group)

Pennsylvanian: East-central Illinois.

E. F. Taylor and G. H. Cady, 1944, Illinois Geol. Survey Rept. Inv. 93, p. 22–26. Limestone called Millersville in this report [Moultrie, Coles, Shelby, and Cumberland Counties] is believed to be same as limestone exposed near Millersville, Christian County. In outcrops, limestone is gray to buff, crystalline, fossiliferous, with interbedded shales; near base of a porous coquina composed of aggregate of small spheroid-shaped particles with chalky incrustations and the numerous minute fossils of algae, fusulinids, and other foraminifera are important at some localities; thickness 5 to 6 feet. In this report, is known only from drill cuttings, is 30 to 50 feet thick and includes one or more prominent shale beds. Lies about 600 feet above Herrin (No. 6) coal bed and 40 to 50 feet below Upper Bogota limestone in vicinity of Louden pool. Bed has been variously called LaSalle, New Haven, Carthage, and Livingston limestone.

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 39, 50 (table 1), 71. Rank reduced to member status in Bond formation (new). Top of formation in central and southwestern Illinois, where it overlies Coffeen limestone member (new). In southeastern and eastern Illinois, equivalent to Livingston limestone on east side of LaSalle anticline.

Type locality: Secs. 28 and 34, T. 12 N., 1 W., Christian County.

Millerton Formation[1]

Pleistocene: Western California.

Original reference: R. E. Dickerson, 1922, California Acad. Sci. Proc., 4th ser., v. 11, no. 19, maps.

C. E. Weaver, 1949, Geol. Soc. America Mem. 35, p. 16 (table 3), 99–103, pls. Composed of conglomerates, brownish-gray soft sandy shales, and clayey sandstones with interbedded gravels. Beds moderately folded and faulted. Thickness about 60 feet. Overlain by Montezuma formation (new). Base not exposed at Millerton Head. Mason (1934, Carnegie Inst. Washington Pub. 415) considered Dickerson's Millerton and Tomales represented a single stratigraphic unit which he called Tomales.

Named for exposures in headland near Millerton Station, Marin County. Confined to area of Tomales Bay.

Millerville Green Schist[1]

Post-Carboniferous(?): Eastern Alabama.

Original reference: E. A. Smith, 1896, Alabama Geol. Survey Bull. 5, p. 118–125.

Well exposed at Millerville, Clay County.

Millett clay[1]

Miocene(?): Southeastern California and southwestern Nevada.

Original reference: C. R. Keyes, 1923, Pan-Am. Geologist, v. 40, p. 52, 61, 79.

Named for old Millett borax camp, in Furnace Canyon, east of Death Valley, Inyo County, Calif.

Mill Hill slate

Paleozoic: Southeastern Pennsylvania.

Pennsylvania Geological Society, 1954, Pennsylvania Geologists 20th Ann. Mtg., p. 16, pl. 2; A. R. Geyer and Carlyle Gray, 1957, Geol. Soc. America Guidebook Atlantic City Mtg., p. 243, 244 (fig. 2), 245, 246. At Cornwall, a wedge of Paleozoic sediments lies above a dike at contact of Triassic diabase and Cambrian limestones. Sediments of the wedge include three mappable units: a limestone that apparently belongs to oldest member of Conococheague and is overlain by either of two units given local names of Mill Hill slate and Blue Conglomerate. Mill Hill is a hard dense light-brown to black banded hornstone. Believed to be outlier of Martinsburg shale which has been altered by diabase intrusion.

Present at Cornwall, Lebanon quadrangle, Lebanon County.

†Milliard limestone[1]

Cambrian: Utah.

Original reference: C. R. Keyes, 1923, Pan-Am. Geologist, v. 40, p. 53, 79.

Derivation of name and type locality not stated.

†Millican Formation[1]

Precambrian: Western Texas.

Original reference: G. B. Richardson, 1914, U.S. Geol. Survey Geol. Atlas, Folio 194.

P. B. King, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 1, p. 148. Abandoned. Unit divided into two formations, Hazel sandstone above and Allamoore limestone below.

Named for Millican's Ranch, [Culberson County], 10 miles northwest of Van Horn.

Milligen Formation[1]

Devonian(?) and Mississippian: Southern central Idaho and southwestern Montana.

Original reference: L. G. Westgate and C. P. Ross, 1930, U.S. Geol. Survey Bull. 814, p. 10, 24–29, map.

G. A. Cooper and others, 1942, Geol. Soc. America Bull., v. 53, no. 12, pt. 1, p. 1771, chart 4. Devonian and Mississippian.

C. P. Ross, 1947, Geol. Soc. America Bull., v. 58, no. 12, pt. 1, p. 1112–1113. Described in Borah Peak quadrangle, Idaho, as mainly dark-gray to black carbonaceous shale. Thickness about 1,000 feet. Overlies Three Forks limestone; underlies Brazer limestone.

T. H. Kiilsgaard, 1950, Idaho Bur. Mines and Geology Pamph. 90, p. 40–41. In Warm Springs mining district, formation is more than 5,500 feet thick and possibly greater than 7,500 feet. Comprises three limestones referred to as lower, middle, and upper, and the Elkhorn limestones which are separated from lower limestone by several hundred feet of argillite. Some parts of formation mapped as undifferentiated. These parts are argillites, gradations of limy and siliceous argillites, and quartzites with boundaries too indefinite to map. Underlies Wood River formation.

L. L. Sloss and C. A. Moritz, 1951, Am. Assoc. Petroleum Geologists Bull., v. 35, no. 10, p. 2160–2161. Described in Beaverhead Range, Mont., as dominantly dark-gray to black shales, limy shales, and shaly limestones that weather light or medium gray. Units of more massive limestone, also dark gray to black, form rugged cliffs 50 to 100 feet high. Thickness 2,291 feet in Nicholia Creek section. Relationships to underlying strata not exposed. Tentatively considered to be equivalent to all of Madison group, plus all or part of Big Snowy group.

M. R. Thomasson, 1959, Dissert, Abs., v. 20, no. 3, p. 999. Discussion of late Paleozoic stratigraphy and paleotectonics of central and eastern Idaho. Milligen-Wood River contact is hiatus which is represented by Muldoon formation (new) deposited in Muldoon trough. Deposition was continuous from the Milligen into the Muldoon in the trough. Lower and Middle Paleozoic.

Named for exposure on Milligen Creek, Hailey quadrangle, 6 miles east of Ketchum, Idaho.

Milliken Sandstone Member (of Fox Hills Sandstone)[1]

Upper Cretaceous: Northeastern Colorado.

Original reference: J. Henderson, 1920, Colorado Geol. Survey Bull. 19.

J. D. Moody, 1947, Am. Assoc. Petroleum Geologists Bull., v. 31, no. 8, p. 1457. Milliken in this report [upper Montana group of Golden area] is used to indicate basal sandstone member of Fox Hills formation as restricted by Lovering and others (1932, Am. Assoc. Petroleum Geologists Bull., v. 16, no. 7).

Well exposed near Milliken Station, west of La Salle, Weld County.

Million Shale (in Eden Group[1] or Formation)

Upper Ordovician: Central Kentucky.

Original reference: J. M. Nickles, 1905, Kentucky Geol. Survey Bull. 5, p. 25.

J. L. Rich, 1951, Geol. Soc. America Bull., v. 62, no. 1, p. 18. Referred to as Million shale member of Eden formation.

W. H. Twenhofel and others, 1954, Geol. Soc. America Bull., v. 65, no. 3, chart 2 (column 44). Shown on correlation chart as overlying Fulton shale and underlying Garrard siltstone.

Named for Million, Madison County.

Mill River Conglomerate[1]

Mill River Conglomerate (in Woods Corners Group)

Mill River Limestone Breccia

Middle Cambrian: Western Vermont.

Original reference: B. F. Howell, 1929, Vermont State Geologist, 16th Rept., p. 266–268.

Charles Schuchert, 1937, Geol. Soc. America Bull., v. 48, no. 7, p. 1014–1015, 1047. Described as a local limestone breccia at base of Hungerford slate.

B. F. Howell, 1944, Geol. Soc. America Bull., v. 55, no. 8, chart 1, column 70. Age designated Middle Cambrian on correlation chart.

A. B. Shaw, 1958, Geol. Soc. America Bull., v. 69, no. 5, p. 536, 537–539, pl. 1. Included in Woods Corners group (new). In St. Albans area, forms discontinuous lenses, commonly less than 200 feet long and no more than 35 feet thick. Overlies St. Albans slate; grades upward into Skeels Corners slate. Middle Cambrian.

Named for Mill River just east of which it is exposed about 2 miles southwest of St. Albans, one-quarter mile south of road running west from western foot of St. Albans Hill, Franklin County.

Mills Bed[1]

Eocene, middle: Southern Texas.

Original reference: F. M. Getzendaner, 1930, Am. Assoc. Petroleum Geologists Bull., v. 14, no. 11, p. 1436–1437.

On O. A. Mills Ranch in Zavalla County.

Mills Formation

Upper Cretaceous (Chico Series): Northern California.

J. M. Kirby, 1942, (abs.) Am. Assoc. Petroleum Geologists Bull., v. 26, no. 5, p. 899. Listed as underlying Sites formation and overlying Golden Gate formation (both new).

J. M. Kirby, 1943, California Div. Mines Bull. 118, p. 606. Well-bedded dark- to greenish-gray clay shales. Derivation of name given and good exposures noted.

J. M. Kirby, 1943, Am. Assoc. Petroleum Geologists Bull., v. 27, no. 3, p. 282 (footnote). Name preoccupied; replaced by Yolo formation.

Named from its proximity to Mills Orchard at mouth of Stone Corral Creek in sec. 35, T. 17 N., R. 4 W. Colusa County.

†Millsap division (in Strawn Group)[1]

Pennsylvanian (Allegheny): Central and central northern Texas.

Original reference: W. F. Cummins, 1891, Texas Geol. Survey 2d Ann. Rept., p. 361, 372–374.

Named for Millsap, Parker County.

†Millsap Limestone[1]

Lower Mississippian: Eastern Colorado.

Original reference: W. Cross, 1894, U.S. Geol. Survey Geol. Atlas, Folio 7.

Named for Millsap Creek, Pikes Peak quadrangle.

Millsap Lake Formation (in Strawn Group)[1]

Millsap Lake Group

Middle Pennsylvanian: North-central Texas.

Original reference: E. H. Sellards, 1933, Texas Univ. Bull. 3232, p. 106–108.

M. G. Cheney, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 1, p. 66 (fig. 1), 88. Rank raised to group in Strawn series. Includes (ascending) unnamed subsurface formations, Dickerson, Lazy Bend, and Grindstone Creek formations. Underlies Lone Camp group (new); overlies Smithwick group of Lampasas series (new).

M. G. Cheney, 1945, Am. Assoc. Petroleum Geologists Bull., v. 29, no. 2, p. 163. Stratigraphically restricted below as Lampasas-Strawn boundary in Brazos River outcrop section is placed at base of conglomerate which rests on Dennis Bridge limestone member of Lazy Bend formation at Dennis Highway bridge in Parker County. As thus restricted, overlies Parks group (herein rank raised).

M. G. Cheney, 1947, Jour. Geology, v. 55, no. 3, pt. 2, p. 209. Thickness of Millsap Lake group (restricted) 1,400 feet. Overlies Kickapoo Creek group (new).

Type locality: Millsap Lake, Parker County.

Millsdale Limestone[1]

Upper Ordovician (Richmond) : Northeastern Illinois.

Original reference: J. R. C. Evans, 1929, Chicago Univ. Abs. Theses, Sci. ser., v. 2, p. 199–200.

Lithology and type locality not stated.

Mill Street Conglomerate

Upper Cambrian : Eastern Minnesota.

C. A. Nelson, 1951, Jour. Paleontology, v. 25, no. 6, p. 774. Incidental mention as Mill Street conglomerate.

R. R. Berg, 1954, Geol. Soc. America Bull., v. 65, no. 9, p. 869–870. At Taylors Falls, Minn., Woodhill member of the Franconia has at base a boulder conglomerate containing *Elvinia* fauna. This is Mill Street conglomerate of Berkey (1897). [Berkey, 1897, Am. Geologist, v. 20, no. 6, p. 375, refers to two outcrops of conglomerate on Mill Street in Taylors Falls, and on p. 376 states that "the conglomerate at Taylor's Falls belongs stratigraphically to the lower part of the Franconia."]

Milltown Andesite[1]

Milltown Andesite Series

Tertiary : Southwestern Nevada.

Original reference: F. L. Ransome, 1909, U.S. Geol. Survey Prof. Paper 66, p. 28, 47.

Fred Searls, Jr., 1948, Nevada Univ. Bull., Geology and Mining Ser., no. 48, p. 8–12. Referred to as Milltown andesite series in discussion of Ransome's report. Dacite, which is most important rock in Goldfield, is believed to be a flow that may be grouped with Milltown andesite and not intrusive into it as believed by Ransome.

Named for settlement of Milltown, about 1 mile east of Goldfield, Esmeralda County.

†Milner Formation (in Mesaverde Group)[1]

Upper Cretaceous : Northwestern Colorado.

Original reference: M. R. Campbell, 1931, Tentative correlation of named geologic units of Colorado, compiled by M. G. Wilmarth, U.S. Geol. Survey, separate chart.

Campbell's report was not published. Name Milner Formation appeared in bold face in Wilmarth Lexicon on basis of Wilmarth's correlation chart. Cobban and Reeside (1952, Geol. Soc. America Bull., v. 63, no. 10) used name Milner Formation on Cretaceous correlation chart and cited Wilmarth Lexicon. The U.S. Geological Survey has abandoned the term Milner Formation.

Formation crosses valley of Yampa River in T. 6 N., R. 86 W., and is named for Milner, a small village in this valley.

Milo Tongue (of West River Shale)

Upper Devonian : West-central New York.

W. L. Grossman, 1944, Geol. Soc. America Bull., v. 55, no. 1, p. 65–66, 73. Name proposed for upper shales of West River shale in Keuka Lake valley. Consists of black and dark-gray fissile shale with interbedded light and blue-gray layers, limy bands, and spherical concretions. Shales are uniformly medium argillaceous siltstones. Very few thin flags present. Thickness 90 feet. Underlies Middlesex shale; overlies Keuka flagstone lentil in Starkey tongue of Sherburne formation. Both contacts gradational. Unit has erroneously been called Standish formation.

Named for exposures in streams in Milo Township, Yates County. Type section is in Crosby Gully on east side of Keuka Lake, 7 miles south of Penn Yan.

Milton Dolomite[1]

Milton dolomite facies (of Clarendon Springs Dolomite)

Milton Limestone

Upper Cambrian: Northwestern Vermont.

Original reference: Arthur Keith, 1923, Am. Jour. Sci., 5th ser., v. 5, p. 111–115.

E. O. Ulrich and G. A. Cooper, 1938, Geol. Soc. America Spec. Paper 13, p. 25. Referred to dolomite facies.

A. B. Shaw, 1951, Jour, Paleontology, v. 25, no. 1, p. 97. Limestone included in list of formations.

Best exposed in wide belt passing through town of Milton, about 3 miles west of Milton village, Chittenden County.

Milton Formation[1]

Triassic and Jurassic: Northern California.

Original reference: H. W. Turner, 1894, Am. Geologist, v. 13, p. 232–234.

N. L. Taliaferro, 1942, Geol. Soc. America Bull., v. 53, no. 1, p. 99–100. Near northern end of the Sierras, Triassic and Jurassic sediments and volcanics have been named Milton and Sailor Canyon formations but there is little doubt that they are equivalent. Since name Milton has priority, it is used here to include all Triassic and Jurassic rocks of higher parts of the Sierra Nevada, south of Taylorsville.

K. B. Ketner, 1959, *in* E. D. McKee and others, U.S. Geol. Survey Misc. Geol. Inv. Map I–300, p. 17. About 200 feet of Milton is known to be Triassic. Partly Jurassic and partly Triassic.

Named for exposures in vicinity of Milton, an old stage station on Middle Fork of Yuba River, in Downieville quadrangle.

Milton Quartzite[1]

Cambrian(?): Eastern Massachusetts.

Original reference: M. Billings, 1929, Am. Jour. Sci., 5th, v. 18, p. 99, 101–103.

Exposed just north of the Quincy granite in town of Milton, Norfolk County.

Milwaukee Formation[1]

Middle Devonian: Southeastern Wisconsin.

Original reference: W. C. Alden, 1906, U.S. Geol. Survey Geol. Atlas, Folio 140.

G. O. Raasch, 1935, Kansas Geol. Soc. Guidebook 9th Ann. Field Conf., p. 262 (fig. 207), 263, 264–266. Subdivided into (ascending) Berthelet, Lindwurm, and Northpoint members. Thickness 81 feet. Upper units not exposed. Overlies Thiensville formation. Data on type locality.

Type locality: Along Milwaukee River in Estabrook and Lincoln Parks, Milwaukee County; includes Milwaukee Cement quarries.

Mimbres Conglomerate

Miocene(?) to Pliocene: Southwestern New Mexico.

R. M. Hernon, W. R. Jones, and S. L. Moore, 1953, New Mexico Geol. Soc. Guidebook 4th Field Conf., p. 118 (map), 120. Listed in table of formations. Consolidated and deformed sand, gravel, silt, and clay, with interbedded basalt flows. Thickness about 1,000 feet. Unconformably underlies alluvium; unconformably overlies unnamed lava flows.

Mapped in northeast corner of Santa Rita quadrangle.

†Mimbres Limestone[1]

Ordovician and Silurian: Southwestern New Mexico.

Original references: C. H. Gordon, 1907, Science, new ser., v. 25, p. 824–825; 1907, Jour. Geology, v. 15, p. 91–92.

Named for Mimbres Mountains, western part of Sierra County.

Mimbresian series[1]

Ordovician: New Mexico.

Original reference: C. R. Keyes, 1915, Iowa Acad. Sci. Proc., v. 22, p. 257–259.

Mimbres Peak Rhyolite or Formation

Tertiary: Southwestern New Mexico.

F. J. Kuellmer and others, 1953, *in* New Mexico Geol. Soc. Guidebook 4th Field Conf., p. 42 (map), 50 (map). Name Mimbres Peak rhyolite appears on legends for maps of part of southwestern New Mexico.

H. L. Jicha, Jr., 1954, New Mexico Bur. Mines Mineral Resources Bull. 37, p. 39 (table 3), 45–47. Formation described in Lake Valley quadrangle. Made up of several types of rhyolite—flows, perlite, minor pumiceous rhyolites, and their intrusive equivalents. Much of the rhyolite forms dome eruptions. Where rhyolite is encountered in sequence, it directly overlies Kneeling Nun welded rhyolite or Sugarlump series. Thickness about 200 feet.

W. E. Elston, 1957, New Mexico Bur. Mines Mineral Resources Bull. 38, p. 17 (table 1), 27–29, pl. 1. Formation described in Dwyer quadrangle. At typical section, consists of pink- and gray-banded flow rhyolite, massive gray spherulitic flow rhyolite, black perlitic flow rock, bedded pumiceous rhyolite tuffs, with fragments of silicified rhyolite, and bedded tuffs and tuffaceous sandstones. Thickness of formation about 450 feet. Overlies Kneeling Nun rhyolite; unconformably underlies Box Canyon rhyolite tuff (new). Derivation of name.

Typical section in sec. 3, T. 19 S., R. 10 W., Dwyer quadrangle. Name derived from hill located in sec. 8, T. 19 S., R. 10 W., Dwyer quadrangle.

Mina Grande Formation

Permian (Guadalupe): Southwestern Texas.

C. C. Rix, 1952, Geologic map of Chinati Peak quadrangle, Presidio County, Texas (1:48,000): Texas Univ. Bur. Econ. Geology, prelim. ed; 1953, West Texas Geol. Soc. [Guidebook] Spring Field Trip, May 28–30, p. 1, 5 (chart), 14, 20. Dolomitic reef limestone. Occurs above Ross Mine formation (new); unconformable below Cretaceous Presidio formation.

Type locality and derivation of name not stated.

Minaville Member (of Canajoharie Formation)

Middle Ordovician (Mohawkian) : East-central New York.

G. M. Kay, 1937, Geol. Soc. America Bull., v. 48, no. 2, p. 268–270, pl. 4. Lower member of Canajoharie, Includes two lowest graptolite zones of the Canajoharie. Composed predominantly of black shales, somewhat silty in upper part, and a few metabentonites. Thickness about 750 feet; thins westward from type section. Underlies Fairfield member (new) ; overlies Shoreham limestone.

Type section: Along Chuctununda Creek between Amsterdam and Minaville. Named for Minaville, Florida Township, Montgomery County.

Minco division

Permian : Oklahoma.

D. A. Green, 1937, Am. Assoc. Petroleum Geologists Bull., v. 21, no. 12, p. 1521–1525. Named as second of three time divisions of Permian in Oklahoma. Follows Wanette division and precedes Upper Red-Beds division. Extends from top of Herington limestone, or top of Stratford shale, to base of Marlow formation.

J. E. Adams and others, 1939, Am. Assoc. Petroleum Geologists Bull., v. 23, no. 11, p. 1677–1678. Recommended that in Oklahoma term Minco be dropped in favor of Leonard series which in Oklahoma and Kansas extends from horizon near top of Herington limestone up to Dog Creek shale—that is, to base of Whitehorse group.

Reference locality, town of Minco, Grady County.

Mindego Formation

Oligocene, upper, and Miocene, lower (Zemorrian and Saucesian) : Northern California.

R. M. Touring, 1959, Dissert. Abs., v. 20, no. 4, p. 1325. Name given to at least 2,000 feet of calcarenites, arkosic sandstones, siltstones, mudstones, basalt flows, flow breccias and tuffs which lie disconformably or with slight angular nonconformity on San Lorenzo formation ; conformably underlies Woodhams formation (new). Mindego is equivalent in age to some massive fossiliferous sandstones that have been called Vaqueros sandstone in nearby areas.

Area of report is in Santa Cruz Mountains, 30 to 40 miles south of San Francisco.

†Minden Formation (in Claiborne Group)[1]

Eocene, middle : Northern Louisiana.

Original references: J. W. Whittemore, 1927, Louisiana Dept. Conserv. Bull. 14, p. 6, 9, map ; 1928, Bull. 16, p. 8 ; 1929, Bull. 19, p. 6.

Crops out around Minden, Webster Parish.

Mindi Hill Beds

Miocene : Panamá.

R. T. Hill, 1898, Harvard Coll. Mus. Comp. Zoology Bull., v. 28, no. 5, p. 180–181, 236 (table). Green sand marls of fine, uniform homogeneous texture and structure ; no lamination ; fossiliferous.

W. P. Woodring *in* R. Hoffstetter and others, 1960, Lexique Strat. Internat., v. 5, Amérique Latine, fasc. 2a, p. 339. Suppressed in favor of Gatún formation. Miocene.

Near Gatún, C. Z.

Mine Brook Formation

Middle Silurian: Central Connecticut.

G. P. Eaton and L. J. Rosenfeld, 1960, Internat. Geol. Cong., 21st. Copenhagen, pt. 2, p. 170 (fig. 1), 171 (table 1). Finely laminated biotit-calcite schists and gneisses; subordinate interbedded diopside-amphibolite granulites. Overlies Great Hill formation (new); underlies Camp Jenkins formation (new). Previous workers with the exception of Percival (1842, Report on the Geology of the State of Connecticut: New Haven), grouped the sequence of rocks from Collins Hill schist through Camp Jenkins schist as a single formation, and believed it to be intruded by Glastonbury, Maromas, and Haddom gneisses. Present work shows that these rocks represent four distinct formations, with unconformity separating Collins Hill from the others.

Mine Brook is in central part of Middle Haddam quadrangle, Middlesex County.

Mine Creek Shale Member (of Pawnee Limestone)

Pennsylvanian (Des Moines Series): Eastern Kansas, southwestern Iowa, western Missouri, and northeastern Oklahoma.

J. M. Jewett, 1941, Kansas Geol. Survey Bull. 38, pt. 11, p. 318–319, pl. 1. Name applied to shale unit between Myrick Station member (new) below and Laberdie member (new) above. Shale is mostly gray, more or less carbonaceous, and contains thin bed of limestone in upper part; toward the south black shale is most persistent part of member. Maximum thickness in Kansas about 16 feet.

G. E. Condra, 1949, Nebraska Geol. Survey Bull. 16, p. 46. Noted as quite thin in Iowa.

F. C. Greene and W. V. Searight, 1949, Missouri Geol. Survey and Water Resources Rept. Inv. 11, p. v. (fig. 1), 7. In Missouri underlies Coal City limestone member of Pawnee; term Coal City has priority over Laberdie and name Laberdie is suppressed.

H. G. Hershey and others, 1960, Iowa Highway Research Board Bull. 15, p. 31–32, fig. 5. In Appanoose County, member is composed of shale and clay that varies from light to dark blue gray and has persistent carbonaceous streak or coal smut about 3 feet from top. In Madison County, coal smut is about 4 inches from top and underlies gray fossiliferous shale; beneath coal smut is gray shale resting on 2-foot bed of gray sandy limestone that is locally conglomerate; underlying limestone is sequence of siltstone, sandstone, and shale. Aggregate thickness about 8 feet in Appanoose County: 21 feet in Madison County. Underlies Coal City member; overlies Myrick Station member.

Type exposure: Middle and south side sec. 23, T. 21 S., R. 25 E., on tributary of Mine Creek in Linn County, Kans. Identified as far south as 20 miles south Kansas-Oklahoma line.

Mine Hill Granite Gneiss

Paleozoic: Southwestern Connecticut.

R. M. Gates, 1959, U.S. Geol. Survey Geol. Quad. Map GQ–121. Name used to replace preempted Roxbury granite gneiss (Rodgers and others, 1956). Lustrous white granite gneiss composed of microcline, albite, quartz, muscovite, and biotite. Muscovite forms foliation planes. Relative amounts of microcline and albite vary from layer to layer, and replacement of microcline by albite is conspicuous in albite-rich layers. A semiconcordant, probably syntectonic intrusive into Hartland formation.

Named for typical outcrops on Mine Hill in west-central part of Roxbury quadrangle. Crops out in slablike cliff-forming layers of hogbacks 5 to 20 feet thick; outcrops are restricted to core of foliation dome in otherwise isoclinally folded Hartland formation.

Mineola Limestone[1]

Middle Devonian: North-central Missouri.

Original reference: E. B. Branson, 1920, Am. Jour. Sci., 4th, v. 49, p. 267–276.

E. B. Branson, 1944, Missouri Univ. Studies, v. 19, no. 3, p. 128–136. Formation is heterogeneous in composition and irregular in distribution. One typical phase is highly crystalline crinoidal limestone, almost white in color; another phase is made up of yellowish to pinkish-gray limestone which contains cavities produced by solution of fossils. In some places, lowest member is very sandy. The various phases are never present in one section. Overlies Jefferson City dolomite, St. Peter sandstone, Joachim dolomite, Plattin limestone, Kimmswick limestone, and Maquoketa shale; underlies Callaway limestone, Bushberg sandstone, and Chouteau limestone, though Callaway is commonest overlying unit.

A. G. Unklesbay, 1955, Missouri Geol. Survey and Water Resources Rept. Inv. 19, p. 3. Branson named Mineola as a formation, but relationships in Fulton quadrangle suggest that these beds should be considered facies of the Callaway.

Named for exposures 4 or 5 miles in extent, in vicinity of Mineola, Montgomery County.

Mineral Formation (in Cabaniss Group)

Mineral Formation or cyclothem (in Cherokee Group)

Pennsylvanian (Des Moines Series): Southeastern Kansas, southwestern Missouri, and northeastern Oklahoma.

G. E. Abernathy, 1937, Kansas Geol. Soc. Guidebook 11th Ann. Field Conf., p. 18, 20, 22; 1938, Kansas Acad. Sci. Trans., v. 41, p. 193, 196. Cherokee group is divided into 15 cyclic formational units. Mineral formation (cyclothem), ninth in sequence (ascending), occurs below the Fleming and above the Scammon. Average thickness 12 feet. Includes coals locally known as Weir-Pittsburg, Lightning Creek, and Mineral. [For complete sequence see Cherokee group.]

W. V. Searight and others, 1953, Am. Assoc. Petroleum Geologists Bull., v. 37, no. 1, p. 2748 (fig. 1). Shown on northern midcontinent composite stratigraphic section as Mineral formation. Underlies Robinson Branch formation (new); overlies Scammon formation. Included in Cabaniss group.

C. C. Branson, 1954, Oklahoma Geol. Survey Guide Book 2, p. 5. Listed as a coal cycle in Senora formation, Cabaniss group, in Oklahoma.

W. B. Howe, 1956, Kansas Geol. Survey Bull. 123, p. 60–62. A formation in Cabaniss subgroup of Cherokee group. In southeastern Kansas the following divisions are differentiated (ascending): lower limestone bed, dark shale, underlimestone and sandstone, underclay, Mineral coal. Thickness in Crawford and Cherokee Counties averages about 23 feet; in northeastern Crawford County commonly less than 15 feet.

Named for association with Mineral coal. Succession is well exposed in strip-pit highwall in SE¼NW¼ sec. 24, T. 28 S., R. 25 E., Crawford County, Kans.

Mineral Bluff Formation

Cambrian: Central northern Georgia.

V. J. Hurst, 1955, Georgia Geol. Survey Bull. 63, p. 55–56, pl. 1, map. Sequence of quartz-sericite schist, slate or phyllite, and small amounts of graphitic schist and talcose schist; quartz conglomerate and meta-arkose lenses occur 100 to 200 feet above base. Thickness 300 to 800 feet. Top of formation removed by erosion; contact with underlying Nottely quartzite gradational.

Occupies the trough of Murphy syncline. Well exposed in vicinity of Mineral Bluff, Fannin County.

Mineral Creek Andesite[1]

Tertiary: New Mexico.

Original reference: H. G. Ferguson, 1927, U.S. Geol. Survey Bull. 787.

Named for exposures in south walls of Mineral Creek Canyon above Cooney mine, Mogollon district.

Mineral Fork Tillite

Precambrian: Central northern Utah.

A. E. Granger and others, 1952, Utah Geol. Soc. Guidebook 8, p. 4–6, pl. 1. Black bouldery tillite interbedded with varved shale, dark-gray quartzite, and bouldery conglomerate. Thickness at Superior Peak about 1,000 feet. Thickens to northwest to at least 3,000 feet on east slope of Mill B South Fork. Underlies Mutual formation (new); overlies Big Cottonwood series.

R. E. Cohenour, 1959, Utah Geol. and Mineralog. Survey Bull. 63, p. 19. May be in part equivalent to Dutch Peak tillite (new).

Exposed in Superior Peak, covers almost entire upper basin of Mineral Fork, and extends over ridge to west onto east slope of Mill B South Fork.

Mineral King Beds[1]

Triassic(?): Southern California.

Original references: H. W. Turner, 1894, Am. Geologist, v. 13, p. 231; 1894, U.S. Geol. Survey 14th Ann. Rept., pt. 2, p. 451.

Exposed at old mining camp of Mineral King, about 15 miles southwest of Mount Whitney, at headwaters of Kaweah River, Tulare County.

Mineral Mountain Andesite Porphyry

See Keechelus Andesitic Series.

Mineral Wells Formation (in Strawn Group)[1]

Middle Pennsylvanian: Central and central northern Texas.

Original reference: F. B. Plummer, 1919, Am. Assoc. Petroleum Geologists Bull., v. 3, p. 138.

C. O. Nickell *in* Wallace Lee and others, 1938, Texas Univ. Bur. Econ. Geology Pub. 3801, p. 91–94. Includes Ricker sandstone and Capps limestone members.

M. G. Cheney, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 1, p. 66 (fig. 1), 87. Strawn-Canyon boundary falls within Mineral Wells formation which name is here dropped. Units formerly included in Mineral Wells are reassigned to Lone Camp group (new) or Whitt group (new).

D. H. Eargle, 1960, U.S. Geol. Survey Prof. Paper 315-D, p. 60. Strawn group is used in this report for all rocks in Colorado River valley between top of Smithwick shale of Bend group and base of Brownwood shale member of Graford formation of Canyon group. Term Mineral Wells formation is not used in this area because of marked range in thickness and lithology that occurs in the Strawn between the Brazos and Colorado River valleys.

Named for exposures in vicinity of Mineral Wells, Palo Pinto County.

Miners Castle Member (of Munising Formation)

Upper Cambrian: Northern Michigan.

W. K. Hamblin, 1958, Michigan Dept. Conserv., Geol. Survey Div. Pub. 51, p. 6 (fig. 1), 95–109, fig. 70. Poorly sorted sandstone. Characteristically crossbedded. Size of sets of cross-strata is small; average between 4 and 6 inches thick. Thin lenses of blue shale separate sets of cross-strata in lower part of section. Upper units of pure sandstone and sorting is much better. Thickness at type locality and throughout most of exposure in the Pictured Rocks is 140 feet. Some slight thinning indicated to east and west of Pictured Rocks. Also thins to the south. Overlies Chapel Rock member (new); underlies Au Train formation (new).

Type locality: Miner's Castle in Pictured Rocks cliffs, on southern shore of Lake Superior, Alger County.

Minersville Shale Member (of Friedrich Formation)

Pennsylvanian (Virgil Series): Southeastern Nebraska and northeastern Kansas.

G. E. Condra and E. C. Reed, 1938, Nebraska Geol. Survey Paper 12, p. 9. Defined as basal member of formation. Underlies Palmyra formation (new).

G. E. Condra and E. C. Reed, 1943, Nebraska Geol. Survey Bull. 14, p. 42. Overlies Morton limestone (new).

G. E. Condra, 1949, Nebraska Geol. Survey Bull. 16, p. 14. Composed of red and grayish shales; locally sandy. Thickness 30 feet at Nebraska City and less southward in Nebraska and northeastern Kansas.

Type locality: In Missouri River bluffs near railroad station at Minersville, Otoe County, Nebr.

Minersville Tuff Member (of Needles Range Formation)

Eocene(?) or Oligocene, lower(?): Southwestern Utah.

J. H. Mackin, 1960, Ann. Jour. Sci., v. 258, no. 2, p. 90 (table 1), 92 (fig. 2), 99. Chiefly dark-gray to black devitrified tuff several hundred feet thick. Overlies Wah Wah Springs member (new); underlies Isom formation (new).

Named for occurrence in Minersville Canyon of Beaver River, Iron Springs district.

Mines Dolomite[1] (in Beekmantown Group)

Mines Dolomite Member (of Gatesburg Formation)

Lower Ordovician: Central Pennsylvania.

Original reference: Charles Butts, 1918, Am. Jour. Sci., 4th, v. 46, p. 527, 534, 537.

Charles Butts, 1945, U.S. Geol. Survey Geol. Atlas, Folio 227. Included in Beekmantown group, Lower Ordovician. Underlies Larke dolomite; overlies Gatesburg formation. Thickness about 250 feet.

J. L. Wilson, 1952, Geol. Soc. America Bull., v. 63, no. 3, p. 282, 287, pls. 3, 4. Rank reduced to member status in Gatesburg formation. Consists of dark dolomite, siliceous oolite, and chert, much of it cryptozoon stromatolite. Separated from underlying Ore Hill member by interval, 650 to 700 feet thick, referred to as upper sandy Gatesburg member; upper contact not exposed, probably unconformably underlies Ordovician Larke dolomite or its limestone facies, Stonehenge formation. Upper Cambrian.

Named for old mining town of Mines, several miles southwest of Williamsburg, Blair County.

Minesota Coglomerate[1] (in Central Mine Group)

Precambrian (Keweenawan): Northern Michigan.

Original reference: S. H. Broughton, 1863, Remarks on the mining interest and details of the geology of Ontonagon County, pamphlet of 24 pages and map: Philadelphia, p. 20, map.

Copper district of Keweenaw Point.

Mineta Beds or Formation

Miocene(?), lower: Southeastern Arizona.

P. A. Wood, 1959, Arizona Geol. Soc. Guidebook 2, p. 59. Sequence of strata consisting of conglomerate, limestone, mudstone, and siltstone. Beds consist of three members (ascending): thin-bedded arkosic conglomerate about 1,300 feet thick; limestone member, about 50 feet thick, consisting of alternating marly algal limestone and shale; and detrital member, about 1,400 feet thick, consisting of thin-bedded siltstone, mudstone, and limestone. Beds cut by dikes and sills and overlain by flows of andesite porphyry. Strata exposed in complexly faulted block that is thrust over older metamorphosed rocks to west and is in normal fault contact with younger deposits to east. Probably equivalent to Pantano formation. Probably lower Miocene. Name credited to Chew (unpub. thesis).

W. D. Pye, 1959, Arizona Geol. Soc. Guidebook 2, p. 276. Thickness of formation over 3,000 feet. Type area cited.

Type area: Vicinity of Redington, on northeast side of Rincon Mountains, Pima County.

Minford Silt[1]

Pleistocene (pre-Illinoian): Southern Ohio.

Original reference: Wilber Stout and D. Schaaf, 1931, Geol. Soc. America Bull., v. 42, no. 3, p. 663–672.

S. E. Norris and H. C. Spicer 1958, U.S. Geol. Survey Water-Supply Paper 1460–E, p. 215–225. Maximum thickness more than 80 feet. Commonly rests on fine sand or sandy silt which generally overlies the bedrock and which may represent part of original stream alluvium. Pre-Illionoian in age. Origin discussed.

Named for exposure in cut of Chesapeake & Ohio Railway at Minford, Harrison Township, Scioto County.

Mingo Formation (in Breathitt Group)

Mingo Formation (in Pottsville Group)[1]

Middle Pennsylvanian: Northeastern Tennessee and southeastern Kentucky.

Original reference: G. H. Ashley and L. C. Glenn, 1906, U.S. Geol. Survey Prof. Paper 49, p. 33, 38, 207, pl. 40–A.

H. R. Wanless, 1946, Geol. Soc. America Mem. 13, p. 82–85. Overlies Hance formation; underlies Catron formation. Includes Fork Ridge sandstone member about 40 feet below Mingo coal. Thickness about 466 feet in Claiborne County, Tenn.; about 629 feet in Harlan County, Ky.

Named for Mingo Mountain, Claiborne County, Tenn.

Mingus Shale Member (of Garner Formation)[1]

Middle Pennsylvanian: Central northern Texas.

Original references: F. B. Plummer and R. C. Moore, 1922, Jour. Geology, v. 30, p. 25, 31; 1922, Texas Univ. Bull. 2132, p. 75, 76, charts.

Leo Hendricks, 1957, Texas Univ. Bur. Econ. Geology Pub. 5724, p. 20–21, fig. 3. Total thickness (in Parker County) 210 feet measured in traverse from approximate base of member in bed of Rock Creek to base of Brazos River sandstone member in scarp west of Millsap; base not everywhere exposed. Includes thin coal seam which in this report is not considered to be Thurber coal as described by Plummer and Hornberger (1936). Overlies Goen limestone bed in Grindstone Creek formation.

Named for small mining town south of Mineral Wells, Palo Pinto County.

Mingus Mountain Tuff

Miocene, upper: North-central Arizona.

B. E. Sabels, 1960, Dissert. Abs., v. 21, no. 3, p. 596. Incidental mention in discussion of late Cenozoic volcanism in San Francisco volcanic field.

Minidoka Basalt[1]

Pleistocene: Southern Idaho.

Original references: H. T. Stearns, 1932, Correlation chart of Idaho compiled by M. G. Wilmarth, dated Sept. 1, 1932; 1936, Jour. Geology, v. 44, no. 4, p. 434–439.

H. T. Stearns, Lynn Crandall, and W. G. Steward, 1938, U.S. Geol. Survey Water-Supply Paper 774, p. 29, 83, pl. 4. Thickness about 30 feet. Deposited after Burley lake beds. Younger than Sand Springs basalt.

Named for Minidoka Dam. Probably issued from one of cones near Minidoka, Minidoka County.

Minitimi Limestone

Miocene, middle: Western Panamá.

R. A. Terry, 1956, California Acad. Sci. Occasional Paper 23, p. 52. A coralline limestone which interfingers with Bastimentos shale at base of Gatún formation.

Occurs on Isla Colón (Columbus Island) and Isla Bastimentos (Provision Island).

Mink Creek Conglomerate (in Salt Lake Group)

Pliocene: Southeastern Idaho and central northern Utah.

R. D. Adamson, C. T. Hardy, and J. Stewart Williams, 1955, Utah Geol. Soc. Guidebook 10, p. 2, 7–8. Upper member of Mink Creek formation (of Keller, 1952, unpub. thesis) is here elevated to status of formation and designated Mink Creek conglomerate. Consists of subrounded to angular cobbles and pebbles with some boulders. Matrix consists of light-gray sandy calcareous tuff and pale-yellow marl. Locally interbedded with white tuff. Thickness approximately 3,435 feet. Conformably overlies Cache Valley formation.

Type section: About 1 mile west of Mink Creek, Cache Valley, Franklin County, Idaho.

Minneapolis Limestone[1] (in Beloit formation)

Middle Ordovician: Southern Minnesota.

Original reference: F. W. Sardeson, 1907, Geol. Soc. America Bull., v. 18, p. 185.

G. A. Cooper, 1956, Smithsonian Misc. Colln., v. 127, pt. 1, p. 113. Listed among upper Mississippi Valley formations not in general use.

Named for Minneapolis.

Minnechaduza Beds (in Ash Hollow Formation)

Pliocene: North-central Nebraska.

M. K. Elias, 1942, Geol. Soc. America Spec. Paper 41, p. 142. Name suggested for fragmentary layer at base of rim rock of Ash Hollow formation. Fauna from this layer was designated the Minnechaduza by Stirton (1939, Am. Jour. Sci., v. 237, no. 6, p. 433). Overlies Valentine sands at Valentine. Contains plant fossils.

Stirton designated type locality for Minnechaduza fauna on divide between Little Beaver and Crooked Creeks, SW¼SW¼ sec. 8, T. 34 N., R. 26 W., north pasture Niobrara Game Refuge, Cherry County; name taken from Minnechaduza Creek.

Minneiska Member (of Franconia Formation)

Upper Cambrian (St. Croixian): Southeastern Minnesota.

C. R. Stauffer, G. M. Schwartz, and G. A. Thiel, 1938, (abs.) Geol. Soc. America Bull., v. 49, no. 12, pt. 2, p. 1902. Named in a list of members of Franconia formation in Minnesota. Underlies Bad Axe member; overlies Taylors Falls member.

C. R. Stauffer, G. M. Schwartz, and G. A. Thiel, 1939, Geol. Soc. America Bull., v. 50, no. 8, p. 1238 (table 2), 1239. Dropped in preference to name Hudson member.

Probably named for exposures near village of Minneiska, Wabasha County.

Minnekahta Limestone[1]

Minnekahta Limestone Member (of Goose Egg Formation)

Minnekahta Limestone (in Phosphoria Group)

Lower Permian: Western South Dakota, western Colorado, northwestern Nebraska, and eastern Wyoming.

Original reference: N. H. Darton, 1901, U.S. Geol. Survey 21st Ann. Rept., pt. 4, p. 514.

G. E. Condra, E. C. Reed, and O. J. Scherer, 1940, Nebraska Geol. Survey Bull. 13, p. 2 (fig. 2), 5, strat. sections. Included in Phosphoria group in Laramie Range, Hartville Uplift. Overlies Opeche shale; underlies Glendo shale (new).

H. D. Thomas, 1940, Kansas Geol. Soc. Guidebook 14th Ann. Field Conf., p. 124. Suggests that name Sybille tongue of Phosphoria be abandoned in favor of Minnekahta.

T. L. Broin, 1958, Dissert. Abs., v. 19, no. 1, p. 114. Falcon tongue of Minnekahta extends into Lykins formation from Horse Creek, Wyo., southward to Red Creek Canyon, between Colorado Springs and Canyon City, Colo.

Type locality: Region near the hot springs, South Dakota, originally known as Minnekahta by Indians.

Minnelusa Sandstone[1] or Formation

Pennsylvanian and Permian: Western South Dakota and northeastern Wyoming.

Original reference: N. H. Winchell, 1875, Black Hills of Dakota, by Wm. Ludlow, U.S. Eng. Dept. U.S. Army, p. 38, 65, map.

F. H. Brady, 1958, Wyoming Geol. Assoc. Guidebook 13th Ann. Field Conf., p. 45–47, cross sections. Evaporite deposits in Minnelusa formation in Sundance-Beulah area, Crook County, Wyo., discussed. In this area, creeks have cut deep canyons through Minnekahta and Opeche formations and exposed strata not usually associated with Minnelusa. In these canyons, 383 feet of upper Minnelusa are exposed; of this exposure, 166 feet are local strata not present in formation outcrops in immediately surrounding area. Eighteen columnar sections measured, and section 8 in Sundance Canyon is considered type section. Here Minnelusa underlies Opeche and is 257 feet thick. Late Pennsylvanian to early Permian.

T. V. Jennings, 1959, Jour. Paleontology, v. 33, no. 6, p. 986–1000. Occurrence of Pennsylvanian upper Virgilian of lower Wolfcampian fusulinids described from Minnelusa formation in northern Black Hills.

Type section: Sundance Canyon in SW¼ sec. 10, T. 52, N., R. 61 W., Crook County, Wyo. Minnelusa is Sioux name for rapid water. Formation is exposed on Rapid River 4 or 5 miles above Rapid City, S. Dak.

Minnesotan series[1]

Ordovician: Minnesota.

Original reference: C. R. Keyes, 1912, Iowa Acad. Sci. Proc., v. 19, p. 147–151.

Minnesota Valley Granite Series

Precambrian: Southwestern Minnesota.

E. H. Lund, 1953, Econ. Geology, v. 48, no. 1, p. 48. Term Minnesota River Valley granite series used to include number of masses of granite and granite gneiss in Minnesota River valley. Includes Morton granite gneiss.

E. H. Lund, 1956, Geol. Soc. America Bull., v. 67, no. 11, p. 1482–1490. Formerly referred to as Minnesota River Valley granite series. Granites and granite gneisses that are younger than basic complex. Five rock types distinguished on basis of textural and structural characters. From southeast to northwest, they are the Fort Ridgely granite (new), Morton quartz monzonite gneiss, Sacred Heart granite (new), Montevideo granite gneiss (new), and Ortonville granite (new). Rocks may not be of same age, and limited outcrops make it difficult to establish their relations.

C. D. Walcott (1899, Geol. Soc. America Bull., v. 10, p. 22) used Minnesota River Valley gneiss and granite as descriptive term for basement rocks in southern Minnesota.

Exposed in Minnesota River Valley between New Ulm, Brown County, and Ortonville, Big Stone County.

Minnewaste Limestone Member (of Lakota Formation)

Minnewaste Limestone[1]

Lower Cretaceous: Western South Dakota.

Original reference: N. H. Darton, 1901, U.S. Geol. Survey 21st Ann. Rept., pt. 4, p. 529.

W. J. Mapel and G. B. Gott, 1959, U.S. Geol. Survey Mineral Inv. Field Studies Map MF-218. Rank reduced to member status in Lakota formation (redefined). Underlies Fuson member.

K. M. Waagé, 1959, U.S. Geol. Survey Bull. 1091-B, p. 21, 27, 29, 31, 33, 45-46, 85-86. At reference section of redefined Lakota, Minnewaste consists of light-gray limestone with granulelike blebs of white limestone or calcite; locally sandy, containing parting of limy sandstone with a few black shale interbeds in middle part; bedding irregular, beds 0.5 to 3 feet thick. Thickness 36 feet. Thickness of Lakota above Minnewaste, 115 feet; thickness below, 310 feet. Discussion of history of stratigraphic nomenclature of Inyan Kara group.

First described in vicinity of Hot Springs, southeastern part of Black Hills. Minnewaste is Dakota Indian name for Cheyenne River. Composite section of redefined Lakota is in valley of Fall River in center W½NW¼ sec. 33, and N½NE¼ sec. 32, and adjacent parts of sec. 29, T. 7 S., R. 6 E., Fall River County, Hot Springs quadrangle, South Dakota. Minnewaste (unit 20) measured in river bluffs about 800 feet east of dam in center. E½W½NW½ sec. 33.

Minnith zone (in Powell Limestone)[1]

Lower Ordovician (Beekmantown): Central eastern Missouri.

Original reference: S. Weller and S. St. Clair, 1928, Missouri Bur. Geology and Mines, v. 22, 2d ser., p. 86-90.

Named for exposures at and near Minnith, Ste. Genevieve County.

Minong Breccia[1] (of Central Mine Group)

Precambrian (Keweenawan): Northern Michigan.

Original reference: A. C. Lane, 1898, Michigan Geol. Survey, v. 6, pt. 1, p. 87, 101, 105, pl. 1.

Named for occurrence in Minong mine, Isle Royale.

Minong Porphyrite[1] (in Central Mine Group)

Precambrian (Keweenawan): Northern Michigan.

Original reference: A. C. Lane, 1898, Michigan Geol. Survey, v. 6, pt. 1, p. 141, 142, 159, 161, 170, 177, 200, 201, 209, 212, pls. 1, 2.

Named for occurrence in Minong mine, Isle Royale.

Minooka Drift

Pleistocene (Wisconsin): Northern Illinois.

D. J. Fisher, 1925, Illinois Geol. Survey Bull. 51, p. 17 (fig. 2), 69 (table 6), 76-79. Older than Rockdale drift and younger than Marseilles drift.

J. S. Templeton and H. B. Willman, 1952, Tri-State Geol. Soc. Guidebook 16th Ann. Field Conf., fig. 4. Shown on columnar section of Pleistocene deposits below Manhattan-Rockdale drifts and above Marseilles drift.

Named from village of Minooka situated on drift about 3 miles south of southwest corner of Joliet quadrangle.

Minshall Limestone (in Brazil Formation)

Pennsylvanian: Southwestern Indiana.

H. R. Wanless, 1939, Geol. Soc. America Spec. Paper 17, p. 96; R. C. Moore and others, 1944, Geol. Soc. America Bull., v. 55, no. 6, chart 6 (column 25). A marine limestone in Brazil formation above Minshall coal.

H. C. Hutchinson, 1960, Indiana Geol. Survey Bull. 16, p. 19–20. Name abandoned because stratigraphy at type locality has not been well understood and many miscorrelations have been made in tracing limestone along its outcrop. Name Perth limestone is applied to marine unit that closely overlies Minshall coal.

Type locality: Town of Minshall, Parke County.

Mint Canyon Formation[1]

Mint Canyon Series

Miocene, upper: Southern California.

Original references: W. S. W. Kew, 1923, Am. Assoc. Petroleum Geologists Bull., v. 7, p. 441–420; 1924, U.S. Geol. Survey Bull. 753.

R. H. Jahns, 1939, Am. Jour. Sci., v. 237, no 11, p. 818–825. Restricted to exclude basal 350-foot unit here named Tick Canyon formation. Name Mint Canyon formation retained for middle and upper beds. Name Mint Canyon series applied to strata as a whole. As restricted, formation comprises slightly more than 4,000 feet of gray sandstone and conglomerate, variegated siltstone and clay, and minor tuffaceous beds. Underlies marine beds containing uppermost Miocene invertebrate fauna.

G. B. Oakeshott, 1958, California Div. Mines Bull. 172, p. 23 (fig. 3), 65–69, pl. 1. Name Mint Canyon formation was given by Kew (1923) to unit previously described by Hershey (1902, California Univ. Pub. Dept., Geol. Bull., v. 3) as Mellenia series, consisting of several thousand feet of nonmarine sedimentary rocks unconformably overlying Vasquez formation (Kew's Sespe(?); Hershey's 1902 Escondido series), and unconformably overlain by marine Modelo (Modelo? or Castaic) formation. Mint Canyon formation is most widely distributed formation of Soledad basin, covering about 45 square miles of northwestern and north-central part of San Fernando quadrangle [this report]. Lies in southwest-plunging folded and faulted syncline which is bounded on north, east, and south, respectively by the Sierra Pelona, Parker Mountain, and San Gabriel Mountains. Present north of San Gabriel fault. Thickness 4,500 feet. Overlies Tick Canyon formation; underlies Modelo formation. In Agua Dulce Canyon, unconformably overlies Vasquez formation; in extreme northwest corner of quadrangle unconformably overlies Pelona schist. In terms of invertebrate chronology, the Mint Canyon is probably early upper Miocene to middle Miocene in age.

Type locality: Mint Canyon, San Gabriel Mountains, Los Angeles County.

Minto Basalts or Lavas

Pliocene to Pleistocene: Northwestern Oregon.

T. P. Thayer, 1936, Jour. Geology, v. 44, no. 6, p. 705–706, 709 (fig. 2), 713 (fig. 3); 1937, Geol. Soc. America Bull., v. 48, no. 11, p. 1616 (fig. 2), 1618, 1625, 1627–1629. High Cascade lavas are divided into four groups; in chronological order these are: Outerson basalts, Minto basalts, Santiam basalts, and Olallie lavas. Probable thickness of Minto basalts 4,000 feet. Where Outerson accumulations were high Minto lavas flowed around them; where Outerson deposits were thinner Minto lavas overrode them and lapped over onto Western Cascades. Basaltic cones of Minto series deeply dissected before extrusion of Olallie lavas.

Name derived from Minto Mountain, Jefferson quadrangle. Lavas formed shield volcanoes whose vents were near axis of present High Cascades.

Mint Spring Marl Member (of Marianna Limestone)[1]

Mint Spring facies (of Glendon Member of Vicksburg Formation)

Oligocene, middle: Southern Mississippi and western Alabama.

Original reference: C. W. Cooke, 1918, Washington Acad. Sci. Jour., v. 8, p. 187, 195–196.

F. F. Mellen, 1940, Mississippi Geol. Survey Bull. 39, p. 26. Referred to as facies of Glendon member of Vicksburg formation. Note on derivation of name.

F. S. MacNeil, 1944, Am. Assoc. Petroleum Geologists Bull., v. 28, no. 9, p. 1315 (fig. 1), 1326–1329. Consists chiefly of fossiliferous sand, sandy marl with numerous limestone concretions, and more rarely, concretionary ledges. Maximum thickness about 25 feet. Overlies Forest Hill sand and, in Alabama, Red Bluff clay.

Named from outcrop below water fall on Mint Spring Bayou, at National Cemetery, Vicksburg, Miss.

Minturn Formation

Pennsylvanian: Central Colorado.

Odgen Tweto, 1949, Colorado Sci. Soc. Proc., p. 152 (table 1), 194–198, 205–228. Name applied to series of clastic rocks about 6,000 feet thick lying between Belden shale and Maroon formation. Made up of lenticular beds of arkosic grit, shale, conglomerate, sandstone, and quartzite with a few relatively persistent beds of dolomite limestone. Includes (ascending) Wearyman dolomite (new), Hornsilver dolomite (new), Resolution dolomite (new), Robinson dolomite, Elk Ridge limestone, White Quail limestone, and Jacque Mountain limestone members. Pennsylvanian and Permian(?). Name Minturn is applied in preference to older names because none of these seems usable; Maroon is used for upper formation; Weber or Weber(?) has long been considered unsatisfactory; Battle Mountain introduced by Brill (1942) was in effect abandoned by him in 1944 when he proposed use of Maroon for same beds and Battle Mountain as defined does not correspond to divisions here recognized.

K. G. Brill, Jr., 1952, Geol. Soc. America Bull., v. 63, no. 8, p. 820, 821. In South Park area, comprises Coffman conglomerate member, Chubb siltstone member, and lower part of Pony Spring siltstone; in Arkansas River section, includes Swissvale gypsum member (new).

D. W. Bolyard, 1959, Am. Assoc. Petroleum Geologists Bull., v. 43, no. 8, p. 1903 (fig. 5), 1919–1922. Described in Sangre de Cristo Mountains between La Veta Pass and Westcliffe, where it is at least 5,000 feet thick and consists chiefly of grayish to greenish sandstones, conglomerates, and shales or siltstones. Base is probably an unconformity; overlies Kerber formation at two localities but elsewhere rests unconformably on Mississippian or older rocks. Underlies Maroon or Sangre de Cristo formations, boundary imperfectly defined. Grades southward into its stratigraphic equivalent, Madera formation.

Named for extensive exposures in cliffs along east side of Eagle Valley near Minturn, Eagle County.

Minwah Limy Gneiss (in Tacoma Series)

Cambro-Ordovician(?): Southwestern Maine.

L. W. Fisher, 1936, Am. Mineralogist, v. 21, no. 5, p. 323. Listed in table of formations. Belongs to Tacoma series (new). Older than Sabattus garnet schist (new); younger than Hill Ridge biotite schist (new).

Occurs in Lewiston area, Androscoggin County.

Mira Basalt[1]

Miocene, upper: Southwestern Nevada.

Original reference: F. L. Ransome, 1909, U.S. Geol. Survey Prof. Paper 66, p. 28, 69.

Caps Mira Mountain and underlies southern part of town of Goldfield, Esmeralda County.

Miraflores Basalt

Miocene, lower: Panamá.

[T. F. Thompson], 1943, Panamá Canal, Spec. Eng. Div., 3d Locks Proj., pt. 2, chap. 3, p. 26. Consists of thick mass of dense hard dark-gray to blue-black rock that has intruded sedimentary rocks. Represents either laccolith or sill.

W. P. Woodring *in* R. Hoffstetter and others, 1960, Lexique Strat. Internat., v. 5, Amérique Latine, fasc. 2a, p. 339–340. Miocene.

Underlies site of Miraflores Locks and composes Cocoli Hill and Aguadulce Hill, Pacific side of Canal Zone.

Miraflores Pumice

Miocene(?): Panamá.

R. T. Hill, 1898, Harvard Coll. Mus. Comp. Zoology Bull., v. 28, no. 5, p. 198–199, 206. Stratified; pink, salmon, and magenta. Term Panamá formation used to include analogous deposits of Barbacoas, San Pablo, and Miraflores.

W. P. Woodring *in* R. Hoffstetter and others, 1960, Lexique Strat. Internat., v. 5, Amérique Latine, fasc. 2a, p. 340. Considered informal name. Miocene(?).

In bluffs at Miraflores, C.Z.

Miraleste Tuff Bed[1] (in Altamira Shale Member of Monterey Shale)

Miocene, middle: Southern California.

Original reference: W. P. Woodring, M. N. Bramlette, and R. M. Kleinpell, 1936, Am. Assoc. Petroleum Geologists Bull., v. 20, no. 2, p. 125–129.

W. P. Woodring, M. N. Bramlette, and W. S. W. Kew, 1946, U.S. Geol. Survey Prof. Paper 207, p. 19–20, pl. 1. Described as a thin tuff bed characterized by abundance of dark-brown pumice lapillae, commonly an inch or less in diameter, embedded in matrix of light-colored impure fine-grained volcanic ash. Generally 2 to 4 feet thick; maximum thickness 8 feet. Occurs in middle part of Altamira member.

Type region: Along west side of upper Agua Negra Canyon, Palos Verdes Hills area, Los Angeles County. Name derived from Miraleste residential district.

Miramar Member (of Naranjo Formation)

Eocene, middle: Puerto Rico.

E. A. Pessagno, Jr., 1960, Geology of the Ponce-Coamo area, Puerto Rico: Puerto Rico Econ. Devel. Adm. and Princeton Univ. Dept. Geology, p. 71–73. Consists of volcanic conglomerate, calcareous siltstone, tuffaceous sandstone, and lenses of Coamo Springs limestone. Thickness 0 to 2,300 feet. Grades up into Coamo Springs member. Rests unconformably on units of late Santonian and early Campanian age.

Type locality: Base of cliffs located about 0.65 kilometer southeast of Miramar hacienda in southeastern part of Jayuga quadrangle.

Mirikattan Limestone

Recent (early Holocene): Mariana Islands (Rota).

Risaburo Tayama, 1939, Correlation of the strata of South Sea Islands: Geol. Soc. Japan Jour., v. 46, no. 549, p. 346 (correlation table) [English translation in library of U.S. Geol. Survey]; 1952, Coral reefs in the south Seas: Japan Hydrog. Office Bull., v. 11, p. 58, table 4 [English translation in library of U.S. Geol. Survey, p. 69]. Named on correlation chart. Correlated with Tanapag limestone on Saipan, Dankuro [Dankuglo] limestone on Tinian, and Garukijokku limestone on Palau. Recent.

S. Hanzawa *in* Jacques Avias and others, 1956, Lexique Strat. Internat., v. 6, Océanie, fasc. 2, p. 47. A raised coral reef elevated 1 to 3 meters above sea level. Believed to be younger than raised-beach deposits. Early Holocene. Name credited to S. Sugawara (unpub. ms.).

Type locality: Rota Island. Exposed in belt surrounding island.

Misenheimer Shale[1]

Middle Devonian: Southwestern Illinois.

Original reference: T. E. Savage, 1920, Am. Jour. Sci., 4th, v. 49, p. 169–178.

J. M. Weller and G. E. Ekblaw, 1940, Illinois Geol. Survey Rept. Inv. 70, p. 15–60; J. M. Weller, 1940, Illinois Geol. Survey Rept. Inv. 71, p. 26. Strata intervening between Grand Tower limestone (or Dutch Creek sandstone where Grand Tower is absent) and Mountain Glen shale (or Springville shale where Mountain Glen is absent) have been referred by Savage to Misenheimer shale and Lingle and Alto limestones. Restudy of area suggests that recognition of these formations may be neither stratigraphically logical nor practically feasible.

A. S. Warthin, Jr., and G. A. Cooper, 1944, Am. Assoc. Petroleum Geologists Bull., v. 28, no. 10, p. 1523. In Jackson and Union Counties, a Hamilton age was formerly assigned to the Misenheimer. In this paper, term Misenheimer is not used because the Misenheimer is considered only a highly leached phase of Hamilton beds. Type Misenheimer is probably equivalent to part of St. Laurent limestone.

Well exposed in banks of Misenheimer Creek and tributaries in NE¼ sec. 34 and NW¼ sec. 35, Misenheimer Township, Union County.

Mission Argillite[1] (in Stevens Series)

Middle Cambrian (?): Northeastern Washington.

Original reference: C. E. Weaver, 1920, Washington Geol. Survey Bull. 20, p. 72, map.

Charles Deiss, 1955, U.S. Geol. Survey Bull. 1027–C, p. 122. Northport limestone restricted to the lower, thicker unit (main mass) of Weaver's Northport. As restricted underlies rather than interbeds with Weaver's Mission argillite. Age of Northport given as Middle Cambrian (?).

Probably named from town of Mission, Stevens County.

Mission Sandstone Member (of Tallant Formation)

Mission Sandstone Member (of Nelagoney Formation)[1]

Pennsylvanian (Missouri Series): Northeastern Oklahoma.

Original reference: M. I. Goldman and H. M. Robinson, 1920, U.S. Geol. Survey Bull. 686–Y, p. 362, 364.

W. F. Tanner, 1956, Oklahoma Geol. Survey Circ. 40, p. 12 (fig. 1), 38–39, pl. 1. Reallocated to Tallant formation. Described as very fine grained, buff to light brown, thin bedded to massive. Occurs near top of formation. Interpreted as a channel deposit, possibly fluvial, but probably shallow marine.

Named for occurrence along Mission Creek, especially in secs. 13, 14, 23, 24 and 25, T. 28 N., R. 11 E., Osage County.

Mission Canyon Limestone (in Madison Group)[1]

Lower and Upper Mississippian: Montana.

Original reference: A. J. Collier and S. H. Cathcart, 1922, U.S. Geol. Survey Bull. 736–F, p. 173.

L. L. Sloss and R. H. Hamblin, 1942, Am. Assoc. Petroleum Geologists Bull., v. 26, no. 3, p. 315, 318, measured sections. Strata called Mission Canyon by Collier and Cathcart are lithologically and faunally identical with Weed's (1899) Castle limestone, but because latter has been discarded, it is proposed that terms Mission Canyon and Lodgepole be applied throughout Montana and northern Wyoming. Overlies Woodhurst member of Lodgepole limestone; underlies Amsden formation, Ellis formation, or Kibbey sandstone.

M. E. Denson, Jr., and N. S. Morrisey, 1952, Wyoming Geol. Assoc. Guidebook 7th Ann. Field Conf., p. 37–43. Formation, in Bighorn [Big Horn] and Wind River basins, Wyoming, consists of two unnamed members: lower, bedded siliceous limestone and dolomite, 140 to 160 feet thick; upper, massive limestone and dolomite, 80 to 155 feet thick. Overlies Lodgepole formation; underlies unit referred to as "upper Madison".

J. W. Strickland, 1956, Wyoming Geol. Assoc. Guidebook 11th Ann. Field Conf., p. 51–57. Mission Canyon is middle unit of Madison group of this report. Overlies Lodgepole formation; underlies unit referred to as Upper Madison limestone. Thickness varies in western Wyoming due partly to pre-Meramec erosion but averages about 250 feet. Thickness at type section, herein stated, about 300 feet. Fossils indicate Osagean age. Mission Canyon correlates with the "massive limestones" of Peale (1893, U.S. Geol. Survey Bull. 110), upper part of Woodhurst of Weed (1899), lower Mission Canyon of Denson and Morrisey (1952), lower part of middle unit of Madison of Andrichuk (1955) and the Deseret of Utah.

M. R. Klepper, R. A. Weeks, and E. T. Ruppel, 1957, U.S. Geol. Survey Prof. Paper 292, p. 4 (table), 18–20, pls. 1, 2, 3. Mission Canyon, in area of this report [southern Elkhorn Mountains, Mont.], is composed of thick and indistinct beds of medium- to light-gray crystalline to granular limestone with subordinate thinner and more distinct beds of darker gray limestone near top and bottom. Thickness 1,107 feet in Limestone Hills (just outside mapped area). Overlies Lodgepole limestone; underlies Amsden formation, erosional unconformity(?). Formation probably wholly late Mississippian in this local area.

W. J. Sando and J. T. Dutro, Jr., 1960, Wyoming Geol. Assoc. Guidebook 15th Ann. Field Conf. p. 117–126. In present report, Madison group comprises two formations Mission Canyon limestone (1,050 feet thick) and underlying Lodgepole limestone. Strickland's (1956) restriction of Mission Canyon and recognition of "Upper Madison limestone" of formational rank is rejected. Strickland seemingly differentiated his "Upper Madison" from the Mission Canyon mainly on the basis that rocks allocated to "Upper Madison" are supposed to be separated from Mission Canyon by major unconformity. In present study, no convincing evidence of major unconformity with the Madison in western Wyoming or southwestern Montana was noted. Mission Canyon in Wyoming undoubtedly contains some beds younger than those present in its type section in Montana, but this does not necessitate recognition of separate unit in uppermost Madison. If future work should support further subdivision of upper part of Madison, it is suggested herein that such new units be recognized as members of the Mission Canyon rather than separate formations. "Massive limestones" of Peale (1893) herein considered to be part of Lodgepole limestone and not part of Mission Canyon as suggested by Strickland. Coral zonation of Mission Canyon discussed.

Type section (Strickland): In canyon of St. Pauls Mission along west flank of Little Rocky Mountain uplift, Little Rocky Mountain region, Montana.

†Mission Creek Series[1]

Paleozoic, Cretaceous, and Tertiary: Southwestern Alaska.

Original reference: J. E. Spurr, 1896, U.S. Geol. Survey 18th Ann. Rept., pt. 3, p. 153–183.

Well exposed at and named for Mission Creek, Yukon gold district.

Mission Creek Shale (in Deer Creek Limestone)[1]

Pennsylvanian: Northeastern Kansas, southwestern Iowa, northwestern Missouri, and southeastern Nebraska.

Original reference: G. E. Condra, 1927, Nebraska Geol. Survey Bull. 1, 2d ser., p. 40, 43, 49, 50.

G. E. Condra and E. C. Reed, 1937, Nebraska Geol. Survey Bull. 11, 2d ser., p. 53–54. Replaced by Burroak shale (new). Exposures on Mission Creek, Doniphan County, Kans., are correlative with Larsh shale of northern outcrops. In naming Mission Creek shale, Condra, (1927) miscorrelated the Rock Bluff and Ozawkie of Iowa Point section with Haynies and Rock Bluff, respectively, of Weeping Water Valley and Jones Point sections of Nebraska.

Named for exposures on Mission Creek, southeast of Iowa Point, Doniphan County, Kans.

†Missisquoi Formation[1]

Upper Cambrian: Northwestern Vermont.

Original reference: A. Keith, 1924, Vermont State Geologist Rept. 1923–24, p. 137.

C. Schuchert, 1937, Geol. Soc. America Bull., v. 48, no. 7, p. 1053. Beds termed Missisquoi by Keith (1924) are now referred to Gorge formation (new). Term Missisquoi preoccupied.

Exposed in gorge of Missisquoi River at Highgate Falls, Highgate village, St. Albans quadrangle, Franklin County.

Missisquoi Schist[1] or Group

Middle Ordovician: Northwestern Vermont.

Original reference: C. H. Richardson, 1919, Vermont State Geologist 11th Rept., p. 120–140.

L. W. Currier and R. H. Jahns, 1941, Geol. Soc. America Bull., v. 52, no. 9, p. 1496. Rocks of Cram Hill formation (new) constitute upper part of Richardson's (1919) "Missisquoi schists" which he at first tentatively placed in Lower Cambrian but later (1927, Vermont State Geologist 15th Rept.) interpreted as Upper Cambrian. This is most recent age assignment made hitherto and was based mainly upon presence of "Missiquoi schists" (later termed "Missisquoi group") unconformably below "Memphremagog slates" (Richardson, 1916, Vermont State Geologist 10th Rept.; Richardson and Camp, 1919, Vermont State Geologist 11th Rept.) which were believed to be of lower Trenton to Deepkill (Beekmantown) age. Authors [Currier and Jahns] believe that the Cram Hill, and consequently upper part of "Missisquoi group," are probably Middle Ordovician and that lower Trenton age for "Memphremagog slates" is open to question.

W. M. Cady, 1956, U.S. Geol. Survey Geol. Quad. Map GQ–79. Moretown formation in Montpelier quadrangle is subdivision of Missisquoi group of Richardson (1924).

Named for exposures in Missisquoi River valley in northern Vermont.

Mississinewa Shale[1]

Middle Silurian: Northeastern Indiana.

Original reference: E. R. Cumings and R. R. Shrock, 1927, Indiana Acad. Sci. Proc., v. 36, p. 71–84.

J. B. Patton, 1949, Indiana Div. Geology Prog. Rept. 3, p. 11. Lowest Silurian formation recognized at surface in Indiana. At most exposures, it is blue-gray argillaceous dolomitic silty massive limestone which has conchoidal fracture and weathers to small rectangular blocks; locally it is gray calcareous shale; interbedding of shale and limestone not common. Exposures of base not found. Normally overlain by Liston Creek limestone, but at Kokomo and Peru it is overlain by Kokomo limestone (Cayugan).

Named for exposures along Mississinewa, at or near river level, at Wabash and Largo, Wabash County.

†Mississippi Clays[1]

Miocene: Mississippi River basin.

Original reference: W. H. Dall, 1892, U.S. Geol. Survey Bull. 84, p. 157, 330.

Developed in basin of Mississippi River.

†Mississippi Slate Series[1]

Precambrian: Minnesota.

Original reference: R. D. Irving, 1888, U.S. Geol. Survey 7th Ann. Rept., p. 440–441.

Mississippi River region.

Missler Member (of Ballard Formation)

Missler Member (of Meade Formation)

Pleistocene: Southwestern Kansas.

C. W. Hibbard, 1949, Michigan Univ. Mus. Paleontology Contr., v. 7, no. 4, p. 67–68. Name applied to beds overlying Meade gravels member (new) of Meade formation and underlying Stump Arroyo member of Crooked Creek formation (both new). Consists of reddish sandy silt. Thickness 17 feet.

C. W. Hibbard, 1958, Am. Jour. Sci., v. 256, no. 1, p. 55 (fig. 1), 56. Reallocated to member status in Ballard formation (new). Overlies Angell member (new).

Type locality: Along tributary of Spring Creek in secs. 6 and 7, T. 32 S., R. 28 W., Meade County. Named for town of Missler on Rock Island Railroad, sec. 26, T. 31 S., R. 29 W.

Missoula Group[1]

Precambrian (Belt Series): Northwestern Montana and northern Idaho.

Original reference: C. H. Clapp and C. F. Deiss, 1931, Geol. Soc. America Bull., v. 42, p. 677, figs. 2, 3.

C. L. Fenton and M. A. Fenton, 1937, Geol. Soc. America Bull., v. 48, no. 12, p. 1900–1901. Consists of argillites, quartzites, and sandstones, with minor beds of conglomerate, limestone, and calcareous shale. Ripple marks, mud cracks, salt crystal casts, and rain prints characteristic. Thickness 10,000 to 18,000 feet. Type locality given. In Glacier National Park, consists of Miller Peak formation below and about 4,800 feet of undifferentiated unnamed beds above. Overlies Sheppard formation of Piegan group (new). Term Missoula antedates and reduces to synonomy term Boulder Pass formation (Fenton and Fenton, 1931).

Charles Deiss, 1943, Geol. Soc. America Bull., v. 54, no. 2, p. 211. In Saypo quadrangle, Miller Peak argillite, Cayuse limestone (new), Hoadley formation (new), and Ahorn quartzite (new) are equivalent in age to lower and middle part of Missoula group of Clapp and Deiss (1931) in Sapphire and Garnet Ranges, Mont.

D. A. Andrews, G. S. Lambert, and G. W. Stose, 1944, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 25, sheet 1. In central western Montana, includes (descending) Sheep Mountain quartzite, Garnet Range formation, McNamara formation, Hellgate formation, and Miller Peak formation. Overlies Siyeh group.

C. P. Ross, 1949, (abs.) Washington Acad. Sci. Jour., v. 39, no. 3, p. 113. Group includes all of Belt series above Piegan group in all localities where the Piegan is recognizable. In northwestern Montana and adjacent parts of Idaho, group is represented by Striped Peak and Libby formations. In and near Glacier Park, the Shepard, Kintla, and other units are included in it. In vicinity of Missoula, group is described as containing 18,000 feet divided into five formations. In vicinity of Helena, Marsh shale is only representative of group, but to the north other units appear; in Saypo quadrangle, four formations [Miller Peak argillite, Cayuse limestone, Hoadley formation, and Ahorn quartzite] have been distinguished. North Boulder group (new) may be equivalent to some part of Missoula group.

C. P. Ross, D. A. Andrews, and I. J. Witkind, 1955, Geologic map of Montana (1:500,000): U.S. Geol. Survey. Group includes numerous named formations, most of which cannot be traced with confidence far from their type localities. Among these are Marsh shale in Helena region, Striped Peak, and Libby formations in northwestern Montana, five near Missoula, and others in and south of Glacier National Park.

C. P. Ross and J. D. Forrester, 1958, Idaho Bur. Mines and Geology Bull. 15, p. 5. Group includes Striped Peak formation in northern Idaho.

W. H. Nelson and J. P. Dobell, 1959, U.S. Geol. Survey Misc. Geol. Inv. Map I–296. Group, as mapped in Bonner quadrangle, Montana, comprises (ascending) Miller Peak argillite, Bonner quartzite (new), McNamara argillite, Garnet Range quartzite, and Pilcher quartzite (new). Overlies Newland limestone of Piegan group.

C. P. Ross, 1959, U.S. Geol. Survey Prof. Paper 296, p. 19 (table), 43–53, pls. 1, 2. In area of this report [Glacier National Park and Flathead region], base of group is redefined and placed at top of definitely calcareous beds of Siyeh limestone of Piegan group (redefined). The Siyeh is thus restricted to exclude a unit of greenish calcareous argillite, up to several hundred feet thick, now included in Missoula group. This places base of group in and near Glacier National Park stratigraphically lower than has been done previously. Argillaceous rocks above Siyeh limestone of present report correspond essentially to Spokane formation of Fenton and Fenton (1937) and to red and green argillite band in Siyeh of Clapp (1932, Montana Bur. Mines and Geology Mem. 4). However, the Spokane cannot be traced satisfactorily into Flathead region; hence, name "Spokane" is not here employed, and beds thus designated by the Fentons are regarded as unnamed parts of Missoula group. The argillaceous beds are overlain by Purcell basalt which in turn underlies Shepard formation. The Shepard can be mapped safely only where it is underlain by the Purcell. Greatest part of group consists of assemblage of grayish-, purplish-, and brownish-red and grayish-green dominantly argillaceous rocks that differ in details from place to place. No stratigraphic names are applied to main body of the group. Thickness of main body of group may be as much as 20,000 feet in Flathead region.

A. B. Campbell, 1960, U.S. Geol. Survey Bull. 1082–I, p. 560–569, pl. 28. In St. Regis-Superior area, Montana, divided into five formations (ascending): Spruce, Lupine quartzite, Sloway, Bouchard (all new), and unnamed feldspathic quartzite. Thickness about 16,000 feet. Overlies Wallace formation; underlies Paleozoic rocks.

Type locality: Slopes east and west of Rattlesnake Creek, northeast of Missoula, Mont.

Missoula[1] (limestone)

Carboniferous: Montana.

Original reference: C. R. Keyes, 1926, Pan-Am. Geologist, v. 46.

Derivation of name not stated.

Missouri Series

Missouri Group[1]

Upper Pennsylvanian: Iowa, Arkansas, Kansas, Missouri, Nebraska, and Oklahoma.

Original reference: C. R. Keyes, 1893, Iowa Geol. Survey, v. 1, p. 114–116.

H. S. McQueen, 1938, Missouri Geol. Survey and Water Resources, 2d ser., v. 25, p. 25–29, pl. 5. Missouri series comprises (ascending) Pleasanton, Kansas City, Lansing, Pedee, Douglas, Shawnee, and Virgil series.

R. C. Moore and others, 1944, Geol. Soc. America Bull., v. 55, no. 6, p. 657–706, chart 6. In upward order, Midcontinent time-rock divisions of the Pennsylvanian are designated as Morrowan, Lampasan, Desmoinesian, Missourian, and Virgilian.

M. G. Cheney and others, 1945, Am. Assoc. Petroleum Geologists Bull., v. 29, no. 2, p. 140 (chart 2), 166–169. Chart shows classification and correlation of type Pennsylvanian section of eastern and western Pennsylvania with costandard sections of Appalachian and Midcontinent regions. Midcontinent region section comprises (ascending) Springer, Morrow, Lampasas, Des Moines, Missouri, and Virgil series. Missouri series is equivalent to Conemaugh series of Appalachian region and to most of Conemaugh of type section in western Pennsylvania. Upper Pennsylvanian. In south Ardmore basin, designated as reference section, beds of undoubted Missouri age, exceed 2,000 feet in thickness, or about 3,000 feet if full thickness of Hoxbar is included.

R. C. Moore, 1948, Am. Assoc. Petroleum Geologists Bull., v. 32, no. 11, p. 2020, 2021 (fig. 1), 2031 (fig. 4). For many years, all Pennsylvanian strata in northern Midcontinent area above so-called Des Moines group, or Lower Coal Measures, were known as Missouri group, or Upper Coal Measures. Boundary between these "groups" was drawn at base of Hertha limestone, or base of Kansas City formation of Missouri Geological Survey usage. Moore (1932, Kansas Geol. Soc. Guidebook 6th Ann. Field Conf.) relocated boundary to coincide with regional disconformity occurring 5 to 100 feet below Hertha limestone and classed redefined Des Moines as series. The former Missouri group, with addition of strata below and removal of beds above, was designated Missouri series. Studies prior to 1932 had revealed existence of widespread disconformity in middle part of old Missouri group and this seemed to rank in importance with other main time-rock boundaries in Pennsylvanian system. Deposits occurring between post-Desmoinesian disconformity and that in mid-part of Upper Pennsylvanian, are classed as belonging to Missourian series. This time-rock division comprises lower part of zone of *Triticites*. Missourian series, as recognized by State Geological Surveys in Midcontinent region, comprises (ascending) Pleasanton, Kansas City, Lansing, and Pedee groups. Underlies Virgilian series. Missouri Geological Survey restricts stratigraphic span of term so that future official usage in that State will conform to definition adopted in neighboring areas. Classification of Missourian strata in northern Oklahoma differs from interstate usage—in that terms Skiatook and Ochelata groups are used.

R. C. Moore and M. R. Thompson, 1949, Am. Assoc. Petroleum Geologists Bull., v. 33, no. 3, p. 297. Approximately upper one-third of Pennsylvanian system belongs to Kawvian series (new). Kawvian rocks are divided into Missourian stage below and Virgilian stage above.

R. C. Moore and others, 1951, Kansas Geol. Survey Bull. 89, p. 78. Outcrop area of Missourian series in Kansas is a 20, to 40-mile wide belt, marked by east-facing escarpments, extending from Doniphan County to northeast Montgomery County in south. Thickness about 700 feet.

W. H. Bradley, 1956, Am. Assoc. Petroleum Geologists Bull., v. 40, no. 9, p. 2284–2285. In Midcontinent region (including Arkansas, Iowa, Kansas, Missouri, Nebraska, and Oklahoma) the U.S. Geological Survey uses following series subdivision of the Pennsylvanian: Morrow, Atoka, Des Moines, Missouri, and Virgil. Missouri series is late Pennsylvanian.

H. G. Hershey and others, 1960, Iowa Highway Research Board Bull. 15, p. 23. In Iowa it is not possible to locate accurately unconformity separating Pedee group of Missouri series from Douglas group of Virgil series. If break in sedimentation exists, it may be above, within, or below sediments lying between Oread limestone of Shawnee group (Virgil series) and Stanton limestone of Lansing group.

Reference section: South Ardmore basin, Oklahoma. Named for development in northwestern Missouri and along Missouri River, Iowa.

Missourian Series or Stage

See **Missouri Series.**

†Missouri Mountain Formation[1]

Devonian and Pennsylvanian: Southwestern Arkansas.

Original reference: A. H. Purdue, 1909, Geol. Soc. America Bull., v. 19, p. 557.

Missouri Mountain Slate or Shale[1]

Silurian: Southwestern Arkansas and southeastern Oklahoma.

Original reference: A. H. Purdue, 1909, Slates of Arkansas: Arkansas Geol. Survey, p. 37.

B. H. Harlton, 1953, Am. Assoc. Petroleum Geologists Bull., v. 37, no. 4, p. 781 (fig. 2), 787–788. In Ouachita Mountains, southeastern Oklahoma, approximately 100 feet thick and consists of green, hard siliceous shale, intercalated thin streaks of finely laminated chert, and locally lenses of conglomerate. Underlies Arkansas novaculite; unconformably overlies Polk Creek shale. Middle Silurian.

H. D. Miser and others, 1954, Geologic map of Oklahoma (1:500,000): U.S. Geol. Survey. Mapped as Silurian.

Named for exposures in Missouri Mountains, Polk and Montgomery Counties, Ark.

Mitchell Limestone[1]

Mississippian: Southern Indiana.

Original reference: C. E. Siebenthal, 1897, Indiana Dept. Geology and Nat. Resources 21st Ann. Rept., p. 296, 298.

T. G. Perry and N. M. Smith, 1958, Indiana Geol. Survey Bull. 12, p. 19. Abandoned by Indiana Geological Survey. Mitchell limestone was defined as overlying Bedford oolitic limestone (Salem), and its upper limit was not defined. Elrod (1899, Indiana Acad. Sci. Proc. 1888) restricted term to beds between Bedford oolitic limestone and Lost River chert. St. Louis group of Elrod contained Bedford oolitic limestone, Mitchell limestone, Lost River chert, and newly proposed Paoli limestone, which extended to the first Kaskaskia sandstone (now called Mooretown sandstone). Cumings (1922, Indiana Dept. Conserv. Pub. 21, pt. 4) returned to names St. Louis, Ste. Genevieve, and Paoli, but referred to them as divisions of the Mitchell limestone. Name Mitchell should have been discarded at this date.

Named for Mitchell, Lawrence County.

Mitchell Mesa Rhyolite (in Buck Hill Volcanic Series)

Mitchell Mesa Rhyolite (in Green Valley Volcanic Series)

Mitchell Mesa Welded Tuff (in Buck Hill Volcanic Series)

Oligocene and younger (?): Western Texas.

S. S. Goldich and M. A. Elms, 1946, (abs.) Geol. Soc. America Bull., v. 57, no. 12, pt. 2, p. 1197. Youngest unit in Green Valley series. Overlies Duff tuff (new).

S. S. Goldich and C. L. Seward, 1948, West Texas Geol. Soc. [Guidebook], p. 13, 14 (table 1), 15, 17 (fig. 3), 21. Included in Buck Hill volcanic series (new) above Duff formation and below Tascotal formation (new). Consists of gray to pink rhyolite; thickness 37 to 150 feet. Youngest unit in series in Buck Hill quadrangle, although younger beds occur above the rhyolite in adjacent areas. [Authors make no reference to term Green Valley volcanic series.]

S. S. Goldich and M. A. Elms, 1949, Geol. Soc. America Bull., v. 60, no. 7, p. 1138 (table 1), 1144 (fig. 3), 1161–1162, pl. 1. Oligocene (?). Derivation of name given.

W. N. McAnulty, 1955, Geol. Soc. America Bull., v. 66, no. 5, p. 536 (table 1), 543, 554–555, pl. 1. Described in Cathedral Mountain quadrangle. Renamed Mitchell Mesa welded tuff. Overlies Duff formation; underlies Tascotal formation. Suggested that units above Crossen trachyte are Oligocene and younger (?).

Named for Mitchell Mesa, northwestern Buck Hill quadrangle, Brewster County.

Mitchells Ferry Beds[1]

Eocene, upper: Eastern Texas and western Louisiana.

Original reference: A. C. Ellisor, 1933, Am. Assoc. Petroleum Geologists Bull., v. 17, no. 11, p. 1302, 1317.

Named for exposures at Mitchell's Ferry, on Sabine River, Tex.

Mitten Black Shale Member (of Pierre Shale)[1]

Upper Cretaceous: Northeastern Wyoming and southeastern Montana.

Original reference: W. W. Rubey, 1930, U.S. Geol. Survey Prof. Paper 165–A.

C. S. Robinson, W. J. Mapel, and W. A. Cobban, 1959, Am. Assoc. Petroleum Geologists Bull., v. 43, no. 1, p. 107, measured sections. Thickness about 80 feet at Driscoll Creek, and about 75 feet a few miles north in sec. 5, T. 9 S., R. 56 E., Carter County, Mont. Thickens southward along west flank of Black Hills to about 500 feet near Thornton, Weston County, Wyo. Overlies Gammon ferruginous member.

H. A. Tourtelot, L. G. Schultz, and J. R. Gill, 1960, U.S. Geol. Survey Prof. Paper 400–B, p. B447–B448. Sharon Springs and Mitten black shale members of Pierre and Claggett shale are contemporaneous units of organic-rich black shale and beds of nonswelling bentonite. Silty and sandy beds overlying the Mitten along west side of Black Hills are 400 to 600 feet thick, and are eastward equivalents of nonmarine Judith River and Mesaverde formations of Montana and Wyoming.

Named for exposures along Driscoll Creek, locally known as Mitten Prong in sec. 22, T. 56 N., R. 68 W., Crook County, Wyo.

Mizpah Trachyte[1]

Tertiary: Central Nevada.

Original references: J. E. Spurr, 1911, Min. and Sci. Press, v. 102, p. 560–561; 1911, Report on geology of property of Montana-Tonopah Mining Co., Tonopah, Nev., published privately; 1915, Econ. Geology, v. 10, p. 713–769.

Named for Mizpah Hill, Tonopah district.

Moab Sandstone Member or Tongue (of Entrada Sandstone)[1]

Upper Jurassic: Central eastern Utah.

Original reference: A. A. Baker and others, 1927, Am. Assoc. Petroleum Geologists Bull., v. 11, no. 8, p. 787, 799, 804, 805.

J. C. Wright and D. D. Dickey, 1958, Intermountain Assoc. Petroleum Geologists Guidebook 9th Ann. Field Conf., p. 173 (table 1), 178 (fig. 6), 179. In its central area, between Moab and Abajo Mountains, tongue joins with main mass of Entrada and displaces nearly entire Summerville formation. Thickness in this area about 150 feet and only a few feet of Summerville separates it from Morrison formation. Thins radially in all directions.

Named for exposures in Moab Valley.

Moat Volcanics[1]

Upper Permian: Central and southern New Hampshire.

Original reference: M. P. Billings, 1928, Am. Acad. Arts and Sci. Proc., v. 63, p. 89.

M. P. Billings, 1955, Geologic map of New Hampshire (1:250,000): U.S. Geol. Survey. Extrusive phase of White Mountain plutonic-volcanic series of Mississippian(?) age. Includes flows, tuffs, and breccias composed chiefly of light-gray and red rhyolite, black basalt, and dark-gray andesite, also red trachyte.

U.S. Geological Survey currently designates the Moat Volcanics as Upper Permian on the basis of a study now in progress.

Type locality: On South Moat Mountain, North Conway quadrangle. Excellent section exposed from elevation 1,100 feet upwards on South Moat trail to Red Ridge.

Moberly Channel Sandstone[1]

Pennsylvanian: East central Missouri.

Original reference: C. F. Marbut, 1898, Missouri Geol. Survey, v. 12, pt. 2 (Sheet Rept. 12), p. 323, 324, 331–332, 350.

H. S. McQueen, 1943, Missouri Geol. Survey and Water Resources, 2d ser., v. 28, p. 96–98, pl. 14. Near east edge of Stoutsville, Monroe County, the Moberly is in contact with Keokuk-Burlington cherty limestone; in sec. 28, T. 55 N., R. 9 W., where thickness is—80 feet, is in contact with Ardmore and Cheltenham formations: in some areas, may be in contact with the Warsaw.

Named from exposures at Moberly, Randolph County.

†Mobile Formation[1]

†Mobile Bay Formation[1]

Pleistocene: Southwestern Alabama.

Original reference: E. A. Smith, 1894, Am. Jour. Sci., 3d, v. 47, p. 285–296.

Borders Mobile Bay and extends up larger rivers to inland margin of coastal plain.

Mobridge Member (of Pierre Shale)

Upper Cretaceous: Central and southeastern South Dakota.

W. V. Searight, 1937, South Dakota Geol. Survey Rept. Inv. 27, p. 44–49, pls. 2, 3. A succession of highly calcareous shale, marl, and chalk beds which lie above Virgin Creek member (new) and below Elk Butte member (new). Thickness 90 to 230 feet.

A. L. Moxon, of O. E. Olson and W. V. Searight, 1939, South Dakota State Coll. Agriculture and Mech. Arts. Tech. Bull., 2, p. 20, 25. Replaced by Interior member, which name has precedence.

J. P. Gries, 1941, South Dakota Geol. Survey Rept. Inv. 38, p. 34–35. Complete equivalence of all Interior beds to Mobridge member is in doubt; term Mobridge retained as originally defined.

H. E. Simpson, 1960, U.S. Geol. Survey Prof. Paper 328, p. 12 (table 1), 32 (table 3), 39. In Yankton area, member is as much as 18 feet thick, upper part removed by erosion. Overlies Virgin Creek member. Separated from sediments of post-Cretaceous age by Sharp unconformity. Commonly overlain by Ogallala formation of Pliocene age.

Type locality: Exposure above west end of highway bridge across Missouri River at Mowbridge. Exposure is in southeastern corner of Corson County opposite Mowbridge, Walworth County. Member extends from near North Dakota boundary to southern boundary of South Dakota.

Moccasin Limestone[1] **or Formation**

Middle Ordovician: Western Virginia, northwestern Georgia, and northeastern Tennessee.

Original reference: M. R. Campbell, 1894, U.S. Geol. Survey Geol. Atlas, Folio 12, p. 2.

Charles Butts, 1940, Virginia Geol. Survey Bull. 52, pt. 1, p. 179–181. Name Lowville-Moccasin used in this report because equivalent of upper three-fourths of the Lowville in middle belts of Appalachian Valley is a red argillaceous limestone or calcareous mudrock facies, which has received name Moccasin limestone, a name extensively used in southwestern Virginia and northern Tennesse. Black River group.

B. N. Cooper, 1942, (abs.) Geol. Soc. America Bull., v. 53, no. 12, pt. 2, p. 1799–1800. Moccasin formation was originally described as a red argillaceous limestone with maximum thickness of 500 feet and was said to overlie blue flaggy Chickamauga limestone. Beds included in type Moccasin consist of 465 feet of red argillaceous limestone, calcareous mudrock, siltstone, and thin intercalations of bluish-gray calcilutyte. Type Moccasin is underlain by following stratigraphic zones (descending): 54 feet of fine-grained limestone containing *Camarocladia* cf. *C. gracilis*, 28 feet of coarse-grained limestone containing *Cryptophragmus antiquatus*, 40 feet of calcilutyte containing *Tetradium cellulosum*, 42 feet of red straticulate mudrock, and 5 feet of calcareous sandstone. Term Lowville-Moccasin has been used for a unit including all these zones. Gray limestone beneath body of red mudrock and above the red straticulate zone have been regarded as an intercalation of Lowville limestone within the Moccasin. *Camarocladia*-bearing limestones at top of so-called Lowville are undoubtedly part of blue flaggy Chickamauga limestone said by Campbell to underlie the Moccasin. Thus, the limestone which has been called Lowville, the red straticulate mudrock, and the sandstone were originally excluded from the Moccasin. So-called Lowville and Moccasin are not equivalent facies. Term Lowville-Moccasin should not be used.

B. N. Cooper and C. E. Prouty, 1943, Geol. Soc. America Bull., v. 54, no. 6, p. 819–886. Lower Middle Ordovician succession of Tazewell County, southwestern Virginia, is subdivided into 29 distinctive zones which are grouped into 8 formations. Detailed mapping led to recognition of inconsistencies in use of stratigraphic names, Stones River, Murfreesboro, Mosheim, Lenoir, Blount, Holston, Ottosee, Lowville, and Moccasin. Name Lowville-Moccasin as used by Butts (1940) is not acceptable. In this paper, original usage of name Moccasin is revived and zones assigned to it are (ascending) red marble, red mudrock, and red siltstones (zones 26, 27, and 28). Thickness 328 feet. Overlies Witten limestone (new) ; underlies Eggleston formation.

Charles Butts and R. S. Edmundson, 1943, Geol. Soc. America Bull., v. 54, no. 11, p. 1678. Includes Walker Mountain sandstone member (new) in upper part in Walker Mountain area, Virginia.

C. E. Prouty, 1946, Am. Assoc. Petroleum Geologists Bull., v. 30, no. 7, p. 1176–1179. Discussion of lower Middle Ordovician of southwest Virginia and northeast Tennessee. Detailed sections measured along seven belts are compared with revised classification of Tazewell County, Va., (Cooper and Prouty, 1943). Blackford, Five Oaks, Lincolnshire, Thompson Valley (new), upper Peery, Benbolt, Wardell, Bowen, Witten, and Moccasin formations extend into northeast Tennessee. The Moccasin overlies Witten limestone and underlies Eggleston formation. Moccasin formation as herein defined is equal to upper part of Butts' "Lowville-Moccasin" in median and southeast belts. Butts included the red claystone of the Bowen in the Moccasin and the limestone intercalations in the "Lowville-Moccasin." The Moccasin is equivalent to "Bays" formation in its type area along Bays Mountain, southeast of Knoxville, Tenn. It is equal to the Bays as mapped in Knoxville folio (Keith, 1895) but not equivalent to the "Bays" of other folios in area, where it was mapped for the younger Juniata formation. Because Bays has been often misused and is not as widely used as Moccasin, it would best be discontinued. Commonly classed as Black River but may be earliest Trenton.

R. L. Miller and J. O. Fuller, 1947, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 76. In Rose Hill oil field, Lee County, Va., includes Hardy Creek member (new) in upper part. Thickness 279 to 297 feet. Overlies Lowville limestone; underlies Eggleston limestone. Middle Ordovician.

Charles Butts and Benjamin Gildersleeve, 1948, Georgia Geol. Survey Bull. 54, p. 30–31, geol. map. Referred to as Lowville-Moccasin limestone. Moccasin and Lowville are facies of same general formation, the Lowville facies being bluish or dove-colored limestone and the Moccasin facies being predominantly red. Thickness 250 to 1,000 feet. Formation occupies strip on margin of belts (designated on map by symbol Oml), next to Stones River belt or to Knoxville dolomite. In complete sequence, as in McLemore Cove, Lowville-Moccasin succeeds Lebanon limestone. Where Newala limestone and Stones River group are absent, Lowville-Moccasin rests on Knox dolomite.

John Rodgers, 1953, Tennessee Div. Geology Bull. 58, pt. 2, p. 83, pls. Moccasin limestone was named by Campbell (1894) for (Big) Moccasin Creek, Scott County, Va., northeast along strike of Clinch Valley belt. Rock is more limy shale and siltstone than limestone; hence, it is here called Moccasin formation. As shown on present map, base is drawn below the lowest maroon and associated yellow shale and silty limestone. Campbell (1894, Folio 12; 1899, Folio 59) but not Keith (1896, Folio 27; 1901, Folio 75) drew base considerably higher, above a thick body of blue limestone, here included in lower part of Moccasin. Cooper (1942) prefers Campbell's original use, but for present map Keith's usage is more satisfactory. If necessary, name Moccasin as here used could be replaced by Bays formation. Equivalent to unit 3 of Chickamauga as mapped.

R. L. Miller and W P. Brosgé, 1950, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 104; 1954, U.S. Geol. Survey Bull, 990, p. 56–58. Replaced by Hardy Creek limestone and Ben Hur limestone (new) in Lee County, Va.

L. D. Harris and R. L. Miller, 1958, U.S. Geol. Survey Geol. Quad. Map GQ–111. Referred to as formation Duffield quadrangle, Virginia. Present only in Copper Creek belt where it contains three members—lower red mudstone, middle limestone, and upper red mudstone. Overlies Witten limestone.

Named for occurrence on Moccasin Creek, Scott County, Va.

Moccasin Gap Member (of Unicoi Formation)

Lower Cambrian: Northeastern Tennessee.

H. W. Ferguson and W. B. Jewell, 1951, Tennessee Div. Geology Bull. 57, p. 11 (table 1), 22–23, pl. 1. A bed of coarse-grained quartzite about 50 feet thick that occurs about 1,000 feet or more from top of formation in parts of Del Rio thrust sheet. Commonly, the lower one of a group of quartzite beds in the formation; however, on northwest side of Yellow Springs Mountain at least two quartzite beds occur below the Moccasin Gap.

Well exposed at Moccasin Gap, Del Rio district, Cocke County.

Moccasin Springs Formation (in Bainbridge Group)

Middle Silurian: Southeastern Missouri and southern Illinois.

H. A. Lowenstam, 1949, Illinois Geol. Survey Rept. Inv. 145, p. 16–18. Upper formation of Bainbridge group. Includes all Niagaran strata that overlie St. Clair formation in outcrop area in Cape Girardeau and Ste. Genevieve Counties, Mo., and Alexander and Union Counties, Ill. Directly underlies Fern Glen limestone in certain parts of Ozark border are in Illinois, in western St. Clair and Monroe Counties, and possibly in northwestern Jackson County. Consists predominantly of red and mottled red and gray to greenish-gray very fine grained silty argillaceous limestone and calcareous argillaceous siltstone; brick-red coloration is more prominent in basal part and purple mottling in upper. Thickness in Missouri outcrops 100 to 130 feet; over most of southern Illinois 160 to 200 feet; at type area, basal 5 to 15 feet not exposed. [Report deals with Niagaran reefs in Illinois and their relation to oil accumulation; much data relative to thickness and distribution of unit are based on subsurface studies.]

Type locality: In small box canyon in Mississippi River bluff in SE¼SE¼NW¼ sec. 24, T. 32 N., R. 14 E., Cape Girardeau County, Mo., (Jonesburg quadrangle) about 3 miles south of Moccasin Springs. [Locality described in detail by Ball, 1939, as type section of Bainbridge formation]. Formation crops out in Niagaran belts adjacent to the

Ozarks, but is partly or entirely replaced laterally by other rock types where Niagaran strata come to surface in Indiana, Kentucky, and Tennessee.

Modale sediments

[Miocene] (Luisian and Mohnian) : Southern California.

S. J. Kriz, 1955, Dissert. Abs., v. 15, no. 3, p. 393. Overlap other Miocene strata (Sespe, Vaqueros, Rincon) in area. Thins northeasterly and grades upward into strata that are probably nonmarine.

Area is Whitaker Peak-Reasoner Canyon in Ventura and Los Angeles Counties.

Modelo Formation[1]

Miocene, upper: Southern California.

Original reference: G. H. Eldridge, 1907, U.S. Geol. Survey Bull. 309.

Thomas Clements, 1937, Am. Assoc. Petroleum Geologists Bull., v. 21, no. 2, p. 215–218. In Tejon quadrangle, underlies Ridge Route formation (new).

Peter Dehlinger, 1952, California Div. Mines Spec. Rept. 26, p. 5–6, pls. Term Modelo, as used in this paper [southern Ridge basin], denotes marine beds of upper Miocene age. This follows usage of Clements (1937) ; in recent years, name "Castaic formation" has also been applied but without adequate definition. Beds crop out in approximately three-quarters of area mapped. A conglomeratic member, ranging from a few feet to nearly 300 feet in thickness, lies at base of formation. Conglomeratic pecten bed, a few inches to about 8 feet thick overlies basal conglomerate and serves as excellent marker bed. Modelo section above pecten bed comprises alternating beds of sandstone, siltstone, and some shale. Thickness decreases markedly and uniformly in northerly direction. About 6,300 feet of lower part of formation is exposed in southern part of area where upper Modelo beds have been removed by erosion. In northern part of area entire thickness of formation is 2,000 feet. Underlies Ridge Route formation; overlies Martinez formation with marked angular unconformity east and northeast of area; southeast of area, overlies Mint Canyon formation, in some places conformable in other places unconformable. Modelo beds have been folded into asymmetrical northwestward plunging syncline, with gently dipping northeast flank and a much steeper dipping southwest flank. San Gabriel fault is parallel to synclinal axis, and lies about 1 mile west of it. Rocks exposed along eastern flank of syncline are chief subject of this report.

G. J. Neuerburg, 1953, California Div. Mines Spec. Rept. 33, p. 6 (table 1), 24. Formation, in eastern part of Griffith Park area, Los Angeles County, lies unconformably on Feliz granodiorite (new) and on conglomerate of Hollycrest formation (new). Thickness about 1,000 feet. Consists of dark-gray organic and calcareous siltstone and shale, with lenses and thin beds of fine-grained argillaceous limestone; abundant wood fragments and fish scales; small basalt sill. Lithology not typical of rest of Modelo in Santa Monica Mountains nor of that in foothills east of Los Angeles River. Upper Miocene.

E. L. Winterer and D. L. Durham, 1954, California Div. Mines Bull. 170, map sheet 5. Along north slope of Santa Susana Mountains, underlies and interfingers with Towsley formation (new).

J. C. Crowell, 1954, California Div. Mines Bull. 170, map sheet 7. In Ridge basin area, beds formerly called Modelo are included in Castaic formation.

G. B. Oakeshott, 1958, California Div. Mines Bull. 172, p. 22 (fig. 2), 23 (fig. 3), 69–74, pls. 1, 3. Formation crops out in two widely separated parts of San Fernando quadrangle, north and south of San Gabriel fault. South of fault, formation is 3,000 feet thick; overlies Topango(?) formation and underlies Elsmere member of Repetto formation. North of fault, formation is 500 feet thick, overlies Mint Canyon formation and underlies Repetto formation; in Bouquet Canyon unconformably underlies Saugus formation. Middle to upper Miocene.

E. L. Winterer and D. L. Durham, 1958, U.S. Geol. Survey Oil and Gas Inv. Map OM–196. On map accompanying this report [part of Ventura Basin in Los Angeles County], Modelo includes rocks in Santa Susana Mountains that Kew (1924) mapped as shale member of Modelo but does not include younger strata that he mapped as sandstone member of Modelo. These younger beds here included in Towsley formation. Modelo, as redefined in this report, is chiefly siltstone. Complete section is exposed near crest of Santa Susana Mountains in vicinity of Rice Canyon. Basal unit there is about 300 feet thick and consists of medium- to coarse-grained sandstone with lenses of pebble conglomerate. Overlying is sequence of beds about 2,700 feet thick consisting of gray to brown siltstone and mudstone that is commonly thin bedded. Light-colored silty to coarse-grained sandstone beds as much as several feet thick are sparingly interbedded with siltstone. Thickness increases westward from Newhall to at least 5,000 feet, but no wells have been drilled to base of formation in western part of area so its maximum thickness is not known. Underlies and interfingers with Towsley formation. Upper Miocene.

Well exposed in Hopper Canyon and head of Modelo Canyon, Ventura County.

Modesto Formation

Pleistocene, upper: Central California.

S. N. Davis and F. R. Hall, 1959, Stanford Univ. Pub. Geol. Sci. v. 6, no. 1, p. 6, 12, 20–22, pls. 2, 3. Consists of silt and sand; beds are lenticular and commonly crossbedded; composition and texture of formation suggest that it was deposited as thin series of coalescing alluvial fans. Overlies Riverbank formation (new); covered by Recent alluvium. Modesto and Riverbank formations together represent the Victor formation and can be traced northward into Mokelumne area.

Type section: NE¼SE¼ sec. 2, T. 4 S., R. 9 E., Ceres quadrangle. Exposed along private road which goes down south bluff of Tuolumne River in eastern Modesto. Crops out in area extending from slightly east of towns of Modesto and Turlock nearly to San Joaquin River; tongues of formation also extend eastward along streams of Sierran foothills.

Modesto Formation (in McLeansboro group)

Pennsylvanian: Illinois.

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 8 (fig. 1), 26 (fig. 4), 27, 36–38, 48–50 (table 1), pl. 1, geol. sections. Includes all strata from top of Danville (No. 7) coal member of Carbondale formation to base of Shoal Creek limestone member of Bond formation (new). Predominantly gray shales with sandstones locally prominent. Commonly about 300 feet thick; maximum thickness more than 400 feet in southeastern part of state; about 200 feet thick in local occurrences in northern Illinois. Members—southeastern Illinois—(ascending) Piasa limestone, De Graff coal (new), Pond Creek coal (new), Lake Creek coal (new), West Franklin limestone, Trivoli sandstone, Chapel (No. 8) coal and New Haven coal; southwestern Illinois—Piasa limestone, Rock Branch coal (new), Athensville coal (new), Scottville limestone, Trivoli sandstone, Chapel (No. 8) coal, Carlinville limestone, Burroughs limestone, Womac coal (new), Macoupin limestone, and New Haven coal; western and northern Illinois—Farmington shale, Gimlet sandstone, Lonsdale limestone, Exline limestone, Trivoli sandstone, Chapel (No. 8) coal, and Cramer limestone (new); eastern Illinois—Chapel (No. 8) coal and West Franklin limestone. Presentation of new rock-stratigraphic classification of Pennsylvanian of Illinois. Cyclical classification is retained but is independent of rock-stratigraphic classification.

Type locality: Sec. 16–17, T. 12 N., R. 9 W., Macoupin County. Named for town of Modesto.

Modin Formation[1]

Upper Triassic: Northern California.

Original reference: J. S. Diller, 1906, U.S. Geol. Survey Geol. Atlas, Folio 138.

A. F. Sanborn, [1953], Stanford Univ. Abs. Dissert., v. 27, p. 436; 1960, California Div. Mines Spec. Rept. 63, p. 6, 8–14, pl. 1. In Big Bend quadrangle, subdivided into (ascending) Hawkins Creek, Devils Canyon, and Kosk members (all new). Overlies Brock shale; underlies Arvison formation (new). Estimated maximum thickness 5,500 feet. Upper Triassic.

Named for exposures near mouth of Modin Creek at its confluence with Squaw Creek in northeast part of Redding quadrangle, Shasta County.

Modoc Basalt[1]

Pleistocene and Recent: Northern California.

Original reference: H. A. Powers, 1932, Am. Min., v. 17, no. 7, p. 253, 273, map.

C. A. Anderson, 1941, California Univ., Dept. Geol. Sci. Bull., v. 25, no. 7, p. 367–372, geol. map. Described and mapped in Medicine Lake Highland area. Basaltic eruptions likely range in age from late glacial stage to within last few centuries.

Medicine Lake Highland area is in center of Modoc Lava Bed quadrangle.

Modoc Lavas[1]

Tertiary (?): Northwestern Nevada.

Origonal reference: R. W. Chaney, 1924, Geol. Soc. America Bull., v. 35, p. 162–163. Washoe County.

Modoc Limestone[1]

Lower Mississippian: Southeastern Arizona.

Original reference: W. Lindgren, 1905, U.S. Geol. Survey Prof. Paper 43.

J. M. Weller and others, 1948, Geol. Soc. America Bull., v. 59, no. 2, p. 136. Name applied locally to Mississippian strata in southeastern Arizona. Carries *Spirifer centronatus* fauna.

Exposed south of Modoc Mountain in Clifton-Morenci region.

Modoc Quartz Monzonite[1]

Eocene: Central northern Colorado.

Original reference: P. G. Worcester, 1921, Colorado Geol. Survey Bull. 21, p. 30–31.

Occurs in a single dike found in Modoc mine about one-half mile due north of Ward, Boulder County.

Moenave Formation (in Glen Canyon Group)

Upper Triassic(?): Northeastern Arizona and southern Utah.

G. A. Williams, 1954, U.S. Geol. Survey Trace Elements Inv. Rept. TEI–440, p. 34. Overlies Wingate sandstone; underlies Kayenta formation.

Paul Averitt and others, 1955, Am. Assoc. Petroleum Geologists Bull., v. 39, no. 12, p. 2517, 2519. Includes two members: lower, sequence of sandstone and siltstone, Dinosaur Canyon sandstone; and upper, Springdale sandstone. Overlies Chinle formation (redefined); underlies Kayenta formation (redefined).

J. W. Harshbarger, C. A. Repenning, and J. H. Irwin, 1957, U.S. Geol. Survey Prof. Paper 291, p. 12–18, 62, 63. At type locality, herein designated, is almost entirely sandstone and includes both Dinosaur Canyon and Springdale members. Thickness 20 to 385 feet. Basal Dinosaur Canyon intertongues with upper part of Lukachukai member of Wingate sandstone; Springdale member is gradational with overlying Kayenta.

R. A. Cadigan, 1957, U.S. Geol. Survey Trace Elements Inv. Rept. TEI–700, p. 126 (fig. 26), 127. In St. George area, Utah, includes middle member, Whitmore Point.

Type locality: Near Moenave, 6 miles west of Tuba City, Coconino County, Ariz.

Moenkopi Formation[1]

Moenkopi Group

Lower and Middle(?) Triassic or Triassic(?): Arizona, California, Colorado, Nevada and southern Utah.

Original reference: L. F. Ward, 1901, Am. Jour. Sci., 4th v. 12, p. 401–413.

H. Bassler and J. B. Reeside, Jr., 1921, U.S. Geol. Survey Bull. 726–C, p. 90–92. Includes Virgin limestone member and Shnabkaib shale member (both new).

J. B. Reeside, Jr., and others, 1927, Am. Assoc. Petroleum Geologists Bull., v. 11, no. 5, p. 797. Includes Sinbad limestone member (new) in San Rafael Swell.

J. S. Williams, 1945, Am. Jour. Sci., v. 243, no. 9, p. 477–478. As Woodside, Thaynes and Ankareh (restricted) formations are traced eastward along south flank of Uinta Mountains each becomes thinner and Thaynes limestone tongue disappears completely. It is clear from these relationships that redbeds east of that point are in part equivalent to Ankareh (restricted) sandstone and shale, and in part to Woodside shale. Neither term alone can be appropriately applied to them. These beds are some times designated Moenkopi, but this name is not completely satisfactory because all of Moenkopi, at least in Zion area, is younger than Woodside shale. Since terms Woodside, Ankareh, or Moenkopi are not appropriate, these beds are herein named Red Wash formation.

H. E. Gregory and N. C. Williams, 1947, Geol. Soc. America Bull., v. 58, no. 3, p. 224–226, pl. 1. Formation described in Zion National Monument where it constitutes a regular north-south belt about 1 mile wide paralleling trend of Hurricane fault. Maximum thickness 1,452 feet. Six subdivisions recognized (ascending): Timpoweap member (new), lower red member, Virginia [Virgin] limestone member, middle red member, Shnabkaib member, and upper red member. Overlies Kaibab limestone and underlies Shinarump conglomerate.

W. F. Scott, 1950, (abs.) Geol. Soc. America Bull., v. 61, no. 12, pt. 2, p. 1530. In central Wasatch Mountains, Thaynes formation thins and disappears to east and southeast where underlying Woodside and overlying Timothy join to constitute Moenkopi formation. Thus combined Woodside, Thaynes, and Timothy are recognized as constituting Moenkopi group.

E. D. McKee, 1951, New Mexico Geol. Soc. Guidebook 2d Field Conf., p. 85–88. Three members recognized in Little Colorado River valley (ascending): Wupatki (new), Winslow (new), and Holbrook. These do not correlate exactly with any of the six members of formation described by Gregory in southwestern Utah.

C. R. Longwell, 1952, Utah Geol. Soc. Guidebook 7, p. 34, 35. In Muddy Mountains, Nev., 1,500 to 2,000 feet thick; disconformably overlies Kaibab limestone and underlies Chinle formation with Shinarump member at base. In Frenchman Mountain area, underlies Thumb formation (new) with angular unconformity.

S. J. Poborski, 1952, (abs.) Geol. Soc. America Bull., v. 63, no. 12, pt. 2, p. 1342; 1953, Plateau, v. 25, no. 4, p. 69; 1954, Geol. Soc. America Bull., v. 65, no. 10, p. 972. Virgin limestone member is herein given formational rank. Suggested that term Moenkopi group be used in St. George area for all lithologic units that have in past been known collectively as Moenkopi formation. Farther east, where Moenkopi is not readily divisible, name formation should be retained.

E. D. McKee, 1954, Geol. Soc. America Mem. 61, 133p. Formation of Triassic age. Composed of series of deposits that form wedge thinning eastward from a maximum of about 2,000 feet in western Colorado, northeastern Arizona, and western New Mexico. Partly marine and partly continental in western sections; entirely continental in east. Invertebrate faunas indicate deposition began either during or preceding middle Early Triassic and continued into late Early Triassic and probably into Middle Triassic Time. Vertebrate faunas indicate an Early Triassic and probably, in part, Middle Triassic age. Three major transgressions and three regressions across southern Utah and northern Arizona are indicated. In southwestern Utah, subdivided into (ascending) Timpoweap, lower red, Virgin limestone, middle red, Shnabkaib, and upper red members. Present classification in Little Colorado River valley is (ascending) Wupatki, Moqui (new), and Holbrook members.

R. C. Robeck, 1956, Am. Assoc. Petroleum Geologists Bull., v. 40, no. 10, p. 2499–2506. In San Rafael Swell, Utah, unconformably underlies Temple Mountain member (new) of Chinle.

D. F. Hewett, 1956, U.S. Geol. Survey Prof. Paper 275, p. 47–48, pl. 1. Formation described in Ivanpah quadrangle and mapped in San Bernardino County, Calif.

J. A. Momper, 1957, Four Corners Geol. Soc. [Guidebook] 2d Field Conf., p. 86 (chart), 91, 92. Stratigraphically extended to include Agua Zarca and Salitral members, units formerly included in Chinle.

M. E. Cooley, 1958, Plateau, v. 31, no. 1, p. 7–15. In Apache and Navajo Counties, Moenkopi unconformably underlies Mesa Redondo member (new) of Chinle; Moenkopi incomplete in this area; includes Holbrook member at top.

W. F. Scott, 1959, Intermountain Assoc. Petroleum Geologists Guidebook 10th Ann. Field Conf., p. 101–108. Discussion of stratigraphy of Triassic sequence in Wasatch and Uinta Mountains. Recommends use of name Moenkopi, Shinarump(?), and Chinle in eastern Uinta Mountains and considers revisions and introduction of new formational named by Williams (1945) and Thomas and Krueger (1946, Am. Assoc. Petroleum Geologists Bull., v. 30, no. 8) to be neither necessary nor desirable.

E. M. Shoemaker and W. L. Newman, 1959, Am. Assoc. Petroleum Geologists Bull., v. 43, no. 8, p. 1835–1851. In salt anticline region of Utah and Colorado, formation is subdivided into (ascending) Tenderfoot, Ali Baba, Sewemup, and Pariott members (all new). Underlies Chinle; overlies Cutler. Wherever Hoskinnini or Tenderfoot is present, age of Moenkopi is Triassic(?) and Early and Middle(?) Triassic.

J. H. Stewart, 1959, Am. Assoc. Petroleum Geologist Bull., v. 43, no. 8, p. 1852–1868. Hoskinnini tongue of Cutler formation redefined as member of Moenkopi; laterally continuous with Tenderfoot member.

T. F. Stipp and H. M. Beikman, 1959, U.S. Geol. Survey Oil and Gas Inv. Map OM–201. Lower and Middle(?) Triassic.

Named for Moenkopi Wash, Grand Canyon area, Arizona.

Moffett formation

[Upper Ordovician(?)]: Northern California.

F. G. Wells, G. W. Walker, and C. W. Merriam, 1959, Geol. Soc. America Bull., v. 70, no. 5, p. 645. States that name is preempted and name Duzel proposed for the phyllitic sequence. [Compiler was unable to locate earlier use of name.]

Area under discussion is northern Klamath Mountains.

Mogadore Till

Pleistocene (Wisconsin): Northern Ohio and northwestern Pennsylvania.

V. C. Shepps and others, 1959, Pennsylvanian Geol. Survey, 4th ser., Bull. G–32, p. 10 (fig. 3). 24, 29. Gray to bluish-gray weakly calcareous moderately pebbly sandy till deposited during Mogadore advance in Tazewell time. Mogadore advance preceded Kent advance.

G. W. White, 1960, U.S. Geol. Survey Bull. 1121–A, p. 2 (table 1), 3 (fig. 1), 3, 5. Thickness at type section 23 feet. Mogadore, especially on uplands commonly overlies bedrock. Where it does not form surface, it is unconformably overlain by Kent till. Type section designated.

Type section: South wall of shale pit of Universal Clay Products Co., Springfield Township, 1 mile west of center of Mogadore, Summit County, Ohio.

Mogollon Andesite[1]

Tertiary: New Mexico.

Original reference: H. G. Ferguson, 1927, U.S. Geol. Survey Bull. 787.

Named for prominent outcrops near town of Mogollon, Catron County.

†Mohave Formation[1]

Eocene: Southern California.

Original reference: J. H. Smith, 1900, Jour. Geology, v. 8, p. 455–456.

D. I. Axelrod, 1949, (abs.) Geol. Soc. America Bull., v. 60, no. 12, pt. 2, p. 1935. Eocene age considered definite on basis of floral fauna evidence.

Described as occurring on north slope of El Paso Range, between Mojave and Owen's Lake.

†Mohawk Group[1]

Lower and Middle Ordovician: New York.

Original reference: J. Hall, 1842, Am. Jour. Sci., 1st, v. 42, p. 52. Mohawk Valley.

Mohawk Lake Beds[1]

Pliocene-Pleistocene or Pleistocene: Northern California.

Original reference: H. W. Turner, 1891, Washington Philos. Soc. Bull. 11, p. 385–410.

Cordell Durrell, 1944, Geol. Soc. America Bull., v. 55, no. 3, p. 256 (footnote). Age believed to be Pleistocene. Generally accepted Miocene age is based upon plant fossils from beds overlain by andesite breccia and not Mohawk lake beds which are younger than the postandestic faulting which created the basin in which they are deposited.

Cordell Durrell, 1957, Pacific Petroleum Geologist, v. 11, no. 3, p. 3. Described as about 1,000 feet of lacustrine deposits. Unconformable above Warner basalt. Probably Pliocene and Pleistocene.

Cordell Durrell, 1959. California Univ. Pub. Geol. Sci., v. 34, no. 3, p. 180–182. Mohawk lake beds are Plio-Pleistocene or Pleistocene and not Miocene as formerly believed. Miocene Mohawk flora, thought to have occurred in the Mohawk lake beds, comes from Bonta formation.

Occurs in Mohawk Valley and vicinity, Plumas County.

†Mohawk Limestone[1]

Middle Ordovician: Eastern New York.

Original references: T. A. Conrad, 1839, Philadelphia Acad. Nat. Sci. Jour., v. 8, pt. 1, p. 228–235; 1839, New York Geol. Survey 3d Ann. Rept., p. 57–66.

Named for occurrence in Mohawk Valley.

†Mohawk Slate Group[1]

Upper Ordovician: Eastern New York.

Original reference: W. W. Mather, 1841, New York Geol. Survey 5th Ann. Rept., p. 91–94, 98–101, 129.

†Mohawk System[1]

Upper Cambrian, Ordovician, and Silurian: New York.

Original reference: T. A. Conrad, 1839, Philadelphia Acad. Nat. Sci. Jour., v. 8, pt. 1, p. 228–235.

Mohawkian Series[1]

Middle Ordovician: North America.

Original references: James Hall, 1842, Am. Jour. Sci., 1st, v. 42, p. 52; J. M. Clarke and C. Schuchert, 1899, Science, new ser., v. 10, p. 876, 877.

Marshall Kay, 1948, Am. Assoc. Petroleum Geologists Bull., v. 32, no. 8, p. 1400–1404. Rocks younger than Canadian and Beekmantownian and older than Cincinnatian series are commonly referred to as Middle Ordovician, and placed in two series, Chazyan and Mohawkian. Proposed that latter be divided into Bolarian and Tretonian series. Mohawkian series originally included higher Black River Lowville ("Birdseye") and Chaumont

("Black River" restricted) limestones and Trenton limestone; older Pamelia limestone is part of defined Black River. Black River and Trenton formations in New York and Ontario lie with regional unconformity on Chazyan, Canadian, Upper Cambrian and Precambrian.

C. G. Winder, 1953 (abs.) Geol. Soc. America Bull., v. 64, no. 12, pt. 2, p. 1493; 1955, Western Ontario Univ. Dept. Geology Contr. No. 9, p. 1–11, maps. Mohawkian sediments in New York, Ontario, and Ottawa-St. Lawrence Lowland have been interpreted for about 100 years as sequence of successively younger formations, and all have been named as such. Reconstruction of paleoecological conditions, based on recent study in Ontario, indicates that Black River and Trenton groups were deposited simultaneously. Each "formation" is a phase of deposition, of which lithology and fauna reflect the environment. Black River sediments are near shore equivalents of the Trenton sediments. Mohawkian was deposited in a transgressive sea, whereas repetition of Mohawkian phases in Cincinnatian in reverse order indicates a regressive sea. Similar environmental conditions during the transgressive and regressive stages of Middle-Upper Ordovician sea explain why Cincinnatian fauna is "recurrent" Mohawkian fauna. For Middle and Upper Ordovician, all time terms other than Mohawkian and Cincinnatian should be invalidated. Black River and Trenton groups are rock units—not time rock units.

G. A. Cooper, 1956, Smithsonian Misc. Colln., v. 127, pt. 1, p. 7–9, correlation chart. Mohawkian series comprises (ascending) Whiterock, Marmor, Ashby, Porterfield, and Wilderness stages (all new). Terms Chazy and Black River discarded. Kay's (1948) term Bolarian considered unsatisfactory.

Marshall Kay, 1960, Internat. Geol. Cong., 21st, Copenhagen, pt. 7, p. 28–33. Discussion of classification of Ordovician system in North America. The Chazyan, Blackriveran, and Trentonian succeed the Canadian in New York, and are classified as separate series, or as two series (Chazyan and Mohawkian), or as one (Champlainian).

Named for Mohawk River, N.Y.

Mohegan Granite[1]

Precambrian: Southeastern New York.

Original reference: C. P. Berkey and Marion Rice, 1921, New York State Mus. Bull. 225, 226, p. 29, 35, 40, 42, 43, 64.

D. H. Newland and C. A. Hartnagel, 1939, New York State Mus. Bull. 319, p. 93. Incidental mention as Mohegan yellow granite. Discussion of mining and quarry industries.

Named for exposures about Mohegan Lake, West Point quadrangle.

†Mohegan Bluff Beds[1] or Series[1]

Pleistocene: Rhode Island.

Original reference: J. B. Woodworth, 1896, U.S. Geol. Survey 17th Ann. Rept., pt. 1, p. 978, table opposite p. 988.

Typically exposed in upper part of Mohegan Bluffs.

Moheganter Shales and Sandstones (in Hamilton Group)[1]

Middle Devonian: Eastern New York.

Original reference: A. W. Grabau, 1930, Sci. Quart. Nat. Univ. Peking, China, v. 1, no. 4, p. 14.

Moheganter Mountain.

Mohnian Stage[1]

Miocene, upper: California.

Original reference: R. M. Klienpell, 1934, Am. Assoc. Petroleum Geologists Bull., v. 18, no. 3, p. 376–378.

R. M. Kleinpell, 1938, Miocene stratigraphy of California: Tulsa, Okla., Am. Assoc. Petroleum Geologists, p. 127–131, figs. 4, 14 (correlation chart). Spans interval between Luisian stage below and Delmontian stage above. Comprises three zones: *Bolivina modeloensis and Bulimina uvigerinaformus* in lower part, and *Bolivina hughesi* in upper part. Systematic catalogue. Type locality designated.

Type locality: Exposures along Topanga Canyon Road immediately north of Mohnian Spring, Los Angeles County.

Moingona till[1]

Pleistocene: Iowa.

Original reference: C. R. Keyes, 1932, Pan-Am. Geologist, v. 58, p. 203.

Moingonan glacial epoch[1]

Pleistocene: Iowa.

Original reference: C. R. Keyes, 1925, Pan-Am. Geologist, v. 44, p. 139–142.

Named after the old pre-glacial Moingona River, in a tributary deep gorge of which the till remnant is now revealed.

Mojado Formation

Lower Cretaceous: Southwestern New Mexico.

R. A. Zeller, Jr., 1958, Roswell Geol. Soc. Guidebook 11th Field Conf., p. 10 (chart). Name appears only on chart. Consists of interbedded sandstone, shale, and clay. Thickness over 5,000 feet. Underlies Tertiary fanglomerate; overlies U Bar formation (new).

Big Hatchet Peak quadrangle, Hidalgo County.

Mokapu Basalt[1] (in Honolulu Volcanic Series)

Pleistocene, upper; Oahu Island, Hawaii.

Original reference: H. T. Stearns, 1935, Hawaii Div. Hydrography Bull. 1.

G. A. Macdonald and D. A. Davis *in* Jacques Avias and others, 1956, Lexique Strat. Internat., v. 6, Océanie, fasc. 2, p. 116. Nepheline basalt lava. Two outcrops described by Stearns (1935) who believed them to be part of single flow, probably from a cone subsequently destroyed by sea. Winchell (1947, Geol. Soc. America Bull. 48, no. 1) showed that lava of one outcrop contains melilite and the other does not; hence, the two outcrops are parts of different flows. He suggested that flow containing melilite may be part of same flow as Mokulea basalt, and and the other correlative with Ulupau tuff.

Named for Mokapu Peninsula. Exposed only in two small outcrops where it projects through emerged reef lmestone on Mokapu Peninsula on northeast coast of Oahu about 11½ miles northwest of Makapuu Head.

Mokelumne Formation

Permian: Northern California.

N. L. Taliaferro, 1951, California Div. Mines Bull. 154, pl. 1 facing p. 128. Shown on structure section across El Dorado County. Underlies or is in fault contact with Cosumnes formation.

Mokelumne Hill Quartz Diorite

Pre-Tertiary: Central California.

R. L. Rose, 1959, California Div. Mines Spec. Rept. 60, p. 12–13, 15 (fig. 3). Gray quartz diorite. At contact with Calaveras quartz-garnet-mica schist, intrusive rock is garnetiferous hornblendite.

Occurs in stock major part of which is east of Mokelumne Hill, Calaveras County. Well exposed in secs. 13 and 24.

Mokolea Basalt[1] (in Honolulu Volcanic Series)

Pleistocene, upper: Oahu Island, Hawaii.

Original reference: H. T. Stearns, 1935, Hawaii Div. Hydrography Bull. 1.

G. A. Macdonald and D. A. Davis *in* Jacques Avias and others, 1956, Lexique Strat. Internat., v. 6, Océanie, fasc. 2, p. 116–117. Melilite-nepheline basalt lava flow remnant. Extent noted.

Named for Mokolea Rock in Kailua Bay which is composed of it. Exposed only in Mokolea Rock, a small stack about 1 mile east of Mokapu Peninsula and 10 miles northwest of Makapuu Head, and possibly a small outcrop on Mokapu Peninsula.

Moku Manu Volcanics[1] (in Honolulu Volcanic Series)

Pleistocene, upper: Oahu Island, Hawaii.

Original reference: H. T. Stearns, 1935, Hawaii Div. Hydrography Bull. 1.

G. A. Macdonald and D. A. Davis *in* Jacques Avias and others, 1956, Lexique Strat. Internat., v. 6, Océanie, fasc. 2, p. 117. An eroded remnant of tuff and cinder cone containing fill of nepheline basalt lava; tuff is brown and contains numerous angular blocks of basalt of Kailua volcanic series, and small amount of marine calcareous material. Thickness unknown; the two islets are 202 and 132 feet high respectively, but rocks extend below sea level. Advanced state of erosion suggests it is older than Ulupau tuff.

Named after the Moku Manu islets on which it occurs. Islets are three-quarters mile north of Mokapu Point and 12½ miles north-northwest of Makapuu Head.

Mokuone Member (of Makaweli Formation)

Pliocene(?): Kauai Island, Hawaii.

G. A. Macdonald, D. A. Davis, and D. C. Cox, 1954, Volcano Letter 526, p. 2; D. A. Davis and G. A. Macdonald *in* Jacques Avias and others, 1956, Lexique Strat. Internat., v. 6, Océanie, fasc. 2, p. 118. Sedimentary breccia and conglomerate beds intercalated with lavas of Makaweli formation, and breccia masses at contact of rocks of formation with older rocks. Maximum thickness of basal breccia 1,000 feet, and of conglomerate beds about 50 feet.

G. A. Macdonald, D. A. Davis, and D. C. Cox, 1960, Hawaii Div. Hydrography Bull. 13, p. 47–49, table facing p. 20, pl. 1. Includes talus breccia at contact of Makaweli formation and layers of conglomerate interbedded with lavas of formation. At type locality, two layers of conglomerate are intercalated with lavas. In southeast wall of valley, 1.7 miles above junction of Mokuone and Makaweli Streams, bed of coarse conglomerate is exposed 75 feet above stream level; bed is about 25 feet thick; second bed of conglomerate, 10 feet thick, is exposed 25 feet higher in same wall.

Conglomerates can be followed along canyon walls in both directions; beds thicken upstream and thin seaward. Thickness about 1,000 feet.

Type locality: Along Mokuone Valley.

Molalla Formation

Pliocene, lower and middle: Northwestern Oregon.

E. M. Baldwin, 1950, Oregon Country Geol. Soc. News Letter, v. 16, no. 11, p. 92. Mentioned in discussion of Molalla leaf locality. Unconformably overlies platy andesite and Columbia River basalt in Molalla River valley.

W. D. Lowry and E. M. Baldwin, 1952, Geol. Soc. America Bull., v. 63, no. 1, p. 13-14, pl. 2. Formation comprises sandstone, conglomerate, and silt which are highly tuffaceous; sandstone and conglomerate occur in lower part of the section; beds show cut-and-fill structures and torrential bedding; sandstone is friable and contains fossil leaves; locally a massive basic volcanic breccia is interbedded with the conglomerate; light-colored tuffs in upper part of formation are nearly identical to and probably grade laterally into the Fern Ridge tuffs farther south. Conformably underlies Boring lava of Pliocene age; unconformably overlies Eocene basic lavas, breccias, and associated sediments. Chart shows Molalla as lower and middle Pliocene. Name was used by R. L. Nichols (1944) in unpublished report.

D. E. Trimble, 1955, (abs.) Geol. Soc. America Bull., v. 66, no. 12, pt. 2, p. 1667. Underlies Rhododendron formation. Middle Miocene.

Well exposed along Molalla River from a point below town of Molalla upstream to a point above Trout Creek, Clackamas County.

Molas Formation[1]

Pennsylvanian: Southwestern Colorado.

Original references: W. Cross and E. Howe, 1905, U.S. Geol. Survey Geol. Atlas, Folio 120; 1905, Geol. Soc. America Bull., v. 16, p. 470–496.

S. A. Wengerd and J. W. Strickland, 1954, Am. Assoc. Petroleum Geologists Bull., v. 38, no. 10, p. 2166–2168. Described in Paradox Salt basin. Divisible into three members. Lowest, varicolored claystone, predominantly red, containing solution-rounded limestone fragments of Mississippian age which appear to be limestone-chert regolith cemented by calcareous silty claystone; regolith fills depressions on karst surface developed in upper 10 to 100 feet of Leadville limestone. Middle, variable siltstone and shale with some intraformational conglomerate. Upper, not everywhere present, is marine red and green shale-sandstone sequence containing fossils of Des Moines age. Thickness, wedge-edge to 200 feet. Underlies Pinkerton Trail formation (new). Formation contains series horizons between Morrow and Atoka, and Atoka and Des Moines. This is section well exposed at type locality. Inasmuch as Molas shale was almost completely covered in areas where Hermosa formation was first studied, it was not described or included in original Hermosa section. It is now recognized that Molas is found only where Mississippian limestone is or was present beneath Pennsylvanian strata.

S. A. Wengerd and M. L. Matheny, 1958, Am. Assoc. Petroleum Geologists Bull., v. 42, no. 9, p. 2056 (table), 2064–2065. In revised classification, Molas formation underlies Pinkerton Trail formation of Hermosa group; overlies Leadville limestone.

W. M. Merrill and R. M. Winar, 1958, Am. Assoc. Petroleum Geologists Bull., v. 42, no. 9, p. 2107–2131. Includes three members, lowest of which is here named Coalbank Hill. Thickness as much as 140 feet. Overlies Leadville or Ouray limestone. Underlies Pinkerton Trail formation. Mississippian-Pennsylvanian boundary probably within Coalbank Hill member or overlying middle member.

Named for exposures on Molas Lake, Needle Mountains quadrangle, in San Juan Mountains on Durango-Silverton Highway.

Moleen Formation (in Ely Group)

Lower Pennsylvanian (Springeran-Atokan): Northeastern Nevada.

R. H. Dott, Jr., 1955, Am. Assoc. Petroleum Geologists Bull., v. 39, no. 11, p. 2234–2243, figs. 2, 5. Thick widespread calcite limestone sequence, which is alternately very cherty and noncherty. Limestones principally light olive gray to grayish black, fine to coarse textured and weather light gray or bluish gray. Light-olive to medium-gray fresh colors predominate in type section. Calcarenite most prevalent with lesser amounts of calcilutite, calcirudite, and rare coquinite, fusulinal, and corraline beds. Calcarenites and calcirudites are clastic and detrital varieties. Divided into three members based on gross lithologic and faunal characters. Lower transitional member characterized by fossiliferous limestones with thin quartz-silty and sandy interbeds. Middle member of thick featureless cherty and noncherty limestone rather barren of good fossils and contains less silt, sand, and conglomerate impurities than others. Upper member contains slightly more clastic quartz and conglomerate and little less nodular chert than middle member and contains lowest abundant fusulinids. Thickness 1,270 feet in type section. Underlies Tomera formation (new); conformably overlies Tonka conglomerate (new) at several points. Moleen and Tomera together are practically equivalent to Ely limestone of east-central Nevada. Proposed to raise Ely to rank of group in Elko and north Diamond Ranges to include the Moleen and Tomera.

Type section: On west side of Grindstone Mountain, formerly Moleen Peak, NW¼ sec. 33, and on north end of Tomera Ridge, just east of that mountain, NE¼ sec. 34, T. 33 N., R. 54 E. Relation of top few units to overlying Tomera formation seen in Tomera Ridge. Named for Moleen Siding on Southern Pacific Railroad, 2 miles northeast of Carlin Canyon, SW¼ sec. 18, T. 33 N., R. 54 E.

Molly Gibson Formation (in Patagonia Group)

Lower Cretaceous: Southeastern Arizona.

A. A. Stoyanow, 1937, (abs.) Geol. Soc. America Proc. 1936, p. 297 (table). Named on table. Composed of gray arenaceous limestone and brown clay. Younger than Hay Flat limestone (new).

A. A. Stoyanow, 1949, Geol. Soc. America Mem. 38, p. 30–31. Composed mainly, and especially in lower part, of brown, gray, chocolate, and red argillaceous and siliceous shales. In upper part of formation are bluish limestone beds; thin and soft varicolored arenaceous and argillaceous shales; and soft and crumbly, light-gray and pinkish arenaceous limestone beds. Thickness 1,000 feet. In fault contact with Paleozoic strata near Molly Gibson mine. Geographic area given.

Near Molly Gibson mine in Patagonia Mountains.

Mona Limestone (in Conemaugh Formation)[1]

Pennsylvanian: Northern West Virginia.

Original reference: R. V. Hennen and R. M. Gawthrop, 1917, West Virginia Geol. Survey Rept. Braxton and Clay Counties, p. 191.

Probably named for Mona, Monongalia County.

Mona Schist[1]

Precambrian: Northwestern Michigan.

Original reference: C. R. Hise and W. S. Bayley, 1895, U.S. Geol. Survey 15th Ann. Rept., p. 490.

W. T. Stuart, E. W. Brown, and E. C. Rhodehamel, 1954, Michigan Dept. Conserv, Geol. Survey Div. Tech. Rept. 3, p. 11 (table 3). Table of geologic formations shows Mona schist, Keewatin series, at base of section below Kitchi schist.

Named for exposures on Mona Hills, southwest of Marquette, Marquette County.

Mona Shale[1]

Oligocene: Panamá and Costa Rica.

Original reference: D. F. MacDonald and others, 1919, Am. Assoc. Petroleum Geologists Bull., v. 3, p. 364.

W. P. Woodring *in* R. Hoffstetter and others, 1960, Lexique Strat. Internat., v. 5, Amérique Latine, fasc. 2a, p. 340. In original reference, name Mona shale, in expression "Watsi and Mona shales" appeared only on table, showing that shales overlie Sensori agglomerate and limestone [Sinosri formation] and underlie Tigre limestone. Fine-grained rocks for which MacDonald used name Mona shale underlie Tigre limestone in hills in Bocas del Toro area, about 15 kilometers southwest of mouth of Río Sixaola. Both underlying Tigre limestone and overlying Sinosri formation are considered of Oligocene age; therefore, Mona shale is assigned to Oligocene.

Mona Creek is local name for small stream flowing eastward into Cano San San, Bocas del Toro Province, Panamá.

Monacillo Formation

Upper Cretaceous: Puerto Rico.

C. A. Kaye, 1959, U.S. Geol. Survey Prof. Paper 317–A, p. 7 (table), 9 (fig. 3), 10 (fig. 4), 19–20, pl. 2. Predominantly a continental deposit, ranging in texture from siltstone to conglomerate; commonly red to purple. Thickness near Trujillo Alto Road about 900 feet. Overlies Frailes formation (new); underlies Trujillo Alto limestone, contacts apparently conformable.

Named from Barrio Monacillo, southwest of Río Piedras.

Monahans Formation

Quaternary: Western Texas.

R. M. Huffington and C. A. Albritton, Jr., 1941, Am. Jour. Sci., v. 239, no. 5, p. 329–331. A dune deposit consisting of massive loose sand of gray to light golden color. Maximum observed thickness 6 feet; probably more than 30 feet in places. Overlies Judkin formation, contact sharp and irregular.

Type locality: South side of Highway 80, 6½ miles northeast of Monahans, near Sand Hills, Ward County.

†Monarch Formation

Upper Devonian: Central northern Montana.

Original reference: W. H. Weed, 1899, U.S. Geol. Survey Geol. Atlas, Folio 55.

G. A. Cooper and others, 1942, Geol. Soc. America Bull., v. 55, no. 12, pt. 1, p. 1742. Listed with names not appearing on Devonian correlation chart. Heading of column reads Upper Devonian.

Mapped at and around village of Monarch, southwestern corner Fort Benton quadrangle.

Monarch Glacial Stage

Pleistocene (late Wisconsin): North-central Colorado.

R. L. Ives, 1937, (abs.) Colorado Univ. Studies, v. 25, no. 1, p. 75. Youngest of four ice advances recognized in Monarch Valley. Evidenced by terminal moraine. Younger than Arapaho glacial stage (new).

R. L. Ives, 1938, Geol. Soc. America Bull., v. 49, no. 7, p. 1060, 1062. Time covered by deposition of Monarch moraine.

In Monarch Valley, Grand County.

Monarch Mill Formation

Pliocene, lower to middle: Western Nevada.

D. I. Axelrod, 1956, California Univ. Pubs. Geol. Sci., v. 33, p. 186–188, figs. 10, 11. Divided into six unnamed mappable units (ascending) tuffaceous clay, conglomerate, 1,350 feet; sandstone, 350 feet; rhyolite tuff and pumice, 275 feet; diatomite and tuffaceous silt, 200 feet; conglomerate, 100 feet; rhyolitic clay, pumice, sandstone, and silt, 300 feet. Aggregate thickness 2,575 feet. Overlies Middlegate formation (new) with contact gradational; unconformably underlies Quaternary deposits.

Exposed along U.S. Highway 50 in region from one-half mile east of Middlegate to 3 miles farther east, where it disappears under alluvial cover. Name taken from site of an old stamp mill which is in upper part of formation, 200 yards south of the highway, Churchill County.

Monastery Formation

Lower Cambrian: West-central Vermont.

P. H. Osberg, 1952, Vermont Geol. Survey Bull. 5, p. 42–49. Dominantly pale-green quartz-chlorite-muscovite schist. Basal conglomerate and schistose sandstone unit is Tyson member (new); intermediate black graphitic quartz-muscovite schist is Battell member (new). Thickness 1,400 to 1,700 feet. Overlies Mount Holly complex with no structural discontinuity; underlies Granville formation (new).

Named from exposures on north-east slopes of Monastery Mountain. Exposed in wide north-south trending belt between Monastery Mountain and Pine Gap and between western slopes of Gillespie Mountain and eastern slopes of Burnt Hill, Rochester-East Middlebury area.

Mon Bluff Formation

Miocene, upper: Southern California.

Otto Hackel and K. F. Krammes, 1958, San Joaquin Geol. Soc. [Guidebook] Spring Field Trip May 17, p. 3–4, road log (p. 1, 6), geol. map. A unit about 50 feet thick that unconformably overlies Round

Mountain silt; underlies Kern River formation. In vicinity of Poso Creek, consists of sandy ash and forms conspicuous ledge; southward, in vicinity of Sharkstooth Hill, and along Kern River unit changes facies to a coarse conglomeratic white sand; here it has been called "Kern Park formation" or "Cottonwood Creek formation."

Present in Round Mountain area, Kern County. Probably named for occurrence in vicinity of Mon Canyon.

Monclova Sandstone[1]

Lower Devonian: Northwestern Ohio.

Original references: E. Orton, 1888, Ohio Geol. Survey, v. 6, p. 20; 1890, Ohio Geol. Survey, 3d Organization, 1st Ann. Rept., p. 24.

Named for Monclova, Lucas County.

Moncrief Member (of Wasatch Formation)

Moncrief Gravel

Eocene, lower: Central northern Wyoming.

R. P. Sharp, 1948, Jour. Geology, v. 56, no. 1, p. 1–14. Name Moncrief gravel applied to thick deposits of coarse bouldery gravel with interbedded silt, sand, and arkose layers that compose large piedmont ridges and spurs along east front of Big Horn Mountains. Consists predominantly of granitic rock fragments derived from Precambrian core of range. Thickness at least 1,200 feet on Clear Creek; 1,400 feet at Moncrief Ridge. Present topographic surface determines top of unit; base and lateral margins are gradational into finer grained "Wasatch" except where gravel lies with angular unconformity on Eocene Kingsbury conglomerate and older formations or is in fault contact with pre-Tertiary rocks of the mountains. May be coarse phase of the Wasatch. Demorest (1938, unpub. thesis) applied name Clear Creek gravels to these deposits; because name Clear Creek is preoccupied, name Moncrief is proposed.

J. D. Love and J. L. Weitz, 1951, U.S. Geol. Survey Oil and Gas Inv. Map OM–122. Allocated to member status in Wasatch formation. Overlies Kingsbury conglomerate member.

W. J. Mapel, 1959, U.S. Geol. Survey Bull. 1078, p. 64–66. Described in Buffalo-Lake De Smet area, Wyoming, where it is as much as 1,400 feet thick and includes beds of conglomerate made up of cobbles and boulders of Precambrian crystalline rocks. Rests on Kingsbury conglomerate member with angular discordance near Bighorn Mountains; eastward both members grade laterally into a conformably, nonconglomeratic sequence of sandstone, shale, and coal that makes up Wasatch formation east of area.

Type locality: North face of Moncrief Ridge, secs. 34 and 35, T. 54 N., R. 84 W., Sheridan County.

Moneta Biotite-Hornblende Gneiss[1]

Moneta Gneiss (in Virginia Blue Ridge Complex)

Precambrian: Central western Virginia.

Original reference: A. A. Pegau, 1932, Virginia Geol. Survey Bull. 33, p. 2–26, 83, pl. 4.

W. R. Brown, 1958, Virginia Div. Mineral Resources Bull. 74, p. 8 (fig. 2), 9, 13, 48. In this report [Lynchburg quadrangle], name Moneta gneiss is modified to include Reusens migmatite facies, Bloomer and Werner's

(1955, Geol. Soc. America Bull., v. 66, no. 5) "basement complex gneiss," and all other prevailingly nongranitoid rocks in region which are older than Marshall-Lovingston granitization. Moneta gneiss, granitized in part in development of Pedlar formation and Marshall gneiss, is possibly early Precambrian.

Named from Moneta, Bedford County.

Monitor Sandstone (in Kanawha Formation[1] or Group)

Pennsylvanian: Southern West Virginia.

Original reference: C. E. Krebs and D. D. Teets, Jr., 1915, West Virginia Geol. Survey Rept. Boone County.

H. R. Wanless, 1939, Geol. Soc. America Spec. Paper 17, p. 96. In this report the Kanawha is considered a group.

Named for exposures at Monitor, Logan County.

Monitor (Lower) Sandstone (in Kanawha Formation[1] or Group)

Pennsylvanian: Southern West Virginia.

Original reference: R. V. Hennen and D. D. Teets, Jr., 1919, West Virginia Geol. Survey Rept. Fayette County, p. 274.

H. R. Wanless, 1939, Geol. Soc. America Spec. Paper 17, p. 93. In this report the Kanawha is considered a group.

Occurs in Logan and Mingo Counties.

Monitor Butte Member (of Chinle Formation)

Upper Triassic: Southeastern Utah and northeastern Arizona.

G. A. Kiersch, 1955, Mineral resources, Navajo-Hopi Reservations, Arizona-Utah, v. 2: Tucson; Arizona Univ. Press, p. 4 (fig. 1), 5. Mostly siltstone and sandstone. Underlies Petrified Forest member; overlies Shinarump conglomerate.

J. H. Stewart, 1957, Am. Assoc. Petroleum Geologists Bull., v. 41, no. 3, p. 452–453. Claystone and clayey sandstone with interstratified lenses of sandstone; greenish-gray with some pale reddish-brown spots. Ranges in thickness from wedge-edge to 250 feet; commonly 100 to 150 feet. Underlies Petrified Forest member in southern part of southeastern Utah, and contact conformable and intertonguing; underlies Moss Back member in other parts of southeastern Utah, and contact is surface of erosion. Conformably overlies Temple Mountain member in San Rafael Swell; conformably overlies Shinarump member in most of southeastern Utah and unconformably overlies Moenkopi formation where Shinarump is absent. Member corresponds to division D of Chinle as described by Gregory (1917, U.S. Geol. Survey Prof. Paper 93).

Named for exposures in southeastern Utah near San Juan River south of Clay Hills area. Present in much of southeastern Utah; pinches out along a northwest line passing through northern part of Elk Ridge area and through southern part of San Rafael Swell. Also recognized in Monument Valley area, Arizona.

Monitor Mountain Limestone (in Hannan Limestone)

Monitor Mountain Limestone Member[1] (of Madison Limestone)

Mississippian (Meramecian): Northwestern Montana.

Original reference: C. F. Deiss, 1933, Montana Bur. Mines and Geology Mem. 6, p. 48.

J. M. Weller and others, 1948, Geol. Soc. America Bull., v. 59, no. 2, pl. 2 (column 38). Shown on correlation chart as the uppermost unit in Hannan limestone. Overlies Rooney chert. Meramecian.

Only known occurrence is in NE¼ sec. 18, T. 17 N., R. 7 W., on upper ridge and top of Monitor Mountain, Lewis and Clark County.

Monk Formation[1]

Cambrian(?): Southeastern British Columbia, Canada, and northwestern Idaho and northeastern Washington.

Original reference: R. A. Daly, 1912, Canada Geol. Survey Dept. Mines Mem. 38, maps 6, 7.

C. F. Park, Jr., and R. S. Cannon, Jr., 1943, U.S. Geol. Survey Prof. Paper 202, p. 6 (chart), 11–13, pl. 1. In Metaline quadrangle, Washington, consists of about 3,800 feet of schists, grits, and limestone. As defined here includes beds between Leola volcanics below and grits at base of Gypsy quartzite. As defined by Daly (1912), Monk did not include upper part of formation as used in this report. Near Sullivan Lake, top of formation is band of white sandy marble that grades upward into quartzite and grit; farther north, contact is placed arbitrarily so that dominantly quartzitic sediments are placed in Gypsy quartzite, and dominantly phyllitic sediments are referred to the Monk. Age unknown. Tentatively placed at base of Cambrian.

Named for exposures north of Monk Creek, British Columbia.

Monkey Hill Formation[1]

Miocene: Panamá.

Original reference: R. T. Hill, 1898, Harvard Coll. Mus. Comp. Zoology Bull., v. 28, no. 5, p. 176, 206–208.

W. P. Woodring *in* R. Hoffstetter and others, 1960, Lexique Strat. Internat., v. 5, Amérique Latine, fasc. 2a, p. 340. Suppressed in favor of Gatún formation. Miocene.

Exposed at Monkey Hill (Mount Hope), C.Z.

Monkton Quartzite[1]

Lower Cambrian: West-central Vermont.

Original reference: Arthur Keith, 1923, Am. Jour. Sci., 5th ser., v. 5, p. 106.

W. M. Cady, 1945, Geol. Soc. America Bull., v. 56, no. 5, p. 525 (table), 530–532. Red quartzite in layers from a few inches up to 3 feet thick separated by beds of pink to gray dolomite. Thickness 0 to 800 feet. Overlies Dunham dolomite; underlies Winooski dolomite (revised).

Named for town of Monkton, Addison County.

Mon Louis Formation[1]

Pleistocene: Southwestern Alabama.

Original reference: E. A. Smith, 1894, Am. Jour. Sci., 3d, v. 47, p. 285–296.

Name derived from Mon Louis Island, on west coast of Mobile Bay.

Monmouth Group[1] or **Formation**[1]

Upper Cretaceous: New Jersey, Delaware, and northeastern Maryland.

Original reference: W. B. Clark, R. M. Bagg, and G. B. Shattuck, 1897, Geol. Soc. America Bull., v. 8, p. 315, 331.

P. H. Jennings, 1936, Bulls. Am. Paleontology, v. 23, no. 78, p. 4, 5 (chart). Monmouth group as used in this report includes (ascending) Mount Laurel, Navesink, Red Bank, and Tinton formations.

C. W. Carter, 1937, Maryland Geol. Survey, v. 13, p. 261–262. Along Chesapeake and Delaware Canal, only Laurel formation of group is present.

W. B. Spangler and J. J. Peterson, 1950, Am. Assoc. Petroleum Geologists Bull., v. 34, no. 1, p. 8 (fig. 4), 40–52. Considered of formational rank and, as defined in this report, consists of beds lying below Hornerstown formation of Eocene age and above base of shell bed formed by *Exogyra, Gryphaea,* and *Belemnitella* which mark base of Navesink member. Includes also (ascending) Red Bank and Tinton members.

M. S. Carr, 1950, U.S. Geol. Survey Bull. 967, p. 32 (fig. 14), 33. Monmouth formation (erroneously called "Matawan" on some geologic maps) crops out east and southeast of Washington. In normal sequence follows Magothy formation but, locally, where Magothy is absent, lies on red clay of Raritan formation. Overlain by Aquia formation (Eocene), but to west, where Eocene deposits are absent is overlapped by Calvert formation.

R. R. Bennett and G. G. Collins, 1952, Washington Acad. Sci. Jour., v. 42, no. 4, p. 115. In Prince Georges County, Md., unconformably underlies Paleocene Brightseat formation (new).

C. W. Cooke, 1952, Maryland Dept. Geology, Mines and Water Resources Bull. 10, p. 8–19. Described in Prince Georges County. No complete section found; total thickness of outcropping Monmouth probably does not exceed 100 feet and may be as little as 40 or 50 feet; presumably thicker in Prince Georges County than farther seaward; dips toward southeast at estimated rate of 25 feet to mile. Unconformably overlies Patapsco formation. Unconformably overlain by beds of Paleocene age or, more commonly, by Aquia greensand or by Miocene Chesapeake group. Extends southward across county from vicinity of Priest Bridge on Patuxent River to Fort Washington on Potomac River; between Priest Bridge and Brightseat outcrop forms a band 2 to 3 miles wide; beyond Brightseat is narrower, crooked, and discontinuous.

J. J. Groot, D. M. Organist, and H. G. Richards, 1954, Delaware Geol. Survey Bull. 3, p. 26, 30 (table 3), 31. Group includes (ascending) Navesink, Mount Laurel, and Red Bank formations.

Named for Monmouth County, N.J.

Mono Limestone[1]

Upper Mississippian: Central northern Utah.

Original reference: S. G. Olmstead, 1921, Econ. Geology, v. 16, p. 438, 452, 453.

Probably named for Mono mine, Ophir district.

Mono series[1]

Monon series[1]

Lower Cambrian: California and Nevada.

Original reference: C. R. Keyes, 1923, Pan-Am. Geologist, v. 40, p. 51, 53, 79.

Named from Mono County, Calif.

Mono Shale[1]

Upper Cretaceous: Southern California.

Original reference: R. N. Nelson, 1925, California Univ. Pub., Dept. Geol. Sci. Bull., v. 15, no. 10, p. 350, 352, pl. 46, map.

B. M. Page, J. G. Marks, and G. W. Walker, 1951, Am. Assoc. Petroleum Geologists Bull., v. 35, no. 8, p. 1746. Upper Cretaceous. Disconformably underlies middle Eocene Sierra Blanca limestone at type locality of the Sierra Blanca.

Named for exposure in canyon of Mono Creek, at mouth of Roble Creek, Santa Barbara County.

Mono Craters Obsidian

Pleistocene: Eastern California.

W. C. Putnam, 1940, (abs.) Geol. Soc. America Bull., v. 51, no. 12, pt. 2, p. 1939. Listed as youngest stratigraphic unit in Pleistocene of area. Younger than Tioga terminal and lateral moraines.

Occurs in region about June Lake in the east-central Sierra Nevada.

Monongahela Formation[1] or Group

Monongahela Series

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

Original reference: H. D. Rogers, 1840, Pennsylvania Geol. Survey 4th Ann. Rept., p. 150.

R. E. Lamborn, C. R. Austin, and Downs Schaaf, 1938, Ohio Geol. Survey, 4th ser., Bull. 39, p. 211–216. Series in Ohio crops out in narrow belt 5 to 15 miles wide that extends across southeastern part of the State from Jefferson and Belmont Counties on east to Lawrence and Gallia Counties on south. Thickness 240 to 270 feet. Composed of beds of shale, sandstone, limestone, clay, and coal with shale, sandstone, and limestone making up about 95 percent of group. Twenty-two members listed including coals. Includes strata from base of Pittsburgh coal to top of Waynesburg No. 11 coal. Overlies Conemaugh series.

W. O. Hickok 4th and F. T. Moyer, 1940, Pennsylvania Geol. Survey, 4th ser., Bull. C–26, p. 100–127. Referred to as group. Described in Fayette County. Comprises Pittsburgh, Redstone, Sewickley, Uniontown, and Waynesburg divisions. Columnar section shows 22 units including coals. These are described as members of Monongahela formation. Overlies Conemaugh group; underlies Permian Washington group.

T. W. Amsden, 1954, Maryland Dept. Geology, Mines and Water Resources Bull. 13, p. 48 (fig. 7), 65. In Maryland, formation is present only in Georges Creek and Upper Potomac basins. Overlies Conemaugh formation; underlies Dunkard group.

D. L. Norling, 1958, Ohio Geol. Survey Bull. 56, p. 10 (fig. 3), 65–87, geol. map. Considered series in this report. Strata included extend from base of Pittsburgh (No. 8) coal to top of Waynesburg (No. 11) coal. Entire Monongahela present in Morgan County. Thickness 247 feet. Twenty-two members (including coals) described.

M. T. Sturgeon and others, 1958, Ohio Geol. Survey Bull. 57, p. 158–189. Series described in Athens County. Average thickness 270 feet. Limits of series are base of Pittsburgh cyclothem and top of Waynesburg (No.

11) coal bed. Twelve cyclothems described. [For sequence see Pittsburgh cyclothem.] Succeeded by Dunkard series of Permian.

W. A. Tallon and R. G. Hunter, 1959, West Virginia Geol. and Econ. Survey Rept. Inv. 17, p. 10. Referred to as series. Consists of tan and gray shales, a few shaly sandstones, clay, coal, and some nonmarine limestones. Thickness 200 to about 500 feet. Principal outcrops are to north and east of Dunkard series in central and western parts of State.

R. R. Dutcher and others, 1959, Geol. Soc. America Guidebook Pittsburgh Mtg., p. 69, 71–72. Monongahela group at top of Pennsylvanian section averages about 375 feet in thickness. Contains Pittsburgh coal seam at base and base of this seam marks lower boundary of Monongahela. Top of Waynesburg coal marks upper boundary and separates Pennsylvanian rocks from overlying Permian(?) or Dunkard rocks. At this systemic boundary, there is no recognizable physical break, the subdivision being made on basis of fossil plants.

Carlyle Gray and others, 1960, Geologic map of Pennsylvania (1:250,000): Pennsylvania Geol. Survey, 4th ser. Formation consists of cyclic sequences of sandstone, shale, limestone, and coal; limestone prominent in northern outcrop areas; shale and sandstone increase southward; commercial coals present; base at bottom of Pittsburgh coal.

Named for exposures along Monongahela River, Pa.

†Monongahela River coal series[1]

Pennsylvanian and Permian: Western Pennsylvania and northern West Virginia.

Original reference: J. P. Lesley, 1877, Pennsylvania 2d Geol. Survey Rept. H_3, p. xxiii.

†Monongahela River Series[1]

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

Original reference: J. J. Stevenson, 1873, Am. Philos. Soc. Trans., new ser., v. 15, p. 15–32.

Named for exposures along Monongahela River, Pa.

†Monroe Beds[1]

Pennsylvanian: Central southern Iowa.

Original reference: S. W. Beyer and L. E. Young, 1903, Iowa Geol. Survey, v. 13, p. 366.

Named for Monroe County.

†Monroe Beds,[1] Formation,[1] or Group[1]

Silurian and Lower Devonian: Southern Michigan and northern Ohio.

Original reference: A. C. Lane, as reported by M. E. Wadsworth, 1893, Michigan Geol. Survey Rept. 1891 and 1892, p. 66.

J. W. Wells, 1947, Ohio Jour. Sci., v. 47, no. 3, p. 121 (fig. 1). Report is paleoecological analysis of Devonian rocks of Columbus region. Columnar section shows Silurian Monroe formation underlying Bellpoint member of Middle Devonian Columbus formation

Named for exposures in Monroe County, Mich.

†Monroe Beds[1] or Slates[1]

Precambrian(?): Southern central North Carolina.

Original reference: H. B. C. Nitze and G. B. Hanna, 1896, North Carolina Geol. Survey Bull. 3, p. 36–37.

Monroe, Union County.

†Monroe Shales[1]

Middle Devonian: Southeastern New York and northern New Jersey.

Original reference: N. H. Darton, 1894, Geol. Soc. America Bull., v. 5, p. 367, 373.

At Monroe, Orange County, N.Y.

Monroe Creek Sandstone (in Arikaree Group)

Monroe Creek Beds[1]

Monroe Creek Formation (in Arikaree Group)

Monroe Creek Member (of Arikaree Formation)

Miocene, lower: Western Nebraska, southern South Dakota, and eastern Wyoming.

Original reference: J. B. Hatcher, 1902, Am. Philos. Soc. Proc., v. 41, p. 116.

C. B. Schultz, 1938, Am. Jour. Sci., 5th ser., v. 35, no. 210, p. 442–443. Proposed that Arikaree be continued as group name and that it include (ascending) Gering, Monroe Creek, and Harrison formations (the latter as Hatcher defined it). Monroe Creek, at type section, is characterized by horizontal dark-gray tubular or pipy concretions and uppermost partly by pseudo-pipes. Thickness about 300 feet.

R. C. Cady and O. J. Scherer, 1947, U.S. Geol. Survey Water Supply Paper 969, p. 20–22, pl. 1. Described in Box Butte County, Nebr., where it is referred to as sandstone. Much of unit is below level of Niobrara River.

S. G. Collins, 1959, Geology of the Martin quadrangle, South Dakota (1:62,500): South Dakota Geol. Survey. Considered member of Arikaree formation in South Dakota. Consists of pink to medium-brown very fine well-sorted mostly quartzose noncalcareous sandstone which is uniform in composition and contains very little clay. Differs from exposures described in Nebraska in that no pipy concretions and very little conglomeratic material or torrential crossbedding are present. Thickness at least 250 feet. Underlies Harrison member with contact gradational and difficult to locate precisely.

J. C. Harksen, 1960, Geology of the Sharps Corner quadrangle, South Dakota (1:62,500): South Dakota Geol. Survey. Formation in Arikaree group. In area of this report, consists of 90 feet of compact buff silty and very fine grained sands that have many small isolated concretions and some fossil rootlets. Underlies Harrison formation; overlies Sharps formation (new).

S. G. Collins, 1960, Geology of the Patricia quadrangle, South Dakota (1:62,500): South Dakota Geol. Survey. Formation in Arikaree group. Consists of medium-brown to light-pinkish-gray very fine well-sorted mostly quartzose noncalcareous sandstone which contains little clay. Contains two mappable facies that are tentatively correlated with Gering channel sand and Mellette limestone; these facies are not typical of the Monroe Creek as described above. Underlies Harrison formation; overlies Sharps formation. Contact with Sharps formation only approximately located, and practicality of separating the two units in future mapping farther to east is questionable.

Well exposed in north face of Pine Ridge, at mouth of Monroe Creek Canyon, 5 miles north of Harrison, Sioux County, Nebr. [This is referred to as type section by Schultz.]

Monserrate Member (of Augustinillo Formation)

Eocene, middle: Puerto Rico.

E. A. Pessagno, Jr., 1960, Geology of the Ponce-Coamo area, Puerto Rico: Puerto Rico Econ. Devel. Adm. and Princeton Univ. Dept. Geology, p. 96–103; 1960, Caribbean Geol. Conf., 2d, Mayagüez, Puerto Rico, 1959, Trans., p. 85. Consists of thin- to massive-bedded black calcareous mudstones which alternate with buff- and gray-colored argillaceous limestones. Thickness 17,000 feet or more; base not exposed in Ponce quadrangle. Interfingers with Collores member (new).

Type locality: Near kilometer post K6H9 on Río Cerrillos Road (Route 139). Name derived for Hacienda Monserrate, Ponce quadrangle. Crops out in Ponce, Jayuya, Peñuelas, and Adjuntas quadrangles.

Monson Gneiss

Monson Granodiorite[1]

Mississippian(?) or older: Central Massachusetts, central Connecticut, and southwestern New Hampshire.

Original reference: B. K. Emerson, 1898, U.S. Geol. Survey Mon. 29, p. 15, 18, 41–45, 57–65.

W. G. Foye, 1949, Connecticut Geol. Nat. History Bull. 74, p. 51–52, pl. 1. Referred to as an orthogneiss. Shows large variations in texture and composition depending on position within batholithic masses. Includes Eastford, Glastonbury, and Haddam gneisses as originally mapped and also igneous part of Willimantic gneiss. Middle Carboniferous(?).

J. B. Hadley, 1949, Bedrock geology of the Mount Grace quadrangle, Massachusetts: U.S. Geol. Survey Geol. Quad. Map [GQ–3]. Termed a gneiss. Ranges in composition from granite to quartz diorite in Mount Grace quadrangle, Massachusetts. Upper Devonian.

J. M. Aitken, 1951, Connecticut Geol. Nat. History Survey Bull. 78, p. 49, 50. Gneiss considered granitized part of Hebron gneiss in eastern Connecticut.

E. N. Cameron and others, 1954, U.S. Geol. Survey Prof. Paper 255, p. 20, 21. Devonian.

Norman Herz, 1955, Connecticut Geol. Nat. History Survey Quad. Rept. 5, p. 16. Resemblance to Glastonbury gneiss is only superficial; two are treated here as separate units.

Robert Balk, 1956, U.S. Geol. Survey Geol. Quad. Map GQ–92. Mapped in Warwick dome in eastern part of Massachusetts part of Northfield quadrangle, Massachusetts-New Hampshire-Vermont. A border facies of the Monson is recognized, and large amphibolite masses in the gneiss are also mapped. Middle Paleozoic.

Frederick Stugard, Jr., 1958, U.S. Geol. Survey Bull. 1042–Q, p. 619, 634–636, pl. 56. In Middletown area, Connecticut, pegmatites cut metasediments of Bolton schist of pre-Mississippian(?) age and, in ascending order of sequence, mafic gneisses, Glastonbury granite gneiss, Maromas granite gneiss, and Monson gneiss. Position of these formations in stratigraphic column cannot be determined with accuracy; their maximum age is indicated by their relation to the pegmatites, which have been dated by uranium- and thorium-lead ratios as about 260 million years old, presumably Mississippian. The Monson is a banded to massive medium-grained biotite granodiorite gneiss. East of Middle Haddam, Monson gneiss has indefinite contact with Hebron gneiss. Crops out in Middletown area in two localities: narrow belt along eastern edge of Middle Haddam quadrangle and in Killingworth dome in southern part of Middle Haddam quadrangle.

Named for occurrence at Monson, Hampden County, Mass. Crops out from Northfield southward through New Salem, Petersham, and Monson in Massachusetts, and across towns of Stafford, Tolland, Vernon, Bolton, Glastonbury, Marlboro, East Hampton, Haddam, Chester, and Saybrook in Connecticut.

†Montalban[1] (Formation)

Precambrian (?) : New Hampshire.

Original reference: C. R. Van Hise and C. K. Leith, 1909, U.S. Geol. Survey Bull. 360, p. 87, 88.

Well exposed in White Mountains.

Mont Alto lignite[1]

Tertiary (?) : Central southern Pennsylvania.

Original reference: J. P. Lesley, 1864, Mont Alto lignite and Appalachian erosion, p. 4, pls.

Montalto Quartzite Member (of Harpers Schist)[1]

Lower Cambrian: Central southern Pennsylvania.

Original reference: G. W. Stose, 1906, Jour. Geology, v. 14, p. 207.

Carlyle Gray and others, 1960, Geologic map of Pennsylvania (1:250,000): Pennsylvania Geol. Survey, 4th ser. Mapped as member of Harpers formation. Cambrian.

Forms Montalto Mountain, Franklin County.

†Montana Breccia[1]

Tertiary: Central Nevada.

Original reference: J. E. Spurr, 1911, Report on geology of property of Montana-Tonopah Mining Company: Tonopah, Nev., published privately.

Named for Montana mine, Tonopah district.

Montana Group[1] or **Formation**[1]

Upper Cretaceous: Montana, Colorado, Kansas, New Mexico, North Dakota, South Dakota, Utah, and Wyoming.

Original references: G. H. Eldridge, 1888, Colorado Sci. Soc. Proc., v. 3, pt. 1, p. 93; 1889, Am. Jour. Sci., 3d, v. 38, p. 313–321.

P. W. Richards, 1955, U.S. Geol. Survey Bull. 1026, p. 50–63, pls. 1, 2. Group in Bighorn Canyon-Hardin area, Montana and Wyoming, comprises (ascending) upper part of Cody shale (with Telegraph Creek shale equivalent to Eagle sandstone, and Claggett shale members), Parkman sandstone, and Bearpaw shale. Overlies Colorado group; underlies Hell Creek formation.

Following formations included in Montana Group: Bearpaw Shale, Claggett Shale, Cody Shale (upper part), Eagle Sandstone, Fox Hills Sandstone, Horsethief Sandstone, Judith River Formation, Lennep Sandstone, Parkman Sandstone, Pierre Shale, Trinidad Sandstone, Two Medicine Formation, and Virgelle Sandstone.

Named for exposures in Montana, especially in upper Missouri River region.

†Montana Series[1]

Upper Cretaceous: Montana.

Original reference: G. H. Ashley, 1923, Eng. Mining Jour.-Press, v. 115, no. 25, p. 1106–1108.

Montana Peak Formation

Cenozoic(?) : Southern Arizona.

B. P. Webb and K. C. Coryell, 1954, U.S. Atomic Energy Comm. RME–2009, p. 7, pl. 1. Consists of rhyolitic lavas, breccias, and tuffs, characterized by a general red or purple color. Thickness about 800 feet. Underlies Atascosa formation (new) generally conformably, with local disconformity; overlies Ruby Road formation (new).

Typically developed at Montana Peak, Ruby quadrangle, Santa Cruz County.

†Montara Granite[1]

Montara Quartz Diorite

[Cretaceous] : Western California.

Original references: A. C. Lawson, 1895, U.S. Geol. Survey 15th Ann. Rept., p. 408; Am. Geologist, v. 15, p. 343–346.

G. H. Curtis, J. F. Evernden, and J. Lipson, 1958, California Div. Mines Spec. Rept. 54, p. 9. Montara quartz diorite discussed in paper dealing with potassium-argon age determinations. Age given as 91.6 million years. Varies from quartz diorite to granite. Unconformably overlain by Miocene sedimentary rock; all other adjacent sedimentary rocks are in fault contact with the granite.

Constitutes mass of Montara Mountain, San Francisco Peninsula.

Montauk Till Member (of Manhasset Formation)[1]

Pleistocene: Southeastern New York and islands of southern New England.

Original reference: M. L. Fuller, 1905, Geol. Soc. America Bull., v. 16, p. 367–390.

Lawrence Weiss, 1954, U.S. Geol. Survey Prof. Paper 254–G, p. 146. Thickness 40 to 60 feet. Underlies Hempstead gravel member; overlies Herod gravel member. Manhasset believed to be of Wisconsin age.

Named for occurrence at Montauk Point, Long Island. Present on Block Island, Marthas Vineyard, Nantucket, No Mans Land, and probably Cape Cod.

Montchauve Group

Pennsylvanian: Central northern Wyoming.

T. W. Todd, 1959, Dissert. Abs., v. 20, no. 6, p. 2230. Includes [ascending] Sacajawea formation, Amsden formation, and Tensleep sandstone, all products of a marine transgressive-regressive cycle that took place on the Wyoming cratonic shelf as one phase in the development of the eastern Cordilleran geosyncline.

In Big Horn Basin.

Montebello Formatioln (in Hamilton Group)

Montebello Sandstone (in Hamilton Formation)[1]

Montebello Sandstone Member (of Mahantango Formation)

Middle Devonian: Central Pennsylvania.

Original reference: E. W. Claypole, 1885, Pennsylvania 2d Geol. Survey Rept. F_2, p. 67–68.

Bradford Willard, 1937, Am. Jour. Sci., 5th ser., v. 33, no. 196, p. 274, 275, 276 (table 2). Mahantango formation is dominated by coarse sandstone, the Montebello member in lower Susquehanna and Juniata Valleys.

G. A. Cooper and others, 1942, Geol. Soc. America Bull., v. 53, no. 12, pt. 1, p. 1772, chart 4. Montebello sandstone, a local development of sandstone in the Mahantango of Pennsylvania in Perry, Dauphin, and Northumberland Counties. Ranges in age from Skaneateles through Ludlowville and possibly into the Moscow.

H. H. Arndt and others, 1959, Geol. Soc. America Guidebook for Field Trips Pittsburgh Mtg., p. 3–4. Formation in Hamilton group. Underlies Sherman Ridge formation (new).

T. M. Kehn, 1960, (abs.) Geol. Soc. America Bull., v. 71, no. 12, pt. 2, p. 2018. Geologic mapping has revealed that, contrary to previously published reports and maps, there are two outcrop belts of the Oriskany, Onondaga, and Marcellus formations between the Schuylkill and Susquehanna Rivers. Area mapped is bounded on north by Second Mountain and on south by Blue Mountain. The Marcellus is overlain by Montebello sandstone member of Mahantango formation.

Named for exposures at Montebello Narrows, on Little Juniata River, Perry County.

Monte Cristo Diorite[1]

Pre-Permian(?): Southeastern Alaska.

Original reference: W. C. Mendenhall and F. C. Schrader, 1903, U.S. Geol. Survey Prof. Paper 15, p. 33–37.

Named for exposure on Monte Cristo Creek, Nebesna and Chisana River region.

Monte Cristo Limestone[1] or **Dolomite**

Lower and Upper Mississippian: Southeastern Nevada and southeastern California.

Original reference: D. F. Hewett, 1931, U.S. Geol. Survey Prof. Paper 162, p. 9–10, 17.

J. C. Hazzard, 1951, (abs.) Geol. Soc. America Bull., v. 62, no. 12, pt. 2, p. 1503; 1954, Am. Assoc. Petroleum Geologists Bull., v. 38, no. 5, p. 880–881, 883 (fig 2). Geographically extended into Nopah Range, Inyo County, Calif., where it consists of (ascending) Dawn limestone, Anchor limestone, Bullion limestone, and Yellowpine limestone members. Thickness 1,587 feet. Name Stewart Valley limestone is abandoned, and Mississippian beds previously ascribed to it are assigned to Dawn limestone member of Monte Cristo. Overlies Crystal Pass member of Sultan limestone; underlies Bird Spring formation.

Charles Deiss, 1952, U.S. Geol. Survey Bull. 973–C, p. 114–117, pl. 13. Described as Monte Cristo dolomite in Sloan district, Nevada, where it includes Dawn, Anchor, and Bullion members. Thickness 695 feet. Overlies Crystal Pass member of Sultan; underlies Bird Spring formation.

D. F. Hewett, 1956, U.S. Geol. Survey Prof. Paper 275, p. 42, pl. 1. Described in Ivanpah quadrangle (California-Nevada) where it consists of (ascending) Dawn limestone, Anchor limestone, Bullion dolomite, Arrowhead limestone, and Yellowpine limestone members. Thickness 350 to 700 feet.

Ben Bowyer, E. H. Pampeyan, and C. R. Longwell, 1958, U.S. Geol. Survey Mineral Inv. Field Studies Map MF-138. Lower and Upper Mississippian.

H. J. Bissell, 1960, Am. Assoc. Petroleum Geologists Bull., v. 44, no. 8, p. 1427 (fig. 3), 1433 (fig. 9), 1434–1435 (fig. 10). In Spring Mountains, Nev., underlies Illipah formation.

Named for exposures near Monte Cristo mine, Goodsprings quadrangle, Nevada.

Monte de Oro Formation[1]

Upper Jurassic: Northern California.

Original reference: H. W. Turner, 1896, U.S. Geol. Survey 17th Ann. Rept., pt. 1, p. 548.

R. W. Imlay, 1952, Geol. Soc. America Bull., v. 63, no. 9, p. 976, chart 8C (column 90. Shown on correlation chart as Middle Jurassic. Stratigraphic position relative to other Jurassic formations of the Sierra cannot be determined because it is an isolated occurrence.

E. D. McKee and others, 1956, U.S. Geol. Survey Misc. Geol. Inv. Map I-175. Shown on paleotectonic map as Upper Jurassic.

Occurs near Oroville, just south of Monte de Oro, Butte County.

Montediablan Stage

Pliocene, early: California.

D. E. Savage, 1955, California Univ. Pubs., Geol. Sci., v. 31, no. 1, p. 19–24. A stage based on mammalian faunal assemblage, Deposits containing Montediablan stage are included in nonmarine Green Valley formation. Superjacent to Cerrotejonian stage (new). Contemporaneous with later part of North American Clarendonian age of Wood and others (1941).

Type section: In beds near base of Green Valley formation on south slope of Mount Diablo, Contra Costa County.

Monte Largo Granite

Precambrian: Central New Mexico.

J. T. Stark, 1956, New Mexico Bur. Mines Mineral Resources Bull. 34, p. 17–18, pl. 1. Mapped as Monte Largo granite. Described as a small stock-like mass of granite, quartz monzonite, and diorite, approximately 1½ miles square. Stock is coarse to medium coarse grained. Exposure bounded on south, east, and northeast by Blue Springs schist, by quartz reefs and Sais quartzite on the north, and by overlying pediment gravels on the west.

Between mouths of Monte Largo and West Bartalo Canyons in parts of secs. 26, 27, 34 and 35, T. 5 N., R. 5 E. [R. 4 E. from map], Valencia County.

Montell Sandstone (in Allegheny Formation)[1]

Pennsylvanian: Western Maryland and northern West Virginia.

Original reference: C. K. Swartz, W. A. Price, and H. Bassler, 1919, Geol. Soc. America Bull., v. 30, p. 572.

West of Piedmont, W. Va. Named for its position above Montell coal.

Montello Granite[1]

Precambrian: Central southern Wisconsin.

Original reference: R. D. Irving, 1877, Geology Wisconsin, v. 2, p. 521.

Crops out in village of Montello, Marquette County.

Monte Neva Formation

Cambrian: Eastern Nevada.

J. C. Young, 1960, Intermountain Assoc. Petroleum Geologists Guidebook 11th Ann. Field Conf., p. 159, 160. Lower half consists of thin-bedded very platy generally dark-gray limestone, siltstone, and shale grading upward into dark-gray silty limestone. Thickness at type section 594 feet. Overlies Eldorado limestone; underlies Raiff limestone (new).

Type section: Northern Egan Range in NW¼ sec. 33, T. 22 N., R. 63 E. on divide north of third large canyon north of Monte Neva Hot Springs. Monte Neva Hot Springs is in Steptoe Valley 5½ miles southeast of type section.

†Monterey Conglomerate[1] or Sandstone

Pennsylvanian: Northeastern Tennessee.

Original reference: L. C. Glenn, 1925, Tennessee Geol. Survey Bull. 33–B, p. 276, 277, 369–372, 374.

H. R. Wanless, 1946, Geol. Soc. America Mem. 13, p. 146. Name locally applied to Bon Air (Newton) sandstone.

Named for occurrence at Monterey, Putnam County.

Monterey Group,[1] Shale,[1] or Formation

Monterey Stage

Miocene, middle and upper: Western California.

Original reference: W. P. Blake, 1856, Philadelphia Acad. Nat. Sci. Proc., v. 7, p. 328–331.

C. F. Tolman, 1927, Econ. Geology, v. 22, no. 5, p. 459. Overlies Lospe formation (new).

G. D. Hanna, 1928, Am. Assoc. Petroleum Geologists Bull., v. 12, no. 10, p. 969–983. Discussion of Monterey shale at its type locality and summary of its fauna and flora.

W. P. Woodring, M. N. Bramlette, and R. M. Kleinpell, 1936, Am. Assoc. Petroleum Geologists Bull., v. 20, no. 2, p. 127–149. In Palos Verdes Hills, includes Altamira shale member (new) with Portuguese tuff and Miraleste tuff beds (both new), Valmonte diatomite member (new), and Malaga mudstone member (new).

W. P. Woodring, Ralph Stewart, and R. W. Richards, 1940, U.S. Geol. Survey Prof. Paper 195, p. 122–125. Study of history of name "Monterey" as affecting Coalinga and nearby regions reveals that it has been used: (1) as formation name for particular type of lithology without any definite chronologic implication other than Miocene; (2) as a formation name based on chronologic implication of varying value; and (3) as a group name. Proposed to abandon Monterey as group name including Vaqueros Sandstone and to treat Monterey shale as formation name for Miocene strata in Coast Ranges characterized by hard siliceous shale and soft shale containing microscopic siliceous fossils, regardless of varying chronologic relations of these strata within the Miocene. The proposal results in abandonment of Salinas shale and Maricopa shale as synonyms of Monterey shale. In areas where units of formation rank are recognized within the Monterey, group usage is still retained. As mapping progresses, member names may be proposed for lithologic units within the Monterey or formations may be recognized, as has been done in San Francisco Bay region. In this report, unit designated McLure shale member of Monterey is only Miocene shale of Monterey type in Reef Ridge and Kettleman Hills section. According to principles advocated in this report, it would be proper to call it simply Monterey shale, as was done 30 years ago. Name McLure, however, has come into such wide usage that it seems undesirable to urge its abandonment. McLure is considered member of Monterey on grounds that it represents a particular type of Monterey lithology—porcelaneous mudstone.

J. E. Eaton, U. S. Grant, and H. B. Allen, 1941, Am. Assoc. Petroleum Geologists Bull., v. 25, no. 2, p. 204–205 (fig. 3), 216, 230–253. In full sections, the Miocene series of California is divisible on basis of coincident faunal and physical groupings into three equal major stages (ascending) Vaqueros, Temblor, and Monterey, commonly described as being, respectively, of lower, middle, and upper Miocene age. Monterey includes three named substages: Briones, Cierbo, and Neroly. At Caliente Mountain, a homoclinal section exposes about 1,100 feet of upper Oligocene(?), 4,500 feet of Vaqueros, 4,700 feet of Temblor, and 4,600 feet of Monterey strata.

R. R. Thorup, 1941, (abs.) Geol. Soc. America Bull., v. 52, no. 12, pt. 2, p. 1958; 1943, California Div. Mines Bull. 118, pt. 3, p. 464 (fig. 190), 465 (fig. 192). Monterey shale, at type locality of Vaqueros formation, overlies Sandholdt formation (new). Fossils at base of Monterey are Luisian. Monterey, in this area, is restricted to lowermost occurring cherts and porcellaneous shales; lower argillaceous shales and sandstones of former definitions excluded.

R. R. Simonson and M. L. Krueger, 1942, Am. Assoc. Petroleum Geologists Bull., v. 26, no. 10, p. 1611 (fig. 2), 1616–1617. Formation, in Crocker Flat landslide area, Temblor Range, comprises (ascending) Devilwater-Gould, McDonald shale, and Antelope shale members. Overlies Temblor-Vaqueros formation; underlies Santa Margarita formation. Thickness about 6,500 feet. Middle and upper Miocene.

I. F. Wilson, 1943, California Jour. Mines and Geology, v. 39, no. 2, p. 220–222, 224 (fig. 3), pl. 4. Group, in San Benito quadrangle, is represented by fairly thin basal shale member overlain by considerable thickness of arkosic sandstone and conglomerate, which is interbedded toward top with diatomaceous shale. Thickness as much as 3,400 feet. Group is confined to Gabilan Range, southwest of Bear Valley fault. Basal shale rests depositionally (either conformably or disconformably) upon Pinnacles formation along Willow Creek; the arkose rests unconformably upon Pinnacles formation and Miocene rhyolite in southern part of quadrangle, and upon granite in northwestern part of area. Underlies alluvium. Upper Miocene.

W. P. Woodring, M. N. Bramlette, and K. E. Lohman, 1943, Am. Assoc. Petroleum Geologists Bull., v. 27, no. 10, p. 1336–1337 (fig. 1), 1339, 1341 (table 1), 1345–1347; W. P. Woodring and others, 1944, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 14; W. P. Woodring and M. N. Bramlette, 1950, U.S. Geol. Survey Prof. Paper 222, p. 11 (table), 18–25, pls. In Santa Maria district, Monterey shale crops out in western Casmalia Hills, eastern Purisima Hills, and Foxen Canyon-Sisquoc River area.

In western Casmalia Hills, only region within mapped area where base is exposed, the Monterey overlies conformably Point Sal formation and has overlaps northward onto basement rocks. Comprises three unnamed members: lower, 200 to 900 feet, phosphatic shale, silty shale, somewhat porcelaneous shale; middle, 185 to 225 feet, chert, cherty shale, porcelaneous shale; upper, 600 to 1,000 feet, porcelaneous shale, laminated diatomite. Underlies Sisquoc formation, in some areas Todos Santos claystone member (new). Middle to upper Miocene.

M. N. Bramlette, 1946, U.S. Geol. Survey Prof. Paper 212, 57 p. Discussion of Monterey formation and origin of its siliceous rocks. Miocene strata that consist predominantly of highly siliceous rocks have received a number of names in different areas, but recent stratigraphic work indicates that most of these locally named stratigraphic units are essentially equivalent. Appears advisable to return to an early and convenient usage by extending term Monterey formation to include many of these locally named units. This report contains stratigraphic sections representing most of areas where local names have been applied, with their suggested correlation. Locality from which formation name was derived is unsatisfactory as type locality. At this area, near town of Monterey, in Monterey County, formation cannot be measured in any unbroken sequence, and complete succession can be worked out only by detailed mapping and by correlating several partial sections. A thick tuff bed forms basal part of formation in many places in San Luis Obispo and Santa Barbara Counties. It is herein named Obispo tuff member.

C. E. Weaver, 1949, Geol. Soc. America Mem. 35, p. 17 (table 3), 67–75, pls. In area of this report [Coast Ranges immediately north of San Francisco Bay region], group comprises (ascending) Sobrante sandstone, Claremont shale, Oursan sandstone, Tice shale, Hambre sandstone, and Rodeo shale. Thickness about 4,250 feet. Overlies San Ramon sandstone; underlies Briones sandstone of San Pablo group. Differentiated divisions of the Monterey immediately south of Carquinez Strait in Mare Island and Carquinez quadrangles are well represented in south limb of San Pablo syncline. Their identity as individual units is lost in north limb of fold where strata are described as Monterey shale. Measured section of shale about 1,855 feet. Overlies Martinez formation; on Point Reyes Peninsula, overlies Laird sandstone (new).

T. W. Dibblee, Jr., 1950, California Div. Mines Bull. 150, p. 34–42, pls. Monterey shale as used in this report [southwestern Santa Barbara County] includes all sediments lying above Rincon shale, and above Tranquillon volcanics (new) where present, and below Sisquoc formation. Term, as herein used, is same as Modelo formation of Ventura basin. Predominantly siliceous shales ranging in age from uppermost Saucesian to lower Delmontian of the Miocene. Shale herein includes Relizian Point Sal formation of northern Santa Maria basin as mapped by Woodring and others (1944) as this unit loses its identity as a formation and becomes inseparable from Monterey shale in Santa Ynez Mountains and southern Santa Maria basin. Throughout area the Monterey is divisible into two lithologic members, lower and upper. Upper Monterey as used in this report corresponds to the middle and upper members as mapped by Woodring and others (1944) in northern Santa Maria basin, Point Sal formation. Thickness about 1,700 feet in Santa Ynez Mountains; 1,800 to 4,500 feet in Santa Maria basin.

H. H. Heikkila and G. M. MacLeod, 1951, California Div. Mines Spec. Rept. 6, p. 11–14, pl. 1. Formation, in Bitterwater Creek area, Kern County, consists of about 4,000 feet of shales and sandstones. Comprises (ascending) Gould-Devilwater shale, Twisselman sandstone (new), and McDonald shale members. Conformably overlies Temblor formation; unconformably underlies Tulare formation. Middle and upper Miocene.

T. W. Dibblee, Jr., 1951, Soc. Econ. Paleontologists and Mineralogists, Pacific Sec. [Guidebook], Stop 2, p. 1–2. In Salisbury Canyon, underlies Bitter Creek sandstone (new).

M. D. Crittenden, Jr., 1951, California Div. Mines Bull. 157, p. 22 (fig. 4), 37–39, pl. 1. Term Monterey formation is here applied [San Jose-Mount Hamilton area] to middle and possibly upper Miocene rocks characterized by abundance of siliceous sediments. They do not include same units mapped by Lawson (1914) who used Monterey group. Strata of formation mapped. Average thickness 500 feet. Overlies Temblor formation; underlies Briones sandstone. In some areas, faulted up against Briones and, in some areas, faulted down into the Cretaceous. On east limb of syncline, where it is overlapped by Briones sandstone; on Sierra Road, it is faulted out along Calaveras fault but appears in Alum Rock Canyon and in Arroyo Aguague where, though poorly exposed, forms thin bed between Briones and Berryessa (new) formations.

G. D. Robinson, 1956, U.S. Geol. Survey Geol. Quad. Map GQ–88. In Hayward quadrangle, group comprises (ascending) Sobrante sandstone, Claremont shale, unnamed middle sandstone and shale, and Rodeo shale. Overlies Chico formation of Lawson with angular unconformity; underlies Briones sandstone with disconformity. Middle Miocene.

C. A. Hall, Jr., 1958, California Univ. Pubs., Geol. Sci., v. 34, no. 1, p. 17–18. In this report [Pleasanton area, Alameda and Contra Costa Counties], term Monterey formation and Monterey group are considered inappropriate for following reasons: (1) widely separate basins of deposition existed in Coast Range area during middle Miocene, and there is no indication that Monterey basin was connected with that in area under discussion; (2) Monterey shale or "formation" cannot be traced from type area to Pleasanton area or even into San Jose quadrangle, where it was mapped by Crittenden (1951); and (3) terms "Monterey formation" and "Monterey group", which have been used in adjoining area to comprise the Sobrante, Claremont, Oursan, Tice, Hambre, and Rodeo "members" or "formations," suggest that these units are related in some way to Monterey shale; they are distinct mappable units that can be traced from their type localities to Pleasanton and adjacent area, and their only relation to Monterey shale is that they may be in part correlated with it on faunal basis.

M. L. Hill, S. A. Carlson, and T. W. Dibblee, Jr., 1958, Am. Assoc. Petroleum Geologists Bull., v. 42, no. 12, p. 2974 (fig. 1), 2975 (fig. 2), 2978–2979 (fig. 3), 2988–2991. In Caliente, La Panza, and Sierra Madre Mountains, the shale conformably above Painted Rock sandstone member (new) of Vaqueros formation and conformably below Santa Margarita sandstone is mapped as Monterey shale. Shale grades laterally eastward into sandstone unit mapped as Branch Canyon formation (new). Shale averages about 2,500 feet in thickness and comprises (ascending) Saltos shale and Whiterock Bluff shale members.

R. M. Touring, 1959, Dissert. Abs., v. 20, no. 4, p. 1325. Formation, in La Honda and San Gregorio quadrangles, San Mateo County, is restricted to late Miocene (Delmontian?) brown siliceous mudstones and porcelanites which lie unconformably upon older formation. Overlies Woodhams formation (new); underlies Purisima formation. Thickness 9,000 feet in west; thins to wedge in east.

L. B. McMichael, chm., 1959, San Joaquin Geol. Soc. Guidebook Field Trip, May 9, p. 13. Formation, in Chico-Martinez Creek area, comprises (ascending) Gould shale, Devilwater silt, McDonald shale, Antelope shale, and Chico-Martinez chert (new) members.

Y. T. Mandra, 1960, Dissert. Abs., v. 20, no. 11, p. 4370; 1960, Internat. Geol. Cong. Rept., 21st, pt. 6, p. 78, 79–81. Formation, near Bradley, southern Monterey County, includes Buttle diatomite member (new).

Typical section (Blake): About 2 miles southeast from center of town of Monterey, Monterey County. Forms part of hill 500 to 600 feet high which fronts the bay and rises on east side of stage road to San Francisco. Hanna (1928) stated that locality is on northwest side of long ridge which partly encircles the bay; exposure can be traced from line of Monterey-Salinas Highway to and a little across Monterey-Carmel Highway. This is a distance of about 4 miles east and west.

†Monterey Sandstone[1]

Lower Devonian: Northwestern Virginia and western Maryland.

Original reference: N. H. Darton, 1892, Am. Geologist, v. 10, p. 13, 15–16.

Named for Monterey, Highland County, Va.

Montesano Formation[1]

Pliocene: Southwestern and northwestern Washington.

Original reference: C. E. Weaver, 1912, Washington Geol. Survey Bull. 15, p. 10–22.

C. E. Weaver, 1937, Washington [State] Univ. Pubs. in Geology, v. 4, p. 173, 187–191. Unconformably overlies Astoria formation. Age given as Pliocene although invertebrate fauna shows characteristics of both upper Miocene and lower Pliocene.

C. E. Weaver and others, 1944, Geol. Soc. America Bull., v. 55, no. 5, p. 593, chart 11. Formation is a composite from numerous sections exposed in banks of Wynoochee and Wishkak Rivers and their tributaries. Maximum exposed thickness 2,800 feet. At certain localities, it is unconformable on the Astoria and Lincoln formations; its relation to the younger Quinault formation is concealed.

Named for Montesano, Grays Harbor County.

†Monte Sano Limestone[1] or Montesano Group[1]

Mississippian (Meramec-Chester): Northern Alabama, Illinois, Kentucky, and Tennessee.

Original reference: E. O. Ulrich, 1911, Geol. Soc. America Bull., v. 22, pl. 29.

J. M. Weller and others, 1948, Geol. Soc. America Bull., v. 59, no. 2, p. 163, chart 5 (column 86) Tennessee Geological Survey finds name Monte Sano limestone useful as a designation for the undifferentiated Ste. Genevieve and Gasper.

Named for exposures at Monte Sano, Madison County, Ala.

†Montevallo Conglomerate[1]

Pennsylvanian: Northern central Alabama.

Original reference: J. Squire, 1890, Alabama Geol. Survey Rept. Cahaba coal field, pt. 1.

Probably named for exposures at Montevallo, Shelby County.

†Montevallo Formation[1]

Lower Cambrian: Alabama.

Original reference: E. A. Smith, 1890, Alabama Geol. Survey Rept. on Chaba coal field, p. 148, map.

Named for Montevallo, Shelby County.

Montevideo Granite Gneiss (in Minnesota Valley Granite Series)

Precambrian: Southwestern Minnesota.

E. H. Lund, 1956, Geol. Soc. America Bull., v. 67, no. 11, p. 1482, 1484–1485, pl. 6. Pink, medium-grained, and contains a small amount of dark minerals, except where it is contaminated with gabbro gneiss which it intrudes. Distinguished from Morton gneiss primarily by its straightness of banding.

Typically developed in vicinity of Montevideo and forms extensive outcrops in Granite Falls vicinity, Chippewa and Yellow Medicine Counties.

Montezuma Formation

Pleistocene: Northwestern California.

C. E. Weaver, 1949, Geol. Soc. America Mem. 35, p. 16 (table 3), 103–106, pls. 6, 7, 9, 10. Composed of deposits of obscurely stratified gravels, sands, and clays that have been uplifted into terraces and dissected by steam erosion. Unconformably overlies Wolfskill, Huichica, and Glen Ellen formations (all new). Deposits may have once connected with gravel and sands of same age and lithologic composition which crop out along northern flank of Los Medanos Hills and south of Pittsburg from which place the formation was named and described by Tolman (1941) as Pittsburg formation; because this name is preoccupied, Montezuma is proposed.

Named from Montezuma Hills in Antioch quadrangle, Solano County.

Montezuma Quartz Monzonite[1]

Eocene: Central northern Colorado.

Original reference: H. B. Patton, 1909, Colorado Geol. Survey 1st Rept., p. 125, 126, 128, map.

T. S. Lovering and E. N. Goddard, 1950, U.S. Geol. Survey Prof. Paper 223, p. 44, 123. Constitutes large porphyritic quartz monzonite stock which is nearly surrounded by Precambrian rocks, but for the western end which has invaded and baked Cretaceous shale.

Town of Montezuma, Summit County, is built on this rock.

Montezuma Schist[1]

Precambrian: Western North Carolina.

Original reference: A. Keith, 1903, U.S. Geol. Survey Geol. Atlas, Folio 90, p. 4.

J. L. Stuckey and S. G. Conrad, 1958, North Carolina Div. Mineral Resources Bull. 71, p. 29–30; J. L. Stuckey, 1958, Geologic map of North

Carolina (1:500,000): North Carolina Div. Mineral Resources. Occurs in association with Linville metadiabase. Flattop schist, and metarhyolite.

Named for Montezuma, Cranberry quadrangle, Mitchell County.

Montezuma shales[1]

Middle Jurassic: Southwestern Colorado and northeastern Arizona.

Original reference: C. R. Keyes, 1936, Pan-Am. Geologist, v. 65, no. 4, p. 303, 306.

Charles Keyes, 1937, (abs.) Geol. Soc. America Proc. 1936, p. 314. Middle Jurassic.

Name derived from Montezuma County in southwestern Colorado.

Montgomery Bed (in Jackson Formation)[1]

Eocene, upper: Northwestern Louisiana.

Original reference: T. L. Casey, 1902, Science, new ser., v. 15, p. 716.

Named for exposures at Montgomery, Grant County.

†Montgomery Buhr,[1] Grits,[1] or Sandstone[1]

Mississippian: Virginia and West Virginia.

Original reference: W. B. Rogers, 1838, Virginia Geol. Survey Rept. 1837, p. 17.

Probably named for Montgomery County, Va.

†Montgomery Formation[1]

Silurian: Southwestern Ohio, southern Indiana, and northern Kentucky.

Original reference: A. F. Foerste, 1896, Cincinnati Soc. Nat. History Jour., v. 18, p. 189, 190.

Named for Montgomery County.

Montgomery Formation

Montgomery Member

Pleistocene: Central and southwestern Louisiana and Texas.

H. N. Fisk, 1938, Louisiana Dept. Conserv. Geol. Bull. 10, p. 78, (fig. 6) 160–163. The series of Pleistocene deposits in Grant and La Salle Parishes is divided into four members, their names corresponding to the four distinct depositional terrace surfaces, Williana (oldest), Bentley, Montgomery, and Prairie. Montgomery member consists of clays and sands, the sandier materials predominating with depth; gravels common but are marginal deposits, reworked concentrations in form of large alluvial fans; highly oxidized plastic red-colored clays at surface grade downward at a depth of 2 feet into mottled red to yellow clays with thin lenses of silty sands; at depth of 20 feet, clays are generally replaced by a thin-bedded group of light-brown to yellow clays and sands which weather into "pinnacly clays;" slightly weathered clays are light brown to bluish gray and caryy carbonized wood fragments and leaf impressions. Thickness uncertain; wells drilled on terrace surface encountered as much as 115 feet of clays and sands. Overlies Miocene Catahoula formation.

H. N. Fisk, 1940, Louisiana Dept. Conserv. Geol. Bull. 18, p. 180–182, pl. 1. Rank raised to formation. Described in Rapides and Avoyelles Parishes where it underlies Prairie deposits and Recent alluvium.

G. E. Murray, 1948, Louisiana Dept. Conserv. Geol. Bull. 25, p. 143–144. Geographically extended into eastern Texas. Thickness in southwesten Louisiana ranges from 85 to 125 feet.

P. H. Jones *in* P. H. Jones, A. N. Turcan, Jr., and H. E. Skibitzke, 1954, Louisiana Dept. Conserv. Geol. Bull. 30, p. 71–74. In vicinity of Oakdale overlies Foley formation (new).

Named for exposures near Montgomery, Grant Parish, La. Well exposed at Waddel Bluff in sec. 8, T. 7 N., R. 4 W.

Montgomery Limestone[1]

Silurian: Northern California.

Original reference: J. S. Diller, 1892, Geol. Soc. America Bull., v. 3, p. 370–394.

C. K. Swartz and others, 1942, Geol. Soc. America Bull., v. 53, no. 4, chart 3. Shown on correlation chart in Niagaran series above Grizzly formation (?) which may be Ordovician.

Named for occurrence on Montgomery Creek, 2⅓ miles south of Taylorsville, Plumas County.

Montgomery Creek Formation[1]

Eocene: Northern California.

Original reference: H. Williams, 1932, California Univ. Pub., Dept. Geol. Sci. Bull., v. 21, no. 8, p. 215.

C. A. Anderson and R. D. Russell, 1939, California Jour. Mines and Geology, v. 35, no. 3, p. 228–231. Thickness at type locality more than 600 feet with base not exposed. Unconformably overlies Chico formation; underlies Tuscan formation.

A. F. Sanborn, 1960, California Div. Mines Spec. Rept. 63, p. 6 (fig. 3), 16–17, pl. 1. In Big Bend quadrangle, is represented by nonmarine conglomerate, arkose, sandstone, and shale. Maximum thickness about 2,600 feet. Overlies Potem formation; underlies Pliocene(?) volcanic rocks.

Type locality: North side of Montgomery Creek, 2½ miles east-northeast of village of Montgomery Creek, Shasta County.

Monticello dolomite[1]

Silurian (Niagaran): Central eastern Iowa.

Original reference: C. R. Keyes, 1912, Iowa Acad. Sci. Proc., v. 19, p. 149, 150.

Probably named for Monticello, Jones County.

Monticello Rhyolites[1]

Precambrian: Central Virginia.

Original reference: W. A. Lambeth, 1901, Thesis presented to University Virginia, p. 11.

In Monticello area, Albemarle County.

Monticello Schist[1]

Precambrian: Central Virginia.

Original reference: W. A. Lambeth, 1901, Thesis presented to University Virginia, p. 9.

Probably named for Monticello, Albemarle County.

Montijo Conglomerate[1] or Formation

Oligocene(?) : Panamá.

Original reference: O. H. Hershey, 1901, California Univ. Dept. Geol. Bull., v. 2, p. 241.

A. A. Olsson, 1942, 8th Am. Sci. Cong. Proc., v. 4, p. 242. Referred to as formation; unconformably overlies Torio limestone (upper Eocene). Middle Oligocene.

W. P. Woodring *in* R. Hoffstetter and others, 1960, Lexique Strat. Internat., v. 5, Amérique Latine, fasc. 2a, p. 341. Poorly defined name. Oligocene(?).

Exposed on west side of Azuero Peninsula, Veraguas Province.

Montosa limestone[1]

Pennsylvanian : New Mexico.

Original reference : C. R. Keyes, 1906, Jour. Geology, v. 14, p. 147–154.

M. L. Thompson, 1942, New Mexico Bur. Mines Mineral Resources Bull. 17, p. 22. Keyes did not give source or definition of term Montosa limestone; therefore, the term is not considered established.

Derivation of name not given.

Montoya Dolomite

Montoya Limestone[1] or Group

Middle and Upper Ordovician : Western Texas and southern New Mexico.

Original reference: G. B. Richardson, 1908, Am. Jour. Sci., 4th v. 25, p. 476, 478–479.

L. P. Entwistle, 1944, New Mexico Bur. Mines Mineral Resources Bull. 19, p. 16–18. Referred to as dolomite. In Silver City area, subdivided into (ascending) Second Value, Par Value, and Raven members. Thickness 275 feet. Underlies Fusselman dolomite; overlies El Paso dolomite.

V. C. Kelley, 1951, Am. Assoc. Petroleum Geologists Bull., v. 35, no. 10, p. 2201 (table). Stratigraphic table shows Montoya group comprises (ascending) Cable Canyon sandstone and Jornada limestone.

V. C. Kelley and Caswell Silver, 1952, New Mexico Univ. Pub. in Geology 4, p. 31 (table), 56–66. In Caballo Mountains, divisions of Montoya proposed by Entwistle in Silver City area, can be mapped and identified in partial exposures. Also, these units, plus a basal sandstone, can be identified in other areas— San Andres, Organ, Santa Rita, Florida, Big Hatchet, and Sacramento Mountains. Therefore, Montoya is herein used as group term and Entwistle's units are given formational status. However, since type localites designated by Entwistle are not in continuous stratigraphic exposure and in addition are faulted and variously altered by mineralization, the Cable Canyon section opposite Sierrite mine, which offers continuous, unbroken, unaltered, and completely exposed outcrop, is used as new type locality. New names are applied to formations (ascending) Cable Canyon sandstone, Upham dolomite, Aleman, and Cutter, upper three correspond to Entwistle's units. Thickness as much as 450 feet. Overlies El Paso group; underlies Fusselman dolomite.

L. C. Pray, 1953, Am. Assoc. Petroleum Geologists Bull., v. 37, no. 8, p. 1897 (fig. 2), 1898 (fig. 3), 1899 (fig. 4), 1900, 1902–1906. Formation described in Sacramento Mountains, N. Mex., where it is 209 feet thick; consists of lower cherty member and upper solid chert member. Underlies Valmont dolomite (new) ; overlies El Paso formation.

Elliot Gillerman, 1958, New Mexico Bur. Mines Mineral Resources Bull. 57, p. 11 (table 2), 24–25, table 1. Limestone described in Peloncillo Mountains where it is as much as 100 feet thick; consists of medium- to dark-gray dolomite, with about 30 feet of alternating dolomite and black chert in beds 2 to 6 inches thick. Overlies El Paso limestone; underlies Percha shale.

L. C. Pray, 1958, Texas Geol. Soc. Guidebook Franklin and Hueco Mountains, p. 30–43. Group described in northern Franklin Mountains, Tex., where it is 429 feet thick and includes (ascending) Upham formation, Aleman formation, and Cutter dolomite. Underlies Fusselman formation; overlies El Paso formation. Age largely Upper Ordovician although lower part may be somewhat older. Type section suggested.

H. J. Howe, 1959, Am. Assoc. Petroleum Geologists Bull., v. 43, no. 10, 2285–2330. Group divided into (ascending) Cable Canyon sandstone (replaced in Baylor Mountains by a St. Peter sandstone equivalent) ; Upham dolomite containing a Red River fauna, which is probably Upper Trenton or possibly lower Cincinnatian in age; Aleman formation with Maquoketa fauna, notably the coral *Paleophyllum thomi*, which crops out in marker bed for 140 miles; and Cutter formation with late Ordovician fauna near its base. Disconformably overlies El Paso formation.

Named for Montoya Station, on Santa Fe Railway, about 10 miles above El Paso, Tex.

Montpelier Sandstone[1]

Middle(?) Devonian: Southeastern Iowa.

Original reference: C. R. Keyes, 1893, Iowa Geol. Survey, v. 1, p. 40–46, pl. 2.

Named for Montpelier, Muscatine County.

†Montpelier Slate[1]

Ordovician: Northeastern Vermont.

Original reference: C. H. Richardson, 1906, Vermont State Geologist 5th Rept., p. 95.

Extends from Montpelier to Northfield, Washington County.

Montreal Amygdaloid[1] (in Central Mine Group)

Precambrian (Keweenawan): Northern Michigan.

Original reference: A. C. Lane, 1911, Michigan Geol. and Biol. Survey Pub. 6, geol. ser. 4, fig. 28.

Probably named for occurrence in Montreal mine, Keweenaw County.

Montreal Flow[1]

Precambrian (Keweenawan): Northern Michigan.

Original reference: B. S. Butler and W. S. Burbank, 1929, U.S. Geol. Survey Prof. Paper 144 (chart compiled by M. G. Wilmarth).

Probably named for occurrence in Montreal mine, Keweenaw County.

Montrose Member (of Keokuk Limestone)

†Montrose chert (in Osage Group)[1]

Mississippian; Southeastern Iowa.

Original reference: C. R. Keyes, 1895, Iowa Geol. Survey, v. 3, p. 320, 341, 445.

J. M. Weller and A. H. Sutton, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 5, p. 795. Referred to as member of Keokuk limestone. Thickness 30 feet. In lower part of Keokuk.

Named for exposures at Montrose, Lee County.

Montrose Redbeds

Montrose Red Shale (in Catskill Formation)[1]

Upper Devonian: Northeastern Pennsylvania.

Original reference: I. C. White, 1881, Pennsylvania 2d Geol. Survey Rept. G_5, p. 68, 115.

G. A. Cooper and others, 1942, Geol. Soc. America Bull., v. 53, no. 12, pt. 1, chart 4. Shown on correlation chart as Montrose red beds; occur above Catawissa red beds and equivalent to Wellsburg shale and sandstone.

Type locality: Montrose, Susquehanna County.

Montrose Sandstone[1]

Upper Devonian: Northeastern Pennsylvania and southern central New York.

Original reference: L. Vanuxem, 1840, New York Geol. Survey 4th Rept., p. 381.

Probably named for town of Montrose, Susquehanna County, Pa.

Monument andesite[1]

Tertiary: Southwestern New Mexico.

Original reference: C. R. Keyes, 1908, Am. Inst. Mining Engrs. Bi-Monthly Bull. 19, p. 7–21.

Type locality; Monument Peak, near Lake Valley, Sierra County.

†Monument Creek Group[1]

Eocene and Oligocene: Eastern central Colorado.

Original reference: F. V. Hayden, 1869, U.S. Geol. Survey Colorado and New Mexico 3d Ann. Rept. p. 39–40, 89.

Monument Creek quadrangle, Denver Basin region.

Monument Hill Bentonitic Member (of Pierre Shale)[1]

Upper Cretaceous: Northeastern Wyoming, southeastern Montana, and northwestern South Dakota.

Original reference: W. W. Rubey, 1930, U.S. Geol. Survey Prof. Paper 165–A.

W. A. Cobban, 1952, Billings Geol. Soc. Guidebook 3d Ann. Field Conf., p. 87. Thickness 165 feet. Overlies unnamed black shale member; underlies a 200-foot dark-gray shale member at top of formation. Area of this report is Crook County, Wyo., Carter County, Mont., and Butte County, S. Dak.

C. S. Robinson, W. J. Mapel, and W. A. Cobban, 1959, Am. Assoc. Petroleum Geologists Bull., v. 43, no. 1, p. 110–111, measured sections. In Carter County, Mont., top of member is about 200 feet below base of Fox Hills sandstone and base is estimated to be about 450 feet above Mitten black shale member of Pierre and 1,500 feet above base of Pierre. In central Crook and Weston Counties, Wyo., rocks equivalent to Monument Hill bentonite member apparently consists of dark-gray shale indistinguishable from dark shale of underlying Kara bentonitic member (new). Thickness 150 to 220 feet.

Named for exposures at Monument Hill, sec. 32, T. 56 N., R. 68 W., Crook County, Wyo.

Monument Spring Dolomite Member (of Marathon Limestone)[1]

Lower Ordovician: Southwestern Texas.

Original reference: P. B. King, 1931, Am. Assoc. Petroleum Geologists Bull., v. 15, no. 9, p. 1066–1069.

W. B. N. Berry, 1960, Texas Univ. Bur. Econ. Geology Pub. 6005, p. 10. Occurs 550 to 600 feet above base of Marathon and ranges from 40 to a maximum of 90 feet in thickness. Consists of oval lenses of blue-gray and yellow-mottled dolomitic limestone surrounded by black shale and thin-bedded, cross-laminated gray limestone. Underlies unnamed interval in upper part of Marathon gray limestone.

Typically exposed one-half mile west of Monument Spring, Marathon uplift, Brewster County.

†Monument Valley Shale[1]

Permian: Northeastern Arizona and southeastern Utah.

Original references: D. Hager, 1924, Mining and Oil Bull., v. 10, no. 2, p. 137; no. 4, p. 385, 423.

Named for exposures in Monument Valley, San Juan County, Utah, and Navajo National Monument, Ariz.

Moody Shale Member[1] (of Toledo Formation)

Eocene, upper: Northwestern Oregon.

Original reference: H. G. Schenck, 1927, California Univ. Pub., Dept. Geol. Sci. Bull., v. 16, no. 12, p. 455, 456, 457, 459.

H. E. Vokes, Hans Norbisrath, and P. D. Snavely, Jr., 1949, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 88. Dark to black hard tuffaceous mudstones, commonly intricately fractured, with occasional discontinuous, irregular, hard cemented limy bands a few inches thick; interbedded fine- and medium-grained sandstones containing glauconite and coarse pumiceous material occur at numerous horizons; carbonaceous material and plant fragments abundant in sandstones near base thickness 1,500 to 1,800 feet. Along Eckman Creek and south of Green Mountain, member becomes markedly tuffaceous and interfingers with volcanic rocks of the Toledo to south. Underlies an unnamed sandy member 1,000 to 1,200 feet thick; overlies Burpee formation. Upper Eocene.

Type locality (Schenck): Railroad cuts at Moody Station on Southern Pacific Railroad, between Yaquina and Toledo, Lincoln County. (Vokes and others): At Moody School, north bank of Yaquina River in sec. 30, T. 11 S., R. 10 W., Lincoln County.

Moody Ledge Granite[1] (in New Hampshire Magma Series)

Upper Devonian or Upper Carboniferous: West-central New Hampshire.

Original reference: M. P. Billings, 1935, Geology of Littleton and Moosilauke quadrangles, New Hampshire, p. 28, Moosilauke map.

M. P. Billings, 1937, Geol. Soc. America Bull., v. 48, no. 4, p. 509–510 pl. 12. Map bracket shows Moody Ledge granite in New Hampshire magma series above French Pond granite and below Pond Hill granite.

Mapped on and around Moody Ledge, Moosilauke quadrangle.

Moodys Marl (in Jackson Group)

Moodys Marl Member (of Jackson Formation)[1]

Eocene, upper: Mississippi and southwestern Alabama.

Original reference: O. Meyer, 1885, Am. Jour. Sci., 3d, v. 30, p. 435.

C. W. Cooke, 1939, Jour. Paleontology, v. 13, no. 3, p. 337–339. Gosport sand of Alabama, heretofore classified as topmost formation of Claiborne group (Eocene), and the only known formation of "upper Claiborne" age, proves to be nearly equivalent to Moodys marl of Jackson group. It is recommended that name Gosport be replaced by Moodys and that Claiborne group be restricted to formations heretofore classified as lower Claiborne.

F. S. MacNeil, 1946, Southeastern Geol. Soc. 4th Field Trip, p. 43. Replaced by Moodys Branch formation. Although not rigidly defined, name Moodys marl apparently was used in this area [southeastern Alabama] for "Scutella bed" and beds here referred to Gosport sand.

Named for exposures along Moodys Branch of Pearl River, in city of Jackson, Miss.

Moodys Branch Marl[1] or **Formation** (in Jackson Group)

Moodys Branch Member (of Jackson Formation)

Eocene, upper: Mississippi, southwestern Alabama, Georgia, and Louisiana.

Original reference: O. Meyer, 1885, Am. Jour. Sci., 3d, v. 30, p. 435.

H. N. Fisk, 1938, Louisiana Geol. Survey Bull. 10, p. 94–98. Moodys Branch marl extended into Louisiana where it is most fossiliferous unit zone in state. Consists of glauconitic sands transitional with lower lignitic silty clays of Cockfield formation and with overlying Yazoo clays. Jackson group.

F. F. Mellen, 1940, Mississippi Geol. Survey Bull. 39, p. 12 (table), 16–18, 19 (fig. 4). Basal member of Jackson formation. Underlies Yazoo member; overlies Yegua silt (Lisbon). Thickness 30 to 45 feet.

Tom McGlothlin, 1944, Am. Assoc. Petroleum Geologists Bull., v. 28, no. 1, p. 56–59. Moodys Branch is calcareous fossiliferous green sand ranging in thickness from about 10 to 50 feet. Author of this report is convinced that at least upper part and perhaps all of so-called "Gosport" of Hatchetigbee anticline is Moodys Branch. Political boundary separating Mississippi and Alabama was apparently given weight in not only changing name of Moodys Branch, but also the age. There is possibility that Jackson-Claiborne contact is located in approximate middle of "Gosport" of Hatchetigbee anticline. Jackson group includes Moodys Branch at base and Yazoo clay at top.

W. E. Belt and others; 1945, Geologic map of Mississippi (1:500,000): Mississippi Geol. Survey. Jackson group, as mapped, includes Moodys Branch formation at base and Yazoo clay above.

F. S. MacNeil, 1946, Southeastern Geol. Soc. Guidebook 4th Field Trip, p. 33–42. Term Moodys Branch formation replaces term Moodys marl. Gosport sand and Claiborne-Jackson contact discussed. Writer has determined equivalence of lower part of Gosport, as originally defined, with uppermost part of Cockfield formation (Yegua), and upper part of Gosport with lower part of Moodys Branch, to his own satisfaction but acknowledges that there are others who would place base of Moodys Branch at both higher and lower levels. Main problem is not whether lower part of Gosport is equivalent to Moodys Branch, but whether or not lower part of Gosport, and at least upper part of Cockfield, are Jackson rather than Claiborne. Practice of U.S. Geological Survey in classifying Gosport as Jackson was based on supposed equivalence of Gosport and Moodys Branch.

F. S. MacNeil, 1947, U.S. Geol. Survey Oil and Gas Inv. Prelim. Chart 29. Correlation chart shows Moodys Branch formation comprises lower sand member and upper limestone member; lower sand member interfingers with "Scutella bed" which extends into Georgia. Formation underlies Yazoo clay and overlies Cockfield formation in Mississippi; hence, in Alabama and Georgia, underlies Ocala limestone.

R. O. Vernon, 1951, Florida Geol. Survey Bull. 33, p. 112 (table 9), 115–156. Moodys Branch formation in Florida is cream to white fragmental marine highly fossiliferous limestone composed of camerinid-rich limestone member, Williston (new), at top and echinoid-rich limestone member, Inglis (new), at base. It is approximately basal 80 feet of Ocala limestone of Cooke (1945). Underlies Ocala limestone (restricted); disconformably overlies Avon Park limestone.

L. D. Toulmin, P. E. LaMoreaux, 1951, Alabama Geol. Survey Spec. Rept. 21, p. 120–121. Formation described in Choctaw County, where it maintains thickness of 10 to 18 feet. Basal formation in Jackson group; underlies Yazoo clay; overlies Gosport sand.

H. B. Stenzel, 1952, Mississippi Geol. Soc. [Guidebook] 9th Field Trip, p. 41. In Alabama, includes Dellett sand member (new).

H. S. Puri, 1953, (abs.) Jour. Sed. Petrology, v. 23, no. 2, p. 130; 1957, Florida Geol. Survey Bull. 38, p. 29–30. Williston and Inglis, originally defined as members of Moodys Branch, are herein raised to formational rank. [This apparently abandons use of Moodys Branch formation in Florida].

H. V. Andersen, 1960, Type localities project Unit 1: Baton Rouge, La., Soc. Econ. Paleontologists and Mineralogists, Gulf Coast Sec., no pagination. Note on type locality. Reference section designated. Thickness 16 feet at reference section.

Type locality: At intersection of Peachtree Street and Poplar Blvd. in city of Jackson, Hinds County, Miss. Reference section: In Riverside Park, in city of Jackson, Miss. Named for exposures along Moodys Branch of Pearl River, in city of Jackson, Miss.

Moon Trachyte (in Garren Group)

Tertiary: Western Texas.

Hugh Hay-Roe, 1957, Texas Univ. Bur. Econ. Geology, Geol. Quad. Map 21. Name proposed for two trachyte lava units which are exposed on Moon Ranch. Lower unit, quartz trachyte member, consists of 45 feet of dark-red slabby to blocky aphanite; upper unit, platy trachyte member, consists of hard light-colored nonvesicular non-porphyritic highly platy alkali-feldspar trachyte about 70 feet thick. Underlies Means trachyte (new); overlies Pantera trachyte (new).

Type section: (Quartz trachyte) small cuesta on Halcon Draw; (Platy trachyte) high hill east of Esperanza well, in Coyote Hills, Jeff Davis County.

Moon Hill Quartzite Member (of Skookum Formation)

Precambrian: Northeastern Washington.

M. C. Schroeder, 1952, Washington Div. Mines and Geology Bull. 40, p. 7 (table), 13–14, pl. 1. Coarse-grained quartzite about 1,100 feet thick at top of Skookum formation (new). Top of Moon Hill quartzite concealed by Tertiary Tiger formation.

Forms crest of Moon Hill, Pend Oreille County.

Moon Lake Diorite[1]

Precambrian: Northwestern New York.

Original reference: A. F. Buddington, 1934, New York State Mus. Bull. 296, p. 62.

Forms much of peninsula on south side of Moon Lake, Antwerp quadrangle, Jefferson County.

Moonlight Formation

Upper Cretaceous: Southern California.

O. T. Marsh, 1956, Dissert. Abs., v. 16, no. 1, p. 101; 1960, California Div. Mines Spec. Rept. 62, p. 7 (fig. 3), 24–26, pls. 1, 2. Proposed for lithologic unit in Orchard Peak area which is equivalent to Pachydiscus silt or Ragged Valley shale of Coalinga area and elsewhere. Consists of two facies: a light-colored siltstone facies in Devil's Den and Sawtooth Ridge synclines and a dark-gray clay shale west of Sawtooth syncline; transition between the two facies occurs rather abruptly, near west end of Sawtooth Ridge syncline. Thickness at type locality 1,550 feet; 1.2 miles to southwest in Sawtooth Ridge syncline, thickness is about 375 feet, this suggests that the Moonlight may be a tongue which pinches out toward south. Except where faulted, formation conformably overlies Serpiente sandstone (new) and underlies Red Man sandstone (new). Contains *Baculites chicoensis*, *Liopistha*, and Foraminifera.

Type locality: Moonlight Valley which runs along south limb of Devil's Den syncline, just north of Avenal Ridge, northeastern Kern County.

Moonshine Conglomerate[1]

Middle Jurassic: Northern California.

Original reference: C. H. Crickmay, 1933, Geol. Soc. America Bull., v. 44, no. 1, p. 81.

R. W. Imlay, 1952, Geol. Soc. America Bull., v. 63, no. 9, chart 8C. Shown on correlation chart above Mormon sandstone and below Hull agglomerate. Middle Jurassic.

Occurs on southwest slope of Mount Jura, Taylorsville area.

Moonstone Rhyolite

Tertiary: Southwestern Texas.

D. L. Amsbury, 1957, Dissert. Abs., v. 17, no. 9, p. 1981. Named in a stratigraphic sequence as younger than Shely group (new) and older than Petan trachyte (new).

Moore Formation

Pennsylvanian (Atokan): Southern Oklahoma (subsurface).

R. H. Wheeler, 1947, World Oil, v. 127, no. 7, p. 156, 161. Name applied to subsurface limestone and shale sequence that underlies overlapping

Deese rocks and overlies successively truncated Mississippian formations from the Caney and Mayes to the Woodford shale. Consists of two members: an upper siliceous, glauconitic, dense brown limestone thickening southward from 50 feet in West Moore to a maximum of 150 feet, and a lower sandy black calcareous shale with a maximum thickness of 180 feet; variations in thickness of the members are due to truncation of the limestone and onlap of the shale.

Occurs in structurally low area centering in northern McClain County between down-faulted South and West Moore structures and the structurally high Lindsey area to the south. Has not been penetrated to north on Oklahoma City uplift.

Moorefield Formation

Moorefield Shale[1]

Upper Mississippian: Northern Arkansas and central eastern Oklahoma.

Original reference: G. I. Adams, 1904, U.S. Geol. Survey Prof. Paper 24, p. 26.

Mackenzie Gordon, Jr., 1944, Am. Assoc. Petroleum Geologists Bull., v. 28, no. 11, p. 1627–1631. Moorefield in Batesville district, Independence County, Ark., consists of lower member of black calcareous shale and limestone and upper member of dark fissile clay shale; lower member has been known as Spring Creek limestone (name preoccupied) and grades laterally into chert that has been mapped incorrectly as Boone chert. Recommended that name Moorefield formation be restricted to lower member, and that name Ruddell shale be erected for upper member.

G. G. Huffman and others, 1958, Oklahoma Geol. Survey Bull. 77, p. 14 (fig. 2), 45, 49–61, pls. 1–4. Described on flanks of Ozark uplift in northeastern Oklahoma where it is divided into four facies of member rank (ascending) Tahlequah, Bayou Manard, Lindsey Bridge, and Ordnance Plant. Advisability of application of term Ruddell to rocks in Oklahoma is questionable at this time; hence, above terminology is applied to its probable equivalent. Unconformably underlies Hindsville formation; unconformably overlies Keokuk formation or, in some areas, the Reeds Spring formation or the Chattanooga shale.

Named for Moorefield, Independence County, Ark.

Moorehouse Member (of Onondaga Limestone)

Middle Devonian: New York.

W. A. Oliver, Jr., 1954, Geol. Soc. America Bull., v. 65, no. 7, p. 628–629, 637, 642. Medium-gray, very fine grained limestone beds separated by thin shaly partings in many places; chert common, more abundant in upper nonshaly half. In west-central New York, limestone is coarser and lighter colored than in central area and seems to contain fewer impurities. Thickness 20 to 25 feet in type area; maximum about 50 feet. Underlies Seneca member: overlies Nedrow member (new) with transitional contact.

Type locality: On southwest extremity of Moorehouse Flats at Onondaga County Prison quarry one-half mile south of County Penitentiary at Jamesville, Onondaga County. Not recognized east of Winfield quadrangle.

Mooretown Formation

Mooretown Sandstone (in Chester Group)[1]

Mooretown Sandstone Member (of Renault Formation)

Upper Mississippian: Southern Indiana and central and western Kentucky.

Original reference: E. R. Cumings, 1922, Handb. Indiana Geology, pt. 4, Sep. Pub. 21, p. 408, 515, chart.

R. E. Stouder, 1938, Am. Assoc. Petroleum Geologists Bull., v. 22, no. 3, p. 268 (fig. 1), 269, 270, (fig. 3), 271, 272. In Meade, Hardin, and Breckinridge Counties, Ky., Mooretown sandstone is considered member of Renault formation. Underlies Beaver Bend limestone member; overlies an unnamed limestone member at base of formation. Maximum thickness 75 feet.

J. M. Weller and A. H. Sutton, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 5, p. 825; J. M. Weller and others, 1948, Geol. Soc. America Bull., v. 59, no. 2, chart 5 (column 76). Considered member of Renault formation in Indiana.

C. A. Malott, 1952, Stratigraphy of Ste. Genevieve and Chester formations of southern Indiana: Ann Arbor, Mich. The Edwards Letter Shop, p. 7, 12–13, 101. Renault formation of standard Chester column has triple expression in southern Indiana (ascending) Paoli limestone, Mooretown sandstone, and Beaver Bend limestone. Each of these is a distinct stratigraphic unit in parity with other formations of the Chester and deserves a name in its own right. Underlies Beaver Bend limestone; in Putnam County, overlapped by Pennsylvanian sandstone. At type locality, about 21 feet of Mooretown is exposed; exposure does not show overlying Beaver Bend.

D. J. McGregor, T. G. Perry, and W. J. Wayne, 1957, Indiana Geol. Survey Field Conf. Guidebook 9, p. 6. Name Bethel formation here used in place of Mooretown sandstone. Bethel has priority and wider usage. Name Mooretown is incorrectly spelled and refers to village that no longer exists; formation is not dominantly sandstone and is not completely exposed at type locality designated by Malott (1952).

T. G. Perry and N. M. Smith, 1958, Indiana Geol. Survey Bull. 12, p. 24, pl. 1. Mooretown sandstone in Indiana is 5 to 30 feet thick; characteristically about 15 to 20; maximum 65. Normal lithology is fine-grained friable tan to dark-brown iron-stained sandstone resting on Paoli limestone; *Stigmaria* common in this zone; dark-gray to black carbonaceous shale, constitutes upper part. Ratio of sandstone to shale ranges from none of either to equal parts of both. Underlies Beaver Bend limestone.

Type locality: SW¼SE¼ sec. 3, T. 3 N., R. 2 W., roadcut north side of State Road 60, about one-fourth mile east of old village site of Mooretown, Lawrence County, Ind.

Mooreville Chalk (in Selma Group)

Mooreville Tongue (of Selma Chalk)[1]

Upper Cretaceous; Northeastern Mississippi and western Alabama.

Original reference: L. W. Stephenson, 1917, Washington Acad. Sci. Jour., v. 7, p. 243–250.

H. R. Belt and others, 1945, Geologic map of Mississippi (1:500,000): Mississippi Geol. Survey; W. H. Monroe and D. H. Eargle, 1946, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 50. Rank raised to formation in Selma group. Includes Arcola limestone member at top. Unconformably overlies Tombigbee sand member of Eutaw formation; underlies Demopolis chalk.

Named for exposures at Mooreville, Lee County, Miss.

Mooringsport Formation (in Trinity Group)

Mooringsport Member (of Rusk Formation)

Lower Cretaceous (Comanche Series): Subsurface in Louisiana, Arkansas, and Texas.

R. W. Imlay, 1940, Arkansas Geol. Survey Inf. Circ. 12, p. 36–37, cross sections. Includes dominantly marine shale and limestone lying above Ferry Lake anhydrite and below red shales and sands of Paluxy formation. Corresponds to Upper Glen Rose formation. Thickness as much as 800 feet. Type section to be described in forthcoming paper.

J. M. Forgotson, Jr., 1957, Am. Assoc. Petroleum Geologists Bull., v. 41, no. 10, p. 2357–2359. Rank reduced to member status in Rusk formation (new). Redefined as that stratigraphic interval and its recognizable equivalent above Ferry Lake anhydrite and below top of first limestone bed within Trinity group in Mooringsport field area of Caddo Parish, La.

Representative section is in Union Producing Co.'s Noel Estate well No. 1–A, Mooringsport field, sec. 11, T. 19 N., R. 16 W., Caddo Parish, La. Top of member 825 feet below top of Trinity group.

Moorman Ranch Formation

Moorman Ranch Member (of Pequop Formation)

Permian (Leonardian to early Guadalupian): Eastern Nevada and western Utah.

J. S. Berge, April 1960, Brigham Young Univ. Research Studies, Geology Ser., v. 7, no. 5, p. 11 (fig. 3). (Footnote and stratigraphic chart refers to Steele's article in Intermountain Assoc. Petroleum Geologists Guidebook 11th Ann. Field Conf.) Name appears on correlation chart credited to Steele (unpub. thesis). Overlies Pequop formation; underlies "Kaibab" limestone of Park City group.

Grant Steele, June 1960, Dissert. Abs., v. 20, no. 12, p. 4635. In eastern Great Basin. Leonardian to earliest Guadalupian marine limestone and dolomite sedimentation, modified by two episodes of evaporited precipitation, is represented by Moorman Ranch formation (new), the unnamed Summit Springs evaporite succession and Hermit and Toroweap formations.

H. J. Bissell, 1960, Am. Assoc. Petroleum Geologists Bull., v. 44, no. 8, p. 1427 (chart). In Moorman Ranch area overlies Pequop formation.

Grant Steele, 1960, Intermountain Assoc. Petroleum Geologists Guidebook 11th Ann. Field Conf., p. 93 (chart 1), 106. (Road logs dated Sept. 8–10.) Rank reduced to member status in Pequop formation. Referred to as lower and upper Moorman Ranch. In Moorman Ranch section, basal 1,750 feet of Pequop is referred to as Lower Moorman Ranch member. Lower member composed of grayish-orange to yellowish-tan micro- to fine-crystalline, thin- to medium-bedded limestone and thin interbeds of dark-yellowish-orange, fine-grained sandstone and silt; lower Leonardian age fusilinids present throughout unit. Disconformably underlies Upper Moorman Ranch member; conformably overlies Riepetown sandstone (new). Upper member is 1,050 feet thick with lower 850 feet assigned to upper Leonardian, and remaining 200 feet lower Guadalupian in age. Underlies Loray formation.

Moorman Ranch section is in T. 17 N., R. 59 E., White Pine County, Nev.

Moosalamoo Phyllite[1]

Moosalamoo Member (of Mendon Formation)

Precambrian: West-central Vermont.

Original reference: Arthur Keith, 1932, Washington Acad. Sci. Jour., v. 22, p. 362, 395.

P. H. Osberg, 1952, Vermont Geol. Survey Bull. 5, p. 28, 30, 34, 35. Reduced to member of Mendon formation. A lenticular body of schist in upper part of formation; absent in some areas. Thickness featheredge to about 900 feet. Grades upward into Cheshire quartzite. Lower Cambrian. This unit termed "mica schist" member of Mendon series (Whittle, 1894).

Named for thickest exposures on slopes of Moosalamoo Mountain, East Middlebury-Rochester area.

Moose Creek Beds[1]

Upper Ordovician: Northern New York.

Original reference: R. Ruedemann, 1925, New York State Mus. Bull. 258.

Well exposed along Moose Creek, Lewis County.

†Moose Island Shale[1] or Series[1]

Silurian: Southeastern Maine.

Original reference: N. S. Shaler, 1886, Am. Jour. Sci., 3d, v. 32, p. 51, 58.

Named for exposures on Moose Island, southeastern coast of Washington County.

Moose Lake Conglomerate

Precambrian (Knife Lake Series): Northeastern Minnesota.

J. T. Stark and V. G. Sleight, 1939, Geol. Soc. America Bull., v. 50, no. 7, p. 1032 (table 2), 1038 (fig. 4). Shown on stratigraphic column and on map legend as occurring at base of Knife Lake series. Thickness 1,700 feet. Underlies Dike Lake slate (new); unconformable above Ely greenstone. [Text describes Saddlebag Lake conglomerate at this horizon.]

J. W. Gruner, 1941, Geol. Soc. America Bull., v. 52, no. 10, p. 1583 (table 1), 1593. Greenstone conglomerate, called Moose Lake by Stark and Sleight (1939) and described by them as Saddlebag conglomerate, occurs in Twin Peaks area where it lies directly on [Ely] greenstone; farther north, gray and flinty slate lies directly on the same greenstone mass, because there is a fault between the slate and the greenstone conglomerate. In this report, the Knife Lake series is divided into 20 members. Table of approximate chronological sequence (ascending) shows Disappointment Mountain and Moose Lake greenstone conglomerates as unit 3 occurring above flinty slates and below Jasper Lake greenstone conglomerates.

Occurs in Kekequabic and Ogishkemuncie Lakes area [Cook County].

Moose River Group

Moose River Sandstone[1]

Lower and Middle Devonian: Western Maine.

Original reference: H. S. Williams, 1900, U.S. Geol. Survey Bull. 165, p. 21–22, 88–92.

P. M. Hurley and J. B. Thompson, Jr., 1950, Geol. Soc. America Bull., v. 61, no. 8, p. 837, 838, pl. 1. Chiefly gray- or buff-weathering sandstone. Gray sandy slates interbedded with sandstones. Few thin beds of impure limestone associated with slates. Age designated Lower Devonian in text, and Lower to Middle Devonian on geologic map (pl. 1).

Named for exposures near Moose River and Moose River settlement, Somerset County.

Moosic[1] (formation

Upper Devonian: Eastern Pennsylvania.

Original reference: G. H. Chadwick, 1933, Pan-Am. Geologist, v. 60, no. 2, p. 104–105.

In Moosic Mountain, west of Pocono Plateau.

Mooyie Argillite[1] or Formation[1]

Precambrian: Idaho, and British Columbia, Canada.

Original reference: R. A. Daly, 1905, Canada Geol. Survey Summ. Rept. 1905, p. 96–100.

Named for its situation on Moyie [Mooyie] River, northeast Idaho and British Columbia.

Moppin Metavolcanic Series

Precambrian: Central northern New Mexico.

Fred Barker, 1958, New Mexico Bur. Mines Mineral Resources Bull. 45, p. 1, 10, 14–21, pl. 1. Consists largely of greenschist and amphibolite with other less abundant rock types including conglomerate, phyllite, gneiss, and schist. Thickness from 1,000 to several thousand feet. Series is intruded by sills and dikes of Burned Mountain metarhyolite (new) and by sills, dikes, and plutonic masses of Maquinita granodiorite (new) and Tres Piedras granite (new). These rocks were called Hopewell series by Just (1937), but are herein renamed because Hopewell is preempted.

Named after exposures in upper Spring Creek just north of Moppin Ranch. Exposed in a northwest trending belt extending from Hopewell to Cow Creek, American Creek, and in part, the southeast part of Kiawa Mountain, Las Tablas quadrangle.

Moqui Member (of Moenkopi Formation)

Triassic: Northeastern Arizona.

E. D. McKee, 1954, Geol. Soc. America Mem. 61, p. 18, 19. Siltstones and claystones, most of them shaly or fissile, and gypsum beds, lenses, nodules, and veins. Strata dominantly olive gray, though pale reddish brown locally common. Thickness, as shown on table, ranges from 20 to 144 feet. Generally light color in contrast to red brown of Wupatki member below and Holbrook member above. Units here called Wupatki and Moqui were referred to as Salt Creek by Hager (1922, Mining and Oil Bull., v. 8, no. 2).

In Poverty Tank-Concho area.

Mora sandstone[1]

Cretaceous: Central northern New Mexico.

Original reference: C. R. Keyes, 1909, Econ. Geology, v. 4, p. 368–369.

Named for Rio Mora, Santa Fe County.

Moraga Formation[1] or **Tuff** (in Berkeley Group)

Pliocene: Western California.

Original reference: A. C. Lawson, 1914, U.S. Geol. Survey Geol. Atlas, Folio 193.

N. L. Taliaferro, 1951, California Div. Mines Bull. 154, p. 143. Interbedded with overlying Siesta and interfingers with underlying Orinda. In Bald Peak syncline where Siesta thins to less than 50 feet, Moraga volcanics are almost in contact with Bald Peak lavas.

D. E. Savage, B. A. Ogle, and R. S. Creely, 1951, (abs.) Geol. Soc. America Bull., v. 62, no. 12, pt. 2, p. 1511 Included in sequence of formations (in west-central Contra Costa County) for which new group name is proposed [name not given] Sequence (ascending) Orinda, Moraga, Siesta, Bald Peak, and an unnamed formation. Unnamed unit is exposed east of Moraga fault system in fault contact with Siesta and Moraga formations: [See Contra Costa group.]

D. E. Savage and O. E. Bowen, 1955, *in* Geol. Soc. America Cordilleran Sec. [Guidebook] Apr. 28–30, Trip 2, p. 2, 3. Road log (between Oakland and Mount Diablo) mentions (1) flow contact of Orinda formation with lower member of Moraga volcanic series (lower member is also locally called Grizzly Peak basalt); (2) prominent, light-colored, water-laid tuff bed in Moraga volcanics; east-dipping bed is in west limb of synclinal structure; (3) depositional contact between east-dipping flows of Moraga volcanics and conformable lake beds of Siesta formation; (4) depositional contact between steeply west-dipping Siesta lake beds and lower member of Moraga volcanics on east limb of syncline; (5) reappearance of light-colored tuff bed in Moraga volcanics in west limb of syncline; (6) contact of Moraga volcanics with conglomerate of Orinda formation along crest of sharp, asymmetrical anticline, Moraga volcanics stand almost vertical whereas Orinda sediments dip east at angles around 45°.

Named for Moraga Valley, Contra Costa County.

Morales Member (of Santa Margarita Formation)[1]

Morales Formation

Miocene, upper: Southern California.

Original reference: W. A. English, 1916, U.S. Geol. Survey Bull. 621, p. 191–215.

T. W. Dibblee, Jr., *in* Chester Stock, 1948, Southern California Acad. Sci. Bull., v. 46, pt. 2, p. 84. Section exposed in Apache Canyon, Ventura County, divided into (ascending) Caliente, Apache, and Morales formations. Morales consists of gray sand, conglomerate, and clays. Pleistocene.

D. E. Savage, 1957, (abs.) Geol. Soc. America Bull., v. 68, no. 12, pt. 2, p. 1845. Shown on chart of formations of Caliente Range, [Ventura County]. Thickness 1,000 feet. Nonfossiliferous. Overlies Quatal formation. Age probably Plio-Pleistocene.

M. L. Hill, S. A. Carlson, and T. W. Dibblee, Jr., 1958, Am. Assoc. Petroleum Geologists Bull., v. 42, p. 2974 (fig. 1), 2978 (fig. 3), 2990 (fig. 8), 2996–2998. Rank raised to formation. At designated type locality, about 2,750 feet thick and consists of basal conglomerate 0 to 50 feet thick; alternating claystone, sandstone, and gravel about 1,300 feet; and sandstone and gravel about 1,400 feet. South of Cuyama River, lower part of Morales consists of about 1,300 feet of gray gypsiferous claystones of lacustrine origin (mapped as Santa Margarita by English, 1916, and as Pleistocene lake beds by Eaton and others, 1941, Am. Assoc. Petroleum Geologists Bull., v. 25, no. 2) which are conformably overlain by 1,500 feet of sand and gravel (here mapped as Cuyama formation by English, 1916, and included in Pleistocene fans by Eaton and others, 1941). Along south margin of Cuyama Valley, between Castro and Santa Barbara

Canyons, as much as 1,000 feet of Morales sandstone, gravels, and claystone (mapped as Cuyama by English, 1916) are exposed and lie directly on Santa Margarita sandstone. In Cuyama Badlands, the Morales (here mapped as Santa Margarita by English, 1916) is approximately 4,200 feet thick and consists of an upper unit (2,200 feet) of coarse gray incoherent conglomerate made up of debris of granitic, gneissic, quartzitic rocks, schist, basalt, sandstone, and white shale; and a lower unit (2,000 feet) of pebble-conglomerate-sandstone with similar debris, and interbeds of gray sandy siltstone resting conformably on Quatal formation. Regionally, Morales is unconformably overlain by Pleistocene alluvial fans; in Cuyama Valley, unconformably overlain by Pleistocene fanglomerates; in northern Cuyama Badlands and Carrizo Plain, overlain by Pleistocene Paso Robles formation. Probably of Pliocene age.

Type locality: From Whiterock Bluff eastward through sec. 25, T. 11 N., R. 28 W., and sec. 30, T. 11 N., R. 27 W., Caliente Mountain quadrangle. Name derived from Morales Canyon.

Moran Formation (in Wichita Group)[1]

Moran Group

Lower Permian (Wolfcamp Series) : Central and central northern Texas.

Original reference: F. B. Plummer, 1919, Am. Assoc. Petroleum Geologists Bull., v. 3, p. 135–145.

M. G. Cheney, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 1, p. 66 (fig. 1), 93. Rank raised to group. Includes (ascending) Dothan, Horse Creek, and Sedwick formations. Underlies Putnam group; overlies Pueblo group (redefined).

R. C. Moore *in* M. G. Cheney, 1948, Abilene Geol. Soc. [Guidebook] Spring Field Trip, June 11–12, p. 13, sheets 3, 4. Formation includes (ascending) Watts Creek shale, Gouldbusk limestone (new), Santa Anna shale, and Sedwick limestone members.

R. C. Moore, 1949, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 80, sheet 2. Described in Colorado River valley where it is about 100 feet thick. Overlies Pueblo formation; underlies Putnam formation. [Includes members as listed in above reference.] Wolfcamp age.

P. T. Stafford, 1960, U.S. Geol. Survey Bull. 1081–G. p. 270. Formation is 155 to 220 feet thick in Brazos River valley. Overlies Pueblo formation; underlies Putnam formation. Only upper member, Sedwick limestone, recognized in area.

Named for Moran, Shackelford County.

†Moran Limestone Member (of Moran Formation)[1]

Permian: Central northern Texas.

Original reference: F. B. Plummer, 1919, Am. Assoc. Petroleum Geologists Bull., v. 3, p. 133–145.

Named for Moran, Shackelford County.

Morapos Sandstone Member (of Mancos Shale)[1]

Upper Cretaceous: Northwestern Colorado.

Original references: E. T. Hancock, 1923, U.S. Geol. Survey Press Memo. 16037, with map; 1925, U.S. Geol. Survey Bull. 757.

Kenji Konishi, 1959, Rocky Mountain Assoc. Geologists 11th Field Conf., Symposium, p. 67–69. Consists of thin-bedded sandstone 15 to 75 feet thick, with well-defined top and poorly defined base that merges into sandy shale. Forms conspicuous escarpment in Axial and Monument Butte quadrangles, where it is about 1,000 to 1,200 feet below Mancos-Mesaverde contact and about 1,000 to 1,100 feet above top of Meeker sandstone member (new). Separated from overlying Loyd sandstone member (new) by two sandstone tongues of Mancos.

Named for outcrops in vicinity of Morapos Creek, Routt County.

Moravian Heights Formation

Precambrian: Eastern Pennsylvania.

D. M. Fraser *in* B. L. Miller, D. M. Fraser, and R. L. Miller, 1939, Pennsylvania Geol. Survey, 4th ser., Bull. C-48, p. 163 (fig. 30), 170–175, 182–183, pl. 1. Light-gray to light-greenish rocks which contain streaks of sericite and sillimanite. Thickness uncertain as in many areas unit contains much injected material. Considered to be approximately same age as Franklin limestone; in Chestnut Hill area, occurs in plot of irregular width adjacent to the Franklin; no contacts between the two observed but both are injected and altered by Byram granitic material. Conformable above Pochuck gneiss and both formations strike N. 50° E. and dip northwest at an angle of 59°. This superposition of Moravian Heights gives no indication of relative periods of origin as all Precambrian rocks have been extensively disturbed; the Pochuck may be older, younger, or interbedded with the Moravian Heights. Name credited to B. L. Miller and E. T. Wherry.

Occurs on south slope of Chestnut Hill north of Easton, Northampton County, in Fairview School ridge, south of Easton, and in other scattered areas through Precambrian area which extends toward Reading.

Moreau Gravels

Pleistocene (pre-Wisconsin): North-central South Dakota.

J. C. Mickelson and C. L. Baker, 1950, Areal geology of the Mouth of Moreau quadrangle (1:62,500): South Dakota Geol. Survey; J. C. Mickelson and A. D. Klein, Jr., 1952, Areal geology of the Cheyenne Agency quadrangle (1:62,500): South Dakota Geol. Survey. Fluvial sand and gravel terrace deposits in old Missouri River flood plain. Overlain by 0 to 20 feet of loess.

Mapped in Dewey and Walworth Counties.

†Moreau Sandstone[1]

Lower Ordovician (Beekmantown): Central Missouri.

Original reference: A. Winslow, 1894, Missouri Geol. Survey, v. 6, p. 331, 370–375.

Named for Moreau Creek, Cole County.

Morehead facies (of Brodhead Formation)

Lower Mississippian: Central Kentucky.

P. B. Stockdale, 1939, Geol. Soc. America Spec. Paper 22, p. 76, 177–191. Constitutes northeastern outcropping phase of Brodhead formation. Dominant lithology is blue-gray, greenish-gray to drab siltstone. Thickness ranges from 195 feet, where it merges with Irvine facies (new) in Powell County, to 270 feet in northwestern Greenup County. Comprises Christy Creek siltstone, Frenchburg siltstone, Haldeman siltstone, Perry Branch siltstone, and Indian Fort shale members (all new) of Brodhead formation. Underlies Floyds Knob formation and overlies New Providence formation, Stanton and Bluestone facies (both new).

Type section: Along road leading to U.S. Forest Tower; bottom of section at intersection with Dry Creek road, 1½ miles southeast of Morehead; top of section at tower, 1½ miles east-southeast of Morehead, Rowan County. Named for Morehead, county seat.

Morehouse Formation

Pennsylvanian (?) : Subsurface in Louisiana and Arkansas.

R. W. Imlay, 1940, Arkansas Geol. Survey Inf. Circ. 12, p. 7–8, cross sections. Name selected by Shreveport Geological Society to designate 1,190 feet of marine silty shales and thin siltstones penetrated at depths of from 9,285 to 10,475 feet in type well. Underlies Eagle Mills formation apparently conformably and gradationally. Base not determined. Probably Jurassic.

R. W. Imlay and J. S. Williams, 1942, Am. Assoc. Petroleum Geologists Bull., v. 26, no. 10, p. 1672–1673. Fauna indicates late Paleozoic age; probably not older than Pennsylvanian.

R. T. Hazzard, W. C. Spooner, and B. W. Blanpied, [1947], Shreveport Geol. Soc. 1945 Ref. Rept., v. 2, p. 484 (table 1), 486. Morehouse, in this report, considered younger than Eagle Mills. Underlies Werner formation (new). Permian.

W. S. Hoffmeister and F. L. Staplin, 1954, Am. Assoc. Petroleum Geologists Bull., v. 38, no. 1, p. 158–159. Middle to Upper Pennsylvanian. This determination made on basis of study of plant spores in interval from 10,243 to 10,253 feet in type well.

E. D. McKee and others, 1956, U.S. Geol. Survey Misc. Geol. Inv. Map I–175. Neither relation of Morehouse to overlying and underlying formations, nor its position relative to Eagle Mills formation is clear. Three interpretations suggested: Eagle Mills older than Morehouse; Morehouse older than Eagle Mills; units separated by fault of unknown dip and displacement. Second interpretation is followed in this report.

Type well: Union Producing Co. Tensas Delta No. 1–A well, sec. 8, T. 22 N., R. 4 E., Morehouse Parish, La.

Morehouse Quartzite[1]

Cambrian (?) : Southwestern Utah.

Original reference: B. S. Butler, 1913, U.S. Geol. Survey Prof. Paper 80.

T. B. Nolan, 1943, U.S. Geol. Survey Prof. Paper 197–D, p. 152. In this report, Morehouse quartzite is assigned in part to the Silurian, but it is probably of Cambrian age.

Type locality: Morehouse Canyon, northwest of Frisco, Beaver County.

Morena Rhyolite[1]

Tertiary: Southwestern Nevada.

Original reference: F. L. Ransome, 1909, U.S. Geol. Survey Prof. Paper 66, p. 28, 46.

Occurs on Morena Ridge, Goldfield district.

Morenci Shale[1]

Upper Devonian: Southeastern Arizona.

Original reference: W. Lindgren, 1905, U.S. Geol. Survey Prof. Paper 43.

Present in vicinity of Morenci and at other places in Clifton-Morenci region.

Moreno Formation[1] or Shale[1] (in Chico Group)

Moreno Group

Upper Cretaceous and Paleocene(?): Southern California.

Original reference: R. Anderson and R. W. Pack, 1915, U.S. Geol. Survey Bull. 603.

R. T. White, 1938, (abs.) Geol. Soc. America Proc. 1937, p. 256–257. In Tumey Hills region, disconformably underlies Lodo formation (new).

F. M. Anderson, 1941, (abs.) Geol. Soc. America Bull., v. 52, no. 12, pt. 2, p. 1943. Regarded as group in Chico series.

M. B. Payne, 1941, (abs.) Geol. Soc. America Bull., v. 52, no. 12, pt. 2, p. 1953–1954; 1951, California Div. Mines Spec, Rept. 9, p. 7–11, pls. 2–5. Subdivided in type area. Includes four members (ascending): Dosados sand and shale, Tierra Loma shale (including Mercy sandstone lens), Marca shale, and Dos Palos shale (includes Cima sandstone lens). Members mapped as lithogenetic units for distance of 35 miles. On basis of mapping, it is concluded that Anderson and Pack (1915) show base of Moreno in Ortigalita Creek some 1,800 feet stratigraphically lower than their type Moreno in Moreno Gulch. Thickness about 3,700 feet. Underlies Paleocene glauconitic sandstone; overlies Panoche formation.

I. F. Wilson, 1943, California Jour. Mines and Geology, v. 39, no. 2, p. 204–205. Described in San Benito quadrangle where it is exposed in a narrow belt along northeast side of Butts Ranch syncline. Thickness 300 to 650 feet. Conformably overlies Call sandstone member (new) of Panoche group; relationship to Big Oak Flat shale member (new) of Panoche not certain as the two are not in contact.

A. S. Huey, 1948, California Div. Mines Bull. 140, p. 31–33. Replaced by Moreno Grande formation (new) in Tesla quadrangle.

J. E. Schoellhamer and D. M. Kinney, 1953, U.S. Geol. Survey Oil and Gas Inv. Map OM–128. Described in Tumey Hills region. Moreno-Lodo boundary discussed. Upper Cretaceous and Paleocene.

O. T. Marsh, 1960, California Div. Mines Spec. Rept. 62, p. 28–29, pls. 1, 2. Formation, in Orchard Peak area, crops out only as single arctuate band of brown shale in Devil's Den syncline. This is southernmost surface exposure known. Not known which of Payne's members is represented at Devil's Den. Maximum exposed thickness, 900 feet, is on north limb of syncline. Formation thins southeastward to about 230 feet near eastern end of outcrop belt. Conformably overlies Red Man sandstone (new); underlies upper Eocene Canoas siltstone member of Kreyenhagen shale.

Typically exposed in Moreno Gulch on east flank of Panoche Hills, Fresno County. Moreno Gulch is 8 miles northwest of Panoche Creek.

Moreno Grande Formation

Upper Cretaceous: Central western California.

N. L. Taliaferro, 1944, Am. Assoc. Petroleum Geologists Bull., v. 28, no. 4, p. 472. Name proposed for original Moreno and part of underlying Panoche formation. Name credited to A. S. Huey (unpub. ms.).

A. S. Huey, 1948, California Div. Mines Bull. 140, p. 16 (fig. 2), 31–33, pls. 1, 2, 3. Described as consisting of siliceous, argillaceous, and sandy shale, sandstone beds, limestone concretions, and locally, buff sandstone at top. Thickness as much as 650 feet. As defined, the Moreno Grande, north of

Pacheco Pass, comprises the Moreno as mapped by Anderson and Pack (1915); southward to Coalinga region, the formation comprises the restricted Moreno, Brown Mountain sandstone, and the Ragged Valley (*Pachydiscus* silt) as members. Unconformably underlies Tesla formation; overlapped by Cierbo formation on the north; contact with underlying Panoche not well exposed but appears to be conformable and gradational. Along southside of Corral Hollow, the Moreno Grande dips steeply northward at angles of 60° to 80° into a syncline.

Occurs in Tesla quadrangle which comprises about 240 square miles in parts of Alameda and San Joaquin Counties.

Moretown Formation

Middle Ordovician: Central Vermont.

P. H. Osberg, 1952, Vermont Geol. Survey Bull. 5, p. 116. Name used only on correlation chart. Lower Cambrian. Underlies Cram Hill formation; overlies Stowe formation (new).

W. M. Cady, 1956, U.S. Geol. Survey Geol. Quad. Map GQ–79. Described in Montpelier quadrangle as chiefly granulite, quartzite, phyllite, and slate. Laminated quartz-albite-sericite-chlorite granulite, known as "the pinstripe," most characteristic. Underlies unnamed metamorphics in map area; in some areas, underlies Shaw Mountain formation; overlies Stowe formation, zone of transition as much as 500 feet. Is subdivision of Missisquoi group of Richardson (1924). Ordovician. Type locality given.

A. L. Albee, 1957, U.S. Geol. Survey Geol. Quad. Map GQ–102. In Hyde Park quadrangle overlies Umbrella Hill formation (new).

Named for typical occurrence in eastern Moretown Township on east slope of Northfield Mountains, Montpelier quadrangle.

Morgan Formation[1]

Morgan Formation (in Durst Group)

Morgan Sandstone

Middle Pennsylvanian: Northeastern Utah and western Colorado.

Original reference: E. Blackwelder, 1910, Geol. Soc. America Bull., v. 21, p. 519, 529–542.

K. G. Brill, Jr., 1944, Geol. Soc. America Bull., v. 55, no. 5, p. 632–633. Name Morgan formation is applied to several hundred feet of red and white fine-grained sandstone with intercalated shale and crystalline marine limestone that lie between the Mississippian and the Weber quartzite in Moffat County, Colo. Thickness 941 feet near Elk Springs; more than 1,500 feet on Cross Mountain with top not exposed. Fauna indicates Morgan is of Des Moines age. Sediments have been referred to as "older Pennsylvanian" by earlier workers.

A. J. Eardley, 1944, Geol. Soc. America Bull., v. 55, no. 7, p. 832–833. Referred to as Morgan sandstone. At type locality herein noted, lies below type Weber quartzite and above Brazer limestone. Thickness about 1,000 feet at Round Valley.

A. A. Baker, J. W. Huddle, and D. M. Kinney, 1949, Am. Assoc. Petroleum Geologists Bull., v. 33, no. 7, p. 1179–1182. In Uinta basin, Morgan formation, 400 to about 1,400 feet thick, consists of lower limestone unit and an overlying interbedded gray to red limestone and sandstone unit. Contains fusulinids of Lampasas or Morrow age in lower part and of Des Moines age in upper part. Overlies Mississippian; underlies Weber sandstone.

M. D. Crittenden, Jr., B. J. Sharp, and F. C. Calkins, 1952, Utah Geol. Soc. Guidebook 8, p. 10–11. Doughnut formation (new) includes parts of Morgan formation as defined by Calkins (1943, U.S. Geol. Survey Prof. Paper 201).

C. P. Abrassart and G. A. Clough, 1955, Intermountain Assoc. Petroleum Geologists Guidebook 6th Ann. Field Conf., p. 65, 67–70 [jointly with Rocky Mountain Association of Geologists]. Formaton, in Juniper Mountain area, Colorado, divisible into three mappable members: lower, predominantly sandstone, 66½ feet; middle, thick limestones, nodular limestones, and intercalated shales, 427 feet; upper, thick limestones, sandstones, and some shale and limestone conglomerate beds, 525 feet. Aggregate thickness about 1,019 feet. Section measured west to east, from west entrance of Yampa River Canyon. Overlies Madison formation. Lower Pennsylvanian.

Walter Sadlick, 1955, Wyoming Geol. Assoc. Guidebook 10th Ann. Field Conf., p. 50 (table 1), 57–58. In Uinta Mountains, term Morgan formation stratigraphically restricted below to exclude lower member herein named Round Valley formation. As thus restricted, the Morgan essentially corresponds to definition of type Morgan. Underlies Weber sandstone. The Morgan pinches out eastward at expense of Hells Canyon formation. Thus, the Hells Canyon replaces the Morgan formation eastward.

Walter Sadlick, 1957, Intermountain Assoc. Petroleum Geologists Guidebook 8th Ann. Field Conf., p. 70, 71–75. Included in Durst group (new).

Type locality: In Round Valley, east of town of Morgan, Morgan County, Utah.

Morgan Series[1]

Lower Devonian: West Virginia.

Original reference: G. H. Ashley, 1923, Eng. and Mining Jour.-Press, v. 115, p. 1106–1108.

Probably named from Morgan County.

Morgan Corners Formation[1] or Dolomite

Lower Ordovician: Northwestern Vermont, and southeastern Quebec. Canada.

Original reference: H. W. McGerrigle, [1931], Vermont State Geologist 17th Rept., p. 182, 184, 185.

J. A. Dresser and T. C. Denis, 1944, Quebec Dept. Mines Geol. Rept. 20, v. 2, p. 396, 397–398. Overlies Wallace Creek limestone; underlies Hastings Creek limestone. Thickness 150 feet. Phillipsburg series.

Exposed from northern part of St. Albans quadrangle, Vermont, across the international border for about 20 miles into Quebec.

Morgan Creek Limestone Member (of Wilberns Formation)

Upper Cambrian: Central Texas.

Frederick Romberg and V. E. Barnes, 1944, Geophysics, v. 9, no. 1, p. 88, fig. 7 (geol. map); P. E. Cloud, Jr., V. E. Barnes, and Josiah Bridge, 1946, Texas Univ. Bur. Econ. Geology Pub. 4301, p. 149, 155, pl. 4 [1945]. Red limestone at base grading upward into gray limestone. Underlies Point Peak shale member (new); overlies Welge sandstone member (new). Name credited to Josiah Bridge and V. E. Barnes.

Josiah Bridge, V. E. Barnes, and P. E. Cloud, Jr., 1947, Geol. Soc. America Bull., v. 58, no. 1, p. 114–115, pls. 1, 2. Consists of medium- to coarse-grained abundantly glauconitic well-bedded limestone; lower part commonly reddish, the red tones becoming less pronounced and grading upward into gray or greenish-gray limestone; in many sections, there is a shaly zone in upper part of member; in areas where limestone above this shale is thin, boundary is arbitrarily chosen; individual layers of limestone are from 4 inches to 1 foot or more thick, and thickness of any one bed is rather uniform. Thickness ranges from about 70 feet in Point Peak and Carter Ranch sections to about 160 feet in Salt Branch section; at type section about 110 feet.

P. E. Cloud, Jr., and V. E. Barnes, 1948, Texas Univ. Bur. Econ. Geology Pub. 4621, p. 155, 188, 225, 254, 310 [1946]. Local stratigraphy described.

Type section: On the point just north of junction of north and south forks of Morgan Creek, Burnet County.

Morgan Ranch Formation (in Wassuk Group)

Pliocene, middle and upper (Hemphillian-Blancan): Western Nevada.

D. I. Axelrod, 1956, California Univ. Pubs. Geol. Sci., v. 33, p. 33–36, 66–67, figs. 2, 3, 4. Consists of three mappable lithologic units (ascending): pumice—thickness 10 feet; sandstone and breccia—thickness 100 feet; fanglomerate—thickness 590 feet. Aggregate thickness 700 feet. In conformable contact with underlying Coal Valley formation (new). In fault contact with granitic basement which rims Coal Valley basin at the west. Further study may indicate desirability of retaining separate names for Morgan Ranch formation and Smith Valley beds (new), though they now appear to be facies of same basin of deposition.

Named for exposures in the region extending from one-half mile to over 4 miles south of Morgan's Ranch, Hawthorne quadrangle.

Morgantown Member (of Conemaugh Formation)[1]

Pennsylvanian: Pennsylvania.

Original reference: M. E. Johnson, 1929, Pennsylvania Geol. Survey Tpog. and Geol. Atlas 27.

Pittsburgh quadrangle.

Morgantown Red Bed (in Conemaugh Formation)[1]

Morgantown redbed member

Pennsylvanian: Western Maryland, western Pennsylvania, and eastern Ohio.

Original reference: C. K. Swartz, 1922, Maryland Geol. Survey, v. 11, pl. 6.

M. T. Sturgeon and others, 1958, Ohio Geol. Survey Bull. 57, p. 94 (table 11), 151. Member of Little Clarksburg cyclothem in report on Athens County. Swartz (1922) called redbeds that are a facies of Morgantown sandstone the Morgantown redbed. Name should apparently be applied to redbeds below or at position of Morgantown shale and sandstone. It is possible that redbeds in stratigraphic position of Morgantown are a tongue belonging to Clarksburg redbed above. Where more or less continuous redbed lithology extends from or below Elk Lick member to Clarksburg members or even higher, name Clarksburg is used in this report. Thickness about 12 feet. Conemaugh series.

Morgantown Sandstone Member (of Conemaugh Formation)[1]

Morgantown Sandstone (in Conemaugh Group)

Morgantown sandstone and shale member

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

Original reference: J. J. Stevenson, 1876, Pennsylvania 2d Geol. Survey Rept. K.

W. O. Hickok 4th and F. T. Moyer, 1940, Pennsylvania Geol. Survey, 4th ser., Bull. C–26, p. 78, 97, fig. 21. Separated from overlying Clarksburg red shale by Lonaconing coal and clay; and from underlying Barton limestone by Barton coal. Thickness 50 to 80 feet in Fayette County. Included in Conemaugh group.

D. L. Norling, 1958, Ohio Geol. Survey Bull. 56, p. 10 (fig. 3), 58–59, geol. map. In Morgan County, Morgantown sandstone and shale member (Conemaugh series) includes strata from Birmingham shales to base of Clarksburg limestone. Basal boundary indefinite because of absence of the Elk Lick member, and replacement, at least locally, of a part or all of the Birmingham by sandstone. Where Clarksburg limestone is absent, the Morgantown cannot be differentiated from overlying Connellsville sandstone. When Clarksburg and Birmingham members are present Morgantown member is 15 to 20 feet thick; in areas of sandstone development, thickness varies from 15 to 60 feet, depending upon how low stratigraphically the sandstone sequence begins.

M. T. Sturgeon and others, 1958, Ohio Geol. Survey Bull. 57, p. 94 (table 11), 151. Shale and sandstone member of Little Clarksburg cyclothem in report on Athens County. Occupies position between Elk Lick and Clarksburg members and locally may be replaced by redbed. Sandstone which Condit (1912, Ohio Geol. Survey, 4th ser., Bull. 17) assigned to Morgantown member is now believed to belong to Upper Grafton member. Average thickness of true Morgantown shale and sandstone about 21 feet. Conemaugh series.

Named for Morgantown, Monongalia County, W. Va.

Morita Formation[1] (in Bisbee Group)

Lower Cretaceous (Comanche Series): Sonora, Mexico, and southeastern Arizona.

Original reference: F. L. Ransome, 1904, U.S. Geol. Survey Prof. Paper 21, p. 56, 63–65.

A. A. Stoyanow, 1949, Geol. Soc. America Mem. 38, p. 12, 13. Underlies Lowell formation (new).

James Gilluly, 1956, U.S. Geol. Survey Prof. Paper 281, p. 70–73. Described in central Cochise County, Ariz., where it is present only in Mule Mountains. Thickness 715 feet; thickens southward into Mexico. Gradationally overlies Glance conglomerate; underlies Mural limestone.

Named for Morita Hills, just south of international boundary, between longs 109°45′ and 109°50′, in Sonora, Mex.

Mormon Sandstone[1]

Mormon Formation

Middle Jurassic: Northern California.

Original reference: J. S. Diller, 1892, Geol. Soc. America Bull., v. 3, p. 370–394.

R. W. Imlay, 1952, Geol. Soc. America Bull., v. 63, no. 9, p. 976, chart 8C (column 92). Shown on correlation chart as underlying unnamed volcanic rocks and overlying Thompson limestone.

P. A. Lydon, T. E. Gay, Jr., and C. W. Jennings, 1960, Geologic map of California Westwood sheet (1:250,000): California Div. Mines. Mapped with Middle and (or) Lower Jurassic marine sedimentary and metasedimentary rocks.

Named for exposures at Mormon Station, an old stage route near Taylorsville, Plumas County.

Morning Glory Limestone Member (of Gold Hill Formation)[1]

Cambrian: Central Nevada.

Original reference: H. G. Ferguson, 1924, U.S. Geol. Survey Bull. 723.

Exposed near Morning Glory mine, Manhattan district.

Moroni Formation

Tertiary, middle or upper: Central Utah.

S. L. Schoff, 1938, Ohio State Univ. Abs. Doctors' Dissert. 25, p. 381–382. Consists of varied pyroclastic rocks (thought to be largely water-laid); metamorphosed tuff, breccia, volcanic conglomerate, green sandstones, and conglomerates. Thickness varies; maximum about 1,500 feet. Overlaps all older exposed formations: in places the relief on the unconformity amounts to 1,000 feet in less than 1 mile.

Named for the town of Moroni, with type locality at The Cliff, nearby.

Morovis Limestone

Eocene: Puerto Rico.

R. C. Mitchell, 1956, Am. Assoc. Petroleum Geologists Bull., v. 40, no. 12, p. 2971. Name applied to siliceous fine-grained limestones, intermingled with reddish brecciated limestones, and fine-grained dense blue-gray limestones at locality along Morovis-La Torrecilla Road. On lithologic ground, this Morovis limestone could be correlated with Corozal limestone. Kaye (1956, Am. Assoc. Petroleum Geologists Bull., v. 40, no. 1) suggests that Paleocene-Eocene boundary may pass through his Corozal exposures, the Eocene lying west of the northwest-striking outcrops, and thus the Morovis would be higher stratigraphically.

Described from locality along Morovis-La Torrecilla Road; paved road going south 2 kilometers before Torrecilla leading to Barrio Pasto.

Morphy[1]

Morphy Shale Member (of Canajoharie Shale)

Middle Ordovician: Eastern New York.

Original reference: Rudolf Ruedemann and G. H. Chadwick, 1935, Science, new ser., v. 81, no. 2104, p. 400.

Rudolf Ruedemann, 1947, Geol. Soc. America Mem. 19, p. 118. Referred to as Morphy shale member of Canajoharie; lowermost member; underlies Sprakers shale.

Type locality and derivation of name not given but may have been named from Morphy Creek near Amsterdam in Montgomery County.

Morrill Limestone Member (of Beattie Limestone)

Morrill Limestone (in Council Grove Group)[1]

Permian: Eastern Kansas and southeastern Nebraska.

Original reference: G. E. Condra, 1927, Nebraska Geol. Survey Bull. 1, 2d ser., p. 234, 235, 237.

R. C. Moore, J. C. Frye, and J. M. Jewett, 1944, Kansas Geol. Survey Bull. 52, pt. 4, p. 166. Uppermost member of Beattie limestone. Overlies Florena shale member; underlies Stearns shale. Consists of brown to gray impure cellular limestone that, in northern part of outcrop area, contains a thin shale parting; in southern Kansas, thickens mainly as a result of algal accumulations in upper part. Thickness 2 to 8 feet. Wolfcamp series.

M. R. Mudge and H. R. Burton, 1959, U.S. Geol. Survey Bull. 1068, p. 13 (table 2), 76, pls. Thickness 3¼ to 7½ feet in Wabaunsee County, Kans. Overlies Florena shale member; underlies Stearns shale.

Type locality: West and one-half mile north of Morrill, Brown County, Kans.

Morris Granite[1]

Precambrian: New York.

Original reference: H. P. Cushing, 1907, New York State Mus. 60th Ann. Rept., pt. 2, p. 482, 510, 525, map.

Named for occurrence on west slopes of Mount Morris, Franklin County.

Morris Ferry Greensand[1]

Upper Cretaceous (Gulf Series): Southwestern Arkansas and southeastern Oklahoma.

Original reference: R. T. Hill, 1888, Arkansas Geol. Survey Ann. Rept. 1888, v. 2, p. 89.

Crops out near low-water line of river at Morris' Ferry on Little River, in northern edge of Little River County, Ark.

Morris Mountain Shaly Member (of Logan Formation)[1]

Mississippian: Northeastern Kentucky.

Original reference: Charles Butts, 1922, Kentucky Geol. Survey, ser. 6, v. 7, p. 46.

P. B. Stockdale, 1939, Geol. Soc. America Spec. Paper 22, p. 229. "Morris Mountain shaly member of the Logan formation" of northeastern Kentucky, which has been regarded as topmost division of New Providence, is combination of an uppermost shale member, Indian Fort (new), of Brodhead formation (new) and a basal shale unit, Rothwell (new), of Muldraugh formation (new) with an intervening Floyds Knob horizon. "Morris Mountain shaly member" should be discarded as a single stratigraphic unit.

Named for Morris Mountain, about 4 miles north of Stanton, Powell County.

Morrison Formation[1]

Upper Jurassic: Colorado, Arizona, Kansas, Montana, New Mexico, Oklahoma, South Dakota, Utah, and Wyoming.

Original reference: G. H. Eldridge, 1896, U.S. Geol. Survey Mon. 27. [Formation was named by Eldridge in this monograph, within the area of which is its type locality; but Pikes Peak folio, by W. Cross, in which the formation was also described was published in 1894, before publication of the monograph.]

N. H. Darton, 1904, Geol. Soc. America Bull. v. 15, [no. 8], p. 388. Thickness of Morrison as much as 150 feet in Black Hills region. Absent to the southeast where its place apparently is represented by an unconformity of erosion on surface of Unkpapa sandstone. Unconformably underlies Lakota sandstone. Formation has been known as "Atlantosaurus beds" and Beulah shale.

C. A. Fisher, 1909, U.S. Geol. Survey Bull. 356, p. 28–30, pls. 1, 7. Morrison formation, which is extensively exposed along Rocky Mountain Front Range in southern Montana and Wyoming, is also believed to occur along northern base of Little Belt Mountains. In previous investigations in this field by Weed and others, Morrison formation has not been recognized, and beds comprising it have been grouped with the Kootenai and included in "Cascade" formation. During fieldwork for present study, dinosaur bones provisionally regarded as of Jurassic age were found at several localities; at one exposure, sec. 3, T. 16, N., R. 2 E., about 30 feet below bone-bearing bed, a green shale containing fresh-water fauna later than Ellis formation was observed. These rocks, here provisionally regarded as constituting Morrison formation, consists of sandstone and bright-colored sandy shale with scattered layers of impure limestone, many of them lenticular in form. Lies with apparent conformity on the Ellis and overlain conformably by the Kootenai. Thickness 60 to 120 feet. Future investigation may prove that rocks here tentatively regarded as Morrison constitute in reality a basal member of the Kootenai.

W. R. Calvert, 1909, U.S. Geol. Survey Bull. 390, p. 22–24. Morrison formation has not previously been recognized in Lewiston coal field, although Weed and Pirsson (1898, U.S. Geol. Survey 18th Ann. Rept., pt. 3) suggested that certain beds in Judith Mountain district might be equivalent of Morrison of Colorado and Wyoming. In area of present report, Morrison consists of shales, sandstones, and argillaceous limestones, all apparently of fresh-water origin. Greens and pinks are predominating colors. Thickness about 125 feet. Overlies Ellis formation; underlies Kootenai. No suggestion of unconformity noted at either base or top. Lines of delimitation somewhat uncertain, especially as regards upper limit. Top of Morrison is believed to be marked by persistent sandstone member 10 to 15 feet thick, in which bone fragments are found. Above this member, beds are distinctly arenaceous and are mapped as Kootenai on account of their lithology and of occurrence of Lower Cretaceous plants a short distance from their base.

G. W. Stose, 1912, U.S. Geol. Survey Geol. Atlas, Folio 186. Lowest formation exposed in Apishapa quadrangle, Colorado. Consists of red, green, and drab blocky shale or argillite, soft sandstone, and thin beds of limestone. Thickness about 120 feet. Underlies Purgatoire formation (new) which was formerly regarded as part of Dakota sandstone. Jurassic or Cretaceous.

G. I. Finlay, 1916, U.S. Geol. Survey Geol. Atlas, Folio 203. In Colorado Springs quadrangle, formation consists of fresh-water marl that includes many lenticular bodies of limestone and thin beds of sandstone. Maximum thickness 245 feet, near Colorado City. Unconformably overlies Lykins formation, a relation that is not very apparent in Colorado Springs quadrangle but is evident elsewhere. Conformably underlies Lytle sandstone member (new) of Purgatoire formation. Jurassic or Cretaceous.

W. T. Lee, 1920, Am. Jour. Sci., 4th ser., v. 49. no. 219, p. 183–188. Type section of Morrison redefined. Strata originally assigned to Morrison include some that are equivalent to an older formation (Sundance of Jurassic) and others at top which contain fossil plants of Upper Cretaceous type. Section at Morrison comprises 10 units (numbered in descending order 1–10). Units 1–5 are Dakota group, 265 feet thick. Units 6 and 7 are Morrison formation, 160 feet thick. Units 8–10 are Sundance formation, 17 feet thick. According to G. L. Cannon, who accompanied writer [Lee] and who assisted in work on Denver Monograph [27], Nos. 1–3 of section were regarded as the two sandstones of the Dakota and the shale as the "Dakota fire clay." Other geologists have followed this usage, and when the "lower Dakota" and shale above it a few miles farther south were correlated with Purgatoire, No. 3 of Morrison section was regarded as Lower Cretaceous. No. 4 (100 feet thick) of section is part of Morrison as originally defined yet it contains fossil plants which Knowlton described as belonging to "Dakota flora." Unit 5 (10 feet thick) is conglomeratic sandstone—Saurian conglomerate—containing dinosaur bones and pebbles of quartz and jasper; sharply separated from underlying shale.

W. T. Lee, 1927, U.S. Geol. Survey Prof. Paper 149, p. 17, pl. 1. At Morrison, Colo., type locality of Morrison formation, rocks were once assigned to this formation which do not belong there—at base 17 feet or more of orange sandstone which is now known to be unconformable with overlying Morrison and underlying Lykins, and at top nearly 200 feet of beds younger than Morrison. Reasons for revision of type section were given by Lee (1920), but thicknesses given in present paper should replace those previously published. Cretaceous(?).

James Gilluly and J. B. Reeside, Jr., 1928, U.S. Geol. Survey Prof. Paper 150–D, p. 81–82, measured sections. In San Rafael Swell, Utah, formation is 415 to 847 feet thick; includes Salt Wash sandstone member near base. Overlies Summerville formation of San Rafael group; underlies Dakota(?) sandstone. Lower Cretaceous(?).

W. S. Burbank, 1930, Colorado Sci. Soc. Proc., v. 12, no. 6, p. 171–173. Described in Ouray district, Colorado. Comprises the middle limestone and upper sandstone members of the "La Plata sandstone" of Cross and entire thickness of "McElmo" formation as these two formations are defined by Cross and Howe in Ouray folio. Thickness 700 to 750 feet. Comprises a basal limestone, sandstone, and shale member, herein named Wanakah, a middle sandstone member, and an upper shale member. Underlies Dakota(?) sandstone; overlies Upper(?) Jurassic sandstone. Lower Cretaceous(?).

A. A. Baker, C. H. Dane, and J. B. Reeside, Jr., 1936, U.S. Geol. Survey Prof. Paper 183, p. 9–10, 32–44, 58–63, charts. Discussion of correlation of Jurassic formations of parts of Utah, Arizona, New Mexico, and Colorado. Morrison formation is interpreted as including, besides the more usual variegated mudstones (McElmo formation of many authors), in New Mexico the Todilto limestone and beds heretofore called "Navajo" sandstone (Zuni sandstone of Dutton) and in Colorado beds formerly assigned to middle and upper La Plata sandstone by Cross and others. Age of Morrison has for many years been topic for debate, and literature bearing on it has been extensive. Mook (1916, New York Acad. Sci. Ann. Rept., v. 27) listed over 200 papers describing or discussing the formation, not including those of purely descriptive paleontology and considerable numbers have been added since 1916. Several writers have assigned to beds here included in Morrison formation an age widely different in one area from that assigned in another area. For example, the Morrison (of present report) of southeastern Utah has been called "early Jurassic", while the Morrison (of present report) of northeastern Utah has been called on a later page of same paper "late Jurassic." Present writers see no basis for such separation but consider formation everywhere of essentially same age—late Upper Jurassic. Discussion of history of nomenclature.

H. E. Gregory, 1938, U.S. Geol. Survey Prof. Paper 188, p. 58–59, 36 (table), pls. Formation in San Juan country, Utah, subdivided into (ascending) Bluff sandstone, Recapture shale, Westwater Canyon sandstone, and Brushy Basin shale members (all new). Thickness as much as 1,415 feet. Overlies Summerville(?) formation of San Rafael group; underlies Dakota(?) sandstone. Upper Jurassic.

M. I. Goldman and A. C. Spencer, 1941, Am. Assoc. Petroleum Geologists Bull., v. 25, no. 9, p. 1751–1765. Formation in La Plata Mountains, Colo., comprises (ascending) Pony Express limestone, Bilk Creek sandstone (new). Wanakah marl (restricted), and Junction Creek sandstone (new) members. Overlies Entrada sandstone.

W. L. Stokes, 1944, Geol. Soc. America Bull., v. 55, no. 8, p. 951–992. Formation in and adjacent to Colorado Plateau currently includes diverse lithic units, many of which cannot properly be included if limitations of type section and relationships to other formations are considered. Todilto limestone, Bluff sandstone, Wanakah marl. Pony Express limestone, and Bilk Creek sandstone can be correlated with San Rafael group and dated as Upper Jurassic by the marine beds in the group. Salt Wash sandstone, Brushy Basin shale, Recapture sandstone, and Westwater Creek sandstone are considered equivalent to type Morrison and have yielded vertebrate remains which are almost certainly Jurassic. Succeeding these are two new formations, Buckhorn conglomerate, and Cedar Mountain shale, which have yielded no fossils but are tentatively classed as Lower Cretaceous.

W. A. Waldschmidt and L. W. LeRoy, 1944, Geol. Soc. America Bull., v. 55, no. 9, p. 1097–1114. Revised type section proposed. Subdivided into six lithologic units. Basal sandstone unit, 7 feet of buff massive locally crossbedded coarse- to medium-grained calcareous sandstone, conglomeratic in lower part; north from type locality unit thickens to at least 30 feet. Gray and red shale unit, represents lower 55 feet of Morrison. Gray clay and limestone unit, an interbedded series of gray clays and gray lithographic fresh-water limestones, 49¾ feet thick. Gray shale and sandstone unit, 51½ feet thick. Red shale unit 36¾ feet thick; most highly colored interval in formation. Sandstone and shale unit 76½ feet thick; variegated sandy shales, maroon most prevalent, constitute about 30 percent of interval. Formation, as herein described, is cartographic unit between Dakota sandstone as originally defined by Eldridge (1896) and strata assigned to probable Sundance by Lee (1920) which have in part been assigned to Ralston formation (new). Morrison, as defined in present report, is considered Jurassic. There has been controversy regarding position of Morrison-Dakota boundary. Lee (1920), in a somewhat confusing paper, redefined Morrison at its type locality. It appears that in his reconsideration he erroneously interpreted Eldridge's Morrison-Dakota boundary to be somewhat stratigraphically higher than Eldridge had originally indicated. Consequently, Lee proposed that the contact be lowered to Eldridge's original boundary. Later Lee (1927) reexamined Dakota and Morrison formations near Morrison, Colo. In this work, he designated the lowest Dakota unit as the "Lower Sandstone" (10 to 40 feet) and described it as "massive, conglomeratic." This boundary corresponds to that proposed in present report. As herein defined, the Morrison lies with apparent disconformity below conglomeratic phase of Dakota as defined by Eldridge (1896) and Lee (1927) and overlies disconformably the red, sandy shales assigned by various workers to Lykins formation. At some localities, basal sandstone of Morrison is in juxtaposition with strata that have been correlated by Lee (1920) with Sundance (Jurassic) and which have been included in Ralston formation.

W. A. Cobban, R. W. Imlay, and J. B. Reeside, Jr., 1945, Am. Assoc. Petroleum Geologists Bull., v. 29, no. 4, p. 451–453. Morrison formation overlies Ellis formation at type section of Ellis. Here the Morrison is 110 feet thick.

W. A. Cobban, 1945, Am. Assoc. Petroleum Geologists Bull., v. 29, no. 9, p. 1269–1270, 1290. In Sweetgrass arch, Montana, the Ellis is raised to group rank to include (ascending) Sawtooth, Rierdon, and Swift formations. Overlying Ellis group are continental beds of Upper Jurassic and Lower Cretaceous age. Thickness ranges from 348 feet in Flat Coulee oil field on north side of Sweetgrass Hills to about 1,300 feet along Rocky Mountain Front near Craig. Beds are divisible into three major rock units. Lowest unit consists chiefly of fine-grained rocks, largely clay shale and mudstone, dense gray limestone, and fine- to very fine-grained gray and brown sandstones. Dominant color greenish-gray. Unit is as much as 310 feet thick and rests conformably on Swift formation. Along Little Belt Mountains and west to Craig, top of unit is either coal bed or black carbonaceous clay and mudstone. Charophyte oogonia and ostracods from lower part of unit show definite Morrison (Jurassic) affinities. This unit is assigned to Morrison formation and the two overlying units to Kootenai. West of Kevin-Sunburst dome, the Kootenai rests unconformably on Morrison, Swift, and Rierdon formations. An understanding of this unconformity is important in interpretation of Morrison-Kootenai beds.

R. W. Brown, 1946, Am. Assoc. Petroleum Geologists Bull., v. 30, no. 2, p. 238–248. Discussion of fossil plants and Jurassic-Cretaceous boundary in Montana and Alberta, Canada. Cobban's (1945) studies demonstrate presence of erosional interval that marks unconformity between Morrison and older Jurassic formations and a basal sandstone or conglomerate of Kootenai formation in vicinity of Cut Bank, Mont. Extended southeastward toward Great Falls and Lewistown, this horizon corresponds with a level at or just above the coal bed that occurs in basal part of unit now known as Kootenai in Montana (originally named Yellowstone formation and then Dakota sandstone by Weed [1899, U.S. Geol. Survey Geol. Atlas, Folio 45]). This coal is 75 feet, more or less, above stratum that Fisher (1909) and Calvert (1909) considered to be top of Morrison, the 75-foot sequence consisting of unfossiliferous soft greenish or reddish sandy shale. In Montana, the Morrison (called Cascade formation by Weed, 1899), as defined by Fisher and Calvert, is practically barren of plant fossils throughout most of its sequence. Among lower and middle strata are beds of platy marly limestone that contains oogonia of alga, *Chara*. If the Morrison be enlarged to include the 75 feet, more or less, of basal beds hitherto referred to the Kootenai, that is, all the greenish shales and coal, with its associated dark shale, up to the unconformity of Cobban, then a small florule of ferns, cycads, and conifers becomes available for comparison with the flora found in the overlying strata. This enlarged Morrison is most likely equivalent in whole or in large part to Kootenay of Canada; and Kootenai of the United States corresponds in large part with lower Blairmore of Canada.

H. D. Thomas and M. L. Krueger, 1946, Am. Assoc. Petroleum Geologists Bull., v. 30, no. 8, p. 1255–1293. Jurassic formations of western Uinta Mountains are (ascending) Nugget sandstone, Twin Creek limestone, Preuss redbeds, Stump sandstone, and Morrison formation. Eastward along mountains, the Nugget persists but is called Navajo on east, Twin Creek limestone intertongues with Carmel redbeds, Preuss redbeds grade into crossbedded Entrada sandstone, Stump sandstone grades into Curtis shales and limestones, and Morrison thins and becomes less conglomeratic.

A. A. Baker, C. H. Dane, and J. B. Reeside, Jr., 1947, Am. Assoc. Petroleum Geologists Bull., v. 31, no. 9, p. 1664–1667. Report is revised correlation of Jurassic formations of parts of Utah, Arizona, New Mexico, and Colorado. Todilto limestone is excluded from Morrison, and also the gypsum as being probably an evaporite related to withdrawal of Upper Jurassic sea. Massive sandstone above the Entrada at Todilto Park, at Navajo Church near Fort Wingate, at Lupton, and elsewhere in northern Arizona seems most probably a facies of Morrison formation.

J. W. Huddle and F. T. McCann, 1947, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 75. Formation, in Duchesne and Wasatch Counties, Utah, is 1,450 to 1,550 feet thick and consists of multicolored lenses of shale, sandstone, siltstone, conglomerate, and a few thin beds of fresh-water limestone. Overlies Curtis formation, contact appears conformable but not gradational. Underlies Dakota sandstone. Contact with overlying Cretaceous rocks concealed throughout area.

W. L. Stokes and D. A. Phoenix, 1948, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 93. Described in San Miguel and Montrose Counties, Colo., where it is about 350 feet thick and includes Salt Wash sandstone and Brushy Basin shale members. Underlies Burro Canyon formation (new).

E. B. Eckel and others, 1949, U.S. Geol. Survey Prof. Paper 219, p. 9 (table), 30. Morrison formation, in La Plata district, Colorado, is restricted to strata above Junction Creek sandstone which is herein given formation rank, and below Dakota(?) sandstone. As restricted, formation is 400 to 625 feet thick. The Wanakah, formerly included in Morrison is also given formation rank and includes Pony Express limestone and Bilk Creek sandstone as members. These latter units were considered members of Morrison by Goldman and Spencer (1941).

J. T. Stark and others, 1949, Geol. Soc. America Mem. 33, p. 49–50, pl. 1. Described in South Park, Colo., where it is 250 to 360 feet thick. Along the Dakota Hogback, the formation rests unconformably upon Garo sandstone (new) and is in turn unconformably overlain by Dakota sandstone. Along eastern side of the park, the Morrison overlaps the Precambrian; near Hartsel overlaps the Garo, Maroon, and Precambrian.

C. T. Smith, 1951, New Mexico Geol. Soc. Guidebook 2d Field Conf., p. 13; 1954, New Mexico Bur. Mines Mineral Resources Bull. 31, p. 15–18. In Thoreau quadrangle, McKinley and Valencia Counties, Morrison formation comprises (ascending) Chavez member (new), Prewitt sandstone member (new), and Brushy Basin shale member. Overlies Thoreau formation (new); underlies Dakota(?) formation.

K. G. Brill, 1952, Geol. Soc. America Bull., v. 63, no. 8, p. 828. Believed that unit termed Bullington conglomerate member of Magdalena by Ray and Smith (1941) is coarse-grained facies of Morrison.

Teng-Chien Yen and J. B. Reeside, Jr., 1952, U.S. Geol. Survey Prof. Paper 233–B, p. 22–25, pls. Report contains summary of stratigraphy of formation and systematic description of molluscan fauna.

H. D. Miser and others, 1954, Geologic map of Oklahoma (1:500,000) : U.S. Geol. Survey. Mapped in Cimarron County.

L. C. Craig and others, 1955, U.S. Geol. Survey Bull. 1009–E, p. 127–168. Morrison formation has been recognized over most of western interior of United States; except where removed by erosion, it is present over all of Colorado, eastern Utah, northwestern New Mexico, and part of northeastern Arizona. Over most of western interior, the Morrison has not been divided into members. In western Colorado, eastern Utah, northeastern Arizona, and northwestern New Mexico, formation can be separated into lower and upper part, each of which has two members. Arbitrary line separating undifferentiated Morrison of central Colorado from subdivided Morrison to the west extends irregularly from northwestern Colorado to south-central Colorado. This line is approximately the limit of recognizable Salt Wash member. Lower part consists solely of Salt Wash member in most of eastern Utah and western Colorado and solely of Recapture member in most of northeastern Arizona and northwestern New Mexico. These members interfinger and grade into each other over a broad area, in vicinity of Four Corners. Upper part of Morrison consists of Westwater Canyon and Brushy Basin members. Westwater Canyon member constitutes lower unit of upper part in southern part of region of study. Brushy Basin member is present over most of region of study. East of arbitrary line marking limits of recognizable Salt Wash the Morrison is undifferentiated. Area of undifferentiated Morrison includes all central and eastern Colorado and extends eastward into western Kansas to a subsurface pinchout of formation. This area includes type section of formation, near Morrison, Colo., where formation is nearly 300 feet thick (section described by Waldschmidt and LeRoy, 1944). Northward from type section into Wyoming, the Morrison can be divided roughly into three units: lower unit of thin-bedded gray shale and limestone with charophyte oogonia and ostracods, a medial unit of crossbedded sandstone and conglomerate with dinosaurian remains, and an upper unit of variegated shale. West of type section, in central Colorado basin, the Morrison consists of claystone beds with thin intercalated limestone and sandstone beds. Dense limestones are abundant in this area but are lenticular and cannot be correlated with type section. Formation thins over crest of Uncompahgre uplift. Base of Morrison defined in Colorado Plateau region as base of terrestrial fluvial Jurassic deposits overlying beds of marine or marginal marine San Rafael group. Detailed criteria for selecting contact vary from one area to another. Lower Cretaceous beds overlie Morrison in Colorado, eastern Utah, small area in northeastern Arizona, and northern New Mexico. In the past, these beds have been included in either Morrison formation or Dakota sandstone, depending on basis of their characteristics and affinities in different areas. In southeastern Colorado and northeastern New Mexico, the Purgatoire separates the Morrison and Dakota. In north-central Colorado, beds usually called Dakota probably contain equivalents of Lower Cretaceous Cloverly of Wyoming. In Four Corners area and northward through western Colorado and easternmost Utah, Burro Canyon formation has been recognized as separate formation of Early Cretaceous age. In central Utah, the Cedar Mountain formation (Stokes, 1944) forms widespread Lower

Cretaceous unit. No field evidence for major disconformity has been recognized at base of Lower Cretaceous strata.

K. M. Waagé, 1955, U.S. Geol. Survey Prof. Paper 274–B, p. 23–26. In northern Front Range foothills, Colorado, the Morrison underlies Lytle formation of Dakota group. Morrison-Lytle contact is indefinite in many places because (1) conglomeratic beds are not persistently present at base of Lytle, and (2) rocks in upper part of Morrison are similar to those in the Lytle. Both the new and the old type sections of Morrison have indefinite upper contacts. Not all six informal units recognized by Waldschmidt and LeRoy in new type section can be identified away from Alameda Parkway section, and a more generalized subdivision of the Morrison is necessary for northern Front Range foothills. Their [Waldschmidt and LeRoy's] two middle units make up most characteristic part of Morrison, a light- to greenish-gray marl and claystone with intercalated thin limestone beds and a few thin calcareous sandstone lenses. This zone occupies 100 feet or more of the Morrison throughout Front Range foothills and includes dinosaur-bearing beds as well as beds containing freshwater molluscan fauna (Yen, 1952, U.S. Geol. Survey Prof. Paper 233–B). Above these undoubted Morrison strata, the sequence locally consists of dominantly red variegated silty claystone with lenses of sandstone, the whole too variable laterally to permit division into useful subunits. At many localities, discontinuous lenses of conglomerate occur approximately at contact of the dominantly red variegated beds and the underlying greenish-gray beds. The Lytle is similar to upper dominantly red variegated zone of Morrison and differs only in its local predominance of sandstone and conglomeratic sandstone, in the somewhat lighter hues of its variegated bed, and in the composition of its conglomerates. Three principal types of stratigraphic relationships are present at Morrison-Lytle contact along Front Range. Most obvious is formed where a thick conglomeratic sandstone lens of the Lytle rests unconformably on greenish-gray claystone and marl of undoubted Morrison. Second type is formed by basal conglomeratic sandstone lens in the Lytle resting with obvious unconformity on some part of the dominantly red variegated clay and sandstone in the upper Morrison. Exposures of this type of contact are present on scarp of hogback south of Eldorado Springs, in Turkey Creek gap south of Morrison, on scarp of hogback north of Deer Creek, and at other places throughout hogback between Boulder and Indian Creek. Third type of contact is a variation of the second type in which the contact itself is obscure because entire sequence of beds between disconformity at top of Lytle and greenish-gray claystones of undoubted Morrison consists of alternating lenses of sandstone, or conglomeratic sandstone, and variegated claystone. Indefinite contacts can be seen in Denver and Salt Lake Railroad cut at Plainview, in Eldridge's type Morrison at Morrison, and in the new type Morrison exposure in Alameda Parkway roadcut. At Plainview, five massive sandstone units, four of them conglomeratic to varying degrees, lie between disconformity at top of Lytle and the greenish-gray Morrison. Lateral tracing from Eldorado Springs section, where base of Lytle is clear cut, indicates that second lens from top in Plainview cut is in the correct relative position to be basal lens of Lytle. Indefinite contact between the Morrison and Lytle in both old and new type sections of Morrison raises question of where its upper contact was originally placed. Eldridge's (1896) definition of Morrison did not include measured section and his description of upper limit has been interpreted in different ways. Lee's idea that Eldridge included plant-bearing beds of the Dakota in his original description of the Morrison has been accepted by many geologists (Stokes, 1944; Reeside, 1952); others (Waldschmidt and LeRoy, 1944) contend that Lee misinterpreted Eldridge and that the Morrison-Dakota contact as defined by Eldridge is acceptable. Lee placed the Morrison-Dakota contact at base of ledge-forming sandstone capping the Dakota hogback at Morrison, a horizon above middle of gray shale-bearing part of Dakota group in this area. In terms of nomenclature introduced in present report, this horizon is base of Kassler sandstone member of South Platte formation (both new) of Dakota group. Comparison of the relative thicknesses of the units described by Eldridge demonstrates that he could not have included any of plant-bearing Dakota in his type Morrison. Eldridge gives average thickness of 200 feet for the Morrison; consequently the part of formation he refers to as "upper third" can be expected to be about 60 or 70 feet thick. In section measured by writer [Waagé] at Morrison, 65 feet of variegated clay and sandstone, including a weakly conglomeratic sandstone, lie between the dominantly greenish-gray Morrison and the probable base of the Lytle. Actually, the Morrison is about 270 feet thick at type locality, not 200, but even a third of this larger figure would not make the upper third of the Morrison more than 100 feet thick. If Lee's interpretation is applied to the section at Morrison, the "upper third" of the Morrison is 228 feet thick, and the formation as a whole is between 350 and 300 feet, about double Eldridge's figure. By Lee's interpretation, the overlying Dakota, said by Eldridge to be between 225 and 300 feet thick, is only 78 feet. Lee (1920) revised Eldridge's type Morrison section, placing upper contact under the so-called Saurian sandstone which marked base of upper third of Eldridge's Morrison. His stated reason for this revision was that "no obvious break was found in the section between the plant horizon and the Saurian conglomerate." In Turkey Creek section 1.8 miles south of the type Morrison, Lee (1927) placed his Morrison-Dakota contact at base of the Lytle, apparently unaware that the break he had chosen as the contact at Morrison lay some 98 feet stratigraphically below. Throughout the foothills region Lee (1927) confused the two conglomerates in zones in question and consistently placed his Morrison-Dakota contact at base of the most obvious conglomerate zone, apparently unaware that more than one zone existed. It is most likely that the Morrison-Lytle contact of present report corresponds to Eldridge's Morrison-Dakota contact. Waldschmidt and LeRoy (1944), in recommending a new type section for the Morrison, recognize that Lee (1920) misinterpreted Eldridge's Morrison-Dakota boundary. They believe that Lee corrected this error in a subsequent paper. Lee's 1927 work offers somewhat more accurate section than the estimated section presented in his 1920 work, but the two sections are obviously much the same and can be matched to show that Lee did not change the position of his Morrison-Dakota contact in his 1927 work. Consequently, the top of the Morrison as defined by Eldridge (1896) and as redefined by Lee (1927) is in different stratigraphic position, Lee's being at base of the conglomeratic zone in upper third of Eldridge's Morrison. New type section of Morrison is better exposed than Eldridge's type section, but upper contact is equally obscure. None of the many thin sandstone lenses between disconformity at top of Lytle and the greenish-gray claystones of the Morrison contain pebbles of chert and quartzite, Waldschmidt and LeRoy have chosen base of uppermost massive sandstone lens in the Lytle as top of their Morrison, but this ledge thins out into variegated claystone a short distance north of the roadcut. Chert and quartzite pebble conglomerate, presumably at base of Lytle, crop out locally along hogback north of the parkway and, when followed laterally toward the roadcut, apparently grade into conglomeratic sandstone that lies between 35 and 55 feet below Morrison-Dakota contact chosen by Waldschmidt and LeRoy. Beds between the disconformity that marks the top of Lytle formation and the greenish-gray claystones of undoubted Morrison are highly lenticular and variable in thickness and lithology. They contain two horizons at which conglomeratic lenses are locally common. Upper one of these has the thicker and more persistent conglomeratic lenses, and the unconformity at their base is herein taken as Morrison-Lytle contact. It is believed that this contact corresponds to the Morrison-Dakota contact of Eldridge. Throughout most of northern foothills the local conglomeratic lenses at base of Lytle crop out near enough to one another so that position of Morrison-Lytle contact can be interpolated between them. Where it is not possible to recognize the contact over a large area, it is expedient to map the Lytle with the Morrison as an undifferentiated unit.

J. W. Harshbarger, C. A. Repenning, and J. H. Irwin, 1957, U.S. Geol. Survey Prof. Paper 291, p. 51–55, strat. sections. In Mexican Water area, Arizona, formation comprises (ascending) Salt Wash, Recapture, Westwater Canyon, and Brushy Basin members; overlies Bluff sandstone of San Rafael group; underlies Dakota sandstone. In Fort Wingate area, New Mexico, formation comprises (ascending) Recapture, Westwater Canyon, and Brushy Basin members; overlies Cow Springs sandstone (new); underlies Dakota sandstone.

M. R. Klepper, R. A. Weeks, and E. T. Ruppel, 1957, U.S. Geol. Survey Prof. Paper 292, p. 40. At southern end of outcrop belt, Elkhorn Mountain volcanics (new) are in contact with Morrison formation.

K. M. Waagé, 1959, U.S. Geol. Survey Bull. 1081–B, p. 38–40, 50–52, measured sections. In Black Hills region, underlies Lakota formation. Measured sections show thickness 21½ to 111 feet. Position of Morrison-Lakota contact is a problem, at least locally, because of lack of persistent well-defined lithic change. At one place, contact suggests gradation and at another angular discordance. There is a possibility that beds called Morrison in Black Hills are equivalent to only part of sequence of beds embraced by type Morrison. At time Darton (1901) introduced term Morrison into Black Hills to replace Jenny's (1899) name Beulah clays, very little was known about detailed stratigraphy of the beds. In area of type Morrison, conglomeratic lenses occur chiefly at two horizons, suggesting hiatuses. One of these is at base of Lytle formation, the other at base of upper third of the Morrison. Top of Lytle is marked by the transgressive disconformity that also marks top of Lakota. Matching the breaks in the Front Range and Black Hills sequence leads to matching the Lytle with the upper Lakota and the upper third of the Morrison with the lower Lakota. This possibility is as tenable as the possibility that entire type Morrison is equivalent to Morrison in Black Hills region.

R. L. Griggs and C. B. Read, 1959, Am. Assoc. Petroleum Geologists Bull., v. 43, no. 8, p. 2003–2007. In Tucumcari-Sabinoso area, overlies Bell Ranch formation (new); underlies Tucumcari shale.

Ralph Moberly, Jr., 1960, Geol. Soc. America Bull. v. 71, no. 8, p. 1141–1145, 1151–1153, 1157, 1165. Morrison formation of Bighorn Basin, as here restricted, includes the earliest formed nonmarine sedimentary rocks [of sequence studied], conformably overlying Sundance formation. Rocks are interlensed calcareous quartz sandstones, green mudstones and shales, and subordinate limestones, with locally conspicuous red-banded mudstones. Thickness 130 to 280 feet with thinner sections generally on western side of basin. Unconformably underlies Pryor conglomerate member (new). of Cloverly formation (redefined) in outcrops from Sykes Mountain northwestward to Red dome and at some exposures on west side of basin.

Type locality: Morrison, Jefferson County, Colo. Type section (Waldschmidt and LeRoy): Exposure along north side of West Alameda Parkway roadcut SE¼ sec. 23, T. 4 S., R. 70 W., Morrison quadrangle, Jefferson County, Colo., 2 miles north of Morrison.

†Morrison Sandstone[1]

Middle Jurassic: Northern California.

Original reference: O. H. Hershey, 1904, Am. Geologist, v. 33, p. 356–360.

Trinity and Shasta Counties.

Morristown Dolomite Member[1] (of Conococheague-Copper Ridge formation)

Upper Cambrian: Eastern Tennessee.

Original reference: C. R. L. Oder, 1934, Jour. Geology, v. 42, no. 5, p. 476–478, 493, 496.

C. E. Resser, 1938, Geol. Soc. America Spec. Paper 15, p. 4, 18. Abandoned. Morristown dolomite and Bloomingdale limestone members (Oder, 1934) are parts of the Copper Ridge or Conococheague; use of these terms does not seem warranted.

Josiah Bridge, 1956, U.S. Geol. Survey Prof. Paper 277, p. 33. Oder's (1934) Morristown seems to correspond approximately to entire Copper Ridge as here delimited.

Type locality: Along U.S. Highway 25E, about 2 miles northwest of Morristown, Hamblen County.

Morrow Series

Morrow Group[1] or Formation[1]

Lower Pennsylvanian: Arkansas, Iowa, Kansas, Missouri, Nebraska, and Oklahoma.

Original reference: G. I. Adams and E. O. Ulrich, 1904, U.S. Geol. Survey Prof. Paper 24, p. 28, 109–113.

R. C. Moore and others, 1937 (abs.) Geol. Soc. America Proc. 1936, p. 93. Referred to as Morrow series.

R. C. Moore, 1937, Kansas Geol. Soc. Guidebook 11th Ann. Field Conf., p. 11–13. Referred to as Morrow subseries. Rocks of Morrow age are exposed in narrow belt along most of boundary between Mississippian and Pennsylvanian beds in northeastern Oklahoma but are not known to extend into Kansas. Unlike development of these deposits in type region, near Fayetteville, Ark., Morrow beds of Oklahoma consist almost entirely of limestone. At many places it is difficult to determine contact between limestones of Morrow age and underlying lithologically similar Pitkin limestone of Chester age. Paleontologic distinctions between these two divisions indicate that disconformity at base of Morrow strata is an important boundary. Underlies Des Moines subseries.

B. H. Harlton, 1938, Am. Assoc. Petroleum Geologists Bull., v. 22, no. 8, p. 853, 854 (fig. 1), 857–859, 861–864, 889–912. Bendian system (period) is subdivided into two series—the older, the Pushmataha (new), and the younger, the Morrow. In southern Ouachitas, the Morrow is subdivided into (ascending) Union Valley sandstone, Round Prairie formation (new), and Barnett Hill formation (new). In frontal Ouachitas and north of Arbuckles, includes (ascending) Union Valley sandstone, Primrose formation, Limestone Gap shale (new), Wapanucka formation, and Barnett Hills formation. South of Arbuckles, includes (ascending) Hale formation (Rod Club, Overbrook, Lake Ardmore), Primrose, Limestone Gap shale, Wapanucka, and Barnett Hill. As shown on chart, the Morrow comprises most of Springer group and the Dornick Hills group. Underlies Pennsylvanian Des Moines series.

M. G. Cheney, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 1, p. 81–87. Proposed four-fold division series classification of Pennsylvanian (R. C. Moore, 1932, (abs.) Geol. Soc. America Bull., v. 43, p. 279–280) does not seem adequate nor applicable. Harlton (1938) placed Stanley and Jackfork groups of "Bendian system" of southern Oklahoma in new series which he called Pushmataha with maximum aggregate thickness of more than 9,000 feet beneath 2,000 feet of beds of Morrow series. A post-Morrow and pre-Strawn series between type Marble Falls and Strawn sediments also appears necessary. Name Lampasas series is here proposed for these beds.

R. C. Moore and others, 1944, Geol. Soc. America Bull., v. 55, no. 6, p. 657–706, chart 6. In upward order, midcontinent time-rock divisions of the Pennsylvanian are designated as Morrowan, Lampasan, Desmoinesian, Missourian, and Virgilian.

M. G. Cheney and others, 1945, Am. Assoc. Petroleum Geologists Bull., v. 29, no. 2, p. 140 (chart 2), 144–146. Chart shows classification and correlation of type section Pennsylvanian section of eastern and western Pennsylvania with costandard sections of Appalachian and midcontinent regions. Midcontinent region section comprises (ascending) Springer, Morrow, Lampasas, Des Moines. Missouri, and Virgil series. Springer is used in preference to Harlton's Pushmataha series. Morrow is equivalent to New River series of Appalachian region and to most of Middle Pottsville of eastern Pennsylvania. Reference section of Morrow designated.

R. C. Spivey and T. G. Roberts, 1946, Am. Assoc. Petroleum Geologists Bull., v. 30, no. 2, p. 181–186. Lampasas is not appropriate as series name because, in its type area, it is only partly exposed and because, as redefined by Cheney and others (1945) it includes beds of Des Moines age and excludes part of Marble Falls, which is post-Morrow in age. Proposed that Atoka formation be elevated to Atoka series and defined to include all beds from top of Wapanucka limestone, Morrow series, to base of Hartshorne sandstone, Des Moines series.

C. A. Moore, 1947, Oklahoma Geol. Survey Bull. 66; p. 22–49, pls. measured sections. Report is a detailed study of outcrops of Morrow series of rocks in northeastern Oklahoma, in an area lying generally north and east of Arkansas River and east of Neosho (Grand) River. Morrow series is basal Pennsylvanian in this area and is considered middle Pottsville in age. The Morrow should be defined to include beds between the Pitkin formation of Chester series (Mississippian), and Atoka formation of Des Moines series, upper Pottsville.

R. C. Moore, 1948, Am. Assoc. Petroleum Geologists Bull., v. 32, no. 11, p. 2019. Deposits of Morrowan age are exposed in northeastern Oklahoma and are recognized in subsurface of western Kansas. In terms of fusuline zonation, Morrowan deposits are defined as belonging to zone of *Millerella*. Probably throughout northern midcontinent area, including Pennsylvanian deposits north of latitude of Tulsa, lower boundary of Morrowan series, where rocks of this age are present, coincides with major unconformity that separates Pennsylvanian from older systems. Upper boundary is well-marked disconformity in most places, but in parts of subsurface there is indication that Morrowan strata are limited above by a disconformity or nonconformity. Superjacent rocks seem definitely assignable to Desmoinesian series in parts of region, but in other parts post-Morrowan-pre-Desmoinesian beds may be differentiated.

R. C. Moore and M. L. Thompson, 1949, Am. Assoc. Petroleum Geologists Bull., v. 33, no. 3, p. 286. Ardian series (new) comprises rocks assigned to Springeran and Morrowan stages.

L. G. Henbest, 1953, Am. Assoc. Petroleum Geologists Bull., v. 37, no. 8, p. 1935–1945. Group comprises lower division of Pennsylvanian of Ozark Highlands in Arkansas and Oklahoma. Consists of limestone and clastic sediments. In Washington County, Ark., where it has its most complete development, it is 300 to 400 feet thick. Comprises Hale formation below and Bloyd shale above. Overlies rocks of late Mississippian age; underlies Atoka formation.

W. H. Bradley, 1956, Am. Assoc. Petroleum Geologists Bull., v. 40, no. 9, p. 2284–2285. In midcontinent region (including Arkansas, Iowa, Kansas, Missouri, Nebraska, and Oklahoma), U.S. Geological Survey uses the following series subdivision of the Pennsylvanian: Morrow, Atoka, Des Moines, Missouri, and Virgil. Morrow is early Pennsylvanian.

C. W. Tomlinson, 1959, *in* Petroleum geology of southern Oklahoma, v. 2: Tulsa, Okla., Am. Assoc. Petroleum Geologists, p. 6 (fig. 2), 18–25. Morrowan series, as used in this report, includes strata between Springeran series and Atokan series. It is identical in Ardmore area with Morrow series as defined by Cheney and others (1945). It includes maximum of about 2,000 feet of strata, from base of Primrose sandstone to a horizon above Otterville limestone and below Bostwick conglomerates. This is sequence of strata which Harlton (1956) designated Golf Course formation.

O. B. Shelburne, Jr., 1960, Oklahoma Geol. Survey Bull. 88, p. 17 (fig. 2), 41–44, pl. 1. Basal part of Atoka formation in Boktukola syncline is Morrowan; middle and upper parts are Atokan and are equivalent to the Atoka formation of frontal Ouachitas.

Reference section: Ardmore basin, Oklahoma. Named for Morrow, Washington County, Ark.

Morrowan Series or Stage

See **Morrow Series.**

†Morrow Creek Member (of Green River Formation)[1]

Eocene: Southern Wyoming.

Original reference: W. H. Bradley, 1926, U.S. Geol. Survey Prof. Paper 140, p. 123, chart, map.

W. H. Bradley, 1959, Am. Assoc. Petroleum Geologists Bull., v. 43, no. 5, p. 1074. Recognition of Wilkins Peak member (new) of Green River formation and its equivalence to Cathedral Bluffs tongue of Wasatch formation forces recognition of equivalence of Morrow Creek member with Schultz (1920) type Laney shale member of Green River. Name Morrow Creek is abandoned and name Laney shale member substituted.

Named for exposures in valley of Morrow Creek, Rock Springs uplift.

Morse Creek Limestone[1]

Middle Devonian: Western New York.

Original reference: A. W. Grabau, 1917, Geol. Soc. America Bull., v. 28, p. 946.

Named from Morse Creek, near Athol Springs, Erie County.

Morses Line Slate

Middle(?) Ordovician: Northwestern Vermont, and Quebec, Canada.

Phillip Fowler, 1950, Vermont Geol. Survey Bull. 2, pl. 1. Name used only on correlation chart. Underlies Highgate formation; overlies Gorge formation. Refers to Shaw (unpub. thesis, 1949).

A. B. Shaw, 1951, Jour. Paleontology, v. 25, no. 1, p. 98. Described as calcareous slate and limestone with intercalated limestone conglomerate. Includes Ordovician conglomerate previously known as "Corliss breccia" as local lens. Thickness at least 2,500 feet. Derivation of name given.

A. B. Shaw, 1958, Geol. Soc. America Bull., v. 69, no. 5, p. 523 (table 1), 532 (fig. 5), 553–554, pl. 1. Includes Corliss conglomerate as member. Estimated thickness of 2,500 feet is probably a minimum. Bounded, top and bottom, by thrusts. On the west, Morses Line slate is believed to be thrust over Highgate formation and older rocks along Gore thrust, whereas on the east formation is overridden by Oak Hill thrust. Only at St. Albans Hill does Morses Line appear to lie in sedimentary contact with Hungerford slate. Middle(?) Ordovician.

W. M. Cady, 1960, Geol. Soc. America Bull., v. 71, no. 5, p. 572, pl. 3 (correlation chart). Geographically extended into Quebec. So extended, merges northward into Stanbridge slate.

Named for town of Morses Line which lies on international boundary in northwestern ninth of Enosburg Falls quadrangle.

Mortimer Member (of Dunleith Formation)

Middle Ordovician: Northern Illinois.

J. S. Templeton and H. B. Willman, 1952, Tri-State Geol. Soc. Guidebook 16th Ann. Field Conf., p. 33, fig. 3. Shown on columnar section as underlying Rivoli member (new) and overlying Fairplay member (new).

Occurs in Dixon-Oregon area.

Morton Granite Gneiss or Quartz Monzonite Gneiss (in Minnesota Valley Granite Series)

Precambrian: Southwestern Minnesota.

G. A. Thiel and C. E. Dutton, 1935, Minnesota Geol. Survey Bull. 25, p. 88–94, pl. 5. Composed of red feldspars and dark minerals which appear mostly in form of streaks and bands; feldspars constitute larger share of rock, both orthoclase and plagioclase being abundant. Because of attractive color tones has been given a variety of trade names such as "Rainbow," "Tapestry," "Antique," and "Imperial."

E. H. Lund, 1953, Econ. Geology, v. 48, no. 1, p. 46–52. Morton granite gneiss is most widespread of a number of masses of granite and granite gneiss which are included in Minnesota River Valley granite series (new). Precambrian.

E. H. Lund, 1956, Geol. Soc. America Bull., v. 67, no. 11, p. 1477 (fig. 1), 1482–1483, pl. 1. Morton quartz monzonite gneiss is most widespread of the five rock types in Minnesota Valley granite series [formerly referred to as Minnesota River Valley granite series]. A hybrid rock formed by strewing out of basic inclusions in a granite magma. Characterized by highly contorted structure and great variety of textures and colors. Pink to dark gray, depending upon degree to which granite magma was contaminated by basic rock. Texture ranges from medium granitoid to very coarse pegmatite. Pegmatite phase does not consist of distinct veins or dikes but is dikelike in that in many places pegmatitic material cuts across earlier structure. Fort Ridgely granite (new), which occurs to the southeast, is probably a less contaminated and more massive facies of Morton gneiss. Sacred Heart granite (new) occurs to the northwest, but age relationship of the two units is not known. Sacred Heart appears to be younger.

Named for occurrence in vicinity of Morton, Renville County. Extends from near New Ulm, Brown County, to a point south of Sacred Heart, Renville County, a distance of about 50 miles.

Morton Limestone

Pennsylvanian (Virgil Series): Southeastern Nebraska, southwestern Iowa, and northeastern Kansas.

G. E. Condra and E. C. Reed, 1943, Nebraska Geol. Survey Bull. 14, p. 41–42, 43. Dark-gray to yellowish or brownish locally irregular sandy to conglomeratic fossiliferous limestone. Thickness about 2 feet. First limestone above Dover formation in Nebraska and lies between Minersville shale member of Friedrich formation and what seems to be the Dry shale.

G. E. Condra, 1949, Nebraska Geol. Survey Bull. 16, p. 14–15. Geographically extended into southwestern Iowa.

Named from outcrops at Morton stockyards in south Table Creek valley, southwest of Nebraska City, Otoe County, Nebr. Extends from near Thurman, Iowa, to northeastern Kansas but not as far as Kansas River valley.

Morton Loess

Pleistocene (Wisconsinan): Northern Illinois.

J. C. Frye and H. B. Willman, 1960, Illinois Geol. Survey Circ. 285, p. 2 (fig. 1), 7, 11. Name applied to pro-Shelbyville loess, formerly called Iowan loess. Calcareous fossiliferous yellow-tan to gray massive silt. At type section, occurs in stratigraphic succession above Farmdale silt and below Shelbyville till. Name for Iowan loess as a rock-stratigraphic unit necessary because radiocarbon dates have demonstrated that Morton loess is at least 15,000 radiocarbon years younger than type Iowan of Iowa. Woodfordian substage.

M. M. Leighton, 1960, Jour. Geology, v. 68, no. 5, p. 541. Presentation of classification of Wisconsin glacial stage of north-central United States. Paper also gives consideration to other classifications including one proposed by Frye and Willman. They proposed renaming Iowan loess, "Morton loess." Town of Morton is in central Illinois 100 miles away from where loess has its phenomenal expression at Iowan drift margin. Morton loess is referred to by Frye and Willman as "pro-Shelbyville loess" without presentation of evidence. "Pro-Shelbyville" should imply that the valley train from which loess was blown came from advancing Shelbyville glaciers. This is not true. Wood from top of Iowan loess in Farm Creek sections averages 1,700 years older than wood from very base of Shelbyville till. Because Labradorean-Iowan came from same direction as Shelbyville glacier, it is possible that Iowan loess may be in part blown from a pro-Labradorean-Iowan valley train.

Type section: Farm Creek Railroad cut, center sec. 31, T. 26 N., R. 3 W., Tazewell County. Named for town of Morton approximately 6 miles southeast of type section.

Mosalem Member (of Edgewood Dolomite)

Lower Silurian: Northeastern Iowa.

C. E. Brown and J. W. Whitlow, 1960, U.S. Geol. Survey Bull. 1123–A, p. 36–39, pl. 3. Proposed for basal member of Edgewood. Underlies Tete des Morts member (new). Unconformably overlies Neda member of Maquoketa shale. Thickness 4 to 94 feet. Member differs lithologically in areas of thin Edgewood from areas of thick Edgewood. This lithologic change is transitional, but for ease of description it is arbitrarily set where the formation is 40 feet thick. Member, where Edgewood is thick, comprises 30 to 94 feet of wavy-bedded argillaceous pale-grayish-orange to olive-gray dolomite and has chert nodules and pale-brown to olive-gray shale partings. Rocks become more argillaceous, have more shale, and are darker toward base.

Named for exposures along Niagara escarpment in Mosalem Township, Dubuque County. Due to the many variations in lithology and thickness no specific exposure can be called typical.

Mosby Sandstone Member (of Colorado Shale)

Mosby Sandstone Member (of Warm Creek Shale)[1]

Upper Cretaceous: Central northern Montana.

Original reference: C. T. Lupton and Wallace Lee, 1921, Am. Assoc. Petroleum Geologists Bull., v. 5, p. 263.

W. A. Cobban, 1953, U.S. Geol. Survey Prof. Paper 243–D, p. 45–54, pls. Member of Colorado shale. Chiefly light-gray fine to very fine grained calcareous sandstone that commonly has concretionary habit; ranges from massive to shaly in short distances and shows crossbedding and ripple marks. At recommended type section, consists of two sandstone beds 5½ feet thick separated by 11 feet of sandy shale. Member lies 743 feet below top of Colorado shale. Cenomanian ammonite fauna.

Type section: Measured east of Musselshell River from one-quarter mile east to one-half mile north of Mosby post office, in S½ sec. 2, and N½ sec. 11, T. 14 N., R. 30 E., Garfield County.

Mosca limestone[1]

Pennsylvanian: New Mexico.

Original reference: C. R. Keyes, 1906, Jour. Geology, v. 14, p. 147–154.

M. L. Thompson, 1942, New Mexico Bur. Mines Mineral Resources Bull. 17, p. 22. Keyes did not give source or definition of term Mosca limestone; therefore, term is not considered established.

Derivation of name not given.

Moscow Shale (in Hamilton Group)[1]

Middle Devonian: Western and central New York and Pennsylvania.

Original reference: J. Hall, 1839, New York Geol. Survey 3d Rept., p. 298–300.

Bradford Willard and A. B. Cleaves, 1938, Pennsylvania Geol. Survey, 4th ser., Bull. G–8, p. 13, pl. 10. Discussion of Paleozoic section in Harrisburg area. In northern part of section above and perhaps including top of thinning Montebello sandstone, and below Portage is the Moscow. It consists of 50 feet or more of dark-gray nonfissile shale with abundance of fossils, and zone of *Vitulina pustulosa* near top.

R. G. Sutton, 1951, Rochester Acad. Sci. Proc., v. 9, nos. 5–6, p. 373–380, pl. 1. Formation includes (ascending) Menteth limestone, Kashong shale, Windom shale, and Leicester marcasite (new) members. Thickness 72 feet in Batavia quadrangle [this report]. Overlies Ludlowville formation; underlies Geneseo formation. Hamilton group.

A. J. Mozola, 1951, New York State Water Power and Control Comm. Bull. GW–26, p. 10 (table 3), 13, pl. 2. In Seneca County, overlies Ludlowville shale and underlies Tully limestone. Thickness about 140 feet.

Wallace de Witt, Jr., and G. W. Colton, 1953, U.S. Geol. Survey Geol. Quad. Map GQ–30. Base of section in Silver Creek quadrangle; only Windom member exposed in area. Underlies Geneseo shale.

Wallace de Witt, Jr., and G. W. Colton, 1959, Am. Assoc. Petroleum Geologists Bull., v. 43, no. 12, p. 2816, 2827. Sutton's Leicester member is here considered a lenticular layer of pyrite and marcasite at base of Geneseo shale member of Genesee formation.

Named for occurrence at Moscow (now Leicester), Livingston County, N.Y.

Moseley Limestone Lentil[1] or Limestone

Eocene: Eastern central Texas.

Original reference: B. C. Renick and H. B. Stenzel, 1931, Texas Univ. Bull. 3101, p. 78, 91.

H. B. Stenzel, E. K. Krause, and J. T. Twining, 1957, Texas Univ. Bur. Econ. Geology Pub. 5407, p. 23. Term Moseley limestone no longer in good use. Unit is part of Stone City beds of present usage.

Named for old Moseley's Ferry site on the Brazos (bridge on the Giddings to Hearne branch of Southern Pacific Railroad), Burleson and Robertson Counties.

Moses Hill Beds

Upper Cambrian to Lower Ordovician (Ozarkian): Northeastern New York.

A. W. Grabau, 1936, Paleozoic formations in the light of the pulsation theory, v. 2, Cambrovician pulsation, pt. 1, Caledonian and St. Lawrence geosynclines: Peiping, China, Univ. Press, Natl. Univ. Peking, p. 517–518. These [shale and limestone] beds, which contain *Acrothele pretiosa* (Billings) the true *Obolella pretiosa* of Billings ("*Linnarssonis pretiosa*" as it appears in the Guide to the Quebec region), appear to belong to an overthrust Cambrian mass. Whether they are part of that series or belong to a lower series exposed perhaps as a fenster, as Ruedemann holds may be case for Schaghticoke and Deepkill exposures, is not determined. It is of course possible that both these [Moses Hill] and Upper or Lauzon

Sillery of Chaudriere River and Cap Rouge, Quebec, from which this species was first described, are of Levis age. Until this identification is verified, it is desirable to regard both the Upper Sillery (Lauzon) and the Moses Hill beds as more likely to belong to early part of the Cambrovician advance, that is, the Upper Cambrian—Tremadoc division (Ozarkian in the restricted sense).

Moses Hill is 2 miles west of North Greenwich near line between Schuylerville and Cambridge quadrangles, Washington County. Fossils mentioned above have been collected from shales 1 mile west-northwest of South Argyle in same region, and from limestone on north side of Bald Mountain, 2 miles northwest of Greenwich, Schuylerville quadrangle. These localities lie within east Adirondack part of St. Lawrence geosyncline.

Mosheim Member (of Lenoir Limestone)

Mosheim Limestone (in Stones River Group)[1]

Middle Ordovician: Eastern Tennessee, northern Alabama, northwestern Georgia, western Virginia, and West Virginia.

Original reference: E. O. Ulrich, 1911, Geol. Soc. America Bull., v. 22, p. 413, 414, 538, 543, 544, 557, 636, pl. 27.

Charles Butts, 1940, Virginia Geol. Survey Bull. 52, pt. 1, p. 135–139. Mosheim limestone immediately overlies Murfreesboro limestone in southwestern Virginia. In belts southeast of Clinch Mountain, where Murfreesboro is generally absent, Mosheim rests upon Beekmantown dolomite. Everywhere succeeded by Lenoir limestone. Maximum thickness about 100 feet. Extends southward along southeast side of Appalachian Valley to vicinity of Shelby, Ala. Also present at Bunker Hill and Martinsburg, Berkeley County, W. Va. Included in Stones River group.

B. N. Cooper and C. E. Prouty, 1943, Geol. Soc. America Bull., v. 54, no. 6, p. 819–886. Lower Middle Ordovician succession of Tazewell County, Va., is subdivided into 29 distinctive zones that are grouped in 8 formations. Detailed tracing and mapping led to recognition of inconsistencies in use of terms Stones River, Murfreesboro, Mosheim, Lenoir, Blount, Holston, Ottosee, Lowville, and Moccasin. Superposition of the Mosheim with respect to the Murfreesboro, as postulated by Ulrich and Butts, is based upon their study of section along Yellow Branch, Lee County, Va. At this locality, two zones of Mosheim-type limestone are present. One calcilutite overlies beds containing *Polylopia billingsi*, a supposedly Murfreesboro guide fossil. The other zone of calcilutite underlies the beds containing this fossil. Butts has not indicated reasons for identifying the calcilutite above the *Polylopia billingsi* as the Mosheim, rather than the calcilutite beneath the horizon of *Polylopia*. In Tazewell County, in exposures one-half mile west of Wittens Mills, two calcilutites are present in succession like that exposed along Yellow Branch, Lee County. The higher calcilutite west of Wittens Mills overlies the *Lophospira* zone which contains the Murfreesboro fauna. Butts identifies the lower calcilutite which underlies Murfreesboro fauna, as Mosheim. By tracing the calcilutites exposed at Wittens Mills, it was found that the calcilutite overlying the Murfreesboro fauna is same zone identified by Butts as Mosheim in exposures south of St. Clair Station, near Bluefield. In proposed revised stratigraphic nomenclature, Cliffield formation (new) includes beds which Butts has called Murfreesboro, Mosheim, Lenoir, Holston, and Ottosee.

B. N. Cooper and G. A. Cooper, 1946, Geol. Soc. America Bull., v. 57, no. 1, p. 1–124. Revised classification proposed for lower Middle Ordovician in Shenandoah Valley, where names Stones River, Mosheim, Lenoir, Holston, Whitesburg, and Athens have been used without adequate evidence. Relationship of Mosheim and Lenoir discussed in their type areas. Type Mosheim occupies stratigraphic position of lowest division of type Lenoir. Probably type Mosheim is calcilutite facies representing substantial part of true Lenoir. Usage of name Mosheim for a pre-Lenoir stratigraphic division should not be extended hundreds of miles away from type locality when evidence that Mosheim underlies the Lenoir is lacking in critical localities. Precise equivalency of Shenandoah Valley Mosheim to type Mosheim of Tennessee has never been demonstrated. New Market limestone (new) is essentially the same as unit identified by Butts as Mosheim in most parts of northern Virginia.

C. E. Prouty, 1946, Am. Assoc. Petroleum Geologists Bull., v. 30, no. 7, p. 1181. Discussion of lower Middle Ordovician of southwest Virginia and northeast Tennessee. Detailed measured sections compared with revised classification of Tazewell County, Va. Inasmuch as "Mosheim" has been applied to type of lithology occurring at different horizons within Cliffield group, it is of no significance as a definite formational name and should be abandoned.

Charles Butts and Benjamin Gildersleeve, 1948, Georgia Geol. Survey Bull. 54, p. 24–25, geol. map. Included in Stones River group in northwestern Georgia. Not extensively exposed. Varies from a few feet to 100 feet in thickness; smaller thickness prevails. Overlies Murfreesboro limestone and underlies Lenoir (Ridley) limestone.

R. L. Miller and W. P. Brosgé, 1950, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 104; 1954, U.S. Geol. Survey Bull. 990, p. 39–43. Rob Camp limestone (new) replaces Mosheim limestone as previously used in Jonesville district, Lee County, Va.

John Rodgers, 1953, Tennessee Div. Geology Bull. 58, pt. 2, p. 69, pls. For the present map, the Mosheim is considered a member of the Lenoir that locally replaces lower part of formation.

R. B. Neuman, 1955, U.S. Geol. Survey Prof. Paper 274–F, p. 145 (table), 147, pl. 28. Mosheim member of Lenoir in Tellico-Sevier belt is identical ithologically with aphanitic limestone in Mosheim section. Stratigraphically above Douglas Lake member of Lenoir. Occurs below unnamed argillaceous limestone member. Middle Ordovician.

J. M. Cattermole, 1955, U.S. Geol. Survey Geol. Quad Map 76; 1960, Map 126. In Shooks Gap and Bearden quadrangles, Tennessee, mapped as member of Lenoir. Middle Ordovician.

G. A. Cooper, 1956, Smithsonian Misc. Colln., v. 127, pt. 1, p. 78–79. Mosheim is a facies rather than a formation and has been widely misidentified as a formation. Name should be used only for calcilutites associated with restricted Lenoir formation in southwestern belts and their equivalents. At type section, formation overlies Knox dolomite but underlies Lenoir lithology. Northeast of Friendsville, Tenn., typical Mosheim appears between beds with typical Lenoir lithology. In town of Friendsville, the Mosheim is underlain by calcarenites with abundant typical Lenoir species. Thus, the Mosheim is a part of the Lenoir, but is discontinuous and appears at different levels in the Lenoir.

Named for exposures in railroad cut at Mosheim Station, Greene County, Tenn.

Mosherville Sandstone Member (of Gailor Dolomite)

Lower Ordovician: East-central New York.

D. W. Fisher and G. F. Hanson, 1951, Am. Jour. Sci., v. 249, no. 11, p. 803, 806, 811. Name proposed for basal member of Gailor dolomite. Relatively pure typically massive white orthoquartzite with locally occurring porous crossbedded brown iron-stained sandstone. Locally represented by conglomerate of dolomite and calcilutite with sand matrix; grades laterally into coarse sandstone. Lithologically similar to older Potsdam sandstone for which it has been mistaken. Thickness 4 to 7 feet. Unconformably overlies Galway formation (redefined) at type locality; overlies Hoyt limestone and Ritchie limestone in other areas.

Type locality: Roadcut 2 miles southwest of village of Galway, Saratoga County, Other occurrences include field exposures one-half mile south of Mosherville, Saratoga County.

Moshup Till Member (of Jameco Formation)[1]

Pleistocene (Kansan): Southeastern Massachusetts.

Original reference: J. B. Woodworth and E. Wigglesworth, 1934, Harvard Coll. Mus. Comp. Zool. Mem., v. 52.

Occurs only on No Mans Land and at Nashaquitsa Cliffs, on south shore of Marthas Vineyard. Named for a "local god finding a place in aboriginal folk-lore concerning the origin of Gay Head."

Mosinee Conglomerate[1]

Precambrian (upper Huronian): Central northern Wisconsin.

Original reference: S. Weidman, 1907, Wisconsin Geol. Nat. History Survey Bull. 16, p. 364.

Occurs on upland area east and southeast of Mosinee, Marathon County.

Mosley Hill Formation (in Jackson Group)

Oligocene: Northern Louisiana.

G. E. Murray, 1952, Am. Assoc. Petroleum Geologists Bull., v. 36, no. 4, p. 700–707. Name proposed for the dark-blue to brown lignitic and carbonaceous micaceous fossiliferous and arenaceous clays and mudstones which are, at least partly equivalent to the type Vicksburg. Thickness varies from less than 200 feet to more than 400 feet. Overlies Danville Landing or Shubata and underlies Chickasawhay or Catahoula formations. East of type locality, Mosley Hill changes facies and is replaced, in part, by calcareous sediments of Vicksburg stage.

H. V. Andersen, 1960, Louisiana Dept. Conserv., Geol. Bull. 34, p. 100–102. Delaney (1958, unpub. thesis) restudied Mosley Hill type locality. He reported presence of three mappable units (two silty clay units separated by a sand) between Danville Landing and Catahoula. He restricted Mosley Hill to basal unit (which is unit exposed at Mosley Hill); the overlying sand, he named Sandel formation; uppermost fossiliferous clays and siltstones between Sandel and Catahoula he named Rosefield formation. Mosley Hill as restricted by Delaney is nonfossiliferous gypsiferous interbedded clay and silty sand unit, estimated by Delaney to be 55 feet thick in eastern and central Sabine Parish. Sandel and Mosley Hill lie within transitional zone between Eocene and Oligocene and are difficult to date.

Delaney depicted Mosley Hill as interfingering with Danville Landing beds which carry Jackson fauna. Mosley Hill is herein included in Jackson group and Eocene-Oligocene boundary mapped at base of Sandel. Comparative outcrops of Mosley Hill in Sabine Parish cited by Murray (1952) restudied, and sediment exposed along U.S. Highway 171 in sec. 31, T. 5 N., R. 10 W., Sabine Parish, is redesignated as alternate type locality for Nash Creek formation (Oligocene). Bulk of sediments at North Lucius Branch (Murray, 1952) is equivalent to Mosley Hill formation as redefined by Delaney and herein considered to be upper Jackson.

Type exposure: Consists of those exposures on and around Mosley Hill in secs. 2, 3, 4, 9, 10, and 11, T. 8 N., R. 2 W., Grant Parish.

Mosquito Porphyry[1]

Eocene: Central Colorado.

Original references: S. F. Emmons, 1882, U.S. Geol. Survey 2d Ann. Rept., p. 215–230; 1886, U.S. Geol. Survey Mon. 12, p. 83.

Named for occurrence in North Mosquito Amphitheater, on north face of Mount Lincoln, north of Alma, Park County.

Moss Porphyry[1]

Tertiary, middle or upper: Northwestern Arizona.

Original references: F. L. Ransome, 1923, U.S. Geol. Survey Bull. 743; Carl Lausen, 1931, Arizona Bur. Mines Bull. 131, Geol. Ser. 6, p. 44.

Moss mine, Oatman district.

Moss Back Member (of Chinle Formation)

Upper Triassic: Southeastern Utah and Southwestern Colorado.

J. H. Stewart and J. F. Smith, Jr., 1954, Intermountain Assoc. Petroleum Geologists [Guidebook] 5th Ann. Field Conf., p. 29, 30 (fig. 2), 31, 32. Moss Back sandstone unit of Chinle formation is typically yellowish-gray and very pale orange fine- to medium-grained sandstone, about 60 feet thick. Includes some conglomeratic sandstone lenses containing limestone, siltstone, quartzite, and quartz and chert pebbles; commonly contains carbonized and silicified wood. Crossbedded on medium scale and channels into underlying claystone and sandstone unit. In White Canyon, it is about 200 feet above base of Chinle; north of White Canyon, claystone and sandstone unit pinches out, and Moss Back rests directly on the Moenkopi. Has been mapped and referred to as Shinarump in many areas.

J. H. Stewart, 1957, Am. Assoc. Petroleum Geologists Bull., v. 41, no. 3, p. 453–457, 464–465. Described as member of Chinle. In northern limits, contains a silty facies which consists of abundant interstitial greenish silt and clay and interstratified lenses of greenish siltstone and claystone. Average thickness 60 feet; may be as much as 150 feet where it fills channels. Overlies Monitor Butte member along southwestern margin, overlaps Monitor Butte toward northeast and overlies Moenkopi along northeastern margin; locally overlies Cutler formation; conformably underlies either Petrified Forest member, Owl Rock member, or Church Rock member; in places, top contact is gradational and intertonguing and is arbitrarily placed at most conspicuous change in lithologic character of strata. Type locality designated and described in detail.

Type section: Measured 0.4 mile west and 0.2 mile south of northern tip of northwesternmost of four buttes that are located on or near divide between Fry and Red Canyons, long 110°08′51″ W., and lat 37°34′46″ N., San Juan County, Utah. Ridge formed by westernmost three buttes is called Moss Back.

Moss Lake Formation (in Cataract Group)

Silurian (Alexandrian) : Northern Michigan.

G. M. Ehlers and R. V. Kesling, 1957, Michigan Geol. Soc. [Guidebook] Ann. Geol. Excursion, p. 2 (table), 6–7, 8 (map). Proposed for gray and buff cherty and noncherty dolomites, and gypsiferous dark-greenish-gray and light-green shales that are underlain by Cabot Head shale and overlain by Lime Island dolomite (new) of Burnt Bluff group. Thickness 10 to 150 feet; at type section about 15 feet. Name Mayville not used in this classification. Highest beds of Mayville are placed in Lime Island dolomite.

Type section: In ditch on north side of road just west of SE cor. sec. 35, T. 41 N., R. 19 W., about 1½ miles west of Isabella, Delta County. Exposed along Moss Lake.

Mossman Picritic Basalt (in Hana Volcanic Series)

Pleistocene(?) : Maui Island, Hawaii.

G. A. Macdonald *in* H. T. Stearns and G. A. Macdonald, 1942, Hawaii Div. Hydrography Bull. 7, p. 230 (table), 247–249, pl. 1. Single widespread flow of pahoehoe, composed of numerous thin flow units; aa present in places but decidedly subordinate. Moderately vesicular but uniform in composition over entire area. Maximum thickness of 80 feet in test holes 50 and 78; elsewhere averages about 35 feet. Along highway overlies Makaino basaltic andesite (new); underlies Kuhiwa basaltic andesite (new) east of Makapipi Stream. In drill holes 48, 49, and 56 is underlain by olivine basalt not recognized elsewhere. East member of series is underlain by local erosional unconformity.

G. A. Macdonald and D. A. Davis *in* Jacques Avias and others, 1956, Lexique Strat. Internat., v. 6, Océanie, fasc. 2, p. 118. Pleistocene(?).

Forms surface of most of area between Hanawi and Makapipi Streams and along coast of Nakiku. Named from Mossman Spring which issues from it.

Mossy Ridge Lentil (in Verda Member of Yazoo Clay)

Eocene (Jackson) : Central Louisiana.

H. N. Fisk, 1938, Louisiana Dept. Conserv. Geol. Bull. 10, p. 101 (fig. 9), 103–104. Ranges upward from lignitic clays, through silty shales and sandy clays, leaf-bearing silts, and lignitic sands to typical beach deposits of massive fossiliferous sands. Thickness about 12 feet. Occurs in upper part of member at about same stratigraphic horizon as Zenoria lentil (new).

Typically exposed in highway cuts north of Montgomery, Grant Parish, NW¼ sec. 10, T. 8 N., R. 5 W.; and center of north line of sec. 18, T. 8 N., R. 3 W.

Mott Haven Limestone[1]

Precambrian : Southeastern New York.

Original reference: J. D. Dana, 1881, Am. Jour. Sci., 3d, v. 21, p. 431–432.

Occurs in vicinity of Mott Haven, Manhattan Island.

Mottville Member (of Marcellus Formation)

Mottville Member (of Skaneateles Shale)[1]

Middle Devonian: Central New York.

Original reference: B. Smith, 1916, Philadelphia Acad. Nat. Sci. Proc., v. 67, p. 561–566.

G. A. Cooper and others, 1942, Geol. Soc. America Bull., v. 53, no. 12, pt. 1, p. 1772, chart 4. Reallocated to member status in Marcellus formation. West of Cayuga Lake the Mottville is believed to be continuous with Stafford limestone previously placed at base of Skaneateles. Stafford also reallocated to Marcellus formation. Underlies Delphi Station member of Skaneateles.

Named for occurrence at Mottville, Onondaga County.

Moulton Diorite[1] (in New Hampshire Plutonic Series)

Upper Devonian or Upper Carboniferous: Northwestern New Hampshire.

Original reference: M. P. Billings, 1935, Geology of Littleton and Moosilauke quadrangles, New Hampshire, p. 27, map.

J. H. Eric and J. G. Dennis, 1958, Vermont Geol. Survey Bull. 11, p. 26–28, pl. 1. Massive coarse-grained green and white metadiorite and finer grained greeen metadiabase. Map bracket shows Moulton diorite in lower part of New Hampshire plutonic series below Kirby quartz monzonite. Devonian.

L. M. Hall, 1959, Vermont Geol. Survey Bull. 13, p. 51–52, pls. 1, 2, 3, 4. Younger than Meetinghouse slate.

Typically exposed on Moulton Hill in northwestern corner of Moosilauke quadrangle.

Moulton Sandstone Member (of Oakville Formation)

Miocene: East-central Texas.

B. C. Renick, 1936, Texas Univ. Bur. Econ. Geology Pub. 3619, p. 77, 78–79, table 1. Crossbedded, thin-bedded to massive sandstone, fine to coarse grained; locally contains reworked Cretaceous fossils. Thickness about 10 feet; occurs in lower part of the middle Oakville.

Town of Moulton, northwestern Lavaca County, is located on outcrop.

†Mound Group[1]

Pennsylvanian: Central western Missouri.

Original reference: G. C. Broadhead, 1873, Missouri Geol. Survey Prelim. Rept. on iron ores, pt. 2, p. 169, 196.

Named for occurrence in mounds of Johnson and Cass Counties.

Mound City Shale[1] (in Swope Limestone)

Mound City Shale Member (of Hertha Limestone)

Pennsylvanian (Missouri Series): Eastern Kansas and northwestern Missouri.

Original references: J. M. Jewett, 1932, Kansas Geol. Soc. 6th Ann. Field Conf. Guidebook, p. 99, 100, 103; R. C. Moore, 1932, Kansas Geol. Soc. 6th Ann. Field Conf. Guidebook, p. 90, 97.

R. C. Moore, J. C. Frye, and J. M. Jewett, 1944, Kansas Geol. Survey Bull. 52, pt. 4, p. 193. Middle member of Hertha limestone. Underlies Sniabar limestone member; overlies Critzer limestone member. Thickness as much as 14 feet; average about 6 feet.

F. C. Greene and W. V. Searight, 1949, Missouri Geol. Survey and Water Resources Rept. Inv. 11, p. 11. The Hertha differs from previous usage of Missouri Survey by inclusion of Critzer limestone and Mound City shale member.

Type locality: Near Mound City, Linn County, Kans.

Mound Ridge Member (of Oneota Formation)

Lower Ordovician: Southwestern Wisconsin.

G. O. Raasch, 1952, Illinois Acad. Sci. Trans., v. 45, p. 86–87 (fig. 3), 92, Comprises number of distinctive strata which are (descending) rather massive dolomite characterized by broad-domed *Cryptozoon* occurring in masses several feet in diameter; at other localities massive cherty to noncherty dolomite occupies this position; dolomite stratum bearing *Cryptozoon* packed as columnar colonies 3 to 6 inches in diameter and rising full height of bed, chert commonly present; green-specked bed—dolomite, coarsely crystalline, vitreous, clean, gray or buff, studded with glauconite, zone of chitons commonly at base; *Cryptozoon* stratum packed with columnar colonies, 1 to 2 inches in diameter and rising to full height of bed; green-specked band like one above, chitons locally present; zone of abundant chitons, commonly associated with rather obscure cryptozoa. Thickness averages 13 feet, ranges from 10 to 17 feet. Underlies Genoa member (new); overlies Hickory Ridge member (new).

Type section: Quarry and Mississippi bluff in NE¼SE¼ sec. 32, T. 13 N., R. 7 W., Stoddard quadrangle, 1 mile south of Genoa, Vernon County.

†Mound Valley Limestone[1]

Pennsylvanian: Eastern Kansas.

Original reference: G. I. Adams, 1896, Kansas Univ. Geol. Survey, v. 1, p. 23.

Caps row of hills, 120 feet high, northwest of Mound Valley, Labette County, and passing under surface at Cherryvale, Montgomery County.

†Mound Valley Shale[1]

Pennsylvanian: Eastern Kansas and northwestern Missouri.

Original reference: E. Haworth, 1898, Kansas Univ. Geol. Survey, v. 3, p. 47, 102.

Named for Mound Valley, Labette County, Kans.

Moundville Quartz Porphyry[1]

Precambrian (pre-Huronian?): Central southern Wisconsin.

Original reference: R. D. Irving, 1877, Geology Wisconsin, v. 2, p. 520.

Crops out at head of Lake Buffalo, on line betweens secs. 8 and 5, T. 14, R. 9 E., Moundville, Marquette County.

Mount Aetna Quartz Monzonite Porphyry

Paleocene(?) to Oligocene(?): Central Colorado.

M. G. Dings and C. S. Robinson, 1957, U.S. Geol. Survey Prof. Paper 289, p. 30–31, pl. 1. Name changed from Etna quartz monzonite porphyry because former name was preempted. Spelling of Etna changed to Aetna to conform to that used on topographic base map of Garfield quadrangle. Rock is coarsest grained porphyry in quadrangle. Light, medium, or pinkish gray, and weathered surfaces generally dull gray with local buff to brown iron-stained areas. Large pink and white feldspar phenocrysts especially conspicuous. Younger than unnamed quartz latite porphyry in area and older than unnamed volcanic breccia.

Type locality: On Mount Aetna, 3 miles north of Monarch, where rock occurs as an irregular stock extending about 3 miles northwest to headwaters of Tomichi creek, Garfield quadrangle, Chaffee and Gunnison Counties.

Mountain Bed[1] or Formation

Lower Cretaceous: Southwestern Texas.

Original reference: J. A. Taff, 1891, Texas Geol. Survey 2d Ann. Rept., p. 730–731.

L. W. Stephenson and others, 1942, Geol. Soc. America Bull., v. 53, no. 3, chart 9. Mountain formation of Taff shown on correlation chart below Quitman formation of Taff.

El Paso County.

Mountain City Formation

Carboniferous: Northeastern Nevada.

A. E. Granger and others, 1957, Nevada Bur. Mines Bull. 54, p. 116, pl. 14. Dark siliceous schist, in part calcareous, with interbedded quartzite. Thickness at least 2,000 feet. Rocks metamorphosed adjacent to quartz monzonite intrusive. Overlies Nelson amphibolite (new).

Named for occurrence in vicinity of Mountain City, Elko County.

Mountain Cove Formation

[Miocene]: Southwestern Utah.

E. F. Cook, 1960, Geol. Soc. America Bull., v. 71, no. 11, p. 1710. Incidental mention in discussion of breccia blocks of Mississippian limestone. Name credited to H. R. Blank (unpub. thesis).

Area of report is Welcome Spring area.

Mountain Girl Conglomerate-Quartzite[1] (in Telescope Group)

Precambrian: Southeastern California.

Original references: F. M. Murphy, 1930, Econ. Geology, v. 25, p. 309–310, map; 1933, California Div. Mines Rept. 28 of State Mineralogist, July-Oct. 1932, p. 329–356.

B. K. Johnson, 1957, California Univ. Dept. Geol. Sci., v. 30, no. 5, p. 355, 365, 378 (fig. 7). This study [Manly Peak quadrangle] has made possible the correlation of formations defined by Murphy (1930, 1932 [1933]) in Telescope Peak quadrangle with formations now commonly in use in Death Valley region. South Park member (new) of Kingston Peak formation (Precambrian) is a correlative of three formations in Murphy's Telescope group: Middle Park formation, Mountain Girl conglomerate-quartzite, and Wildrose formation. None of these formations was recognized as mappable unit in Manly Peak quadrangle.

Probably named for exposures near Wildrose Canyon, Panamint Mountains, Inyo County.

Mountain Glen Shale[1]

Upper Devonian: Southwestern Illinois.

Original reference: T. E. Savage, 1920, Am. Jour. Sci., 4th, v. 49, p. 169–178.

J. M. Weller and A. H. Sutton, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 5, p. 778. Mississippian (Kinderhook). Lies unconformably on Devonian limestone and attains maximum thickness of nearly 50 feet.

J. M. Weller and G. E. Ekblaw, 1940, Illinois Geol. Survey Rept. Inv. 70, p. 16, 18–19; J. M. Weller, 1940, Illinois Geol. Survey Rept. Inv. 71, p. 27. Consists of hard well-laminated black carbonaceous shale of Chattanooga type. Maximum thickness about 500 feet. Underlies Springville shale; overlies Alto limestone.

G. A. Cooper and others, 1942, Geol. Soc. America Bull., v. 53, no. 12, pt. 1, chart 4. Shown on correlation chart as Upper Devonian.

Named for occurrence near Mountain Glen, Union County.

Mountain Home Shale[1]

Mountain Home Shale Member (of Syrena Formation)

Pennsylvanian: Southwestern New Mexico.

Original reference: H. Schmitt, 1933, Am. Inst. Min. and Met. Engrs. Contr. 39, p. 2, 4, 13.

M. L. Thompson, 1942, New Mexico Bur. Mines Mineral Resources Bull. 17, p. 23. Term Mountain Home was used by Schmitt for convenience in mapping and listed in his succession of rocks but not discussed further. Information indicates that Mountain Home of Schmitt includes most of Missouri series. Term will not be used in this report on Pennsylvanian system of New Mexico.

P. F. Kerr and others, 1950, Geol. Soc. America Bull., v. 61, no. 4, p. 283 (fig. 5), 284. Geologic section shows Mountain Home shale as lower member of Syrena. Underlies Humboldt limestone member (Don limestone); overlies Oswald limestone.

Present in vicinity of Mountain Home mine, Santa Rita mining district.

Mountain Lake Member (of Bromide Formation)

Ordovician: Southern Oklahoma.

G. A. Cooper, 1956, Smithsonian Misc. Colln., v. 127, pt. 1, p. 120. Name suggested for the shaly sequence of lower Bromide. Occurs above basal sandstone of the formation. Thickness 194 feet. Underlies Pooleville member (new).

R. W. Harris, 1957, Oklahoma Geol. Survey Bull. 75, p. 95. The Mountain Lake (in general) is the Cool Creek formation as established by Ulrich (1932).

Name taken from Mountain Lake, E½ sec. 22, T. 2 S., R. 1 W., near Woodford, Carter County.

Mountain Meadows Dacite Porphyry

Mesozoic(?): Southern California.

A. O. Woodford, J. S. Shelton, and T. G. Moran, 1944, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 23. Has an outcrop 5,500 by 2,500 feet. Intrudes gneissic bedrock. Dacite and bedrock are overlain unconformably by massive and fragmental volcanic rocks.

A. O. Woodford, T. G. Moran, and J. S. Shelton, 1946, Am. Assoc. Petroleum Geologists Bull., v. 30, no. 4, p. 517 (fig. 2), 520 (fig. 3), 523, 427. Described as a rock with phenocrysts of euhedral oligoclase and biotite, and less abundant partly resorbed quartz in a rather pale greenish or yellowish gray, ordinarily altered. Underlies Glendora volcanics. Derivation of name given.

Name derived from the largest exposed mass, 2,000 feet across, intrusive into basement complex at Mountain Meadow Country Club northwest of Pomona, Los Angeles County.

Mountain Spring Volcanics (in Amador Group)

Jurassic: East-central California.

G. R. Heyl, 1948, California Div. Mines Bull. 144, pt. 1, p. 51, 52, 53, pl. 7. A series of schists and greenstone in Newton mine area (near Jackson, Amador County), tentatively correlated with Jurassic Amador group described by Taliaferro (1942), is subdivided into four formations (descending) Mountain Spring volcanics, Dufrene slate, Newton Mine volcanics, and Sunnybrook volcanics, Mountain Spring volcanics consist of sequence of feldspathic chlorite schist, dark-blue-gray slate, and pale green slaty tuffs with thin intercalations of dark-blue-gray shale. Approximate thickness 560 feet. In absence of fossil evidence, wider regional studies will be necessary to determine definitely whether Mountain Spring volcanics and Dufrene slate should be considered uppermost Amador or part of Mariposa slate. Measured section, along Mountain Spring Creek from Mariposa slate eastward, dips steeply to east; relation of beds to Mariposa slate suggests section is overturned, and is on west limb of an overturned anticline or its faulted equivalent.

Named from exposures on Mountain Spring Creek, near Newton mine, Amador County.

Mount Airy Granite

Paleozoic(?) : Northern North Carolina.

J. L. Stuckey and S. G. Conrad, 1958, North Carolina Div. Mineral Resources Bull. 71, p. 22–23; J. L. Stuckey, 1958, Geologic map of North Carolina (1:500,000) : North Carolina Div. Mineral Resources. Light gray nearly white biotite granite of medium texture composed of orthoclase, plagioclase, quartz, biotite, and minor amounts of apatite, zircon, muscovite, chlorite, and epidote; on basis of feldspar content, it is best classed as a quartz monzonite.

Named for occurrences around Mount Airy, northeastern Surry County. Forms body approximately 8 miles long and 4 miles wide.

Mount Alto Quartz Monzonite[1]

Eocene: Central northern Colorado.

Original reference: P. G. Worcester, 1921, Colorado Geol. Survey Bull. 21, p. 34–35.

Occurs as a single dike about one-quarter mile north of Mount Alto Park and about 1 mile east of Gold Hill Station, Boulder County.

Mount Antero Granite

Paleocene(?) to Oligocene(?) : Central Colorado.

M. G. Dings and C. S. Robinson, 1957, U.S. Geol. Survey Prof. Paper 289, p. 28–29, pl. 1. Granite is light gray to nearly white, and weathered surfaces are slightly glistening white, with local pinkish or brownish tones. Typically medium grained and composed mostly of feldspar and quartz, with subordinate small grains of biotite. Younger than Mount Pomeroy quartz monzonite (new), Mount Princeton quartz monzonite, and unnamed andesite in the area.

Type locality: On Mount Antero, the crest of which lies a few hundred feet east of the eastern boundary of Garfield quadrangle, Chaffee County. In eastern part of Garfield County, the granite occurs as two stocks, several small outlying bodies, and dikes.

Mount Anthony Formation

Middle and Upper Ordovician (?) : Southwestern Vermont.

J. A. MacFadyen, Jr., 1956, Vermont Geol. Survey Bull. 7, p. 16, 28–29. Altered sandy green to gray argillite. Some of these beds had formerly been included in Taconic slate, but new name is advisable because of age and structural connotations of Taconic. Occasional limestone and dolomite lenses are present. Fine-grained sericite and chlorite schist on western margin grade toward east into chlorite-biotite schist. Maximum thickness 1,250 feet. Overlies Walloomsac slate unconformably.

Best exposed on Mount Anthony and its southern extension, Bennington area.

Mount Ascutney Granite[1]

Carboniferous: Southeastern Vermont.

Original reference: C. H. Hitchcock, 1884, Am. Mus. Nat. History Bull., v. 1, p. 178–179.

Occurs only at Mount Ascutney, Claremont quadrangle, Windsor County.

Mount Athos Formation[1] (in Evington Group)

Paleozoic (?) : Central Virginia.

Original reference : A. S. Furcron, 1931, Pan-Am. Geologist, v. 55, p. 317.

W. R. Brown, 1953, Kentucky Geol. Survey, ser. 9, Spec. Pub. 1, p. 91 (fig. 1), 93. Quartzite, commonly conglomeratic; mica schist; and white, gray, and pink marble. Marble in discontinuous lenses. Thickness 100 to 800 feet. Chronologic sequence of formations in James River synclinorium found to be reverse of that interpreted by Furcron. Underlies Slippery Creek greenstone (new) ; overlies Pelier schist (new) all in Evington group (new). Paleozoic (?).

G. H. Espenshade, 1954, U.S. Geol. Survey Bull, 1008, p. 15 (table 1), 17–19, pl. 1. Extended to include white marble previously placed in underlying Cockeysville marble. Overlies Archer Creek formation (new). Derivation of name given.

W. R. Brown, 1958, Virginia Div. Mineral Resources, Bull. 74, p. 8 (fig. 2), 35–37, pl. 1. Lower schist phase of Mount Athos formation (as defined by Furcron) separated and named Pelier schist. Age shown on columnar section as Lower Paleozoic (?).

Named for occurrence at Mount Athos, east of Lynchburg, along James River.

Mount Athos Greenstone[1]

Precambrian [?] : Southeastern Virginia.

Original reference: A. S. Furcron, 1935, Virginia Geol. Survey Bull. 39, pl. 1.

W. R. Brown, 1953, Kentucky Geol. Survey, ser. 9, Spec. Pub. 1, p. 93 (columnar section). Chronologic sequence of formations in James River synclinorium found to be the reverse of that interpreted by Furcron, and Mount Athos greenstone overlies Mount Athos formation instead of underlying it.

Extends over several counties east of Lynchburg, James River region.

Mount Auburn Shale Member (of McMillan Formation)[1]

Mount Auburn Formation (in Maysville Group or McMillan Group)

Upper Ordovician: Southwestern Ohio, southeastern Indiana, and northwestern Kentucky.

Original reference: J. M. Nickles, 1902, Cincinnati Soc. Nat. History Jour., v. 20, p. 85.

A. C. McFarlan, 1943, Geology of Kentucky: Lexington, Ky., Kentucky Univ., p. 11, 26, 27. In Kentucky considered a formation in McMillan group. In Cincinnati region, overlies Corryville formation; in southern Blue Grass region, underlies Sunset member of Arnheim formation and overlies Gilbert limestone; contact gradational. Thickness 10 to 35 feet.

J. B. Patton, T. G. Perry, and W. J. Wayne, 1953, Indiana Geol. Survey Field Conf. Guidebook 6, pl. 1. Shown on chart of Ordovician rocks, exposed in Jefferson and Switzerland Counties, as Mount Auburn formation in Maysville group. Consists of irregularly bedded rubbly argillaceous fossiliferous limestone. Thickness 3 to 20 feet. Underlies Arnheim formation; overlies Corryville formation.

K. E. Caster, E. A. Dalve, and J. K. Pope, 1955, Elementary guide to the fossils and strata in the vicinity of Cincinnati, Ohio: Cincinnati Mus. Nat. History, p. 12 (fig. 3), 18. Member of McMillan formation, Maysville group. Overlies Corryville member; underlies Arnheim formation, Richmond group. Thickness 15 feet.

Named for Mount Auburn, Cincinnati, Ohio.

Mount Baker Lava[1]

Mount Baker Andesitic Volcanics

Quaternary: Central northern Washington.

Original reference: G. O. Smith and F. C. Calkins, 1904, U. S. Geol. Survey Bull. 235, p. 35.

H. A. Combs, 1939, Geol. Soc. America Bull., v. 50, no. 10, p. 1494, 1499, 1501 (fig. 2). Volcanic rocks associated with Mount Baker are divided into three groups, oldest to youngest, Mount Baker lava, Black Buttes, and scattered flow remnants. Suggests Pleistocene to Recent age.

Peter Misch, 1952. The Mountaineer, v. 45, no. 13, p. 4 (geol. map), 18. Mount Baker andesitic volcanics are younger than Hannegan volcanics (new). Shown on map as early Pleistocene.

Occurs on Mount Baker.

Mount Belknap Rhyolite

Mount Belknap Volcanic Series

Pliocene(?): Central Utah.

Eugene Callaghan, 1939, Am. Geophys. Union Trans. 20th Ann. Mtg., pt. 3, p. 438 (fig. 2), 440 (fig. 3), 442 (fig. 7), 447–449. Consists of two facies, not equally distributed; gray facies extends farther to west, south, and east than red tuffaceous facies. Entire mass forms lenticular body, and in conformity with regional structure, dips to west on west side, to north on north side, and to east on east side. Base is at altitude of over 11,000 feet in center of Tushar Mountains but reaches valley floor on either side. Each facies has maximum thickness of about 2,000 feet. Overlies Bullion Canyon volcanics; in contact with Dry Hollow latite (new), Joe Lott tuff (new), and Sevier River formation on east; on west underlies Joe Lott tuff. Tertiary.

P. F. Kerr and others, 1957, Geol. Soc. America Spec. Paper 64, p. 24–26, pl. 12. Referred to as Mount Belknap volcanic series. Petrographic discussion.

U.S. Geological Survey currently designates the age of the Mount Belknap Rhyolite as Pliocene(?) on the basis of restudy of Bullion Canyon Volcanics.

Composes crest of Tushar Mountain near northern end, and Mount Baldy and Mount Belknap Peaks, Marysvale region.

Mount Bennett Rhyolite[1]

Oligocene(?) : Southwestern Idaho.

Original reference: I. C. Russell, 1902, U.S. Geol. Survey Bull. 199, p. 42.

H. T. Stearns, Lynn Crandall, and W. G. Steward, 1938, U.S. Geol. Survey Water-Supply Paper 774, p. 33. A local name applied to volcanics along border of Snake River Plain.

Named for occurrence on Mount Bennett.

†Mount Bohemia Conglomerate[1]

Precambrian (Keweenawan) : Northern Michigan.

Original reference: A. C. Lane, 1906, Mines and Minerals, v. 27, p. 204–206.

Named for fact it caps Bohemian Range, Keweenaw County.

Mount Carmel Sandstone[1]

Mount Carmel Sandstone Member (of Bond Formation)

Pennsylvanian: Southeastern and eastern Illinois.

Original reference: A. H. Worthen, 1875, *in* Geology and Paleontology, v. 6, p. 51–60, Illinois Geol. Survey.

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 39, 50 (table 1), pl. 1. Rank reduced to member status in Bond formation (new). Occurs above Shoal Creek limestone member and below Flannigan coal member (new). Presentation of new rock-stratigraphic classification of Pennsylvanian strata in Illinois; cyclical classification is independent of rock-stratigraphic classification.

Type locality: W½ sec. 21, T. 1 S., R. 12 W., Mount Carmel quadrangle, Wabash County.

Mount Catherine Rhyolite

Eocene(?) : Central Washington.

R. J. Foster, 1957, Dissert. Abs., v. 17, no. 9, p. 1982; 1960, Geol. Soc. America Bull., v. 71, no. 2, p. 114, pl. 1. Light-purple, light-orange, and light-blue-gray rhyolite flows, tuff, and breccia, most of which contain small clear quartz phenocrysts. Included in Guye formation by Smith and Calkins (1906). Outcrop pattern is crude oval, open to northwest. Overlies Guye formation with angular unconformity; rhyolite dips away from inside of arc at moderate to steep angles, and Guye formation dips steeply southeast, so that rhyolite is parallel with Guye on southeast side of arc but overlies it discordantly elsewhere. Underlies Naches formation, apparently concordant. Unfossiliferous. Probably Eocene.

Type area: Steep-walled canyon of Mill Creek, the southeasterly running creek just northeast of Mount Catherine, central Cascade Mountains.

Mount Champion Formation

Recent: Central Colorado.

G. M. Richmond, 1953, Friends of the Pleistocene Rocky Mountain Sec. [Guidebook] 2d Ann. Field Trip, Oct. 4–5, Correlation chart, geol. map. Formation consists of lower member, very weak soil, and an upper member. Overlies Lake Creek formation (new).

Twin Lakes area, Lake County, Colo.

Mount Champion Quartz Monzonite[1]

Precambrian (?) : Central Colorado.

Original reference: J. V. Howell, 1919, Colorado Geol. Survey Bull. 17, p. 43.

Typically exposed on Mount Champion, Lake County.

Mount Clark Granite[1]

Probably Cretaceous: California.

Original reference: F. C. Calkins, 1930, U.S. Geol. Survey Prof. Paper 160, p. 128, map.

Named for the fact that it composes Mount Clark, Yosemite National Park.

Mount Deception Granite[1]

Precambrian (?) : Northern New Hampshire.

Original reference: C. H. Hitchcock, 1877, Geology New Hampshire, pt. 2, p. 124.

Mount Deception, White Mountains.

Mount Eagle Volcanics

Mount Eagle Series[1]

Upper Cretaceous: St. Croix, Virgin Islands.

J. F. Kemp, 1926, New York Acad. Sci. Scientific Survey of Porto Rico and the Virgin Islands, v. 4, pt. 1, p. 49 (reprinted? from J. F. Kemp, 1923, Report to H. H. Hough, Captain, U.S.N., Governor, Virgin Islands. Printed at the Naval Station, St. Thomas). Mount Eagle series consists almost entirely of fragmental volcanic rocks. Steeply tilted; inclinations commonly from 60° to vertical, rarely below 45°. Overlain by Kingshill series (new).

D. J. Cederstrom, 1941, Am. Jour. Sci., v. 239, no. 8, p. 556. Referred to as Mount Eagle volcanics. Intruded by diorite. Upper Cretaceous. Underlies Kingshill marl.

D. J. Cederstrom, 1950, U.S. Geol. Survey Water-Supply Paper 1067, p. 16–19, pl. 1. In some areas, underlies Jealousy formation.

Kemp refers to Mount Eagle Range. Cederstrom shows Mount Eagle (1,165 feet) in northwestern part of island.

Mount Ebel Sandstone Member[1] (of Edwardsville Formation)

Lower Mississippian: Southern Indiana.

Original reference: P. B. Stockdale, 1931, Indiana Dept. Conserv., Div. Geology Pub. 98, p. 76, 251, 253, 258, 261, 270, 272.

P. B. Stockdale, 1939, Geol. Soc. America Spec. Paper 22, p. 74, 224; J. M. Weller and others, 1948, Geol. Soc. America Bull., v. 59, no. 2, pl. 1. Included in Allens Creek facies of formation.

Type exposure: Along Smithville-Fairfax Road a short distance south of Mount Ebel Church, NE¼NW¼ sec. 23, T. 7 N., R. 1 W., 3 miles south of Smithville, Monroe County.

Mount Eden Formation[1]

Pliocene: Southern California.

Original reference: D. M. Fraser, 1931, Mining in California, v. 27, no. 4, p. 511–514.

D. I. Axelrod, 1938, Carnegie Inst. Washington Pub. 476, p. 128–219. Consists of red bed member about 1,800 feet thick and lower Mount Eden member about 1,500 feet thick. Underlies San Timoteo formation.

Named from Mount Eden, a hill in San Jacinto quadrangle. Well exposed south of Beaumont at western end of San Gorgonio Pass between San Bernardino and San Jacinto Mountains.

Mount Edgar Limestone

Lower Permian: Southern California.

J. C. Hazzard, 1938, (abs.) Geol. Soc. America Proc. 1937, p. 240. Listed as unconformably underlying Lower Triassic Moenkopi(?) and overlying Pennsylvanian Providence Mountains limestone (new). Thickness about 2,130 feet.

Occurs in Providence Mountains, near Kelso, San Bernardino County.

Mount Elden Formation

Upper Devonian: North-central Arizona.

Incidental mention: Louis Hussakof, 1941, (abs.) Geol. Soc. America Bull., v. 52, no. 12, pt. 2, p. 1988.

Louis Hussakof, 1942, Am. Mus. Novitates, no. 1186, p. 1–2. A series of strata of limestone, sandstone, etc., 148 feet in thickness. Locality cited.

Exposed on slopes of Mount Elden, near Flagstaff, Coconino County.

Mount Emmons Volcanics

Quaternary: Southwestern Alaska.

G. C. Kennedy and H. H. Waldron, 1947, U.S. Geol. Survey Alaskan Volcano Inv. Rept. 2, pt. 2, pl. 2. Agglomerate and interbedded lava flows. Name appears only on geologic map legend.

Mapped on summit of Mount Emmons in vicinity of Pavlof Volcano, Alaska Peninsula.

Mount Evans Quartz Monzonite

Precambrian: Western Colorado.

M. F. Boos and Esther Aberdeen, 1940, Geol. Soc. America Bull., v. 51, no. 5, p. 725, pl. 1. Name applied to coarsely crystalline quartz monzonite in Mount Evans batholith. Most of text discussion deals with batholith; Mount Evans quartz monzonite is shown on geologic map.

M. F. Boos, 1946, (abs.) Geol. Soc. America Bull., v. 57, no. 12, pt. 2, p. 1179. Falcon granite gneiss, Mount Evans quartz monzonite and quartz monzonite gneiss, Santa Fe Mountain pluton and fringing dikes, Rosalie lobe of Pikes Peak batholith, and Indian Creek plutons (Silver Plume type granite) invaded Idaho Springs and younger Precambrian formations in order named, probably in Algonkian time.

Mapped in vicinity of Mount Evans on eastern slope of Front Range west of Denver.

Mount Eve Granite

Precambrian: Northern New Jersey and southern New York.

J. M. Hague and others, 1956, Geol. Soc. America Bull., v. 67, no. 4, p. 453–454. Light coarse-grained rock, mostly structureless, locally exhibits banding. Intrudes marble and gneisses in vicinity of Glenwood syncline and in Mount Eve area in form of stocks which have dike- or sill-like apophyses. Occurs as thick sill-like mass near nose of anticline formed by Losee gneiss west of Glenwood syncline. At Mount Eve is a light medium-grained granitic gneiss considered to be border facies of Mount Eve granite, formed by reaction of granite with intruded gneisses.

In Franklin-Sterling area located in Sussex County, N.J., and Orange County, N.Y.

Mount Garfield Formation (in Mesaverde Group)[1]

Upper Cretaceous: Western Colorado.

Original reference: C. E. Erdmann, 1934, U.S. Geol. Survey Bull. 851, p. 22, 33.

W. A. Cobban and J. B. Reeside, Jr., 1952, Geol. Soc. America Bull., v. 63. no. 10, chart 10b, column 43. Shown on correlation chart in Mesaverde group below Hunter Canyon formation and above Anchor Mine tongue of Mancos shale.

R. G. Young, 1955, Geol. Soc. America Bull., v. 66, no. 2, p. 187. Terms Mount Garfield and Hunter Canyon dropped; term Neslen facies adopted for coal-bearing rocks of Price River formation; and term Farrer facies adopted for noncoal-bearing rocks above Neslen facies.

J. D. Fisher, C. E. Erdmann, and J. B. Reeside, Jr., 1960, U.S. Geol. Survey Prof. Paper 332, p. 19. Formation ranges in thickness from 970 to 1,070 feet and contains most of coal beds in Book Cliffs of Colorado. Lower part, 305 to 666 feet, constitutes the "coal measures;" upper part, 405 to 665 feet constitutes "barren measures." In lower part, in vicinity of Colorado River, includes Rollins sandstone member, so designated because it is believed to be unit so named by Lee (1912, U.S. Geol. Survey Bull. 510) in Grand Mesa area. Southeast of Colorado River, beds of lower part of Mount Garfield below Rollins sandstone member pass into marine shales indistinguishable from Mancos shale, and Rollins becomes basal unit of Mesaverde group. Mount Garfield is conformable with underlying Sego sandstone and overlying Huuter Canyon formation. Upper part of the "coal measures" of the Mount Garfield and the "barren measures" are together equivalent to Bowie and Paonia shale members of the Mesaverde.

Named for Mount Garfield, about 3 miles northwest of Palisade. Recognized along Book Cliffs from Utah-Colorado State boundary as far as Grand Mesa.

Mount Garfield Porphyritic Quartz Syenite[1] (in White Mountain Plutonic-Volcanic Series)

Mississippian(?): West-central New Hampshire.

Original reference: M. P. Billings and C. R. Williams, 1935, Geology of Franconia quadrangle, New Hampshire, p. 15, map.

C. R. Williams and M. P. Billings, 1938, Geol. Soc. America Bull., v. 49, no. 7, p. 1025, 1030–1031. Age tentatively considered Mississippian, possibly Lower Pennsylvanian.

M. P. Billings, 1955, Geologic map of New Hampshire (1:250,000): U.S. Geol. Survey. Included in White Mountain plutonic-volcanic series of Mississippian(?) age.

Named for Mount Garfield, Franconia quadrangle.

Mount Garfield Volcanic Formation

[Oligocene(?)]: Northwestern Washington.

R. C. Ellis, 1959, Dissert. Abs., v. 20, no. 3, p. 990. Similar in lithology to and may be correlative with Keechelus formation.

Report discusses geology of Dutch Miller Gap area.

Mount Gilead Sandstone (in Dixon Formation)

Mount Gilead Sandstone (in Henshaw Formation)[1]

Pennsylvanian: Western Kentucky.

Original reference: L. C. Glenn, 1922, Kentucky Geol. Survey, ser. 6, v. 5, p. 120.

H. R. Wanless, 1939, Geol. Soc. America Spec. Paper 17, p. 96. Mount Gilead Sandstone in Dixon formation. [Apparently so designated by Glenn, 1922.]

Occurs around and on ridge west of Mount Gilead School, Webster County.

Mount Gilead Shale (in Dixon Formation)

Mount Gilead Shale (in Henshaw Formation)[1]

Pennsylvanian: Western Kentucky.

Original reference; L. C. Glenn, 1922, Kentucky Geol. Survey, ser. 6, v. 5, p. 120.

H. R. Wanless, 1939, Geol. Soc. America Spec. Paper 17, p. 96, Mount Gilead shale in Dixon formation. [Apparently so designated by Glenn (1922).]

Exposed near Mount Gilead School, Webster County.

Mount Givens Granodiorite

Cretaceous: Central eastern California.

D. G. Sherlock and Warren Hamilton, 1958, Geol. Soc. America Bull., v. 69, no. 10, p. 1254–1255, pl. 1. Typically light-gray biotite-hornblende granodiorite in which hornblende is in distinct small prisms and uniform over broad areas. Forms bedrock in southwest corner of area. Principal rock type in Mount Givens pluton that crops out in an area 10 miles wide and extends northwest (boundaries as yet unknown) for more than 30 miles.

Occurs in north half of Mount Abbott quadrangle, Sierra Nevada, Fresno County. Mount Givens pluton is named for occurrence around Mount Givens in Huntington Lake area.

Mount Glen Terrane[1]

Upper Devonian: Illinois.

Original reference: C. R. Keyes, 1923, Pan-Am. Geologist, v. 39, no. 4, p. 320 (table).

Mount Hague Volcanics

Quaternary: Southwestern Alaska.

G. C. Kennedy and H. H. Waldron, 1947, U.S. Geol. Survey Alaskan Volcano Inv. Rept. 2, pt. 2, pl. 2. Agglomerate and interbedded lava flows, one of which is Volcano Bay basalt (new). Name appears only on geologic map legend.

Mapped on summit and slopes of Mount Hague, Pavlof Volcano area, Alaska Peninsula.

Mount Hamilton Group

Upper Cambrian and Lower Ordovician: Northeastern Nevada.

F. L. Humphrey, 1960, Nevada Bur. Mines Bull. 57, p. 16–23. Name proposed to include all rocks which Hague (1877) originally placed in Pogonip formation. Divided into two formations: the Goodwin, represented by two members, and the Pogonip by four. Most pronounced lithologic change in group sequence is between the second and third members, second member being massive dolomite and third a thin-bedded shaly nodular limestone. Name Pogonip is restricted to four upper members, and the two lower members are designated Goodwin formation. Structure in area is complex, and no complete stratigraphic section of group was measured. Sequence presented is built up from a number of partial sections. Thickness about 3,700 feet. Overlies Dunderberg shale; underlies Eureka quartzite.

Named for exposures in Mount Hamilton area, White Pine mining district, White Pine County.

†Mount Harris Formation (in Mesaverde Group)[1]

Upper Cretaceous: Northwestern Colorado.

Original reference: M. R. Campbell, 1931, Tentative correlation of named geologic units of Colorado, compiled by M. G. Wilmarth, U.S. Geol. Survey, separate chart.

Campbell's report was not published. Name Mount Harris Formation appeared in bold face in the Wilmarth Lexicon on the basis of Wilmarth's correlation chart. Cobban and Reeside (1952, Geol. Soc. America Bull., v. 63, no. 10) used name Mount Harris Formation on the Cretaceous correlation chart and cited the Wilmarth Lexicon. U.S. Geological Survey has abandoned the name Mount Harris Formation.

Crops out at Mount Harris, a coal mining town on Yampa River, Yampa coal field.

Mount Herman Sandstone[1]

Upper Devonian: Southwestern New York.

Original reference: J. M. Clarke, 1902, New York State Mus. Bull. 52, p. 525.

G. A. Cooper and others, 1942, Geol. Soc. America Bull., v. 53, no. 12, pt. 1, p. 1742. Upper Devonian.

Well exposed in number of small quarries on Mount Herman, just south of Olean, Cattaraugus County.

Mount Hoffman Complex

Pleistocene to Recent(?): Northern California.

C. A. Anderson, 1941, California Univ. Dept. Geol. Sci. Bull., v. 25, no. 7, p. 365–367. Name applied to a complex characterized in large part by silicic lavas, which dominantly are perlitic rhyolites.

Occurs in vicinity of Mount Hoffman, Medicine Lake Highland, Modoc Lava Bed quadrangle.

Mount Hole Granodiorite

Cretaceous: Southern California.

E. S. Larsen, Jr., and N. B. Keevil, 1947, Geol. Soc. America Bull., v. 58, no. 6, p. 489–490. Named in a report on a study of the batholith of southern California.

E. S. Larsen, Jr., 1948, Geol. Soc. America Mem. 29, p. 89–90. pl. 1. An intermediate type of granodiorite. Intrudes Woodson Mountain granodiorite. Derivation of name given. [Spelled Mt. Hole in this reference.]

Named from its characteristic outcrops on Mount Hole, near Corona, Riverside County.

Mount Holly Complex

Mount Holly Gneiss[1]

Mount Holly Series

Precambrian: West-central Vermont.

Original reference: C. L. Whittle, 1894, Am. Jour. Sci., 3d ser., v. 47, p. 347–355.

H. E. Hawkes, Jr., 1941, Geol. Soc. America Bull, v. 52, no, 5, p. 653, 654. Mount Holly series excluded from eastern flanks of Green Mountains; name replaced by Pico Peak series (new).

P. H. Osberg, 1952, Vermont Geol. Survey Bull. 5, p. 21–26, 44–48. Name emended to Mount Holly complex a more accurate term than Mount Holly series. Includes units lithologically similar to those of original Mount Holly series. In western sequence, Green Mountain anticlinorium underlies Mendon formation; in eastern sequence, underlies Monastery formation (new), but relation between the two units not clear.

W. F. Brace, 1953, Vermont Geol. Survey Bull. 6, p. 22–27, 29 (table 1), 42 (table 2). In western sequence, Rutland area, unconformably underlies Wilcox formation (new). In eastern sequence, unconformably underlies Saltash formation (new). Thickness in both areas about 7,000 feet.

Named for development in town of Mount Holly, Rutland County.

Mount Holly Conglomerate[1]

Pliocene(?): Southern New Jersey.

Original reference: H. C. Lewis, 1881, Philadelphia Acad. Nat. Sci. Proc., v. 32, p. 271, 288.

Occurs on top of hill at Mount Holly, Burlington County.

Mount Hood Lavas

Pliocene, upper, and Pleistocene: Northwestern Oregon.

Name appears on chart only: W. D. Lowry and E. M. Baldwin, 1952, Geol. Soc. America Bull., v. 63, no. 1, pl. 2.

In Portland area.

Mount Hope Formation[1]

Pleistocene: Panamá.

Original reference: A. P. Brown and H. A. Pilsbry, 1913, Philadelphia Acad. Nat. Sci. Proc., v. 65, p. 493.

W. P. Woodring *in* R. Hoffstetter and others, 1960, Lexique Strat. Internat., v. 5, Amérique Latine, fasc. 2a, p. 341. Fossiliferous Pleistocene deposits. Contains numerous species of mollusks, nearly all of which are Recent.

Occurs in Black Swamp near Mount Hope, C.Z.

†Mount Hope Marl[1] or phase[1]

Eocene (Jackson): Southern South Carolina.

Original reference: E. Sloan, 1905, South Carolina Geol. Survey geognostic map of South Carolina, advance copies; published in 1908, in South Carolina Geol. Survey, ser. 4, Bull. 2; 1907, Summary of mineral resources of South Carolina, p. 12, 17, 18.

Named for exposures at Mount Hope, on Santee River, Berkeley County.

Mount Hope Shale Member (of Fairview Formation)[1]

Mount Hope Formation (in Maysville Group)

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

Original reference: J. M. Nickles, 1902, Cincinnati Soc. Nat. History Jour., v. 20, p. 75, 76.

J. B. Patton, T. G. Perry, and W. J. Wayne, 1953, Indiana Geol. Survey Field Conf. Guidebook 6, pl. 1. Shown on generalized stratigraphic column as Mount Hope formation in Maysville group. Occurs at base of group below Fairmount formation and above McMicken formation of Eden group. Thickness 25 to 45 feet.

Named for an exposure on southeastern slope of Price Hill, known as Mount Hope, at Cincinnati, Ohio.

Mount Houghton Felsite[1]

Mount Houghton Quartz Porphyry[1]

Precambrian (Keweenawan): Northern Michigan.

Original reference: A. C. Lane, 1911, Michigan Geol. and Biol. Survey Pub. 6, geol. ser. 4, p. 83, 175–750.

Composes Mount Houghton, Keweenaw County.

Mount Jefferson Formation[1]

Pliocene: Central northern Oregon.

Original reference: E. T. Hodge, 1927, Geol. Soc. America Bull., v. 38, p. 163.

Forms Mount Jefferson and other mountains in Cascade Mountains.

Mount Jefferson Sandstone Member (of Rockfish Conglomerate)

Age not stated: Western Virginia.

H. B. Cooke, Jr., 1952, (abs.) Virginia Jour. Sci., v. 3, new ser., no. 4, p. 336. Rockfish conglomerate is divided into two members: Rockfish conglomerate (restricted) and Mount Jefferson sandstone.

Type locality and derivation of name not stated.

Mount Kate Series

Mount Kate Volcanics

Pliocene: Western Nevada.

V. P. Gianella, 1934, Mining and Metallurgy, v. 15, no. 331, p. 299. Volcanics represented by lavas that cover large areas in neighborhood of Silver City. Thickness 1,500 feet.

R. R. Coats, 1936, California Univ. Pubs., Dept. Geol. Sci. Bull., v. 24, no. 4, p. 78, 79. Series consists of unconsolidated tuffs and breccias in Washoe district.

Exposed over large areas around Silver City and Virginia City.

Mount Lafayette Granite Porphyry[1] (in White Mountain Plutonic-Volcanic Series)

Mississippian(?): West-central New Hampshire.

Original reference: M. P. Billings and C. R. Williams, 1935, Geology of Franconia quadrangle, New Hampshire, p. 13, map.

C. R. Williams and M. P. Billings, 1938, Geol. Soc. America Bull., v. 49, no. 7, p. 1025, 1028–1030. Age tentatively considered Mississippian, possibly Lower Pennsylvanian.

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M. P. Billings, 1955, Geologic map of New Hampshire (1:250,000): U.S. Geol. Survey. Included in White Mountain plutonic-volcanic series of Mississippian (?) age.

Typically exposed on summit of Mount Lafayette, Franconia quadrangle.

Mount Laurel Sand[1] (in Monmouth Group)

Mount Laurel Member (of Matawan Formation)

Upper Cretaceous: New Jersey and Delaware.

Original reference: W. B. Clark, R. M. Bagg, and G. B. Shattuck, 1897, Geol. Soc. America Bull., v. 8, p. 315, 333.

C. W. Carter, 1937, Maryland Geol. Survey, v. 13, p. 243 (fig. 32), 262–263. Geographically extended into Delaware where it is present along Chesapeake and Delaware Canal for a distance of 1 7/8 miles at its eastern end. At St. Georges Bridge, 8½ feet of formation is exposed above water level, full thickness probably not cut by canal. Only representative of group in immediate canal area. Unconformably overlies Marshalltown formation; unconformably overlain by Wicomico and Talbot formations (Pleistocene).

W. B. Spangler and J. J. Peterson, 1950, Am. Assoc. Petroleum Geologists Bull., v. 34, no. 1, p. 8 (fig. 4), 24, 36–39. Rank reduced to member status in Matawan formation. Uppermost member of formation; overlies Wenonah member; underlies Navesink member of Monmouth formation.

J. P. Minard and J. P. Owens, 1960, U.S. Geol. Survey Prof. Paper 400–B, p. B184, B185. Basal member of Monmouth group. Underlies Navesink formation; overlies Wenonah formation of Matawan group. Average dip SE 35 feet per mile.

Named for Mount Laurel, Burlington County, N.J.

†Mount Lebanon Formation (in Claiborne Group)[1]

Eocene: Northwestern Louisiana.

Original reference: H. K. Shearer, 1930, Am. Assoc. Petroleum Geologists Bull., v. 14, no. 4, p. 439–441.

Named for Mount Lebanon, Bienville Parish.

Mount Lowe Granodiorite[1]

Upper Jurassic or Lower Cretaceous: Southern California.

Original reference: W. J. Miller, 1926, (abs.) Geol. Soc. America Bull., v. 37, p. 149.

W. J. Miller, 1946, Geol. Soc. America Bull., v. 57, no. 5, table 4. Listed with Late Mesozoic rocks in San Gabriel Mountains. Younger than Wilson diorite.

Named because of typical occurrence on Mount Lowe and vicinity, San Gabriel Mountains, Los Angeles County.

Mount Mansfield Series

Age not stated: Northern Vermont.

E. C. Jacobs, 1935, (abs.) Geol. Soc. America Proc. 1934, p. 85. A series of schists and gneisses. On the west is in undetermined contact with Fairfax schist (new) of probable Precambrian age. Series extends across mountain massive to Hardwick where it is bordered by belts of, probably Ordovician, phyllites, and limestones. In Elmore, the Mansfield series is in contact with amphibolites.

Present in Green Mountain area.

Mount Marion Formation (in Hamilton Group)

Mount Marion Beds[1]

Middle Devonian: Eastern New York.

Original reference: A. W. Grabau, 1917, Geol. Soc. America Bull., v. 28, p. 954.

G. A. Cooper, 1941, Washington Acad. Sci. Jour., v. 31, no. 5, p. 180. Stony Hollow member (new) of Marcellus formation underlies Mount Marion formation of Grabau at its type section; hence, Mount Marion is interpreted as sandy facies of Chittenango black shale member.

Theodore Arnow, 1949, New York State Water Power and Control Comm. Bull. GW–20, p. 8 (table 1), 11 (fig. 3), 15, pl. 2. In Albany County, Mount Marion formation overlies Bakoven shale and underlies Ashokan formation. Consists of argillaceous sandstones and sandy shales which are dark blue gray when fresh, and heavier sandstones; heavier sandstones predominate in higher horizons and entire formation tends to weather to brownish color. Thickness over 1,400 feet.

Well exposed at Mount Marion, west of Saugerties, Ulster County.

Mount Mazama Andesites, Dacites, Lavas, Flows

Pleistocene to Recent: Southwestern Oregon.

Howel Williams, 1942, Carnegie Inst. Washington Pub. 540, 162 p. Geologic map of Crater Lake National Park maps Mount Mazama dacites and Mount Mazama andesites. Text uses terms Mount Mazama lavas, Mazama lavas, Mazama flows, Mazama andesites.

Diller and Patton (1902, U.S. Geol. Survey Prof. Paper 3) described following andesite areas: Castle Creek, Dutton Cliff, Eagle Crags, Munson Point, Round Top, Sentinel Rock, Steel Bay, Union Peak, Watchman and Wizard Islands, and several andesite dikes.

Mount Mazama Pumice

Pleistocene to Recent: Southwestern Oregon.

H. P. Hansen, 1942, Am. Midland Naturalist, v. 27, no. 2, p. 523–534. Name applied to pumice erupted from former Mount Mazama. Depth of pumice varies from more than 10 feet in vicinity of Crater Lake to several inches about 100 miles to north. Depth of peat profiles and rate of peat formation suggest that eruption of Mount Mazama occurred between 5,000 and 7,500 years ago.

I. S. Allison, 1945, Geol. Soc. America Bull., v. 56, no. 8, p. 789–808. Section of lake beds exposed in trench of Ana River below Ana Spring near northwest corner of Summer Lake basin, in Lake County, reveals near top at least six layers of pumice. Four of these appear to record eruptions of Mount Mazama which led finally to formation of Crater Lake; source of fifth is not known; sixth is attributed to eruption of Newberry Crater. Because certain layers in associated sediments imply shallow-water conditions, these eruptions must have occurred when last pluvial lake, formerly about 215 feet deep, had been reduced by evaporation to depth of about 85 feet, probably about 14,000 years ago. Data appear to extend back ages of Mount Mazama pumice, of Crater Lake, and of Paleo-Indian occupation of area by several thousand years. First layer of Mount Mazama pumice herein described would be a little more than 14,000 years old, age of main Crater Lake pumice layer would be about 500 years less than that. Eruption of Newberry pumice took place about 3,000 years later or about 10,500 years ago.

H. P. Hansen, 1946, Am. Jour. Sci., v. 244, no. 10, p. 710–734. Discussion of post glacial forest succession and climate in Oregon Cascades. By correlating Pleistocene and post-glacial lake levels in Summer Lake basin with those of Lake Lahontan basin of Nevada, Allison (1945) dates eruption of Mount Mazama between 10,000 and 14,000 years ago. On the contrary, the thickness of bog sediments overlying Mount Mazama pumice, the stratigraphic position of interbedded pumice in relation to the warm, dry stages as interpreted from pollen profiles, and the correlation of many pollen profiles from the Pacific Northwest indicate that eruption of Mount Mazama took place between 8,000 and 10,000 years ago. [Geologic map (fig. 1) shows distribution of Mount Mazama pumice. This map is adapted from Williams (1942, fig. 16) which shows thickness and distribution of Crater Lake pumice.]

Mount Mazama was at present site of Crater Lake.

Mount Merino Member (of Normanskill Formation)

Middle Ordovician: Eastern New York.

Rudolf Ruedemann, 1942, New York State Mus. Bull. 327, p. 23, 24. Incidental mention in discussion of Cambrian and Ordovician fossils.

Rudolf Ruedemann, 1942, New York State Mus. Bull. 331, p. 89–101, geol. map [1946]. Referred to as chert and shale member. Thickness varies; 40 feet of chert exposed at south end of Mount Merino. Underlies Austin Glen member; overlies Deepkill shale.

W. H. Twenhofel and others, 1954, Geol. Soc. America Bull., v. 65, no. 3, chart 2 (column 14). Shown on correlation chart as Mohawkian (Black River).

Well exposed on Mount Merino, Catskill quadrangle.

Mount Mesnard Quartzite[1]

Precambrian: Northern Michigan.

Original reference: M. E. Wadsworth, 1893, Michigan Geol. Survey Rept. State Bd., 1891, 1892, p. 64–65.

Well exposed on Mount Mesnard.

Mount Moat Conglomerate[1]

Devonian(?): Northern New Hampshire.

Original reference: C. H. Hitchcock, 1873, Boston Soc. Nat. History Proc., v. 15, p. 304, 307.

Mount Moat, White Mountains.

Mount Morris Limestone Member (of Washington Formation)[1]

Mount Morris Limestone (in Washington Group)

Mount Morris limestone member

Pennsylvanian: Southwestern Pennsylvania, eastern Ohio, and northern West Virginia.

Original reference: I. C. White, 1891, U.S. Geol. Survey Bull. 65, p. 39–40.

W. O. Hickok 4th and F. T. Moyer, 1940, Pennsylvania Geol. Survey, 4th ser., Bull. C–26, p. 135, 147. In Fayette County, occurs in two beds separated by shale or sandstone. These limestones are here designated as lower and upper Mount Morris limestones; intervening sandstone is termed Mount Morris sandstone. In some areas, the lower Mount Morris limestone is cut out and Mount Morris sandstone lies on Waynesburg sandstone. Upper Mount Morris limestone is separated from overlying Colvin Run limestone by Waynesburg A coal. Thickness of limestones with intervening sandstone about 27 feet. All units included in Washington group.

R. E. Lamborn, 1951, Ohio Geol. Survey, 4th ser., Bull. 49, p. 40. In eastern Ohio, Mount Morris limestone member (Washington series) is local in its occurrence. Consists of nodules or thin layers of limestone, of fresh- or brackish-water type, embedded in argillaceous shales. Occurs 30 to 40 feet above horizon of Waynesburg coal.

M. T. Sturgeon and others, 1958, Ohio Geol. Survey Bull. 57, p. 203 (table 14), 208. Mount Morris limestone named as member of Waynesburg "A" cyclothem in report on Athens County, although generally absent in county, but well developed in Monroe and Belmont Counties.

Named for exposures on north bank of Dunkard Creek at Mount Morris, Greene County, Pa.

Mount Morrison Formation

Precambrian: Central northern Colorado.

M. F. Boos, 1954, Geol. Soc. America Bull., v. 65, no. 2, p. 118–119, fig. 2, pl. 1. Finely gneissic quartz monzonite, migmatite, and injection gneiss with associated pegmatites and aplites. Chief rock is gneiss that occurs as imbricated sheetlike masses and stocks. Gneiss, medium-grained, and on fresh exposure gray to almost white or tan.

Type locality: On Mount Morrison where a large body of it is well exposed, Jefferson County, Denver Mountain Parks area. Large bodies well exposed on Santa Fe and Saddleback Mountains southeast of Idaho Springs. Composes most of Mount Falcon and small masses outcrop in Deer Creek drainage area.

Mount Olympus Granite[1]

Precambrian: Central northern Colorado.

Original reference: M. B. Fuller, 1924, Jour, Geology, v. 32, p. 51–63.

T. S. Lovering and E. N. Goddard, 1950, U.S. Geol. Survey Prof. Paper 223, p. 28, 29. As used in this report, Cripple Creek granite of Pikes Peak quadrangle, and Longs Peak and Mount Olympus granites of Estes Park region are included in Silver Plume granite.

Named for peak and quadrangle over much of whose surface it is exposed.

Mount Ord Pyroxenite

Precambrian: Central Arizona.

E. D. Wilson, 1939, Geol. Soc. America Bull., v. 50, no. 7, p. 1128, pl. 11. Dense blackish porphyry. Typically pale greenish gray on weathered surfaces and black on fresh fracture, with phenocrysts of pyroxene up to 5 mm in diameter in dense groundmass. Forms stock intruding Alder series and in turn invaded by granite on its southeast. Many dikes of this rock, generally less than 75 feet wide and trending northeastward, intrude Alder series for about 3,000 feet from stock.

Crops out as belt ¾ mile to 2⅛ miles wide that extends northeastward across Mazatzal Range at Mount Ord.

Mount Ord Series

Mesozoic (Jura-Trias): California.

O. P. Jenkins, 1938, Geologic map of California (1:500,000): California Div. Mines, sheet 4. Grouped under metavolcanics on map legend.

Mount Osborn Glaciation

Pleistocene: Central western Alaska.

D. M. Hopkins, 1953, *in* T. L. Péwé and others, U.S. Geol. Survey Circ. 289, p. 11, 13 (table 1). Four Quaternary glaciations recognized on Seward Peninsula. Mount Osborn preceded by Salmon Lake glaciation (new). Deposits recognized on aerial photographs of the valley heading in west wall of Mount Osborn and in a few other valleys in Kigluaik Mountains. End moraines small sharp-crested ridges that enclose parts of valleys, in which talus accumulations are small and rock glaciers uncommon.

Recognized on Mount Osborn, southwestern part of Seward Peninsula.

Mount Osceola Granite[1] (in White Mountain Plutonic-Volcanic Series)

Mississippian(?): Central New Hampshire.

Original reference: M. P. Billings and C. R. Williams, 1934, Geology of Franconia quadrangle, New Hampshire, p. 15, map.

C. R. Williams and M. P. Billings, 1938, Geol. Soc. America Bull., v. 49, no. 7, p. 1031–1032, pl. 3. Age changed to Mississippian(?).

M. P. Billings, 1955, Geologic map of New Hampshire (1:250,000): U.S. Geol. Survey. Belongs to White Mountain plutonic-volcanic series.

Named for characteristic exposures on Mount Osceola, Franconia quadrangle.

Mount Pleasant Conglomerate[1]

Upper Devonian: Northeastern Pennsylvania.

Original reference: I. C. White, 1881, Pennsylvania 2d Geol. Survey Rept. G_5, p. 58–59.

Caps summit of hill at village of Mount Pleasant, Wayne County.

Mount Pleasant Phosphate[1]

Middle Ordovician: Central Tennessee.

Original reference: J. M. Safford and J. B. Killebrew, 1900, Elements of geology of Tennessee, p. 105, 127–128, 209–211.

Named for Mount Pleasant, Maury County.

Mount Pleasant Red Shale Member (of Catskill Formation)[1]

Upper Devonian: Northeastern Pennsylvania.

Original reference: I. C. White, 1881, Pennsylvania 2d Geol. Survey Rept. G_5, p. 59, 63.

Bradford Willard, 1939, Pennsylvania Geol. Survey, 4th ser., Bull. G–19, p. 282–283. Highest red member of Catskill. White applied name to more than one unit, including a conglomerate and red shale under the one name. The Mount Pleasant is herein restricted to the shale and embraces beds from base of Pocono to top of Elk Mountain sandstone. This includes in Wayne County the highest redbeds below Griswolds Gap conglomerate which White thought probably were Devonian-Mississippian transitional strata, but they are here assigned entirely to Devonian. Thickness about 500 feet in type region.

Well exposed along road descending from village of Mount Pleasant, Wayne County. Town now called Pleasant Mount, but township is still Mount Pleasant and contains type locality.

Mount Pleasant Sandstone

Mount Pleasant Shales and Sandstones (in Chester Group)[1]

Upper Mississippian: Southwestern Indiana and central western Kentucky.

Original reference: W. N. Logan, 1924, Indiana Dept. Conserv. Pub. 42, p. 11, 125.

Norval Ballard, 1938, Am. Assoc. Petroleum Geologists Bull., v. 22, no. 11, p. 1521 (table 1). Table gives age as Upper Mississippian.

C. A. Malott, 1952, Stratigraphy of the Ste. Genevieve and Chester formations of southern Indiana: Ann Arbor, Mich., The Edwards Letter Shop, p. 6. Mount Pleasant sandstone replaced by Degonia sandstone. Local Indiana names of upper Chester are dropped, and formations given names of standard Chester column.

Named for exposure at Mount Pleasant, Perry County, Ind.

Mount Pomeroy Quartz Monzonite

Paleocene(?) to Oligocene(?): Central Colorado.

M. G. Dings and C. S. Robinson, 1957, U.S. Geol. Survey Prof. Paper 289, p. 23–24, pl. 1. Name changed from Pomeroy quartz monzonite because former name was preempted. Typically a pinkish-gray medium-grained rock, with weathered surfaces dull greenish gray or dull reddish brown. Hornblende, the most abundant mafic mineral, typically chloritized; this feature, combined with pinkish tone, is characteristic of most of the rock and helps to distinguish the Mount Pomeroy from other Tertiary intrusive rocks, particularly the Mount Princeton quartz monzonite. Older than both quartz latite porphyry in area and Mount Princeton quartz monzonite.

Type locality: On Pomeroy Mountain, Garfield quadrangle, Chaffee County.

Mount Princeton Quartz Monzonite[1]

Paleocene(?) to Oligocene(?): Central Colorado.

Original reference: J. T. Stark and F. F. Barnes, 1935, Colorado Sci. Soc. Proc., v. 13, no. 8, p. 475, map.

M. G. Dings and C. S. Robinson, 1957, U.S. Geol. Survey Prof. Paper 289, p. 25–27, pl. 1. Generally fresh-appearing rock on weathered as well as newly broken surfaces. Typically gray and medium grained but locally light gray, pinkish, or rarely white. Texture ranges from even granular through lightly porphyritic to prominently porphyritic. Older than Mount Antero granite (new); younger than Mount Pomeroy quartz monzonite (new). Formerly designated the Princeton quartz monzonite. Paleocene(?) to Oligocene(?). Type locality designated. Mount Princeton quartz monzonite is one of largest bodies of Tertiary intrusive rocks in Colorado. It forms small batholith roughly circular in outline with maximum diameter of about 20 miles. Only southern part is present in Garfield quadrangle [this report]. The quartz monzonite lies chiefly east of Continental Divide. Many of highest peaks in quadrangle are composed of this quartz monzonite, especially those north and west of Chalk Creek.

Type locality: On Mount Princeton, the summit of which lies less than one-half mile east of northeast corner of Garfield quadrangle. Excellent exposures at type locality.

Mount Prospect Complex

Age not stated: Northwestern Connecticut.

E. N. Cameron, 1951, Connecticut Geol. Nat. History Survey Bull. 76, p. 1–2, 4, 8–37. Includes three major groups of widely differing rock types. Oldest includes metasedimentary mica gneisses, mica quartzites, and quartz-mica schists of Hartland and Berkshire formations; the Mount Tom hornblende gneiss; an assemblage of dioritic gneisses (previously known as Brookfield diorite) comprising bulk of complex; biotite pyroxenite and biotite hornblendite; and quartz monzonite porphyry. Second is a sequence of mafic igneous rocks, olivine norite, quartz norite, hypersthene pyroxenite, and dike rocks which intrude oldest group. The third consists of granites, aplites, and pegmatites which cut oldest group, but may be older than younger mafic intrusives. Complex lies along boundary between Berkshire and Hartland formations. Bedding and foliation in metasediments are parallel; foliation of dioritic gneisses is parallel to their layering and their contacts with the metasediments.

Named for Mount Prospect. Occupies an area of about 14 square miles around village of Bantam, Litchfield County.

Mount Rainier Lavas[1]

Mount Rainier Volcanics

Pleistocene: Western Washington.

Original reference: H. C. Culver, 1936, Washington Dept. Conserv. and Devel., Div. Geology Bull. 32, p. 21.

H. A. Coombs, 1936, Washington (State) Univ. Pubs. in Geology 3, no. 2, p. 172–190. Mount Rainier volcanics (or lavas) roughly divided into two groups; loose and crumbly pyroclastics, and compact flows. Pyroclastics are abundant on higher slope of mountain, and lava flows attain greatest development in basal parts of mountain although they also occur on higher slopes intercalated with the pyroclastics. Exact time of issuance of lavas unknown, but it is thought that greater part of volcano was formed during Pleistocene time. Paleobotanical evidence indicates post-Pliocene eruptions.

Lavas occupy approximately 100 square miles, of this amount about 45 square miles are covered by perennial snow and ice. Vertically lavas range from upland surface of Cascades, at an elevation of 6,000 feet, to crater at 14,408 feet.

Mount Rogers Volcanic Group

Mount Rogers Volcanic Series

Precambrian: Southwestern Virginia, northern North Carolina, and northeastern Tennessee.

G. W. Stose and A. J. Stose, 1944, Am. Jour. Sci., v. 242, no. 8, p. 410–411. Volcanic series, which is 1,000 or more feet thick, consists of series of rhyolite flows underlain by tuff, arkose, and basalt flows, and overlain by a series of red tuff and arkose. Considered late Precambrian as it overlies, and is structurally discordant with, the injection complex and is overlain by Lower Cambrian Unicoi formation.

A. J. Stose and G. W. Stose, 1957, Virginia Div. Mineral Resources Bull. 72, p. 48–49, pl. 1. In Gossan Lead district, comprises (descending) rhyolite, and Flat Ridge formation (new). Thickness near Comers Rock, Grayson County, about 800 feet. Derivation of name given.

P. B. King and H. W. Ferguson, 1960, U.S. Geol. Survey Prof. Paper 311, p. 29–32, pls. In northern part of region [northeastern Tennessee], Mount Rogers volcanic group wedges in between basement rocks and rocks of definite Paleozoic age. Group is sequence of silicic flows and tuffs and clastic sedimentary rocks many thousands of feet thick, which were probably laid down during latest Precambrian time.

Named for occurrence on Mount Rogers, highest peak in Virginia, located on Smythe-Grayson county line 16½ miles west of western boundary of Gossan Lead district.

Mount Rorah Coal Member (of Spoon Formation)

Pennsylvanian: Southeastern Illinois.

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p 33, 45 (table), 64, pl. 1. Proposed to replace Bald Hill coal because of prior use of name Bald Hill. Thickness about 2 feet. Stratigraphically above Creal Springs limestone member (new) and below Wise Ridge coal member (new). Presentation of new rock-stratigraphic classification of Pennsylvanian of Illinois. Cyclical classification is retained but is entirely independent of rock-stratigraphic classification.

Type locality: SE¼ sec. 35, T. 10 S., R. 4 E., Williamson County. Name derived from Mount Rorah Church about 2 miles northwest of type outcrop.

Mount Rosa Granite[1]

Mount Rosa Quartzite

Precambrian: East-central Colorado.

Original reference: G. I. Finlay, 1916, U.S. Geol. Survey Geol. Atlas, Folio 203.

T. S. Lovering and E. N. Goddard, 1950, U.S. Geol. Survey Prof. Paper 223, pl. 6. Shown on columnar section as Mount Rosa quartzite and credited to Finlay, 1916.

Most extensively developed on slopes of Mount Rosa, Colorado Springs region.

Mount Rowe Member (of Miller Peak Formation)

Precambrian (Belt Series): Northwestern Montana, and southwestern Alberta, Canada.

C. L. Fenton and M. A. Fenton, 1937, Geol. Soc. America Bull., v. 48, no. 12, p. 1902–1903. Red quartzites, in thin to thick beds, many of which show crossbedding, ripple marks, and mud conglomerates. Quartzites grade upward into rose-red argillites, which are thinly bedded and fissile. Thickness about 1,500 feet. Overlies Roosville member; underlies undifferentiated rocks of Missoula group.

Type locality: South crest of Mount Rose, near Akamina Pass, Waterton Lakes National Park, Alberta.

Mount Ruth Leucogranodiorite

Lower Cretaceous(?): Northeastern Oregon.

W. H. Taubeneck, 1957, Geol. Soc. America Bull., v. 68, no. 2, p. 206–209, 235. Fine-grained light-colored rock with large scattered biotite crystals. Intrudes Bald Mountain tonalite (new).

Exposed on summit and upper part of Mount Ruth, Elkhorn Mountains [Grant County]. Forms part of Bald Mountain batholith.

Mount St. Helens Lavas

Quaternary: Southwestern Washington.

Jean Verhoogen, 1937, California Univ., Dept. Geol. Sci. Bull., v. 24, no. 9, p. 283–294. Name applied to lavas from Mount St. Helens. Lavas are mainly basic, rhyolites are lacking, dacites occur sparingly in pyroclastics; pyroxene andesites and olivine basalts are common rock with andesites more abundant than basalts.

Mount St. Helens occurs on western slope of Cascade Range, 40 miles north of Columbia River.

Mount Savage Fire Clay (in Pottsville Formation)[1]

Mount Savage Underclay (in Kanawha Member of Pottsville Formation)

Pennsylvanian: Western Maryland, central southern Pennsylvania, and northern West Virginia.

Original reference: C. A. Ashburner, 1878, Pennsylvania 2d Geol. Survey Rept. F.

J. B. McCue and others, 1948, West Virginia Geol. Survey [Repts.], v. 18, p. 18. Mount Savage clay occurs beneath Tionesta coal about 50 feet below top of the Pottsville. Thickness about 14 feet in Mineral County.

R. L. Nace and P. P. Bieber, 1958, West Virginia Geol. Survey Bull. 14, p. 23 (table 6). Listed as Mount Savage underclay in Kanawha member of Pottsville formation.

Named for occurrence at Mount Savage, Allegany County, Md.

†Mount Savage Group (in Pottsville Formation)[1]

Pennsylvanian: Central southern Pennsylvania and western Maryland.

Original reference: C. A. Ashburner, 1878, Pennsylvania 2d Geol. Survey Rept. F.

In southern part of Huntingdon County, Pa.

Mount Savage Sandstone (in Allegheny Formation?)[1]

Pennsylvanian: Western Maryland.

Original reference: C. K. Swartz, W. A. Price, and H. Bassler, 1919, Geol. Soc. America Bull., v. 30, p. 572.

Allegany and Garrett Counties.

Mount Scott Lavas

Pleistocene: Southwestern Oregon.

Howel Williams, 1942, Carnegie Inst. Washington Pub. 540, p. 36, pl. 3. Lavas are pyroxene andesites rich in phenocrysts of feldspar and carry many basic inclusions. Lavas issued from Mount Scott, a parasitic cone not far above eastern base of former Mount Mazama. None of the lavas exposed on walls of Crater Lake came from Mount Scott. In that direction, the flows did not spread more than a mile from the vent. In other directions, the Mount Scott lavas were able to move farther. Eastward, they pass beneath flows and domes of later dacite. Mount Scott probably ceased to erupt before dacites of Llao Rock, Cleetwood Cove, and Red Cloud escaped from Northern Arc of Vents.

Mount Scott is highest peak in Crater Lake National Park.

Mount Selman Formation (in Claiborne Group)[1]

Eocene: Southern and eastern Texas.

Original reference: W. Kennedy, 1892, Texas Geol. Survey 3d Ann. Rept., p. 45, 52–54.

J. M. Patterson, 1942, Am. Assoc. Petroleum Geologists Bull., v. 26, no. 2, p. 259 (fig. 2), 260–261. Discussed in area between Laredo and Rio Grande City. About 1,000 feet of Mount Selman beds exposed. Lower 700 feet probably Queen City in age. Above Queen City are 300 feet of red and green shales with some sandstones of approximate age of the Weches. Base of section; underlies Garceno sandstone member (new) of Cook Mountain formation.

Formation includes (ascending) Reklaw, Queen City, Sand, and Weches Greensand Members.

Named for Mount Selman, Cherokee County.

Mount Simon Sandstone[1] (in Dresbach Group)

Mount Simon Member (of Dresbach Formation)

Upper Cambrian: Southwestern Wisconsin and Minnesota.

Original reference: C. D. Walcott, 1914, Smithsonian Misc. Colln., v. 57, p. 354.

C. R. Stauffer, G. M. Schwartz, and G. A. Thiel, 1938, (abs.) Geol. Soc. America Bull., v. 49, no. 12, pt. 2, p. 1901–1902. Listed as basal member of Dresbach formation in Minnesota. Underlies Eau Claire member.

C. R. Stauffer and G. A. Thiel, 1941, Minnesota Geol. Survey Bull. 29, p. 30, 33, measured sections. In much of Minnesota, member overlies Hinckley sandstone. Thickness 80 to 200 feet. Outcrops confined to Pine County. Encountered in deep wells in southwestern part of state. Underlies Eau Claire member of Dresbach. St. Croixian series.

J. S. Templeton, Jr., 1950, Illinois Acad. Sci. Trans., v. 43, p. 151–159. In subsurface in northern Illinois subdivided into (ascending) Crane, Kenyon, Lovell, Mayfield, Lacey, Gunn, and Charter members (all new). Unconformably overlies Precambrian basement; underlies Eau Claire. Thickness 400 to 2,120 feet.

Forms escarpment called Mount Simon near Eau Claire, Wis.

Mount Stuart Granodiorite[1]

Pre-Tertiary: Central Washington.

Original reference: I. C. Russell, 1900, U.S. Geol. Survey 20th Ann. Rept., pt. 2, p. 100–137, map.

R. C. Ellis, 1959, Dissert. Abs., v. 20, no. 3, p. 990. Rocks of Mount Stuart block are exposed along east margin of Dutch Miller Gap area and consist of Hawkins greenstone, Ingalls peridotite (new), and Mount Stuart granodiorite.

Occurs on and in vicinity of Mount Stuart, Chelan County.

Mount Susitna Glaciation

Pleistocene: Central southern Alaska.

T. N. V. Karlstrom *in* T. L. Péwé and others, 1953, U.S. Geol. Survey Circ. 289, p. 3, 13 (table 1). At least four major Quaternary glaciations recognized in Upper Cook Inlet area. Mount Susitna, oldest glaciation in area, preceded Caribou Hills glaciation. Summit level of Mount Susitna and other high-level surfaces with apparent ice-scoured forms lie above truncated spurs and marginal deposits of subsequent glaciations and record oldest glaciation in area. Scattered boulders and thick veneer of unconsolidated material present on some of these high-level surfaces. In general, unconsolidated deposits are intricately dissected and extensively modified by mass wasting.

Evidence on summit level of Mount Susitna in southern Susitna lowland, Upper Cook Inlet region.

Mount Tabor Shale Member (of Cook Mountain Formation)

Mount Tabor Shale Member (of Crockett Formation)

Eocene, middle (Claiborne) : Eastern Texas.

H. B. Stenzel, 1938, Texas Univ. Bur. Econ. Geology Pub. 3818, p. 20 (table), 151–154, 159. Name applied to uppermost member of Crockett formation. Consists of interbedded silts and shales in upper part and chiefly brown shales in lower part. Thickness varies from 45 feet at type locality to as much as 100 feet in eastern part of area. Overlies Spiller sand member (new) with contact transitional; underlies Yegua formation with boundary placed where sands become more abundant than shales.

H. B. Stenzel, 1939, Texas Univ. Bur. Econ. Geology Pub. 3945, pt. 2, p. 859 [1940]. Includes Serbin sand lentil (new) at top.

H. B. Stenzel, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 9, 1664, 1665, 1671 (fig. 3). Reallocated to member status in Cook Mountain formation.

Type locality: In east ditch of U.S. Highway 75, on slope north of Mount Tabor School, Madison County.

Mount Toby Conglomerate (in Newark Group)[1]

Upper Triassic: Central southern Massachusetts.

Original reference: B. K. Emerson, 1891, Geol. Soc. America Bull., v. 2, p. 452.

M. E. Willard 1951, Bedrock geology of Mount Toby quadrangle, Massachusetts: U.S. Geol. Survey Geol. Quad. Map [GQ–8]. Mount Toby conglomerate as originally defined by Emerson included, in addition to conglomerate above Deerfield diabase, those parts of Turners Falls sandstone (new) and Sugarloaf formation exposed in Mount Toby highland and coarse talus breccia on east face of Mount Toby that was named Leverett breccia by Reynolds and Leavitt (1927). Mount Toby as mapped in present investigation includes only coarse and fine conglomerate above Deerfield diabase and talus breccia (Leverett breccia).

Named for occurrence on Mount Toby.

Mount Tom Hornblende Gneiss[1]

Paleozoic: Western Connecticut.

Original reference: W. M. Agar, 1927, Connecticut Geol. Nat. History Survey Bull. 40.

E. N. Cameron, 1951, Connecticut Geol. Nat. History Survey Bull. 76, p. 2, 11–12. Assigned to Mount Prospect complex (new).

R. M. Gates, 1952, *in* R. M. Gates and W. C. Bradley, Connecticut Geol. Nat. History Survey Misc. Ser. 5, p. 21–25. Dark-greenish-black or mottled black and white rock composed essentially of hornblende and plagioclase. Coarse to fine grained, massive to foliated and lineated. Evidence in New Preston quadrangle for probable igneous origin.

R. M. Gates, 1959, U.S. Geol. Survey Geol. Quad. Map GQ–121. Name Mount Tom hornblende gneiss is used in this report, as it applies primarily to hornblende gneisses in general area of Litchfield, New Preston, and Roxbury quadrangles. Forms cluster of intrusive bodies in Hartland formation.

Forms Mount Tom, Little Mount Tom, and Mount Rat, Litchfield County.

Mount Tripyramid Complex

Carboniferous(?): East-central New Hampshire.

A. P. Smith and others, 1938, Geologic map and structure selection of the Mount Chocorua quadrangle, New Hampshire (1:62,500): New Hampshire Highway Dept. Includes dark-gray coarse- to medium-grained gabbro, gray-mottled medium-grained hypersthene diorite, very light gray medium-grained monzodiorite, light-gray medium-grained and pink moderately fine-grained monzonite, dark-gray fine-grained porphyritic quartz monzonite, and pink medium-grained quartz syenite. Included in White Mountain magma series.

Crops out around Mount Tripyramid in northwestern part of Mount Chocorua quadrangle.

†Mount Vernon Beds[1]

Silurian (Niagaran): Central eastern Iowa.

Original reference: W. H. Norton, 1895, Iowa Geol. Survey, v. 4, p. 130–135.

Named for Mount Vernon, Linn County.

†Mount Vernon Series[1]

Lower Cretaceous: Eastern Virginia.

Original reference: L. F. Ward, 1895, U.S. Geol. Survey 15th Ann. Rept., p. 324.

First discovered about 1 mile below Mount Vernon mansion, directly underneath high bluff known as Rose's Delight, within former Mount Vernon estate.

†Mount Washington Series[1]

Cambrian and Ordovician: Southwestern Massachusetts and northwestern Connecticut.

Original reference: W. H. Hobbs, 1893, Jour. Geology, v. 1, p. 717–736, 780–802.

Named for occurrence on Mount Washington, Berkshire County, Mass.

Mount Wilson Quartz Diorite[1]

Late Mesozoic: Southern California.

Original reference: W. J. Miller, 1926, (abs.) Geol. Soc. America Bull., v. 37, p. 149.

W. J. Miller, 1946, Geol. Soc. America Bull., v. 57, no. 5, p. 468, 469, table 4. Wilson quartz diorite shown on correlation chart in San Gabriel, Santa Monica, and San Bernardino Mountains. Text refers to Wilson diorite. Late Mesozoic.

Named for exposures on and near Mount Wilson.

Mount Zion Porphyry[1] (in Gray Porphyry Group)

Eocene: Central Colorado.

Original references: S. F. Emmons, 1883, U.S. Geol. Survey Atlas of Leadville dist., Colo.; U.S. Geol. Survey Mon. 12, p. 76.

C. H. Behre, Jr., 1953, U.S. Geol. Survey Prof. Paper 235, p. 46. Mount Zion porphyry not recognized in immediate region [Mosquito Range] though it is possible that some of what is here mapped as Evans Gulch porphyry is actually Mount Zion porphyry.

Named for exposures on Mount Zion, north of Leadville, Lake County.

Mowich Formation

Mowich Group

Lower Jurassic: East-central Oregon.

F. L. Davis, 1937, Oregon Country Geol. Soc. News Letter, v. 3, no. 2, p. 14. Referred to as Mowitch formation.

R. L. Lupher, 1941, Geol. Soc. America Bull., v. 52, no. 2, p. 227 (table 1), 229, 235–238. Mowich group consists of three formations (ascending): Robertson, Suplee, and Nicely black shale (all new). Total thickness less than 500 feet. Group steeply folded; in some localities, inclined more than 45° and in some places nearly vertical. Unconformably underlies Colpitts group (new); overlies Donovan formation (new). Type area and derivation of name given.

Type area: Along head waters of South Fork of Beaver Creek, 7 miles southeast of Suplee post office, in secs. 26, 27, 28, and 29, T. 18 S., R. 26 E., Crook County. Named for Mowich Mountain.

Mowich Hypersthene Basalt

See Keechelus Andesitic Series.

Mowitch Formation

See Mowich Formation, Group

Mowitza Shale[1]

Upper Devonian: Southwestern Utah.

Original reference: B. S. Butler, 1913, U.S. Geol. Survey Prof. Paper 80.

Type locality: Mowitza shaft, Star district, southeast of Frisco district, Beaver County.

Mowry Shale (in Colorado Group)[1]

Mowry Shale Member (of Colorado Shale)

Mowry Shale Member (of Mancos Shale)

Mowry Shale Member (of Graneros Shale)

Lower Cretaceous: Wyoming, Colorado, Montana, western South Dakota, and Utah.

Original reference: N. H. Darton, 1904, Geol. Soc. America Bull., v. 15, p. 394–401.

W. W. Rubey, 1930, U.S. Geol. Survey Prof. Paper 165, p. 4. Clay Spur bentonite bed occurs at top of Mowry siliceous shale member of Graneros shale.

J. B. Reeside, Jr., 1944, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 10. Shown on correlation chart as Mowry shale; overlies Newcastle sandstone; underlies Belle Fourche shale. [Has been considered member of Graneros shale.] Upper Cretaceous.

H. L. Foster, 1947, Am. Assoc. Petroleum Geologists Bull., v. 31, no. 9, p. 1573–1577. Mowry shale in Gros Ventre River and Mount Leidy Highland areas is about 1,070 feet thick and consists of salt and pepper sandstones, black and gray shale, bentonite, thin dolomites, and many porcellanite beds. Contact with overlying Frontier gradational. For mapping purposes, contact is placed at base of typical Frontier-type sandstone, above which no bentonite or porcellanite beds were observed. Contact with underlying Thermopolis gradational in most areas. Base of Mowry chosen at bottom of first salt and pepper sandstone.

B. C. Petsch, 1949, South Dakota Geol. Survey Rept. Inv. 65, p. 11–13; R. E. Stevenson, 1952, South Dakota Geol. Survey Rept. Inv. 69, p. 6, 7. Classified as member of Graneros shale. Underlies Belle Fourche shale member; overlies Newcastle sandstone member.

A. J. Crowley, 1951, Am. Assoc. Petroleum Geologists Bull., v. 35, no. 1, p. 85 (table 1). Generalized stratigraphic section in Black Hills area shows Mowry shale member of Graneros shale underlies Belle Fourche member and overlies Newcastle sandstone member of Skull Creek group. Thickness about 200 feet.

W. A. Cobban and J. B. Reeside, Jr., 1951, Am. Assoc. Petroleum Geologists Bull., v. 35, no. 8, p. 1892–1893. Recently, uncrushed ammonites have been collected from Mowry shale and equivalent rocks at several localities in Colorado, Wyoming, and Montana. These collections show that impressions and crushed internal molds of ammonites previously assigned to Upper Cretaceous genera *Metoicoceras*, *Acompsoceras* and *Neocardioceras* (as *Kanabiceras*) belong to lower Cretaceous genera *Gastroplites* and *Neogastroplites*. Largest collection of *Neogastroplites* is from bed of concretions in Mowry shale near Cody, Wyo.

W. A. Cobban, 1951, Am. Assoc. Petroleum Geologists Bull., v. 35, no. 10, p. 2179–2181. Formations that are equivalent to Colorado shale are Fall River sandstone, Skull Creek shale, New Castle sandstone, Mowry shale, Belle Fourche shale, Greenhorn formation, Carlile shale, and Niobrara formation. Mowry, in northern Black Hills, consists of about 235 feet of light-gray-weathering siliceous shale containing abundant marine fish scales. Interbedded with creamy white layers of bentonite, with Clay Spur bentonite at top. In central Montana, these beds are less siliceous and more sandy, but thickness is little changed. Farther west, rocks of Mowry age thicken and become more sandy, and lower part passes into nonmarine sediments with conspicuous amount of tuff, bentonite, and bentonitic mudstone. Mowry is considered a formation in the Black Hills and a member of the Colorado shale in central Montana. Lower Cretaceous.

D. M. Kinney, 1955, U.S. Geol. Survey Bull. 1007, p. 98–102, pls. 1, 6. Basal member of Mancos shale in Uinta River-Brush Creek area, Utah. Consists of dark-gray hard fissile light-gray-weathering shale. Thickness 30 to 120 feet. Underlies Frontier sandstone member; overlies Dakota sandstone. Upper Cretaceous. Name Mowry preferred to name Aspen in this area.

M. M. Knechtel and S. H. Patterson, 1955, U.S. Geol. Survey Mineral Inv. Field Studies Map MF–36. Mowry shale includes Clay Spur bentonite bed in northern Black Hills district, Montana, Wyoming, and South Dakota.

R. K. Hose, 1955, U.S. Geol. Survey Bull. 1027–B, p. 58–59. Mowry shale described in Johnson County, Wyo., where it is about 500 feet thick and consists of two major units which grade into each other; lower, about 150 feet thick, is soft grayish-black shale with several thin beds of bentonite; upper unit, 350 feet, consists of light-gray brittle laminated siliceous shale, with several yellowish bentonite beds and a few thin sandstones. Overlies Newcastle sandstone; underlies Frontier formation. [Colorado group not used in this report.]

R. F. Walters, 1957, Rocky Mountain Assoc. Geologists Guidebook to the geology of North and Middle Parks basin, Colorado, p. 85, 86. Generalized stratigraphic section for Independence Mountain area, North Park, Colo., shows Mowry formation, 205 feet thick, overlies Thermopolis shale and underlies Frontier formation.

Herbert Skolnick, 1958, Am. Assoc. Petroleum Geologists Bull., v. 42, no. 4, p. 787–815. Skull Creek shale, Newcastle sandstone, and lower part of Mowry shale are considered Lower Cretaceous in age, correlated by Foraminifera with rocks of Kansas, Oklahoma, and Texas. Newcastle sandstone is considered to be a member of the Skull Creek. Mowry shale, with its widespread distribution, distinctive lithologic features, and characteristic fauna, can be mapped in the field and should be considered a formation. Since, locally, the basal part of the Mowry in Black Hills area appears more closely related to underlying Skull Creek shale than to typical siliceous upper Mowry shale, it is probable that a redefinition of the Mowry will assign its basal part to Skull Creek shale.

W. J. Mapel, 1959, U.S. Geol. Survey Bull. 1078, p. 40–43. As described by Darton on eastern side of Bighorn Mountains, Mowry beds were middle unit of his Colorado formation and consisted of sequence of hard light-gray shale and thin-bedded sandstone that weathers light gray and forms ridges. These shale beds are separated from Newcastle sandstone by 150 to 200 feet of soft black shale which when occurring on western side of Bighorn Mountains, has in past been mapped as part of Thermopolis shale. Thompson, Love, and Tourtelot (1949) advocated that Mowry shale in central Wyoming be defined to include not only the black shale but also the underlying black shale. Mowry shale as used in this report [Buffalo-Lake De Smet area, Johnson and Sheridan Counties, Wyo.] follows usage advocated by Thompson, Love, and Tourtelot. It includes strata lying between Muddy sandstone member of (Newcastle sandstone of this report) of Thermopolis shale and Frontier formation. As thus used, the Mowry shale is equivalent to rock in Black Hills which Rubey (1930) included in Mowry shale. Thickness of Mowry about 525 feet in area of present report. Includes a lower nonresistant black shale member about 200 feet thick and an upper resistant light-gray siliceous member about 325 feet thick.

J. B. Reeside, Jr., and W. A. Cobban, 1960, U.S. Geol. Survey Prof. Paper 355, p. 2–9, measured sections. Some difference of opinion has existed, with respect to central and western Wyoming, as to where in sequence of rocks the boundaries of Mowry should be placed. In this area, the Mowry is overlain by Frontier formation and underlain by Thermopolis shale. In original definition of Thermopolis shale, Lupton (1916) described a "Muddy sand" near the middle. This later became known as Muddy sandstone member of the Thermopolis, which is the present classification of U.S. Geological Survey. Love (1948, Wyoming Geol. Assoc. Guidebook 3d Ann. Field Conf.) has pointed out that that part of the Thermopolis that overlies Muddy sandstone member grades upward into Mowry shale and that a satisfactory boundary cannot be determined either at outcrops or from well cuttings. Love and associates (Love, 1948; Thompson, Love, and Tourtelot, 1949; Love and others, 1951) favor elevating Muddy sandstone to formation rank and extending Mowry downward to top of the Muddy. Foster (1947) placed boundary between Mowry shale and Thermopolis shale still lower and included Muddy sandstone in lower part of Mowry. Upper boundary has likewise been placed at different levels according to personal opinion. Love and associates place upper boundary in central Wyoming at base of medium- to coarse-grained soft porous bed of sandstone that contains numerous dark grains. This sandstone is overlain by widespread unit of white bentonite, tuff, and porcellanite. In southwestern Wyoming, a similar white tuffaceous unit lies in lower part of Frontier formation at its type locality. In Jackson Hole area, Foster (1947) included this tuffaceous unit in upper part of Mowry. It makes little difference for present purposes whether this tuffaceous interval is called Mowry or Frontier. Presumably the tuff represents one of latest eruptions in the series that contributed to formation of Mowry shale, and its assignment depends on the personal opinion as to whether Mowry shale should include only main mass of volcanic debris or all of it. Systematic description of fossils.

D. L. Eicher, 1960, Yale Univ., Peabody Mus. Nat. History Bull. 15, p. 5 (fig. 2), 6, 7, 8, 10–12, 26, 49. Overlies Shell Creek formation (new).

Named for Mowry Creek, northwest of Buffalo, Johnson County, Wyo.

Moxahala Clay (in Allegheny Formation)[1]

Pennsylvanian: Southeastern Ohio.

Original reference: E. Orton, 1884, Ohio Geol. Survey, v. 5.

Named for Moxahala, Perry County.

Moya Formation (in Keller Group)

Pennsylvanian (Virgil Series): Central New Mexico.

M. L. Thompson, 1942, New Mexico Bur. Mines Mineral Resources Bull. 17, p. 27 (table 2), 70 (fig. 7), 71, 72–73. Term proposed for limestone between top of Del Cuerto formation (new) and base of Bruton formation (new) of Fresnal group (new). At type locality, formation is composed largely of massive to massively bedded limestone, with a few thin layers of irregularly bedded to nodular limestone; in some areas, sandstones and shales are interbedded with the limestones. Thickness at type locality 51 feet.

Type locality: Northeast side of Oscura Mountains, Socorro County. Name derived from Moya Spring on east slope of Oscura Mountains, about 8 miles south of north side of range.

Moyer Member (of Frankfort Formation)

Upper Ordovician (Cincinnatian): Central New York.

Marshall Kay, 1953, New York State Mus. Bull. 347, p. 66–67. Name proposed for uppermost member of formation. Composed principally of gray, somewhat arenaceous shale with beds up to 1 foot thick of finely cross-laminated sandstone like those in Harter shale member (new) at base of formation. Proportion of sandstone to shale decreases toward top. Thickness about 400 feet. Overlies Hasenclever sandstone member (new); disconformably underlies Oneida formation.

Typically exposed along lower course of Moyer Creek southwest of Frankfort, Herkimer County. Also well exposed along stream flowing north-northeast of Frankfort Hill into Ferguson Creek.

Moyers Formation (in Stanley Group)

Mississippian (Meramecian): Southeastern Oklahoma.

B. H. Harlton, 1938, Am. Assoc. Petroleum Geologists Bull., v. 22, no. 7, p. 854 (fig. 1), 856, 870–874. Proposed for a sequence of sandstones and shales overlying Tenmile Creek formation (new) and underlying Chickasaw Creek siliceous shale (new); includes a 20-foot fossiliferous siliceous shale at base. Aggregate thickness about 1,100 feet. Stanley group. Pushmataha series (new); Bendian period.

L. M. Cline and O. B. Shelburne, 1959, *in* The geology of the Ouachita Mountains—a symposium: Dallas Geol. Soc. and Ardmore Geol. Soc., p. 179 (table 1), 182. Middle formation in Stanley group. Overlies Ten Mile Creek formation; underlies Chickasaw Creek shale. At type locality, consists of 1,110 feet of alternating sandstones and shales. Mississippian (Meramecian).

Type locality: At and north of village of Moyers, in T. 2 S., R. 16 E., Pushmataha County. Well exposed on flanks of Tuskahoma syncline in Tps. 1 and 2, R. 16 E.

Muav Limestone (in Tonto Group)[1]

Middle Cambrian: Northwestern Arizona.

Original reference: L. F. Noble, 1914, U.S. Geol. Survey Bull. 549.

E. D. McKee, 1945, Carnegie Inst. Washington Pub. 563, p. 14 (fig. 2), 21–24, 80–110. Numerous excellent key beds which serve as time planes are developed in various parts of Muav formation. They clearly illustrate relation between facies distribution and time. Seven principal members recognized in formation are here named (ascending) Rampart Cave, Sanup Plateau, Spencer Canyon, Peach Springs, Kanab Canyon, Gateway Canyon, and Havasu. Newly named tongues are (ascending) Elves Chasm, Garnet Canyon, Lava Falls, Parashant, and Boucher. Thickness of formation as redefined varies from 136 feet near Little Colorado at eastern end of Grand Canyon to 827 feet along Grand Wash Cliffs at western end. Intertongues with Bright Angel shale to east.

Named for Muav Canyon, Grand Canyon district, in lower part of which formation is well exposed.

Mud Sandstone (in Bluestone Formation)[1]

Mud Shale (in Bluestone Formation)[1]

Mississippian (Chester Series): Southwestern Virginia and southeastern West Virginia.

Original reference: D. B. Reger, 1926, West Virginia Geol. Survey Rept. Mercer, Monroe, and Summers Counties, p. 294, 320–321.

B. N. Cooper, 1944, Virginia Geol. Survey Bull. 60, p. 184. Lower Mud shale, Lower Mud sandstone, Upper Mud shale, and Upper Mud sandstone (Reger, 1926) grouped into single member and named Mud Fork member of Bluestone formation.

Exposed on Mud Fork of Bluestone River in Tazewell County, Va.

Muda Limestone[1]

Cretaceous(?): Puerto Rico.

Original reference: D. R. Semmes, 1919, New York Acad. Sci. Scientific survey of Porto Rico and Virgin Islands, v. 1, p. 74.

Mudd Pond Member (of Bull Formation)

Lower Cambrian: Eastern New York and western Vermont.

E-an Zen, 1959, New England Intercollegiate Geol. Conf. Guidebook 51st Ann. Mtg., p. 1–2. White vitreous medium-grained orthoquartzite with rare dolomitic pods, locally there are two quartzite beds separated by green slate. Thickness as much as 20 feet. Underlies Castleton conglomerate member (new); overlies Zion Hill member. Locally absent.

Type locality not stated.

Muddy Sandstone Member (of Thermopolis Shale)

Muddy Sand[1] or Sandstone

Lower Cretaceous: Surface and subsurface in central northern Wyoming and subsurface in central southern Montana.

Original reference: F. F. Hintze, Jr., 1915, Wyoming State Geol. Bull. 10, p. 20–21.

Helen Foster, 1947, Am. Assoc. Petroleum Geologists Bull., v. 31, no. 9, p. 1572. Muddy sandstone, which is good marker in other areas, has not been found in Gros Ventre River area. There is a possibility that it is represented by basal salt-and-pepper sandstone which is here included in the Mowry.

R. M. Thompson, J. D. Love, and H. A. Tourtelot, 1949, U.S. Geol. Survey Oil and Gas Inv. Prelim. Chart 36; J. D. Love and others, 1951, U.S. Geol. Survey Oil and Gas Inv. Chart OC–43. Allocated to member status in Thermopolis shale. Overlies a lower black shale member and underlies a black shale member. Upper Cretaceous. Writers of this report prefer to consider Muddy as separate formation, but this classification is not accepted by U.S. Geological Survey.

C. P. Ross, D. A. Andrews, and I. J. Witkind, 1955, Geologic map of Montana (1:500,000): U.S. Geol. Survey. In subsurface, Montana, Thermopolis shale includes Muddy sandstone member.

M. M. Knechtel, 1959, U.S. Geol. Survey Bull. 1072–N, p. 740–741. In earlier publications dealing with area [Little Rocky Mountains, Mont.], unit herein called Cyprian sandstone member of Thermopolis was tentatively designated Muddy sand.

D. L. Eicher, 1960, Yale Univ., Peabody Mus. Nat. History Bull. 15, p. 5 (fig. 2), 11, 14–16, 25–26, strat. sections. Nomenclatorial problems of Thermopolis shale and Muddy sandstone discussed. Status of Muddy sandstone appears to be key to much of problem. Two concepts of Muddy sandstone are prevalent: (1) it consists of separate and discontinuous sandstone lenses or tongues of dubious correlation which lie isolated within and surrounded by thick body of black shale; this view would not encourage recognition of Muddy as a formation; and (2) it consists of a single, persistent unit of highly variable lithology which occupies a single stratigraphic interval and records an important historical episode of basin-wide deposition; this view would encourage recognition of Muddy as formation. However, there is popular resistance toward formally recognizing Muddy and establishing type section for it. In this report, Muddy sandstone is considered a formation. Term sandstone is misnomer because in many areas unit does not consist predominantly of sandstone. Thickness commonly 30 to 50 feet; locally more than 100 feet. Overlies Thermopolis shale (restricted); underlies Shell Creek shale (new). Reference locality suggested.

As corollary to action taken in regard to change in boundary between Upper and Lower Cretaceous series, age of Muddy Sandstone Member of Thermopolis Shale is considered Lower Cretaceous.

Reference locality: Exposure near Greybull, N½ sec. 36, T. 53 N., R. 93 W., Bighorn County, Wyo.

Muddy Creek Beds

Oligocene(?): Southwestern Montana.

Robert Scholten, K. A. Keenmon, and W. O. Kupsch, 1955, Geol. Soc. America Bull., v. 66, no. 4, p. 369, table 1, pl. 1. Tuff with some shales, conglomerates and fresh-water limestone; basal pebble conglomerate and sandstone in Muddy Hole Basin; some bituminous shales; color, mostly white, light gray and buff with some pink, red, brown, and black. Maximum thickness exceeds 1,000 feet. Unconformably overlies Paleozoic rocks and underlies andesites and basalts.

Restricted to the intramontane Muddy Creek and Muddy Hole Basins in the Tendoy Range, Beaverhead County.

Muddy Creek Formation[1]

Pliocene(?): Southeastern Nevada, northwestern Arizona, and southwestern Utah.

Original reference: Chester Stock, 1921, Geol. Soc. America Bull., v. 32, p. 147.

C. R. Longwell, 1936, Geol. Soc. America Bull., v. 47, no. 9, p. 1419, 1423. Stratigraphically extended to include highly tilted strata near mouth of Bitter Spring Wash, Nev. These include breccia, gray sandstone, and peculiar green volcanic tuff in addition to clay and gypsum—all previously assigned to underlying Horse Spring formation. Overlies Black Canyon group (new), angular unconformity. Referred to early Pliocene(?).

C. R. Longwell, 1946, Am. Jour. Sci., v. 244, no. 12, p. 823, 834. More warrant for Miocene(?) than for Pliocene(?) age classification, and evidence of regional aridity favors upper Miocene assignment rather than one older.

F. B. Van Houten, 1956, Am. Assoc. Petroleum Geologists Bull., v. 40, no. 12, p. 2810. Upper Miocene or lower Pliocene.

E. F. Cook, 1960, Utah Geol. and Mineralog. Survey Bull. 70, p. 18 (fig. 1), 39 (map legend), 45–48. In area of this report [Washington County] a time during which generally fine light-colored locally tuffaceous sediments were deposited in troughs and basins is represented by "Muddy Creek" formation. Correlation with known beds of the Muddy Creek in southern Nevada has not been established. Beds in Beaver Dam Wash regarded as "Muddy Creek" in mapping for present report have been called Muddy Creek by C. M. Tschanz (personal letter). Elsewhere in Washington County, the "Muddy Creek" as mapped includes Blank's Reservoir formation (1959, unpub. thesis) and Cook's Parunuweap(?) formation (1957, Utah, Geol. and Mineralog. Survey Bull. 58). Maximum thickness 1,400 feet. Rest in older rocks with marked angular unconformity. "Muddy Creek" of Washington County thought to be mainly Pliocene, but may include some early Quaternary sediments. Chart shows Muddy Creek formation stratigraphically above Ox Valley tuff (new) and equivalent to Flattop Mountain suite (new).

Exposed along southwest side of Muddy River, between villages of Overton and Logan [Logandale], Nev., and in Meadow Valley, approximately 80 miles south of Panaca, Nev.

Muddy Creek Volcanics

Oligocene: Southwestern Montana.

Robert Scholten, K. A. Keenmon, and W. O. Kupsch, 1955, Geol. Soc. America Bull., v. 66, no. 4, p. 374–375, pl. 1. Name applied to rhyolitic tuffs and lava flows interbedded with Tertiary sediments. Range from white and light gray to pink and buff. Water-laid origin.

In Muddy Creek and Muddy Hole basins, Beaverhead County.

Muddy Mountain Chert Member (of Madison Limestone)

Mississippian: Northwestern Wyoming.

J. D. Love, 1939, Geol. Soc. America Spec. Paper 20, p. 25. Conspicuous chert sequence near middle of Madison formation. Chert is extremely compact but considerably brecciated by later folding and faulting. Dominant color is red brown but some black, blue, and white layers present. Bedding poor. Between 50 and 100 feet thick on Black Mountain. Underlies gray limestone; overlies coral bed in blue limestone.

Exposed on southeastern slope of Black Mountain and on southern flank of Owl Creek Mountains. Named for Muddy Mountain (Monument Peak), at head of Dry Creek, in central eastern part of area of this report [roughly the southeastern end of Absaroka Range, Fremont County].

Muddy Peak Limestone[1]

Middle Devonian and older(?): Southeastern Nevada, northwestern Arizona, and southwestern Utah.

Original references: C. R. Longwell, 1921, Am. Jour. Sci., 5th, v. 1, p. 46–53; 1928, U.S. Geol. Survey Bull. 798.

G. A. Cooper and others, 1942, Geol. Soc. America Bull., v. 53, no. 12, pt. 1, p. 1773, chart 4. Upper Devonian.

A. H. McNair, 1951, Am. Assoc. Petroleum Geologists Bull., v. 35, no. 3, p. 514, 515 (fig. 2), 516. Thickness 552 feet in section measured in North Virgin Mountains, Clark County, Nev. Truncates Pogonip(?) and all formations of Cambrian by transgressive overlap. Underlies Rogers Spring limestone. Upper Devonian.

C. T. Snyder, 1952, Utah Geol. Soc. Guidebook 7, p. 8. Present in Beaver Dam Mountains, Utah, and Virgin Mountains, Ariz.

Named for exposures in vicinity of Muddy Peak Basin, especially on north side of Muddy Peak, Muddy Mountains, Nev.

†Muddy Valley Beds[1]

Pliocene(?): Southeastern Nevada.

Original reference: C. Stock, 1921, Am. Jour. Sci., 5th, v. 2, p. 254–257.

Probably named for Muddy Valley.

Mud Fork Beds (in Bluestone Group or Formation)

Mud Fork Member (of Bluestone Formation)

Mississippian (Chester Series): Southwestern Virginia and southeastern West Virginia.

B. N. Cooper, 1944, Virginia Geol. Survey Bull. 60, p. 184, pl. 15. Reger (1926) subdivided the 90-foot succession of red beds immediately above Glady Fork sandstone into four units which he named Lower Mud shale, Lower Mud sandstone, Upper Mud shale, and Upper Mud sandstone. The four units are herein grouped into single member named Mud Fork member of Bluestone formation. Thickness at type section 91 feet. Underlies Belcher member (new).

J. M. Weller and others, 1948, Geol. Soc. America Bull., v. 59, no. 2, chart 5 (columns 97, 98). Shown on correlation chart as Mud Fork beds in Bluestone group and formation.

Type section: Along Road 656 about 1½ miles north of Bailey, Burkes Garden quadrangle, Tazewell County, Va. Name derived from Mud Fork, a tributary of Bluestone River.

Mud Hill Basalt or Flow (in Clayton Basalt)

Late Cenozoic: Northeastern New Mexico.

Brewster Baldwin and W. R. Muehlberger, 1959, New Mexico Bur. Mines Mineral Resources Bull. 63, p. 120–121, pl. 1–b. Ten basalt flows in what is termed Folsom sequence of Clayton basalt are named and mapped. Stratigraphic position of six of these basalts has been determined. Mud Hill basalt is third in known sequence. Older than Bellisle Mountain and younger than Big Hill.

Mud Hill cone is in Dry Cimarron River drainage area, Union County.

Mud Hill Series[1]

Miocene to Pleistocene(?): Southern California.

Original reference: E. E. Free, 1914, Carnegie Inst. Washington Pub. 193, p. 22–23.

Named for occurrence in Mecca Mud Hills, Mecca, Riverside County.

Mud Springs Group

Pennsylvanian (Derry Series): Central New Mexico.

M. L. Thompson, 1942, New Mexico Bur. Mines Mineral Resources Bull. 17, p. 27 (table 2), 31 (fig. 2), 33–34, 36–37. Term proposed for all strata between top of Green Canyon group (new) below and the base of Des Moines series above. Thickness about 113 feet. Includes (ascending) Hot Springs formation and Cuchillo Negro formation (both new). Underlies Armendaris group (new).

M. L. Thompson, 1948, Kansas Univ. Paleont. Contr. 4, Protozoa, art. 1, p. 73 (fig. 8), 74. Includes Fra Cristobal formation and Cuchillo Negro formation. Term Fra Christobal replaces preoccupied name Hot Springs.

Type locality: Near north end of Mud Springs Mountains at west end of Whiskey Canyon, SW¼ sec. 1, T. 13 S., R. 5 W., Sierra County.

Muir Sandstone

Eocene, middle: Northwestern California.

C. E. Weaver, 1953, Washington [State] Univ. Pubs. in Geology, v. 7, p. 19 (chart), 36–44, pls. 4A, 4B, 4C. Composed of brownish-gray medium- to fine-grained marine silty sandstone with interstratified thin layers of silty shale; shale layers commonly contain foraminifera, and nodular layers in sandstone yield molluscs and corals. Thickness at type locality 835 feet. Underlies Escobar sandstone (new); overlies Las Juntas shale (new). Strata mapped as Muir sandstone at Muir Station originally were considered as upper part of Martinez group by Merriam (1897) and others at time when the Eocene of California was classified only as Martinez and Tejon. Muir sandstone together with overlying Escobar sandstone in east limb of Pacheco syncline were mapped as Tejon group in San Francisco folio by Lawson (1914).

B. Y. Smith, 1957, California Univ. Pubs. Geol. Sci., v. 32, no. 3, p. 144–146, 147, pls. Since Pacheco syncline is generally accepted as type area for Martinez, it is difficult to follow Weaver's (1953) omission of that term as an appropriate designation for lower part of sequence, and it seems desirable that Weaver's new units, Vine Hill, Las Juntas, and Muir, be included either as members within Martinez formation or as formations within Martinez group. Systematic description of Foraminifera.

Type section: In west limb of Pacheco syncline in cuts along county highway at Muir Station, south and parallel to Santa Fe Railway, near Martinez, Contra Costa County. Northward from type section Muir is offset by faulting.

Mukwa Granite[1]

Precambrian (Laurentian): Central northern Wisconsin.

Original reference: T. C. Chamberlin, 1877, Geology Wisconsin, v. 3, p. 248.

Occurs in SE¼NE¼ sec. 26 and NW¼SW¼ sec. 25, town of Mukwa, Waupaca County.

Mulatto Tongue (of Mancos Shale)[1]

Upper Cretaceous: Northwestern New Mexico.

Original reference: J. D. Sears, 1934, U.S. Geol. Survey Bull. 860–A.

C. B. Hunt, 1936, U.S. Geol. Survey Bull. 860–B, p. 44–45, pls. Lies between Dilco coal member and Dalton sandstone member of Mesaverde formation. Thickness 250 to 400 feet in Mount Taylor coal field. Stratigraphically below Satan tongue of Mancos.

Named for exposures at mouth of Canyon Mulatto, in T. 14 N., R. 9 W., 9 miles northwest of San Mateo, Valencia County.

Muldoon Formation

Lower Mississippian to [Upper Mississippian or Pennsylvanian]: Central and eastern Idaho.

M. R. Thomasson, 1959, Dissert, Abs., v. 20, no. 3, p. 999. A flysch series consisting of a pelitic facies of black limestones and mudstones, and a psammitic series of graded immature graywackes ranging from 1 millimeter to 43 feet thick. Graded limestones also present. Subdivided into four new members (ascending): Copper Creek, Garfield, Iron Mine, and Wildhorse. Thickness approximately 10,000 feet in Muldoon trough. Overlies Milligen formation; conformably underlies Wood River formation in Muldoon trough, but formations have unconformable relationship in western source area.

Deposited in Muldoon trough, alined N. 30° W., between western positive element, and slightly negative eastern shelf area.

Muldraugh Formation (in Borden Group)

Lower Mississippian: Central Kentucky.

P. B. Stockdale, 1939, Geol. Soc. America Spec. Paper 22, p. 76, 200–222, pls. 6, 15. Proposed for rocks which lie between Floyds Knob formation beneath and Harrodsburg (restricted) limestone or younger strata above. Thickness up to 95 feet. Differentiated into five lithologic facies (west to east): West Point calcareous, Steels Knob chert, Maretburg, Hummel, and Olive Hill. Includes Cummins Station shale member (new) in Maretburg facies, Rothwell shale member (new) in Olive Hill facies, and Wildie siltstone in Hummel facies. Occurs throughout entire Lower Mississippian belt of outcrop in Kentucky except where it is cut out by one of the unconformities—that at base of Ste. Genevieve limestone or major one at base of Pottsville unit.

Type section: Along secondary road leading up "Muldraugh Escarpment" for one-half mile south-southwest from road intersection one-half mile south of Philipsburg, Marion County. Name derived from prominent scarp which rises from southern and western border of Lexington Plain to the Highland Rim, long known as Muldraugh (sometimes spelled Muldraw) Hill or Escarpment.

Mule sandstone[1]

Lower Cretaceous: Southeastern Arizona.

Original reference: C. R. Keyes, 1935, Pan-Am. Geologist, v. 64, no. 2, p. 125–140.

Type section: In Mural Hill, east of Bisbee, Cochise County. Name derived from Mule Mountains.

Mule Mountain Granite

Post-Devonian: Northern California.

I. E. Klein, 1960, Sacramento Geol. Soc. [Guidebook] Field Trip June, 3, 4, and 5, p. 11. Name applied to granite in Mule Mountain stock. Has complex intrusive and faulted relations with Devonian Balaklala rhyolite and Copley metavolcanics.

Present in Mount Shasta area.

Muleros sandstone[1]

Lower Cretaceous (Comanche): Western Texas and southeastern Arizona.

Original reference: C. R. Keyes, 1922, Pan-Am. Geologist, v. 38, p. 247, 250, 337.

Caps Cerro de Muleros, west of El Paso, Tex.

Muleshoe Porphyry

Tertiary: Central Colorado.

J. T. Stark and others, 1949, Geol. Soc. America Mem. 33, p. 81, 85. Quartz monzonite porphyry. Intrusive relation to Upper Cretaceous formations.

Located along a fault on west side of South Park, 3½ miles southwest of Antero junction; in sec. 10, T. 13 S., R. 77 W.

Mulford Formation[1]

Pennsylvanian: Western Kentucky.

Original reference: L. C. Glenn, 1912, Kentucky Geol. Survey Rept. Prog. 1910 and 1911, p. 26.

Probably named for Mulfordtown, Webster County.

Mulholland Formation (in Contra Costa Group)

Pliocene, lower to middle: Northern California.

C. K. Ham, 1952, California Div. Mines Spec. Rept. 22, p. 3, 6 (fig. 3), 14–16, pl. 1. Blue-gray to maroon lacustrine shales, siltstones, argillaceous limestone, pebbly sandstone; tuff bands, bentonite stringers, and limestone lentils common. Thickness 800 to 5,000 feet. Overlies Pinole tuff; unconformable below Pleistocene terraces.

Exposures along upper reaches of Kaiser and Cull Creeks, in Las Trampas Ridge area, east Oakland.

Mulky Formation (in Cabaniss Group)

Mulky Formation or cyclothem (in Cherokee Group)

Pennsylvanian (Des Moines): Southwestern Missouri, southeastern Kansas, and northeastern Oklahoma.

G. E. Abernathy, 1937, Kansas Geol. Soc. Guidebook 11th Ann. Field Conf., p. 18, 19, 23; 1938, Kansas Acad. Sci. Trans., v. 41, p. 193, 195. Cherokee group divided into 15 cyclic formational units. The Mulky, 15th in sequence (ascending), overlies the Bevier. Average thickness 65 feet. [For complete sequence see Cherokee group.]

W. V. Searight and others, 1953, Am. Assoc. Petroleum Geologists Bull., v. 37, no. 12, p. 2748 (fig. 1). Shown on northern midcontinent composite stratigraphic section as Mulky formation. Overlies Lagonda formation; underlies Excello formation. In Cabaniss group.

C. C. Branson, 1954, Oklahoma Geol. Survey Guide Book 2, p. 5. Listed as coal cycle in Senora formation in Oklahoma; underlies Excello shale; overlies Lagonda coal cycle. Includes Kinnison shale and Breezy Hill limestone members. Cabaniss group.

W. V. Searight, 1955, Missouri Geol. Survey and Water Resources Rept. Inv. 20, p. 31 (fig. 20), 38. Formation in Missouri includes Breezy Hill limestone at base, underclay, and Mulky coal bed. Separated from base of Marmaton group by Excello formation. Thickness about 19 inches in Vernon County. Cabaniss group.

W. B. Howe, 1956, Kansas Geol. Survey Bull. 123, p. 22 (fig. 5), 84–88, measured sections. Formation includes beds above Iron Post coal or its horizon and extending to top of Mulky coal bed after which formation was named. Thus defined, formation includes lower shale (Kinnison), restricted to northern Oklahoma, Breezy Hill limestone member, and underclay, and Mulky coal. Thickness 6 inches to about 10 feet. Overlies Lagonda formation; underlies Excello formation. Cabaniss subgroup of Cherokee group.

Mulky coal was named by Broadhead (1873, Preliminary report on the iron ores and coal fields from field work of 1872: Missouri Geol. Survey) from Mulky Creek, Johnson County, Mo.

Mullinix Formation

Upper Triassic(?): North-central Nevada.

R. R. Compton, 1960, Geol. Soc. America Bull., v. 71, no. 9, p. 1388–1389, pl. 1. Sequence of laminated to massive (silty and sandy) phyllites. Thickness about 5,000 feet. Overlies Andorno formation (new) with contact gradational.

Named for exposures in hilly ground west of Tertiary volcanic rocks between Mullinix and Solid Silver Canyons, Santa Rosa Range, Winnemucca area.

Mumford Formation

Upper Pennsylvanian: Southwestern Indiana.

C. E. Wier, 1955, Dissert. Abs., v. 15, no. 12, p. 2515. Proposed for youngest Paleozoic rocks in Indiana.

Type locality and derivation of name not stated.

Mumford Hills Sandstone (in McLeansboro Formation)

Pennsylvanian: Southeastern Illinois and southwestern Indiana.

J. A. Culbertson, 1932, The paleontology and stratigraphy of the Pennsylvanian strata between Caseyville, Kentucky, and Vincennes, Indiana: Urbana, Ill., Univ. Illinois, Abs. Thesis, p. 7. Between Friendsville coal and Aldrich coal of Indiana is variable, but usually prominent sandstone, here designated Mumford Hills sandstone.

Derivation of name not given.

Muncie Creek Shale[1] Member (of Iola Formation)

Muncie Creek Shale Member (of Chanute Shale)

Pennsylvanian (Missouri Series): Northeastern Kansas, southwestern Iowa, northwestern Missouri, southeastern Nebraska, and northeastern Oklahoma.

Original reference: R. C. Moore, 1932, Kansas Geol. Soc. Guidebook 6th Ann. Field Conf., p. 92, 97.

H. S. McQueen and F. C. Greene, 1938, Missouri Geol. Survey and Water Resources, 2d ser., v. 25, pl. 5. Shown on chart as member of Chanute shale in Missouri.

E. H. Wenberg, 1942, Iowa Acad. Sci. Proc., v. 49, p. 339 (fig. 2). Name appears on stratigraphic column of Virgil and Missouri series in Iowa.

R. C. Moore, 1948, Am. Assoc. Petroleum Geologists Bull., v. 32, no. 11, p. 2031 (fig. 4), 2032. Muncie Creek shale member of Iola formation; underlies Raytown limestone member; overlies Paola limestone member. This is classification agreed upon by State Geological Surveys of Iowa, Kansas, Missouri, Nebraska, and Oklahoma, May 1947. Muncie Creek shale had been treated as member of Chanute shale by Missouri Geological Survey.

M. C. Oakes, 1952, Oklahoma Geol. Survey Bull. 69, p. 81–82. Described in Tulsa County where it is 15 to 30 feet thick; upper part locally interfingers with overlying Avant (Raytown) limestone member.

H. G. Hershey, 1960, Iowa Highway Research Board Bull. 15, p. 26. fig. 5. In Madison and Union Counties, composed of two contrasting shale beds. Upper, dark gray to green about 1 foot thick; lower, about 1½ feet thick is hard platy black shale containing conodonts. Underlies Raytown limestone member; overlies Paola limestone member.

Type locality: Named for Muncie Creek in southern part of Wyandotte County, Kans., east of town of Muncie.

Mundy Breccia[1]

Precambrian: Southwestern Texas.

R. L. Harbour, 1960, Am. Assoc. Petroleum Geologists Bull., v. 44, no. 11, p. 1786 (fig. 1), 1788–1790. A black angular breccia as much as 250 feet thick. Unconformably overlies Castner limestone (new). Locally pinches out between Castner limestone and Lanoria quartzite. Thickness about 190 feet.

Type locality: One and one-half miles southeast of North Franklin Mountain and one-half mile northwest of point at which Fusselman Canyon issues from mountains. Name derived from Mundy's Spring, 2 miles northwest of type locality.

Munising Sandstone[1]

Munising Formation

Upper Cambrian: Northern Michigan.

Original reference: A. C. Lane and A. E. Seaman, 1907, Jour. Geology, v. 15, p. 680, 692.

F. T. Thwaites, 1943, Michigan Acad. Sci., Arts and Letters, Papers, v. 28, p. 501. Original Munising sandstone is the Franconia of Wisconsin.

W. K. Hamblin, 1958, Michigan Dept. Conserv., Geol. Div. Pub. 51, p. 6 (fig. 1), 71–114, pls. 1, 2, 4. Lane and Seaman (1907) applied name Munising to upper 250 feet of "Lake Superior sandstone." Formation discussed in detail. Consists of (ascending) basal conglomerate—maximum thickness 15 feet; Chapel Rock member (new)—40 to 60 feet; Miners Castle member (new)—140 feet. Overlies Jacobsville with unconformity; underlies Au Train formation (new) with unconformity. Much of the confusion concerning correlation of the Munising results from inaccessibility of vertical Pictured Rocks cliffs, which constitute principal exposure of formation. Since section exposed in Pictured Cliffs is unfossiliferous and lithic units of Wisconsin cannot be traced into area, terminology of Cambrian of Wisconsin should not be used in northern Michigan.

Named for exposures in bluffs back of Munising, Alger County.

Munterville Limestone or cyclothem

Pennsylvanian: Eastern Iowa and western Illinois.

L. M. Cline and D. G. Stookey *in* J. M. Weller and others, 1942, Am. Assoc. Petroleum Geologists Bull., v. 26, no. 10, p. 1586 (fig. 1), 1587–1588. In Iowa, two thin but well-marked cyclothems are present in section equivalent to Seahorne cyclothem of Illinois. Name Munterville is introduced for lower of these two cyclothems and for limestone which is its most prominent member. Underlies Seahorne limestone; underlying strata not discussed.

Numerous outcrops occur within radius of 1½ miles of Munterville, Wapello County, Iowa.

Mural Limestone[1] (in Bisbee Group)

Lower Cretaceous (Comanche Series): Southeastern Arizona.

Original reference: F. L. Ransome, 1904, U.S. Geol. Survey Prof. Paper 21, p. 56, 65.

A. A. Stoyanow, 1949, Geol. Soc. America Mem. 38, p. 8, 20. Overlies Pedragosa member of Lowell formation (both new); underlies Cintura formation. Light-gray limestone, in lower part bedded, with *Orbitolina texana* (Roemer) and *Lima muralensis*, n. sp.; upper part massive with rudistid reefs.

James Gilluly, 1956, U.S. Geol. Survey Prof. Paper 281, p. 8 (table), 73–76, pl. 1. In central Cochise County, extends in a strip about 1,000 feet wide along eastern side of Mule Mountains from Abbot Canyon, where it disappears beneath alluvium of Sulphur Spring Valley, to south edge of quadrangle. Composed of three members: lower part, generally making up a little more than half of formation, composed of relatively thin-bedded limestone interbedded with preponderant shale and sandstone; middle member composed of massive limestone with very little clastic material; and upper member, thinner beds ranging from shale and sandstone to mudstone and limestone. Thickness about 650 feet. Overlies Morita formation; underlies Cintura formation.

Caps Mural Hill, Bisbee quadrangle.

Muralian series[1]

Lower Cretaceous: Arizona.

Original reference: C. R. Keyes, 1935, Pan-Am. Geologist, v. 64, no. 2, p. 125–140.

†Murat Limestone[1]

Murat calcarenite facies (of Lincolnshire Limestone)

Middle Ordovician: Central western Virginia.

Original reference: H. D. Campbell, 1905, Am. Jour. Sci., 4th, v. 20, p. 445–447.

B. N. Cooper and G. A. Cooper, 1946, Geol. Soc. America Bull., v. 57, no. 1, p. 53–54, 76–77, 84 (fig. 6). The Murat, as originally defined, included cherty *Hesperorthis* beds as well as succeeding thick zone of light-gray calcarenite and associated cherty limestone with *Dinorthis atavoides*. Butts regarded the Murat as applicable only to the coarse-grained limestone and believed granular beds to be younger than any part of associated cherty limestone which was identifed with the Lenoir. Thus, the Murat, regarded as a synonym for Holston, ceased to be used. Butts presumably was not aware that cherty limestones with *Sowerbyites triseptatus* and *Dinorthis atavoides*, which he identified elsewhere as Lenoir, actually overlie the granular beds which he called Holston. Obviously, Holston is an inappropriate name for the granular beds because the Holston is supposed to be younger than the Lenoir. Holston should not be used as time-stratigraphic name. In Tennessee, as well as in Virginia, there are many Holston type beds at many different horizons in the Middle Ordovician. Therefore, Murat could be revived on grounds that original definition was misunderstood and also by reason of the fact that Holston is not strictly applicable. It is proposed herein to revive Murat and to use it for the name of a characteristic facies of clastic reefy limestone, which is an essential part of Lincolnshire limestone.

Well exposed along Buffalo Creek at Murat, Rockbridge County.

Murderian Stage

Upper Silurian (Cayugan): North America.

D. W. Fisher, 1959, New York State Mus. Sci. Service Geol. Survey Map and Chart Ser. 1. Cayugan series divided into Canastota(n) and Murder(ian) stages. Murderian rocks encompass those from the Falkirk (or Oatka?)-Fiddlers Green-Binnewater to top of Silurian. Thickness 65 feet at type section; 90 feet in central New York; 40 feet in Rosendale quadrangle.

Type section: Along Murder Creek in Akron Falls Park, Akron, Medina quadrangle, New York.

Murdock Breccia[1]

Tertiary: Northwestern Arizona.

Original reference: C. Lausen, 1931, Arizona Bur. Mines Bull. 131.

Near Murdock mine, Oatman district, Mohave County.

Murfreesboro Limestone (in Stones River Group)[1]

Middle Ordovician: West-central and eastern Tennessee, northwestern Georgia, and western Virginia.

Original reference: J. M. Safford and J. B. Killebrew, 1900, Elements of geology of Tennessee, p. 105, 125.

Charles Butts, 1940, Virginia Geol. Survey Bull. 52, pt. 1, p. 120–135. Basal formation in Stones River group in Virginia. Includes two facies: St. Clair, purely limestone; and Blackford, a heterogeneous sequence of red shale, red mottled argillaceous dolomite, gray shale, gray clay, and gray magnesian limestone. Thickness 27 to 1,152 feet. Overlies Beekmantown formation; underlies Mosheim limestone. Chazyan series.

B. N. Cooper and C. E. Prouty, 1943, Geol. Soc. America Bull., v. 54, no. 6, p. 861, 863–868. Lower Middle Ordovician succession in Tazewell County, Va., revised. Further use of terms Stones River, Murfreesboro, Mosheim, Lenoir, Blount, Holston, Ottosee, Lowville, and Lowville-Moccasin in Tazewell County and other parts of southwestern Virginia seems inadvisable. Unit called Murfreesboro by Butts is included in Cliffield formation as herein defined.

C. E. Prouty, 1946, Am. Assoc. Petroleum Geologists Bull., v. 30, no. 7, p. 1140–1191. Although revised classification of lower Middle Ordovician in Tazewell County, Va., is somewhat local in nature, it can be usefully applied through much of southwest Virginia and northeast Tennessee. Use of terms Murfreesboro, "Mosheim", "Holston", "Ottosee", "Heiskell", Lowville, and "Bays" should be discontinued as distinct formational names throughout this area. Typical Murfreesboro fauna of Central basin of Tennessee occurs chronologically above, rather than below, "Mosheim", Lenoir, and "Holston." Central basin Murfreesboro has then been erroneously correlated into Virginia and Tennessee sequence. Since greater part of type Murfreesboro is unexposed, direct correlation cannot be successfully made into the Valley sequence.

Charles Butts and Benjamin Gildersleeve, 1948, Georgia Geol. Survey Bull. 54, p. 22–24, geol. map. Geographically extended into northwestern Georgia where it is included in Stones River group. Underlies Mosheim limestone; overlies Newala formation or Knox dolomite.

C. W. Wilson, Jr., 1949, Tennessee Div. Geology Bull. 56, p. 24–32. Described in central Tennessee where it is basal formation in Stones River group. Base not exposed in Central basin; approximately 70 feet exposed at several localities. Conformably underlies Pierce limestone. Safford and Killebrew did not designate type section. On basis of priority, section on Stones River 1 miles west of old Pierce's mill would be most logical type locality. However, at this section, contact with overlying Pierce limestone is not exposed. At old Pierce's mill, this contact and about 10 feet of Murfreesboro limestone are well exposed. On the basis of derivation of name, the section of Murfreesboro behind ice plant just south of where Bradyville Road leaves Murfreesboro-Manchester Highway on southern edge of Murfreesboro would deserve consideration as alternative type locality. Contact with overlying Pierce limestone not exposed at this locality.

R. L. Miller and W. P. Brosgé, 1950, U.S. Geol. Survey Oil and Gas Prelim. Map 104; 1954, U.S. Geol. Survey Bull. 990, p. 32 (table 1), 33–34, 35. In Lee County, Va., name Murfreesboro is replaced by Dot and Poteet limestones (both new).

Name for Murfreesboro, Rutherford County, Tenn.

†Murfreesboro Stage[1]

Miocene, middle(?) and upper: Northeastern North Carolina and eastern Virginia.

Original reference: A. Olsson, 1917, Bulls Am. Paleontology, v. 5, no. 28.

Typically exposed at Murfreesboro, Hertford County, N.C.

Murphy Marble[1]

Murphy Series

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

Original reference: A. Keith, 1907, U.S. Geol. Survey Geol. Atlas, Folio 143, p. 5.

G. W. Stose and A. J. Stose, 1949, Geol. Soc. America Bull., v. 60, no. 2, p. 286–291. Murphy marble is present only in Murphy syncline. Nottely quartzite is in contact with the marble only in main belt from Ellijay, Ga., northeastward. Murphy syncline is tightly compressed compound syncline and at most places is bounded by thrust faults; these faults cut off Murphy marble at northeast and at many places cut out both the marble and Nottely quartzite. In places in northeastern part of syncline, Valleytown formation is on both sides of the marble, apparently in fault contact; elsewhere the marble, and in places the Nottely, are in fault contact with Nantahala slate and Great Smoky quartzite. It is generally agreed that sequence (ascending) is Valleytown formation, Murphy marble, Andrews schist, and Nottely quartzite. Only locality where Valleytown was found to be in normal contact with overlying formations is in main syncline in northern Georgia where the Nottely dips 70° southeast to vertical and lies between the marble at the west and the Valleytown at the east; a coarse conglomerate on the east side of the quartzite is in contact with the Valleytown. The conglomerate suggests a coarse initial sediment at base of clastic deposits; if conglomerate is at base of the Nottely, that quartzite is overturned and overlies the Valleytown and underlies Murphy marble at west, and the stratigraphic order of conglomerate, quartzite, and limestone is the common order of sedimentary deposition. It is suggested that Murphy marble may represent the Lower Cambrian dolomite horizon, and Nottely quartzite the underlying Lower Cambrian quartzite and that the Andrews schist represents the iron- and manganese-bearing transition zone commonly present at top of Lower Cambrian formations and therefore overlies the Valleytown [Valleytown and Brasstown here are treated as one unit—the Valleytown].

G. W. Crickmay, 1952, Georgia Geol. Survey Bull. 58, p. 27, 29. Murphy marble included in Talladega series believed to be Precambrian.

A. S. Furcron, 1953, Georgia Geol. Survey Bull. 60, p. 32, 33 (map), 36–38. Referred to as Murphy series.

J. L. Stuckey and S. C. Conrad, 1958, North Carolina Div. Mineral Resources Bull. 71, p. 32; J. L. Stuckey, 1958, Geologic map of North Carolina (1:500,000): North Carolina Div. Mineral Resources. Andrews schist and Murphy marble are mapped together as Lower Cambrian(?). Murphy marble passes by gradation into Andrews schist.

Name for the fact that town of Murphy, Cherokee County, N.C., is partly located on this marble.

Murphys Bluff Formation or Sandstone

Murphys Bluff Sandstone Member (of Shelburn Formation)

Upper Pennsylvanian: Southeastern Illinois and southwestern Indiana.

C. A. Malott, 1937, *in* K. A. Payne, Jour. Paleontology, v. 11, no. 4, p. 277, 278–279. Lowest formation in region. At type locality is massive sandstone 60 feet thick. In Dodds Bridge area, Sullivan County, Ind., consists of 10 feet of flaggy sandstones which become somewhat calcareous in upper part. Separated from overlying Hayden Branch formation (new) by 4 feet of gray shale.

J. D. McGregor, 1958, Indiana Geol. Survey Bull. 15, p. 46 (table 8). Shown on chart as member at top of Shelburn formation. Occurs above Vigo limestone member.

Type locality: Murphy's Bluff, along Ashmore Creek, in Clark County, Ill.

Murphysboro Coal Member (of Spoon Formation)

Pennsylvanian: Southwestern Illinois.

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 33, 45 (table 1), pl. 1. Assigned to member status in Spoon formation (new). At base of formation below Vergennes sandstone member. Coal named by Worthen (1868, *in* Geology and Paleontology, v. 3, Illinois Geol. Survey). Presentation of new rock-stratigraphic classification of Pennsylvanian strata in Illinois. Cyclical classification retained but is independent of rock-stratigraphic classification.

Type locality: SE¼ sec. 9, T. 9 S., R. 2 W., Jackson County.

Murray Shale (in Chilhowee Group)

Murray Shale Member (of Erwin Formation)

Murray Slate (in Chilhowee Group)[1]

Lower Cambrian: Eastern Tennessee and western North Carolina.

Original reference: A. Keith, 1895, U.S. Geol. Survey Geol. Atlas, Folio 16.

G. W. Stose and A. J. Stose, 1949, Geol. Soc. America Bull., v. 60, no. 2, p. 272–273. Precambrian Big Butt quartzite (new), named from the Big Butt, northeast culmination of Bald Mountains, where massive white quartzite and interbedded green argillite and fine-grained arkosic quartzite are enclosed in syncline. Keith (1905, U.S. Geol. Survey Geol. Atlas, Folio 118) named the quartzite Nebo and the softer beds Murray shale, which are names that properly should be applied only to Lower Cambrian formations.

S. S. Oriel, 1950, North Carolina Div. Mineral Resources Bull. 60, p. 12, 13 (table 3). Two sets of formation names for Lower Cambrian clastic rocks are in use in eastern Tennessee and western North Carolina (table 3). Northeast Tennessee names. Unicoi, Hampton, and Erwin, are used in this report for the same rocks which Keith (1904, U.S. Geol. Survey Geol. Atlas, Folio 116) and Stose and Stose (1947, Am. Jour. Sci., v. 245) named Cochran, Nichols, Nebo, Murray, and Hesse, all defined by Keith (1895) in Chilhowee Mountain area, Blount and Sevier Counties, Tenn. Hot Springs area lies midway between type localities for each group of names. Hampton formation as used here includes Murray shale.

P. B. King and others, 1958, Geol. Soc. America Bull., v. 69, no. 8, p. 964. U.S. Geological Survey restricts beds classed as Cambrian to those for which paleontological data are available. Chilhowee group as a whole is classed as Cambrian and Precambrian(?). Helenmode formation at top of group is Cambrian and remaining unfossiliferous formations [including Murray shale] are termed Precambrian(?).

R. B. Neuman and R. L. Wilson, 1960. U.S. Geol. Survey Geol. Quad. Map GQ–131. Murray shale described in Blockhouse quadrangle, Tennessee, where it is 350 feet thick. Overlies Nebo quartzite; underlies Hesse quartzite. Lower Cambrian(?).

P. B. King and H. W. Ferguson, 1960, U.S. Geol. Survey Prof. Paper 311, p. 28 (table), 43. In northeasternmost Tennessee, considered shale member of Erwin formation. Overlies Nebo quartzite member; underlies Hesse quartzite member. Lower Cambrian.

Named for Murray Branch of Walden Creek, Sevier County, Tenn.

Murray Bluff Sandstone Member (of Abbott Formation)

Murray Bluff Sandstone (in Macedonia Formation)

Murray Bluff Sandstone (in Tradewater Formation)

Pennsylvanian: Southern Illinois.

J. M. Weller, 1940, Illinois Geol. Survey Rept. Inv. 71, p. 39, 40. A sandstone at base of Macedonia formation. Underlies a series of shaly strata including several coals and one persistent limestone.

R. C. Moore and others, 1944, Geol. Soc. America Bull., v. 55, no. 6, chart 6 (column 27). Shown on correlation chart as Murray Bluff sandstone in Tradewater formation.

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 31, 45 (table 1), 62, pl. 1. Rank reduced to member status in Abbott formation (new). Occurs above Delwood coal member. Thickness about 52 feet in type section of Abbott. Type locality stated. Presentation of new rock-stratigraphic classification of Pennsylvanian strata in Illinois.

Type locality: NE¼ sec. 35, T. 10 S., R. 5 E., Saline County. Named for hill in southwestern part Saline County.

Murry (formation)

Permian (Wolfcampian): Nevada.

H. J. Bissell, 1960, Am. Assoc. Petroleum Geologists Bull., v. 44, no. 8, p. 1427 (chart). Name appears on correlation chart accompanying preliminary statement on eastern Great Basin Permo-Pennsylvanian strata. Overlies Butte [formation] (new); underlies Pequop formation.

Present in Moorman Ranch area.

Muscatine sandstone

Pennsylvanian: Eastern Iowa.

[C. R.] Keyes, 1941, Pan-Am. Geologist, v. 75, no. 1, p. 78. In view of fact that Illinois part of Pennsylvanian coal measures has no special formational title as yet, the Iowa beds may be termed Muscatine sandstones. Thickness 110 feet.

Named for exposures in Muscatine County.

Muskingum Conglomerate (in Washington Formation)[1]

Permian: Southeastern Ohio.

Original reference: J. P. Lesley, 1856, Manual of coal, p. 105.

Named for Muskingum River.

†Muskogee Group[1]

Pennsylvanian: Central eastern and central Oklahoma

Original reference: C. N. Gould, D. W. Ohern, and L. L. Hutchison, 1910, Oklahoma State Univ. Research Bull. 3, p. 6, 7.

C. C. Branson, 1957, Oklahoma Geology Notes, v. 17, no. 11, p. 102. Abandoned by Oklahoma Geological Survey.

Named for Muskogee County.

Mussey Brook Schist (in Blackstone Series)

Precambrian(?): Northeastern Rhode Island.

Alonzo Quinn, R. G. Ray, and W. L. Seymour, 1948, *in* Alonzo Quinn and others, Rhode Island Port and Indus. Devel. Comm. Geol. Bull. 3, p. 10–11, geol. map; A. W. Quinn, R. G. Ray, and W. L. Seymour, 1949, Bedrock geology of the Pawtucket quadrangle, Rhode Island-Massachusetts. U.S. Geol. Survey Geol. Quad. Map [GQ–1]. Chiefly a light- to medium-gray fine-grained mica schist, thin beds of which usually alternate with fine-grained quartzite. Contains thin beds, sills, and dikes of Hunting Hill greenstone (new). Also contains local beds or lenses of white, buff, and gray fine- to medium-grained marble and dolomitic marble which were formerly included in Smithfield limestone member of Marlboro formation. Maximum thickness about 1,400 to 1,600 feet. Apparently older than Westboro quartzite. Included in Blackstone series.

Well exposed where Mussey Brook leaves Handy Pond and in area to south, Pawtucket quadrangle, Providence County.

Mustang Andesite

Pleistocene(?): Central-western Nevada.

G. A. Thompson, 1956, U.S. Geol. Survey Bull. 1042–C, p. 59, pl. 3. Named for thick flows of fine-grained andesite with abundant large hornblende phenocrysts which are commonly partly replaced by magnetite. Flows generally from 100 to 200 feet thick; lie in part on Kate Peak formation, in part on Truckee formation, and in part on Lousetown formation.

Present only in northeastern part of Virginia City quardangle. Named for Mustang, 9 miles east of Reno on Truckee River.

Mustang Creek Formation

Upper Cretaceous: Southern California.

O. P. Jenkins, 1943, Am. Assoc. Petroleum Geologists Bull., v. 27, no. 3, p. 251 (fig. 1). Appears in list of Cretaceous units in California. Name credited to A. Bennison.

L. I. Briggs, Jr., 1953, California Div. Mines Bull. 167, p. 31. Bennison (1941, unpub. map of late Upper Cretaceous deposits south of San Luis Creek, Merced and Fresno Counties) established Mustang Creek formation which he extended as far southward as Ortigalita Creek, beyond which it loses its identity. Where best exposed in Ortigalita Peak quadrangle, the lower unit is massive concretionary sandstone forming low topographic ridge from Laguna Seca Ranch northwestward beyond limits of quadrangle. In this report [Ortigalita Peak quadrangle], the Mustang Creek is included with several other units (named by Bennison) in discussion of upper part of Panoche formation.

Best exposed at Los Banos Creek, Ortigalita Peak quadrangle. Extends from Laguna Seca Ranch northwestward beyond limits of quadrangle.

Muttleberry limestone[1]

Lower Jurassic: Nevada.

Original reference: C. R. Keyes, 1923, Pan-Am. Geologist, v. 40, p. 52, 80.

Named for exposures in Muttleberry Canyon east of Lovelock, Humboldt County.

Mutual Formation

Mutual Quartzite (in Uinta Mountain Group)

Precambrian: Northeastern Utah.

A. E. Granger and others, 1952, Utah Geol. Soc. Guidebook 8, p. 6, pl. 1. Medium- to coarse-grained red-purple, quartzites and variegated red and green shales. Formation has form of thin wedge whose south edge is near divide between Big and Little Cottonwood Canyons, and which thickens northward to 1,200 feet in area between Big Cottonwood Canyon and mountain front. Unconformably underlies Tintic quartzite; conformably overlies Big Cottonwood series in interval between mountain front and Mill "B" North Fork, and unconformably overlies Mineral Fork tillite (new) a little farther east.

N. C. Williams, 1953, Am. Assoc. Petroleum Geologists Bull., v. 37, no. 12, p. 2737–2738. Mutual quartzite is oldest unit of Uinta Mountain group, in western Uinta Mountains. Thickness 4,025 feet in upper part of Smith and Morehouse Canyons. In top of unit, at mouth of Box Canyon, is sequence of buff quartzitic sandstones and brown micaeous shales termed Box Canyon member (new). Underlies Red Pine shale (new).

R. E. Cohenour, 1959, Intermountain Assoc. Petroleum Geologists Guidebook 10th Ann. Field Conf., p. 34, 37 (fig. 2). In this report [Uinta-Wasatch Mountain junction and part of central Utah], Mutual formation and Red Pine shale are not included in Uinta Mountain group.

In area of Big and Little Cottonwood Canyons, Wasatch Mountains, east of Salt Lake City.

Myatt Lentil (in Verda Member of Yazoo Clay)

Eocene (Jackson): Central Louisiana.

J. Huner, Jr., 1939, Louisiana Dept. Conserv. Geol. Bull. 15, p. 149 (fig. 7), 161–163. A marine lentil characterized by a yellowish-brown bentonite bed and fossiliferous sand. Thickness near Caldwell-Catahoula Parish line about 34 feet. Occurs near middle of member and stratigraphically above Bayou Calamus lentil.

Well exposed at Myatt (Wyant) Landing on west bank of Ouachita River in NE cor. SW¼NE¼ sec. 4, T. 11 N., R. 4 E., Caldwell Parish.

Myers Shale[1] (in Pocono Group)

Lower Mississippian: Northeastern West Virginia and western Maryland.

Original reference: G. W. Stose and C. K. Swartz, 1912, U.S. Geol. Survey Geol. Atlas, Folio 179.

J. M. Weller and others, 1948, Geol. Soc. America Bull., v. 59, no. 2, chart 5 (column 101). Shown on correlation chart as shale in Pocono group; underlies Pinkerton sandstone; overlies Hedges shale. Osagean series.

C. B. Read, 1955, U.S. Geol. Survey Prof. Paper 263, p. 10–11. On basis of paleobotanical studies, it seems that the age of post-Hedges formations should be restudied. Lithologic evidence favors correlation of the Myers with Mauch Chunk, and Pinkerton with basal Pennsylvanian, and flora of the Hedges indicates an upper Pocono age for that unit.

Named for exposures on the Myers place, in Meadow Brook valley, Berkeley County, W. Va.

Myers Hill Sandstone[1]

Upper Cambrian: Wisconsin.

Original reference: C. E. Resser, 1933, Geol. Soc. America Bull., v. 44, no. 4, p. 738.

Myerstown Limestone

Middle Ordovician: Southeastern Pennsylvania.

Carlyle Gray, 1952, Pennsylvania Geol. Survey Prog. Rept. 140, p. 4; 1952, Pennsylvania Acad. Sci. Proc., v. 26, p. 86, 88. Typically dark-blue to black dense thin-bedded graphitic limestone with occasional beds of calcarenite. Contains three or four metabentonites. Weathered outcrops frequently show fluted edges similar to fluting of underlying Annville limestone. Maximum thickness about 200 feet. Contact with Annville marked by one or more beds of black very graphitic shaly limestone succeeded by varying thickness of impure gray crystalline limestone; these beds grade upward into typical Myerstown lithology. Underlies Hershey limestone (new) which is less pure and darker in color. Was previously included in Leesport formation. Name credited to C. E. Prouty.

Carlyle Gray and C. E. Prouty, 1954, Pennsylvania Geologist Guidebook 20th Ann. Field Conf., p. 25, 28. Standard and typical sections described.

Standard section at roadcut in Millardsville [Lebanon County]. Typical section near covered bridge across Swatara Creek, Dauphin County. Not well exposed in Lebanon County; thickest in western Berks County. Probably named for Myerstown, Lebanon County.

Mynot Sandstone Member (of Pride Mountain Formation)

Upper Mississippian: Northern Alabama.

S. W. Welch, 1958, U.S. Geol. Survey Oil and Gas Inv. Chart OC-58. Sandstone, shale, and siltstone. Maximum thickness about 30 feet in southwestern Colbert County; thins eastward to a nonpersistent bed in eastern Colbert County by interfingering with the oolitic limestone of the underlying Sandfall member (new); underlies Green Hill member (new).

Named for exposure in stream bank just southeast of road at community of Mynot, SW¼NW¼ sec. 7, T. 5 S., R. 14 W., in southwestern Colbert County.

†Myrick Formation[1]

Eocene: Southern Texas.

Original reference: T. W. Vaughan, 1900, U.S. Geol. Atlas, Folio 64, p. 2.

Named for Myrick's lower apiary, on Frio River, Uvalde County.

Myrick Station Limestone Bed (in Pawnee Limestone Member of Oologah Formation)

Myrick Station Limestone Member (of Pawnee Limestone)

Pennsylvanian (Des Moines Series): Western Missouri, southwestern Iowa, eastern Kansas, and northeastern Oklahoma.

L. M. Cline, 1941, Am. Assoc. Petroleum Geologists Bull., v. 25, no. 1, p. 26 (fig. 2), 37. Pawnee limestone splits into two limestone separated by shale as it is traced from Kansas into Missouri. Upper limestone split is Pawnee of current usage in west-central Missouri. It is to be regarded as member of Pawnee formation and name will be selected from Kansas locality. Name Myrick Station is proposed for lower limestone member (Lexington cap rock of Missouri Survey terminology). Thickness in type area about 5½ feet.

J. M. Jewett, 1941, Kansas Geol. Survey Bull. 38, p. 316, 317–318, 319. In Kansas, Myrick Station is second member from base of Pawnee. Characteristically brownish gray, massive, and somewhat earthy in lower part. Average thickness about 4 feet. Overlies Anna shale member and underlies Mine Creek shale member (both new).

R. D. Alexander, 1954, Oklahoma Geol. Survey Circ. 31, p. 15, 16 (fig. 2). In Nowata County, Oologah formation consists of Pawnee limestone at base, the Pawnee consisting of (ascending) cap rock of Lexington coal, Anna shale, Myrick Station limestone, and Coal City limestone.

H. G. Hershey and others, 1960, Iowa Highway Research Board Bull. 15, p. 32, fig. 5. In Appanoose County, member consists of two limestone beds separated by a 1-foot bed of fossiliferous shale that is greenish gray above and brown to black below. Upper limestone is light gray, hard, nodular, and earthy; thickness 1 to 9 inches. Lower bed is blue gray, finely crystalline and dense; thickness about 2 feet. In Madison County, consists of upper bed of light-gray dense argillaceous limestone that grades laterally into overlying shale; thickness 0.3 foot. Lower bed bluish-gray dense massive limestone, 0.8 foot thick. Overlies Anna shale member; underlies Mine Creek shale.

Type section: Outcrops in ravines in south bluff of Missouri River near Myrick Station on Missouri Pacific Railroad, just west of Lexington, Lafayette County, Mo.

Myrtis Sand Member (of Queen City Formation)

Eocene (Claiborne): Northwestern Louisiana.

C. R. Smith, 1958, Am. Assoc. Petroleum Geologists Bull., v. 42, no. 10, p. 2519–2522. Fine grained, massive to crossbedded, orange, pink, and red, with some stringers of light-gray silty clay up to 0.2 foot thick. Total thickness 68 feet (52 feet exposed and remainder from bore hole with elevation of 234 feet at top of hole). Overlies Omen member; underlies Weches formation.

Named for exposures in deep roadcuts along Vivian-Atlanta Road in SE¼ sec. 3 and NW¼ sec. 10, T. 22 N., R. 16 W., 1½ miles west of town of Myrtis and 3 miles northwest of Vivian in northwest Caddo Parish.

Myrtle Group

Myrtle Formation[1]

Upper Jurassic and Lower Cretaceous: Southwestern Oregon.

Original reference: J. S. Diller, 1898, U.S. Geol. Survey Geol. Atlas, Folio 49.

N. L. Taliaferro, 1942, Geol. Soc. America Bull., v. 53, no. 1, p. 71–112. Generally accepted correlations of the Jurassic of southwestern Oregon and California are: Galice and Mariposa, Dothan and Franciscan, Myrtle and Shasta. Dothan is said to be younger than Galice. Also, it has been stated that the Dillard, lower part of original Myrtle, is equivalent of the Franciscan. Since the Dillard unconformably overlies the Dothan and Galice, one or the other of these correlations must be erroneous. Evidence is presented to show that the Dothan is older than the Galice and cannot be same age as Franciscan. Dillard, as originally defined, includes Knoxville (Upper Jurassic) and possibly infolded Lower Cretaceous, but bulk of Dillard is to be correlated with the Franciscan. Myrtle, as mapped and defined, includes beds of both Upper Jurassic and Lower Cretaceous age and at least one important unconformity. Name Myrtle should be redefined, restricted, or abandoned.

R. W. Imlay and others, 1959, Am. Assoc. Petroleum Geologists Bull., v. 43, no. 12, p. 2770–2785. Myrtle formation of Diller, based on sequence exposed in valley of Myrtle Creek, is herein restricted and considered to be a group as proposed by Louderback (1905, Jour. Geology, v. 13, no. 6) because it includes two distinct formations herein named Riddle and Days Creek. Group does not include rocks of Late Cretaceous age, such as some of Whitsett limestone lentils of Diller's Myrtle formation, nor does it include any rocks older than Riddle formation, such as were mapped as part of Myrtle in Port Orford and Roseburg quadrangles. These older rocks, now referred to Galice, Rogue, and Dothan formations, do not occur in the Myrtle on Myrtle Creek. Thickness about 3,000 feet. Overlies Rogue or Dothan formation. Upper Jurassic and Lower Cretaceous. Report contains historical summary of use of term Myrtle and discussion of Louderback's (1905) report.

Well developed along Myrtle Creek, Douglas County. Diller did not specify type locality.

Myrtle Beach peat

Pleistocene: Coastal plain of South Carolina.

D. G. Frey, 1952, Am. Jour. Sci., v. 250, p. 212–225. Seaside peat deposit of uncertain stratigraphic relationship to Horry clay, although presumably younger, that dates from a glacial age. Evidence for this is high percentage of spruce among tree pollens present in the peat. The peat is more likely Wisconsin than Illinoian.

Named for occurrence near Myrtle Beach.

Myton Member[1] (of Uinta Formation)

Eocene: Northeastern Utah.

Original reference: H. E. Wood 2d, 1934, Am. Mus. Nat. History Bull., v. 67, art. 5, p. 241–242.

H. E. Wood 2d and others, 1941, Geol. Soc. America Bull., v. 52, no. 1, p. 26, pl. 1. Chart shows Myton overlying Wagonhound member. Uppermost Uintan.

Named for typical exposures at and near Myton, Duchesne County.

Nabesna Limestone[1]

Upper Triassic: Southeastern Alaska.

Original reference: W. C. Mendenhall and F. C. Schraeder, 1903, U.S. Geol. Survey Prof. Paper 15, p. 33–37.

F. H. Moffit, 1943, U.S. Geol. Survey Bull. 933–B, p. 122–124, pl. 6. Consists of a lower thick-bedded member and an upper member of thin beds separated by shale partings. Exposed north of Nabesna River at White Mountain, where named in vicinity of Cooper Pass, and in valleys of Snag River and possibly of Baultoff Creek. At White Mountain, formation consists of 1,200 feet of massive light-gray dense or crystalline limestone and about 800 feet of overlying thin-bedded light-gray limestone. Upper Triassic.

Named for exposures at White Mountain north of Nabesna River. Occurs on upper Nabesna and Chisana Rivers, Upper Tanana River region.

Naborton Formation (in Wilcox Group)

Paleocene: Northwestern Louisiana and northeastern Texas.

Grover Murray, Jr., 1941, (abs.) Am. Assoc. Petroleum Geologists Bull., v. 25, no. 5, p. 941–942. Oldest of three named divisions of Midway sediments that crop out in northwestern Louisiana and outline the highest structural part of Sabine uplift. Consists of basal sand member, middle lignitic shale member, and upper calcareous member. Underlies Logansport formation (new).

D. P. Meagher and L. C. Aycock, 1942, Louisiana Dept. Conserv. Geol. Pamph. 3, p. 13. Includes Chemard Lake lignite lentil (new) at top.

G. E. Murray, Jr., and E. P. Thomas, 1945, Am. Assoc. Petroleum Geologists Bull., v. 29, no. 1, p. 48 (fig. 2), 56–57; G. E. Murray, 1948, Louisiana Dept. Conserv. Geol. Bull. 25, p. 94–101, pl. 10. Includes all strata between Midway Porters Creek black shale which is reached at about 100 feet in wells near Naborton and the overlying basal sand of Dolet Hills member of Logansport formation. Exposed thickness about 175 feet. Type locality designated.

Type locality: Exposures along a local road between Louisiana Highway 9 and Bethlehem Church (between Naborton and Goss) in secs. 3 and 4, T. 12 N., R. 12 W., De Soto Parish, La.

Nacatoch Sand (in Navarro Group)[1]

Upper Cretaceous: Southwestern Arkansas, northwestern Louisiana, and northeastern Texas.

Original reference: A. C. Veatch, 1905, Louisiana Geol. Survey Bull. 1, p. 84, 85, 87–88; 1905, U.S. Geol. Survey Water-Supply Paper 114, p. 180, 183.

L. W. Stephenson, 1941, Texas Univ. Bur. Econ. Geology Pub. 4101, p. 20–22. In Texas, consists mainly of gray massive more or less calcareous marine sand, subordinate parts of which are indurated to hard calcareous concretionary masses of various sizes as much as several feet in longest dimension. Thickness 100 to 200 feet. Narrow belt of outcrop lies immediately to east of, and parallel to, that of Neylandville marl and has been traced southward through Texas as far as northern Falls County, where it passes under transgressing Corsicana marl.

R. G. Drouant, 1960, Dissert. Abs., v. 20, no. 11, p. 4367–4368. Discussion of stratigraphy and Ostracoda of *Exogyra costata* zone which embraces Saratoga, Nacatoch, and Arkadelphia formations of southwestern Arkansas. Units were traced on surface from Little River in Hempstead County to Arkadelphia in Clark County. Nacatoch formation is restricted to include upper arenaceous member and lower glauconitic member. Glauconitic member is a concentrate above an angular unconformity developed upon the chalk and argillaceous-arenaceous member of the Saratoga. Argillaceous-arenaceous member of Saratoga formerly included in Nacatoch.

Typically exposed at Nacatoch Bluff, on Little Missouri River, in Clark County, Ark.

Naches Formation[1]

Eocene: Central Washington.

Original reference: G. O. Smith and F. C. Calkins, 1906, U.S. Geol. Survey Geol. Atlas, Folio 139.

C. E. Weaver, 1937, Washington [State] Univ. Pubs. in Geology, v. 4, p. 45–46, 49–51. Intercalated with Kachess rhyolite. Swauk formation, Naches formation, and Kachess rhyolite are probably in part contemporaneous. Naches is covered by upper part of Keechelus lava series; Swauk and Naches formations rest with marked unconformity upon the older metamorphic and igneous formations.

R. J. Foster, 1957, Dissert. Abs., v. 17, no. 9, p. 1982. In central Cascade Mountains, tightly folded Naches overlies Mount Catherine rhyolite (new) and conformably underlies Keechelus andesite.

R. J. Foster, 1960, Geol. Soc. America Bull., v. 71, no. 2, p. 114–118, pl. 1. Smith and Calkins (1906) believed that Swauk and Naches were of same age on basis of two fossil leaves found in both and that they were laid down in separate contemporaneous lakes. Recent evidence indicates that these rocks are fluviatile, and, in spite of fossil leaves, the complete lack of contemporaneous volcanic rocks in the Swauk suggests that they are of different ages. The two formations are not in stratigraphic contact. Smith and Calkins did show that both the Naches and Swauk unconformably overlie Easton schist. They also showed that, in southern part of Snoqualmie quadrangle, Keechelus volcanic rocks overlie the Naches unconformably. Rocks that are correlated with Naches formation herein were called Teanaway basalt, Guye formation, and Keechelus formation by Smith and Calkins. Naches is underlain with apparent conformity by Mount Catherine rhyolite and unconformably overlain by Keechelus andesite. Locally intruded by Snoqualmie granodiorite. Naches is composed of about 5,000 feet of interbedded basalt, sedimentary rock, and rhyolite. May be Eocene, but dating and correlation considered tentative until diagnostic fossils are discovered.

Well developed on north side of Naches River valley, Snoqualmie quadrangle.

Nachusa Formation (in Platteville Group)

Middle Ordovician: Northern Illinois.

J. W. Templeton and H. B. Willman, 1952, Tri-State Geol. Soc. Guidebook 16th Ann. Field Conf., p. 6, 37, fig. 3, 9. Dolomite or limestone, pure except for argillaceous unit in middle. Thickness about 18 feet. Comprises (ascending) Eldena, Elm, and Everett members (all new). Shown on columnar section as underlying Quimbys Mill formation and overlying Grand Detour formation (new).

Type locality: In abandoned quarry on east side of Illinois State Highway 2, south of Dixon.

Nacimiento Group[1] or Formation

Paleocene: Northwestern New Mexico.

Original references: C. R. Keyes, 1906, Science, new ser., v. 23, p. 921; Am. Jour. Sci., 4th, v. 21, p. 298–300.

C. H. Dane, 1946, U.S. Geol. Survey Oil and Gas Inv. Prelim. Chart 24. Referred to as formation. Chiefly drab and gray clays and quartzose sandstones 600 to 1,000 feet thick; it is equivalent of the lithologically unseparated beds in southern part of San Juan basin that carry Puerco and Torrejon faunas of Paleocene age. Conformably overlies Ojo Alamo sandstone; grades northward into Animas formation.

G. G. Simpson, 1948, Am. Jour. Sci., v. 246, no. 5, p. 272. Because Puerco and Torrejon are not recognizable except as faunal zones, it would seem best to consider this part of stratigraphic sequence as a single formation, the Nacimiento, not divisible into Puerco and Torrejon formations but containing markedly different Puerco and Torrejon faunas. Underlies San Jose formation (new).

Harley Barnes, E. H. Baltz, Jr., and P. T. Hayes, 1954, U.S. Geol. Survey Oil and Gas Inv. Map OM-149. Formation described in Red Mesa area, La Plata and Montezuma Counties, Colo., where it corresponds to Reeside's (1924) Torrejon formation. Overlies Animas formation (redefined); underlies unit referred to as Wasatch-type rocks. Paleocene.

Named for town of Nacimiento (also known as Cuba), Sandoval County.

Naco Limestone,[1] Formation, or Group

Pennsylvanian and Permian: Southeastern Arizona and southwestern New Mexico.

Original reference: F. L. Ransome, 1904, U.S. Geol. Survey Prof. Paper 21.

A. A. Stoyanow, 1936, Geol. Soc. America Bull., v. 47, no. 4, p. 521–523. Restricted to Pennsylvanian.

J. W. Huddle and Ernest Dobrovolny, 1945, U.S. Geol. Survey Oil and Gas Inv. Prelim. Chart 10. In central and northeastern Arizona, formation ranges from 400 to 800 feet in thickness and consists of limestone, shale, and sandstone. At type locality, includes beds of Pennsylvanian and Permian age; only Pennsylvanian beds ranging in age from Lampasas to Virgil were identified in area of this report. Overlies Redwall limestone; underlies Supai formation with contact drawn above a sequence of gray limestone and shale and below a sequence of red sandstone, shale, and limestone.

W. G. Hogue, and E. D. Wilson, 1950, Arizona Bur. Mines Bull. 146, Geol. Ser. 18, p. 100 (fig. 31). Generalized columnar section Bisbee quadrangle, shows Naco limestone, 3,000 feet thick, above Escabrosa limestone and unconformably below Glance conglomerate.

N. P. Peterson, 1950, Arizona Bur. Mines Bull. 156, Geol. Ser. 18, p. 100 (fig. 31). Columnar section in Globe-Miami district shows Naco limestone, about 500 feet thick, disconformable above Escabrosa limestone and unconformable below Whitetail conglomerate.

R. L. Jackson, 1951, Plateau, v. 24, no. 2, p. 90 (fig. 2). In Fossil Creek area, Arizona, underlies Packard Ranch member (new) of Supai formation; in Fort Apache area, underlies Amos Wash member (new) of Supai. Overlies Redwall limestone. Pennsylvanian.

E. D. Wilson, 1951, Arizona Bur. Mines Bull. 158, Geol. Ser. 19, p. 50. In Empire Mountains, Naco formation underlies Andrada formation (new) and overlies Escabrosa limestone. Thickness 1,200 feet.

James Gilluly, J. R. Cooper, and J. S. Williams, 1954, U.S. Geol. Survey Prof. Paper 266, p. 15–44. Rank raised to group and subdivided into (ascending) Horquilla limestone, Earp formation, Colina limestone, Epitaph dolomite, Scherrer formation, and Concha limestone (all new).

D. L. Bryant, 1955, Dissert. Abs., v. 15, no. 7, p. 1224. Group stratigraphically restricted above to exclude Scherrer formation and Concha limestone, which together with Rainvalley formation (new) comprises Snyder Hill group.

James Gilluly, 1956, U.S. Geol. Survey Prof. Paper 281, p. 36–44. Group comprises (ascending) Horquilla limestone, Earp formation, Colina limestone, and Epitaph dolomite; other formations not present in this area. Overlies Escabrosa limestone. Pennsylvanian and Permian.

Elliot Gillerman, 1958, New Mexico Bur. Mines Mineral Resources Bull. 57, p. 11 (table 2), 31–43, pl. 1. In central Peloncillo Mountains, N. Mex., group includes (ascending) Horquilla limestone, Earp formation, Colina limestone, Scherrer formation, and Chiricahua limestone (substituted for synonymous term Concha limestone). Overlies Paradise formation; underlies Bisbee group (McGhee Peak formation, new).

First described in Naco Hills, near west edge of Bisbee quadrangle, Arizona.

Nacogdoches Beds (in Claiborne Group)[1]

Eocene: Eastern Texas.

Original reference: E. T. Dumble, 1920, Texas Univ. Bull. 1869, p. 57, 65, 67, 79–101, 255.

Well exposed at Nacogdoches and along streams flowing southward into Angelina River in Nacogdoches County.

Nadeau Gravel

Pleistocene, upper(?): Southern California.

L. F. Noble, 1953, Geology of the Pearland quadrangle, California: U.S. Geol. Survey Geol. Quad. Map [GQ–24]. Consists of gravel and schist fragments and interbedded micaceous sand; prevailingly dark color; unconsolidated or poorly consolidated. Deposit greatly dissected. Thickness commonly less than 50 feet. Some exposures not easily differentiated from those of Harold formation (new).

Roadcuts one-half mile north of San Andreas fault on Old Nadeau Road, Pearland quadrangle.

Nadine Limestone (in Conemaugh Formation)

Pennsylvanian: Western Pennsylvania.

J. J. Burke, 1958, Science, v. 128, no. 3319, p. 302. Relatively pure limestone, light to dark gray on fracture, 4 inches to 1½ feet thick. Occurs approximately 172 feet below Ames limestone, 32 feet above Cambridge limestone, and 170 feet above Upper Freeport coal. Name Nadine is applied to limestone described by Johnson (1929) under Woods Run limestone; in Pittsburgh region, it occurs approximately 8 to 17 feet below the Woods Run as described by Raymond (1910); the two strata have been referred to as Woods Run limestone or as Upper and Lower Woods Run limestone.

Type locality: On Allegheny River east of Pittsburgh, near Nadine, Allegheny County.

Naese Sandstone Member (of Lee Formation)[1]

Lower Pennsylvanian: Southeastern Kentucky and northeastern Tennessee.

Original reference: G. H. Ashley and L. C. Glenn, 1906, U.S. Geol. Survey Prof. Paper 49, p. 31, 35, 86.

H. R. Wanless, 1946, Geol. Soc. America Mem. 13, p. 41–42, 146. Designated by Ashley and Glenn as top bed of Lee formation but is considered higher than strata referred to Lee in other areas. Should probably be referred to lower Briceville rather than upper Lee.

Named from Naese Cliff on Cumberland River, about 8 miles by road above Pineville, Bell County, Ky.

†Naftan Limestone

Pliocene-Pleistocene: Mariana Islands (Saipan).

Risaburo Tayama, 1938, Geomorphology, geology, and coral reefs of Saipan Island: Tropical Industry Inst., Palau, South Sea Islands, Bull. 1 [English translation in library of U.S. Geol. Survey, p. 69–71]. Consists of well-bedded limestone, commonly conglomeratic and pink or white. *Halimeda*-bearing. Unconformably underlies Mariana limestone; unconformably overlies Laulau limestone or Donny [Donni] beds.

Josiah Bridge *in* W. S. Cole and Josiah Bridge, 1953, U.S. Geol. Survey Prof. Paper 253, p. 12. Foraminifera from Naftan are practically identical with those of Mariana limestone, and both formations have been assigned to Plio-Pleistocene.

S. Hanzawa *in* Jacques Avias and others, 1956, Lexique Strat. Internat., v. 6, Océanie, fasc. 2, p. 48. Pleistocene.

P. E. Cloud, Jr., R. G. Schmidt, and H. W. Burke, 1956, U.S. Geol. Survey Prof. Paper 280–A, p. 80. Naftan limestone of Tayama is included in Mariana limestone of this report.

Area of outcrop confined to Naftan Point and to small area on east side of Hagman Point.

Nafutan Limestone

See Naftan Limestone.

Nagany Limestone

Middle Ordovician (Blackriveran): Pennsylvania.

R. S. Bassler, 1950, Geol. Soc. America Mem. 44, p. 12, 270. Incidental mention in faunal list.

Name may be derived from Naginey, Mifflin County.

Nagas Beds

Eocene: Mariana Islands (Guam).

Risaburo Tayama, 1952, Coral reefs in the South Seas: Japan Hydrog. Office Bull., v. 11, p. 49, table 4 [English translation in library of U.S. Geol. Survey, p. 59]; S. Hanzawa *in* Jacques Avias and others, 1956, Lexique Strat. Internat., v. 6, Océanie, fasc. 2, p. 40. Marl and shale. Correlated with Mariiru beds on Rota Island and Matansa limestone on Saipan. Unconformably overlie Bolanos formation.

Type locality: Nagas, Guam.

Naha Formation

Quaternary, upper: Northeastern Arizona.

J. T. Hack, 1941, Geog. Rev., v. 31, no. 2, p. 262–263; 1942, Harvard Univ. Peabody Mus. Am. Archaeology and Ethnology Papers, v. 35, no. 1, p. 53–54, fig. 29. Composed mostly of loose sand with gravel lenses. Contains two members, which are evidence of an interruption of deposition by an epicycle of erosion. Contains many pottery fragments of Pueblo IV and Pueblo III age: also a firepit was found at top of formation. Dated between Pueblo III time (1100 to 1300 A.D.) and 1700 A.D. Overlies Tsegi formation.

Traced throughout Jeddito Valley. Naha Well is located in lower reaches of Jeddito Valley, western Navajo country.

†Nahant Gabbro[1]

Lower Paleozoic: Northeastern Massachusetts.

Original reference: C. H. Clapp, 1910, Igneous rocks of Essex County, Mass.

At Nahant, Essex County.

†Nahant Limestone[1]

Lower Cambrian: Eastern Massachusetts.

Original reference: J. H. Sears, 1891, Essex Inst. Bull., v. 22, p. 32.

Occurs on south side of Nahant Head, at the Shag Rocks, and extends about 300 yards to just beyond Bennetts Head on north.

†Nahant Schist[1]

Lower Cambrian: Eastern Massachusetts.

Original reference: N. S. Shaler, 1889, U.S. Geol. Survey 9th Ann. Rept., p. 577–578.

Name probably derived from Nahant Head, Essex County.

Naheola Formation (in Midway Group)[1]

Paleocene: Southern Alabama and eastern Mississippi.

Original reference: E. A. Smith and L. C. Johnson, 1887, U.S. Geol. Survey Bull. 43, p. 57–60.

Lyman Toulmin, Jr., 1944, Alabama Acad. Sci. Jour. v. 16, p. 42. Formation comprises (ascending) "Matthews Landing marl," "Oak Hill beds," and "Coal Bluff beds." Uppermost formation of Midway group. Overlies Porters Creek formation; underlies Nanafalia formation of Wilcox group with disconformity.

F. S. MacNeil, 1946, U.S. Geol. Survey Strategic Minerals Inv. Prelim. Rept. 3–195, p. 12–14. Restricted to sand and shale beds above Matthews Landing marl member of Porters Creek clay. Lower glauconitic sands and shales of Coal Bluff beds of Brantly (1920) are added to top as Coal Bluff marl member. Underlies Nanafalia formation. Thickness 10 to 160 feet in Alabama. May be equivalent to Betheden formation. Thickness 10 to 160 in Alabama.

L. D. Toulmin, P. E. LaMoreaux, and C. R. Lanphere, 1951, Alabama Geol. Survey Spec. Rept. 21, p. 41–44. In Choctaw County, includes Oak Hill member (new) and Coal Bluff marl member. Overlies Matthews Landing marl member of Porters Creek clay; underlies Nanafalia formation. Thickness about 180 feet.

W. F. Roux, Jr., 1958, Dissert, Abs., v. 19, no. 5, p. 1056. Formation includes Matthews Landing, Oakhill, and Kemper (new) members. Coal Bluff is given formation rank.

R. J. Hughes, Jr., 1958, Mississippi Geol. Survey Bull. 84, p. 119–131, pls. 1, 5, 7, 10. Described in Kemper County where it is as much as 100 to 115 feet thick. Consists of dark-gray to black carbonaceous silty muscovitic clay shale, interlaminated gray and yellow-gray argillaceous silt and muscovitic fine sand. Unconformably overlies Matthews Landing marl member of Porters Creek clay; unconformably underlies Fearn Springs member of Nanafalia formation.

P. E. LaMoreaux and L. D. Toulmin, 1959, Alabama Geol. Survey County Rept. 4, p. 22 (fig. 6), 79–92. Described in Wilcox County, where it includes Oak Hill member below and Coal Bluff marl member above.

Conformably overlies Matthews Landing marl member of Porters Creek formation; unconformably underlies Gravel Creek sand member (new) of Nanafalia formation.

Named from Naheola Bluff, on Tombigbee River in SE¼ sec. 30, T. 15 N., R. 1 E., Choctaw County, Ala.

†Naheola Marl[1]

Eocene, lower: Southwestern Alabama.

Original reference: E. A. Smith, 1887, U.S. Geol. Survey Bull. 43, p. 57–60.

Named for exposures in lower part of section at Naheola, on Tombigbee River, in Choctaw County.

Naiad limestone[1]

Silurian(?): Southwestern New Mexico.

Original references: C. R. Keyes, 1915, Iowa Acad., Sci. Proc., v. 22, p. 257–259; 1915, Conspectus of geologic formations of New Mexico: Des Moines, Robert Henderson, State Printer, p. 3, 10.

In Silver City region. Derivation of name not stated.

Naish Limestone[1]

Pennsylvanian: Eastern Kansas.

Original reference: R. C. Moore, 1932, Kansas Geol. Soc. Guidebook 6th Ann. Field Conf., p. 87, 97.

Derivation of name not stated.

Nakaibito Formation

Recent: Northwestern New Mexico.

L. B. Leopold and C. T. Snyder, 1951, U.S. Geol. Survey Water-Supply Paper 1110–A, p. 9–15. At type locality, consists of 22 feet of interbedded tan-brown sand and silt, including several thick layers of uncemented yet massive sand. The fill is irregularly crossbedded and contains occasional lenses of unconsolidated subrounded fine gravel, particularly near base. Contains potsherds. Disconformably overlies Gamerco formation (new).

Type locality: Mexican Springs Wash near Nakaibito, 18 miles north of Gallup. Nakaibito is Navajo word for Mexican Springs and is local name for immediate vicinity of experiment station headquarters building.

Nakaye Formation (in Magdalena Group)

Pennsylvanian: Southwestern New Mexico.

V. C. Kelley and Caswell Silver, 1952, New Mexico Univ. Pubs. in Geology 4, p. 92–93, 254–255, figs. 2, 11. Consists dominantly of thick to massive ledges of limestone which often contain abundant bands, lenses, or nodules of chert. Limestone is medium gray to dark gray and very fine grained in most places. Many beds weather a light tan-brown and others weather light gray to medium gray. Thickness at type section 419 feet; unit thickens slightly southward or southeastward along the range. Comprises little more than middle third of group. Underlies Bar B formation (new) and overlies Red House formation (new) with conformable contacts.

Type section: Measured in Caballo Mountains at South Ridge, sec. 10, T. 15 S., R. 4 W., Sierra County. Named from Nakaye Mountain in southwestern part of area where formation forms most of ridge.

Nakimuan series[1]

Precambrian: Cordilleran region.

Original reference: C. R. Keyes, 1917, Iowa Acad. Sci. Proc., v. 24, p. 56.

Naknek Formation[1]

Upper Jurassic: Southern Alaska.

Original reference: J. E. Spurr, 1900, U.S. Geol. Survey 20th Ann. Rept., pt. 7, p. 169–171, 179, 181.

C. E. Kirschner and D. L. Minard, 1948, U.S. Survey Oil and Gas Inv. Prelim. Map 95 [1949]. Divided into (ascending) Chisik conglomerate member, 300 to 600 feet; siltstone member, approximately 700 feet on Iniskin Bay; Pomeroy member (new), 600 to 1,300 feet; and upper sandstone member, 1,000 to 3,000 feet. Siltstone is hard, dark gray to black, and thick bedded. Upper sandstone member is light-gray medium-grained arkose; includes youngest Jurassic strata exposed on Iniskin Peninsula; beds average 10 feet in thickness. As exposed on Iniskin Peninsula, formation approximately 3,500 feet thick. Overlies Chinitna siltstone.

A. S. Keller and H. N. Reiser, 1959, U.S. Geol. Survey Bull. 1058–G, p. 269–273, pls. 29, 32. Described in Mount Katmai area where it crops out in mountainous belt 20 to 38 miles wide which trends northeastward across entire area. On northwest side of its outcrop belt, formation is in fault contact with igneous rocks of Early and (or) Middle Jurassic age. In northeastern part of map area, it is overlain partly by rocks of Cretaceous age, and both here and over much of central part of map area it is overlain by volcanic rocks of Tertiary or Quaternary age. Comprises Chisik conglomerate member in lower part and an unnamed upper member, 6,000 to 9,000 feet thick, of marine sandstone, siltstone, conglomerate, and shale. Relationship to Upper Cretaceous Kaguyak formation (new) not discussed.

Crops out about halfway from mouth of Naknek Lake to head of Savonoski, also on Iniskin Peninsula, Cook Inlet region.

†Nampa Beds[1]

Miocene, Pliocene, and Pleistocene: Idaho.

Original reference: S. F. Emmons, 1890, Boston Soc. Nat. History Proc., v. 24, p. 432–433.

Nampa sediments

Pleistocene, upper: Southwestern Idaho.

C. N. Savage, 1958, Idaho Bur. Mines and Geology County Rept. 3, p. 20 (table 1), 27, 41, 48, figs. 3, 4. Clay, silt, sand, and gravel, nonconsolidated fluviatile chiefly, some caliche. Thickness as much as 50 feet. Underlies Caldwell sediments (new); overlies intermediate Snake River eruptives.

In Boise Valley, generally below 2,800 feet elevation, Ada and Canyon Counties.

Nanafalia Formation (in Wilcox Group)[1]

Eocene, lower: Southern Alabama, southwestern Georgia, and eastern Mississippi.

Original reference: E. A. Smith and L. C. Johnson, 1887, U.S. Geol. Survey Bull. 43, p. 51–57.

J. E. Brantly, 1920, Alabama Geol. Survey Bull. 22, p. 148–152. Formation, lowermost of Wilcox group, consists of from 125 to 150 feet of (ascending) lignite, massive and laminated sands and clays, crossbedded sands, highly fossiliferous greensand marl and kaolinlike laminated to thick-bedded clays, and thin highly fossiliferous indurated beds. Divisible into three divisions on basis of both lithology and fossil content. Lowest of three phases is referred to as Coal Bluff beds and two upper phases as Gullette Bluff beds. Smith used term Coal Bluff to apply to lignite at base of Nanafalia. In this report, name is extended to include all strata (42 to 70 feet) below Gullette Bluff fossiliferous marl. Overlies Naheola formation; underlies Tuscahoma formation.

Lyman Toulmin, Jr., 1944, Alabama Acad. Sci. Jour., v. 16, p. 42. Formation comprises (ascending) basal sand, "Nanafalia Landing (*Ostrea thirsae*) marl," and "Gullette Bluff beds." Basal formation of Wilcox group; underlies Tuscahoma formation; overlies Naheola formation of Midway group with disconformity.

L. D. Toulmin, Jr., 1944, Southeastern Geol. Soc. [Guidebook] 1st Field Trip, p. 8. Formation extends across State of Alabama and lies disconformably on formations of Midway group—Clayton formation in eastern Alabama, and Naheola formation in central and western Alabama. Comprises three members: basal coarse crossbedded sandstone 30 feet thick, containing rounded pellets of clay in lower part; middle greensand marl member 35 to 80 feet thick, packed with shells of *Ostrea thirsae;* upper glauconitic sandy clay member indurated in central Alabama and called pseudobuhrstone, 50 feet or more thick, containing molds of *Turritella.* Basal sand is absent in some areas. Basal sand was included by Cooke (1933, Am. Assoc. Petroleum Geologists Bull., v. 17, no. 2) in his Ackerman formation in Alabama.

F. S. MacNeil, 1946, U.S. Geol. Survey Strategic Minerals Inv. Prelim, Rept. 3–195, p. 20. Lowest formation of Wilcox group in Alabama. Upper coarse sand of Coal Bluff beds of Brantly are here included in Nanafalia as Fearn Springs sand member. Thickness of formation above Fearn Springs member ranges from about 25 to about 100 feet, and it is roughly divisible in western Alabama into two zones—upper predominantly sandstone, sandy claystone, and laminated clay (Grampian Hills rock or "pseudobuhrstone" of Smith, Johnson, and Langdon, 1894, Report on the geology of the Coastal Plain of Alabama: Alabama Geol. Survey), and lower loose to tough sand with ledges or concretionary zones of sandstone; this lower part is commonly referred to as *Ostrea thirsae* beds. Type locality exposes only a few feet of upper sandstone and claystone facies. In easternmost Alabama, formation consists of two sand and clay sequences.

F. S. MacNeil, 1947, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 72. Mapped in southwestern Georgia.

R. J. Hughes, Jr., 1958, Mississippi Geol. Survey Bull. 84. p. 143–166, pls. 1, 5, 7, 9. Described in Kemper County, Miss., where it is about 230 feet thick and includes Fearn Springs sand member in lower part. Wilcox group. Overlies Naheola formation; underlies Tuscahoma sand. History of usage of name.

P. E. LaMoreaux and L. D. Toulmin, 1959, Alabama Geol. Survey County Rept. 4, p. 95–111, pls. 2, 3. In Wilcox County, consists of three members (ascending): Gravel Creek (new), unnamed unit (*Ostrea thirsae* beds), and Grampian Hills. Name Fearn Springs sand member not used in this report because boundary positions of Fearn Springs type locality are in dispute and stratigraphic relationships with section in Alabama are uncertain. Thickness 112 to 260 feet. Overlies Coal Bluff marl member of Naheola formation; conformably underlies Tuscahoma sand, top placed at base of lowermost bed of tan to greenish-gray fine-grained silty sand with fine-grained glauconite and prints of small fossils. Smith and Johnson (1887) separated Nanafalia into three divisions—lower division 80 feet, middle division "*Ostrea thirsae* beds," 70 to 80 feet, and upper division "pseudobuhrstone," 40 feet. Lower division of Smith and Johnson was named Coal Bluff beds by Brantly (1920). In present report, these beds, except for a coarse-grained crossbedded sand at top, constitute Coal Bluff marl member of Naheola formation, and the coarse-grained crossbedded sand is Gravel Creek sand member of Nanafalia. Middle and upper divisions of Smith and Johnson are equivalent to "Gullette Bluff beds" of Brantly (1920) and, in this report, comprise middle and Grampian Hills members of Nanafalia.

Named for exposures at Nanafalia Landing on Tombigbee River, in Marengo County, Ala.

Nanafalia Landing Marl (in Nanafalia Formation)

†Nanafalia Marl (in Wilcox Group)[1]

Eocene, lower: Southwestern Alabama.

Original reference: E. A. Smith, 1883, Alabama Geol. Survey Prog. Rept. 1881–1882, p. 256, 318–321.

L. D. Toulmin, Jr., 1940, Alabama Geol. Survey Bull. 46, p. 28–29. Formation as restricted by Cooke (1933, Am. Assoc. Petroleum Geologists Bull., v. 17, no. 2) is equivalent to "Gullette Bluff beds" of Brantly (1920). It consists of 50 to 80 feet of light-colored sands and greensand marls packed with *Ostrea thirsae* Gabb, overlain by 40 to 120 feet of gray clays and glauconitic sandy clays indurated in some regions and called "pseudobuhrstone." Conformably underlies Tuscahoma formation.

Lyman Toulmin, Jr., 1944, Alabama Acad. Sci. Jour., v. 16, p. 42. "Nanafalia Landing (*Ostrea thirsae*) marl" listed in Nanafalia formation. Overlies a basal sand and underlies "Gullette Bluff beds."

Named for exposure at Nanafalia Landing, on Tombigbee River, in Marengo County.

Nanaimo Group[1] or Formation

Upper Cretaceous to Eocene(?): Northwestern Washington, and southwestern British Columbia, Canada.

Original reference: G. M. Dawson, 1886, Canada Geol. Survey Rept. 1886, p. 10B; 1890, Am. Jour. Sci., 3d, v. 39, p. 181–183.

J. S. Bradley, 1950 (abs.) Geol. Soc. America Bull., v. 61, no. 12, pt. 2, p. 1520. Namaimo sediments are predominantly conglomerate and graywacke; graywackes are normally crossbedded and contain conglomeratic layers. Conglomerates of Chuckanut formation, assigned to Eocene, on plant evidence, are indistinguishable from "Cretaceous" conglomerates immediately above Cretaceous faunal horizons; thus, group may be in part post-Cretaceous.

T. J. Etherington, 1951, Am. Assoc. Petroleum Geologists Bull., v. 35, no. 2, p. 191 (table). Named in list of formations of western Washington and described as sandstone and shale with some local conglomerate and coal beds; thickness about 10,000 feet. Occurs stratigraphically above San Juan group and below Solduc formation.

First described on Vancouver Island. On northernmost San Juan Islands, strata occur in northwest-trending belt.

Nanjemoy Formation (in Pamunkey Group)[1]

Eocene, lower and middle: Eastern Maryland and eastern Virginia.

Original reference: W. B. Clark and G. C. Martin, 1901, Maryland Geol. Survey, Eocene Volume, p. 58.

C. W. Cooke, Julia Gardner, and W. P. Woodring, 1943, Geol. Soc. America Bull., v. 54, no. 11, chart 12. Correlation chart shows age as lower and middle Eocene. Includes Potapaco clay member below and Woodstock greensand above. Overlies Aquia formation.

N. H. Darton, 1947, Econ. Geology, v. 43, no. 2, p. 154–155; 1951, Geol. Soc. America Bull., v. 62, no. 7, p. 753–754, 755, 757 (fig. 5), 760. Includes Marlboro clay member at base.

D. J. Cederstrom, 1957, U.S. Geol. Survey Water-Supply Paper 1361, p. 24, 26–28, pl. 2. Lower Potapaco clay member of Nanjemoy is early Eocene; upper Woodstock greensand marl member is middle Eocene. Potapaco clay member truncates Aquia formation. Downdip, the Aquia formation and Potapaco member of Nanjemoy, as well as basal Marlboro clay member of Nanjemoy, have been truncated by transgressive sea of middle Eocene time during which upper part of Nanjemoy was deposited. Hence, eastward Woodstock member of Nanjemoy generally rests upon beds of Mattaponi formation (new) in subsurface. Underlies Chickahominy formation. Area of report is York-James Peninsula, Va. Report includes subsurface data.

Named for Nanjemoy Creek, Charles County, Md.

Nankoweap Group

Precambrian (Grand Canyon Series): Northern Arizona.

C. E. Van Gundy, 1934, Grand Canyon Nature Notes, v. 9, no. 8, p. 345–346; 1951, Geol. Soc. America Bull., v. 62, no. 8, p. 953–959, pl. 1. Thin-bedded brown well-indurated sandstone with interbeds of sandy shale, light gray, reddish, or purplish brown; also medium- to fine-grained massive quartzite, light-gray to white cross-bedded sandstones, and thin-bedded light-gray sandy limestone containing thin laminae of green shale. Includes lower member of Chuar group as described by Walcott and upper part of Walcott's Unkar group. Thickness at type section, 330 feet. Separated from both Unkar and Chuar groups by erosional unconformities. Algonkian.

Type section: In Basalt Canyon of Grand Canyon region, where complete and undisturbed section is well exposed. Complete section also exposed on north side of Nankoweap Valley. Partial sections in Unkar Creek, Comanche Creek, and west of Tanner Canyon.

†Nannie Basin Limestone[1]

Middle(?) Cambrian: Northeastern Montana.

Original reference: C. F. Deiss, 1933, Montana Bur. Mines and Geol. Mem. 6, p. 6, 36, and passim.

Charles Deiss, 1939, Geol. Soc. America Spec. Paper 18, p. 38–39. Name Nannie Basin dropped and original Damnation and Nannie Basin limestones combined under Damnation limestone.

Type locality: Where the limestone forms the lower cliffs, which are rim of physiographic feature known as Nannie Basin.

Nansemond Formation

Pleistocene: Eastern Virginia.

W. E. Moore, 1956, Virginia Acad. Sci., Geology Sec., Field Trip Guidebook, no pagination. Deposited in tidal lagoon environment and includes a number of facies which range through clay, silt, sand, and peat; marine shell beds locally present. Residual material from Sedley formation (new) and lag gravels and cobbles from Kilby formation (new) underlie the Nansemond beneath westernmost parts of Dismal Swamp terrace. Underlies Dismal Swamp terrace and Princess Anne terrace. Terrace, as used here, refers to land form only and does not refer to or imply existence of any deposits genetically related to them.

Area discussed is south of James River.

Nantahala Slate[1]

Nantahala Schist

Precambrian(?); Western North Carolina, central northern Georgia, and eastern Tennessee.

Original reference: A. Keith, 1907, U.S. Geol. Survey Geol. Atlas, Folio, 143, p. 4.

G. W. Stose and A. J. Stose, 1946, (abs.) Geol. Soc. America Bull., v. 57, no. 12, pt. 2, p. 1233; 1949; Geol. Soc. America Bull., v. 60, no. 2, p. 272, 273, 282–285. Term Nantahala slate is used as defined by Keith (1907) but included in Ocoee series and age given as late Precambrian. Slate is present above Great Smoky quartzite in main syncline of Ocoee series in Bald Mountains, in Great Smoky Mountains in vicinity of Newfound Gap and southwestward, and on flanks of Murphy syncline from northeast corner of Nantahala quadrangle southwestward into northern Georgia. In deeper parts of the syncline, as in Bald Mountains and Murphy syncline, slate is overlain by Big Butt (Tusquitee) quartzite. Northwest of main syncline, from Little Tennessee River southward across southern Tennessee and North Carolina, slate is enclosed in minor synclines in Great Smoky quartzite.

G. W. Crickmay, 1952, Georgia Geol. Survey Bull. 58, p. 27, 29. Nantahala schist included in Talladega series believed to be Precambrian.

V. J. Hurst, 1955, Georgia Geol. Survey Bull. 63, p. 43–44, 45–47, pl. 1, geol. map. In Mineral Bluff quadrangle, Georgia, slate crops out in two belts, one on each limb of Murphy syncline. Thickness commonly 1,000 to 1,800 feet; less than 500 feet where thinned by faulting east of Weaver Creek. Underlies Tusquitee quartzite; overlies Dean formation (new) of Great Smoky group, formations appear to be gradational through a zone less than 20 feet thick, and concordant. Cambrian-Precambrian boundary placed at base of Nantahala.

P. B. King and others, 1958, Geol. Soc. America Bull., v. 69, no. 8, p. 951, 953 (table 1). As defined in this report, top of Ocoee series is placed at base of Nantahala slate, and Nantahala is included in rocks of Murphy marble belt under heading Precambrian(?) and early Paleozoic(?):

J. L. Stuckey and S. G. Conrad, 1958, North Carolina Div. Mineral Resources Bull. 71, p. 36–37; J. L. Stuckey, 1958, Geologic map of North Carolina (1:500,000): North Carolina Div. Mineral Resources. Mapped as Nantahala slate in Ocoee series. Upper Precambrian. Age designation of Nantahala questionable, but it is mapped in Ocoee series because present knowledge of formation in North Carolina does not warrant assigning it to Cambrian.

Named for exposures along Nantahala River in Nantahala quadrangle, Macon and Swain Counties, N.C.

Nanushuk Group

Nanushuk Formation[1]

Lower and Upper Cretaceous: Northern Alaska.

Original reference: F. C. Schrader, 1902, Geol. Soc. America Bull., v. 13, p. 247.

George Gryc, W. W. Patton, Jr., and T. G. Payne, 1951, Washington Acad. Sci. Jour., v. 41, no. 5, p. 160 (table 1), 162–164, fig. 3. Redescribed as group of Lower and Lower(?) Cretaceous age. In Colville River region, it includes shale, sandstone, conglomerate, and coal beds with little or no bentonite or tuff. Estimated thickness 5,750 feet in outcrop area; thins slightly northward. Includes two new intertonguing formations—Chandler (nonmarine) and Umiat (marine). Overlies Torok formation (new) with gradational contact; unconformably underlies Colville group. Type section indicated.

R. L. Detterman *in* George Gryc and others, 1956, Am. Assoc. Petroleum Geologists Bull., v. 40, no. 2, p. 233, figs. 2, 3. Group includes four formations: Tuktu (redefined-marine) at base, Grandstand and Ninuluk formations (new-marine), and Chandler (nonmarine) which intertongues with and grades into two upper marine formations. Early Cretaceous and early Late Cretaceous.

E. G. Sable, 1956, Am. Assoc. Petroleum Geologists Bull., v. 40, no. 11, p. 2635–2637, fig. 3. Redefined in Utukok-Corwin area (western part of northern Alaska) where group consists of two formations: the Kukpowruk (new) and Corwin (redefined). Thickens southwestward from about 6,500 feet on lower Utukok River to more than 15,000 feet at Corwin Bluff. Kukpowruk and Corwin formations gradational and intertonguing; the same relationship exists between Kukpowruk and underlying Torok formation.

Type section: Belt of rocks beginning 5 miles north of junction of Colville and Anaktuvuk Rivers and extending south for 30 miles. Exposed along Nanushuk River where river cuts across Arctic Foothills province. Known to crop out throughout foothills north of Brooks Range from Sagavanirktok River west as far as Kukpowruk River.

Naomi Peak Limestone Member (of Langston Formation)

Middle Cambrian: Southeastern Idaho and northern Utah.

G. B. Maxey, 1955, Dissert. Abs., v. 15, no. 4, p. 558. Incidental mention.

G. B. Maxey, 1958, Geol. Soc. America Bull., v. 69, no. 6, p. 671, fig. 2. Light- to medium-neutral-gray finely crystalline arenaceous limestone with numerous lenses of coarsely crystalline very fossiliferous pure limestone. In many places, few thin beds of gray medium-grained brown-weathering calcareous or dolomitic sandstone occur near base of member. Thickness 32 feet in High Creek section. Thickens to 40 feet to the north and east. Not recognized in Left Fork of Blacksmith Fork, or in central or western Utah. Underlies Spence shale member and conformably overlies Pioche(?) shale.

Excellent section on north side of North Fork of High Creek, approximately 6½ miles northeast of Richmond, Utah. High Creek section considered "standard" for Cambrian of northeastern Utah and southeastern Idaho. Member extends from Left Fork of Blacksmith Fork River northward beyond Spence Gulch and Malad, Idaho, and from east side of Bear River Range to Wellsville Mountain.

Napali Formation (in Waimea Canyon Volcanic Series)

Pliocene(?): Kauai Island, Hawaii.

G. A. Macdonald, D. A. Davis, and D. C. Cox, 1954, Volcano Letter 526; D. A. Davis and G. A. Macdonald *in* Jacques Avias and others, 1956, Lexique Strat. Internat., v. 6, Océanie, fasc. 2, p. 119. Thin lava flows and associated pyroclastic rocks that accumulated on flanks of major Kauai shield volcano, outside boundaries of caldera. Predominantly olivine basalt. Exposed thickness 2,700 feet; total thickness above ocean floor about 19,000 feet. Oldest unit of series. Separated from Olokele, Haupu, and Makaweli formations (all new) by eroded fault scarps bounding Olokele and Haupu calderas and Makaweli graben.

G. A. Macdonald, D. A. Davis, and D. C. Cox, 1960, Hawaii Div. Hydrography Bull. 13, p. 23–32, table facing p. 20, pl. 1. Lava flows and associated pyroclastic rocks that accumulated on flanks of major Kauoi shield volcano, outside boundaries of the caldera. Constitutes major part of shield and extends to its base at ocean floor. Exposed thicknesses 2,400 to 2,700 feet. Separated from Olokele and Haupu formations by boundary of faults of calderas and from Makaweli formation by eroded fault scarps at edge of Makaweli graben. Exact age not known. Probably formed during Pliocene.

Type locality: West wall of Waimea Canyon. Named for exposures along Napali Coast, on northwestern side of island.

Napanee Member (of Rockland Formation)

Middle Ordovician (Mohawkian): Southern Ontario, Canada and northern New York.

G. M. Kay, 1937, Geol. Soc. America Bull., v. 48, no. 2, p. 252, 255–256, pl. 2. Name proposed for upper member of formation. Described as terrace- and scarp-forming gray-blue medium-textured rather heavy ledged limestone with shaly partings common in lower part. Has few heavy ledges and is more shaly in New York. Thickness 34 feet at type locality. Overlies Selby member; underlies Hull formation. Overlaps lower beds along upper Black River valley.

Type section: One mile north of Napanee Station, along Selby Creek in Lot 22, Conc. III, Richmond Township, Lenox and Addington County. Ontario.

Napa Valley Series

Pliocene, lower: California.

O. P. Jenkins, 1938, Geologic map of California (1:500,000): California Div. Mines, sheet 4. Shown on map legend.

Naples Member (of Millboro Formation)

†Naples Shale[1] or Group[1]

Naples Shale (in Portage Group)

Upper Devonian: Western to central New York and Virginia.

Original reference: J. M. Clarke, 1885, U.S. Geol. Survey Bull. 16.

B. N. Cooper, 1939, Virginia Geol. Survey Bull. 55, p. 43–44. Upper member of Millboro shale (new). Overlies Marcellus member. Underlies Brallier formation. Consists of carrot-red to apricot-buff shales and fine-grained siltstone. Thickness not accurately determined because of drag folding and crumpling of beds, but probably 500 to 600 feet. Early Portage in age. Area of report, Draper Mountains.

P. H. Price and H. P. Woodward, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 11, p. 1992. Naples shale in Portage group. Thickness 25 feet in Berkeley County; thickens westward to more than 300 feet in Mineral County. Rock is black fissile platy or slabby shale overlying Hamilton formation in northeastern counties, and coalescing with Marcellus black shale in more southerly regions. Underlies Brallier shale. Previously mapped as "Genesee." Discussion of Devonian of West Virginia.

G. A. Cooper and others, 1942, Geol. Soc. America Bull., v. 42, no. 12, pt. 1, chart 4. Shown on correlation chart as group comprising (ascending) Middlesex shale, Cashaqua shale, Rhinestreet shale, and Hatch sandstone; in Lake Erie area, includes Attica shale. Overlies Genesee group; underlies Grimes sandstone or Angola shale.

H. P. Woodward, 1943, West Virginia Geol. Survey, v. 15, p. 410–411. Term Naples black shale as recently used (Price and Woodward) for the "Genesee" may be premature because it anticipates correlation that has not been confidently confirmed. Name Harrell used herein as an alternative to applying a new name.

R. G. Sutton, 1960, New York State Mus. Bull. 380, p. 56. Group comprises (ascending) Middlesex black shale, Cashaqua formation, Rhinestreet black shale, and Hatch formation. Name Attica shale, formerly applied to Naples strata above Cashaqua formation in Lake Erie region, is herein abandoned, and term Rhinestreet black shale is applied westward to Lake Erie. Thickness increases from west to east; 169 feet at Lake Erie; 858 feet at Keuka Lake. Underlies Grimes sandstone; underlies Gardeau formation where Grimes is absent. Grimes and Gardeau are equivalent to Angola shale, in part, which overlies Rhinestreet black shales where Hatch formation is absent west of Attica. Overlies Genesee group.

Named for town of Naples, Ontario County, N.Y.

Napoleon Sandstone Member (of Marshall Sandstone)

Napoleon Sandstone (in Marshall Group)

Napoleon Sandstone[1] or Group[1]

Mississippian: Michigan.

Original reference: W. H. Taylor, 1839, Michigan Geol. Survey Rept. State Geologist in re improvement of State salt springs, Michigan Leg. H. R. Doc. 2.

G. V. Cohee, 1944, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 11. Napoleon sandstone member of Marshall sandstone is approximately 20 feet thick in outcrop at Napoleon. Overlies unnamed member.

J. M. Weller and others, 1948, Geol. Soc. America Bull., v. 59, no. 2, chart 5 (columns 80, 81). Shown on correlation chart as Napoleon sandstone at top of Marshall group. Occurs below Michigan formation.

Exposed at Napoleon, Jackson County.

Napoleonville Stage

Miocene: Southeastern Louisiana (subsurface).

C. M. McLean, 1957, Gulf Coast Assoc. Soc. Trans., v. 7, p. 241, 242 (fig. 1), 243. A stage name, based on faunal assemblages occurring in sediments commonly termed "Upper" Miocene in subsurface of southeastern Louisiana. Clovelly and Duck Lake stages proposed as replacements for "Lower" and "Middle" Miocene respectively. Names were selected arbitrarily only because denoted fields demonstrate representative sections for each; nothing in way of principal producing horizons is implied.

Naptowne Glaciation

Pleistocene: Central southern Alaska.

T. N. V. Karlstrom, 1953, *in* T. L. Péwé and others, U.S. Geol. Survey Circ. 289, p. 4, 13 (table 1). At least four major Quaternary glaciations recognized in Upper Cook Inlet area. Naptowne, the youngest, succeeded Swan Lake glaciation (new). Represented by conspicuous spatula-shaped end moraine and by similar morainal belts at mouth of Matanuska Valley and on margin of lowland in front of trunk valleys heading in glaciers of Alaska Range and Kenai Mountains. Along lower slopes of these trunk valleys, marginal moraines and fresh ice scour features occur nearly continuously about 1,000 feet below Swan Lake moraines. Moraines have little-modified knob and kettle topography, and kettle lakes are common.

D. B. Krinsley, 1953, *in* T. L. Péwé and others, U.S. Geol. Survey Circ. 289, p. 6, 13 (table 1). In southwest part of Kenai Peninsula, Naptowne glaciation was followed by Nikolai Creek glaciation (new).

T. N. V. Karlstrom, 1957, Science, new ser., v. 125, no. 3237, p. 74. Chart of Alaskan glacial sequences shows sequence in Cook Inlet area (ascending): Swan Lake, Naptowne, and Alaskan (new).

T. N. V. Karlstrom, 1960, U.S. Geol. Survey Prof. Paper 400–B, p. B330–B332. Lower boundary of Naptowne glaciation is dated between 46,000 and 37,000 B.C. (about 45,000 B.C.). Upper boundary placed about 3,500 B.C. Naptowne records a major glacial cycle of about 40,000 years.

Spatula-shaped end moraine is crossed by the Stirling Highway near Naptowne on Kenai Peninsula, Upper Crook Inlet area.

Naranjo Formation

Triassic: Northeastern New Mexico.

G. O. Bachman, 1953, U.S. Geol. Survey Oil and Gas Inv. Map OM–137. Sequence of interbedded brownish-red sandstone, siltstone, and shale. Thickness 15 to 64 feet. Overlies Chinle formation; underlies Ocate sandstone (new). Jurassic.

R. L. Griggs and S. A. Northrop, 1956, New Mexico Geol. Soc. Guidebook 7th Field Conf., p. 134–135. In Sangre de Cristo Mountains, N. Mex., overlies Dockum group; unconformably underlies Ocate sandstone. Triassic.

Named for exposures in cutbank near village of Naranjo, about 2 miles east of Ocate, Mora County. Present also at Turkey Mountains, 12 miles southeast of Ocate.

Naranjo Formation (in Jacaguas Group)

Eocene, middle: Puerto Rico.

E. A. Pessagno, Jr., 1960, Geology of the Ponce-Coamo area, Puerto Rico: Puerto Rico Econ. Devel. Adm. and Princeton Univ. Dept. Geology, p. 70–94. Consists of 13,000 feet of marine sediments. Divided into four members: Miramar (new), Coamo Springs limestone, Río Descalabrado, and Guayo conglomeratic sandstone. In eastern part of Ponce quadrangle, interfingers with and is overlain by Augustinillo formation (new).

E. A. Pessango, Jr., 1960, Caribbean Geol. Conf.:, 2d, Mayagüez, Puerto Rico, 1959, Trans., p. 83, 84. Thickness 13,000 feet; maximum exposed. Divided into four members: Los Puertos (new) at base, Coamo Springs, Río Descalabrado, and Guayo conglomeratic sandstone (new). Interfingers with Augustinillo formation (new) in eastern part of Ponce quadrangle; also overlain in part by the Augustinillo in northeastern part of quadrangle. Footnote states that the Guayabal is currently called Jacaguas group.

Typically exposed along Camino Naranjo 1.1 kilometers east of Juana Díaz. Extends approximately from Salinas to somewhat west of the Río Guayo.

†Narcissa Sandstone (in Cherokee Shale)[1]

Pennsylvanian: Northeastern Oklahoma.

Original reference: S. Weidman, 1932, Oklahoma Geol. Survey Bull. 56, p. 24.

C. C. Branson, 1957, Oklahoma Geology Notes, v. 17, no. 11, p. 102. Abandoned by Oklahoma Geological Survey. Name inadvertantly given to unit termed Little Cabin sandstone.

Named for town in Ottawa County.

Narizian Stage

Eocene, late: California.

V. S. Mallory, 1953, (abs.) Jour. Paleontology, v. 27, no. 6, p. 903. Named as one of six stages, based on foraminiferal assemblages, in lower Tertiary of California. Includes interval between Fresnian [Fresnoian] stage above and Ulatisian stage below.

V. S. Mallory, 1959, Lower Tertiary biostratigraphy of the California Coast Ranges: Tulsa, Okla., Am. Assoc. Petroleum Geologists, p. 55–72, 78–81, 96–98, fig. 7, tables. Redefined to include Fresnian stage. Composed of two zones, basal *Bulimina corrugata* and upper *Amphimorphina jenkinski;* a third zone may lie within predominantly arenaceous foraminifer faunules just subjacent to Refugian stage.

Type is taken at Point of Rocks, in sec. 2, T. 26 S., R. 18 E., in northwestern Kern County in Devils Den area—the typical Point of Rocks sandstone with possible exception of basal 75 feet, plus Welcome member of Kreyenhagen formation, to a point below superjacent Wagonwheel formation.

†Narragansett Basin Series[1]

Pennsylvanian and Permian(?): Rhode Island.

Original reference: G. R. Mansfield, 1906, Harvard Coll. Mus. Comp. Zoology Bull., v. 49, Geol. Ser., v. 8, no. 4, p. 99.

Narragansett Basin.

Narragansett Pier Granite

Upper Pennsylvanian or post-Pennsylvanian: Southern Rhode Island.

D. R. Nichols, 1956, U.S. Geol. Survey Geol. Quad. Map GQ–91. Name proposed for granite whose composition varies from granite to quartz monzonite. Typically reddish, medium-grained. Massive to gneissic. Texture variable with irregular patches of pegmatitic and aplitic material dispersed through granite. Contains schist inclusions locally. Intrusive into metamorphosed Pennsylvanian sedimentary rocks, also into Scituate granite gneiss and other gneissic rocks. Previously termed Boston Neck granite; also had been included with Sterling granite gneiss.

Named from exposures along shore of Narragansett Bay south of Narragansett Pier, Washington County.

Narrow Canyon Limestone

Upper Devonian and Lower Mississippian: Southern Nevada.

M. S. Johnson and D. E. Hibbard, 1957, U.S. Geol. Survey Bull. 1021–K, p. 356, pls. 32, 33. Consists of dark-gray silty limestone well defined in beds less than an inch thick. Weathers into thin buff-colored plates and forms talus-covered slopes. Thickness 175 feet at type locality. Conformably overlies Devils Gate(?) limestone in sharp contact; underlies Mercury limestone (new) with contact gradational.

Type locality: In Narrow Canyon at southeast margin of the Atomic Energy Commission Nevada proving grounds area, Nye and Clark Counties. Well exposed about one-half mile from mouth of canyon in narrow, northwestward-trending band and are characterized by buff-colored slope-forming appearance.

Narrows Chert (in Beekmantown Limestone)[1]

Lower Ordovician: Southwestern Virginia and southeastern West Virginia.

Original reference: D. B. Reger, 1926, West Virginia Geol. Survey Rept. Mercer, Monroe, and Summers Counties, p. 641–643.

Type locality: On low spur of Wolf Creek Mountain, west of Mill Creek, south of Wolf Creek and about 2.2 miles southwest of Narrows, Giles County, Va.

Nash Marble Series[1] (in Snowy Range Series)

Precambrian: Southeastern Wyoming.

Original reference: E. Blackwelder, 1926, Geol. Soc. America Bull., v. 37, p. 620, 623, 636.

J. J. Runner, 1928, (abs.) Geol. Soc. America Bull., v. 39, no. 1, p. 202. Included in Snowy Range series (new).

R. S. Agatston, 1951, Wyoming Geol. Assoc. Guidebook 6th Ann. Field Conf., p. 130. Precambrian metamorphics consist of Anderson phyllite, Deep Lake metaquartzite, French slate, Heart metagraywacke, Headquarters schist, Nash marble series, Seminoe formation, and Towner greenstone.

Exposed on west branch of Nash Fork, Medicine Bow Mountains.

†Nashaquitsa Series[1]

Pleistocene: Southwestern Massachusetts.

Original reference: N. S. Shaler, 1888, U.S. Geol. Survey 7th Ann. Rept., p. 303–363.

At Nashaquitsa Cliffs, on south shore of Marthas Vineyard.

Nash Creek Formation

Oligocene, upper: West-central Louisiana.

H. V. Andersen, 1960, Louisiana Dept. Conserv., Geol. Bull. 34, p. 104 (fig. 18), 105 (fig. 19), 106–107. Proposed for gray to chocolate-brown carbonaceous and micaceous bentonitic clays containing fossil leaf impressions and occasional lenses of pure bentonite and sand which overlie Sandel formation. Thickness about 35 feet at type locality. Underlies Catahoula formation. Alternate type locality noted.

H. V. Andersen, ed., 1960, Type localities project unit 1: Baton Rouge, La., Soc. Econ. Paleontologists and Mineralogists, Gulf Coast Section, p. [40–42]. Upper Oligocene.

Type locality: Cut bank on west side of Nash Creek and adjacent K. C. S. Railroad cut near center of NE¼ sec. 6, T. 4 N., R. 10 W., Sabine Parish. Alternate type locality: Gully which heads on west side of U.S. Highway 171, 0.3 mile south of Hodges Gardens main entrance (NW¼SE¼ sec. 31, T. 5 N., R. 10 W.).

Nashoba Formation

Carboniferous: Eastern Massachusetts.

L. W. Currier and R. H. Jahns, 1952, Guidebook for field trips in New England: Geol. Soc. America, p. 106–108, 110. Name proposed for thick section of metamorphic rocks referred to by Emerson (1917) as Bolton gneiss and "gneisses and schists of undetermined age." Consists of biotite paragneiss and schist with amphibolite beds and marble lenses. Name credited to W. R. Hansen (unpub. ms.).

W. R. Hansen, 1956, U.S. Geol. Survey Bull. 1038, p. 1, 31–39, pl. 1. Gneissic formation moderately to strongly feldspathized. Youngest metasedimentary rock in area. Grades downward into mica schist facies of Worcester formation through an amphibolitic transition zone. Outcrop breadth several miles; although breadth of outcrop may be due in part to multiple folding, the formation is probably at least 5,000 feet thick. Gospel Hill gneiss (new) may be granitized facies of Nashoba.

Named for exposures in valley of Nashoba Brook in Maynard and Westford quadrangles. Well exposed near town of Bolton.

†Nashua Marl[1]

Pliocene, lower: Northeastern Florida.

Original reference: G. C. Matson and F. G. Clapp, 1909, Florida Geol. Survey 2d Ann. Rept., p. 128–133, table opposite p. 50.

Named for exposures on St. Johns River near Nashua, Putnam County.

†Nashville Group[1]

Middle and Upper Ordovician: Western, central, and eastern Tennessee.

Original reference: J. M. Safford, 1851, Am. Jour. Sci. 2d., v. 12, p. 353, 356–357.

C. W. Wilson, Jr., 1948, Tennessee Div. Geology Bull. 53, p. 11 (footnote), geol. map. Nashville group of Safford (1851, 1856) is redefined to include strata of the Hermitage, Bigby, Cannon, and Catheys formations and to exclude strata of the Leipers, Arnheim, and Fernvale formations. Thus, name Nashville group will replace name Trenton group of New York, which has been used in general for these four formations. Underlies Maysville group; overlies Stones River group. Age given on map as Ordovician.

W. H. Twenhofel and others, 1954, Geol. Soc. America Bull., v. 65, no. 3, chart 2 (column 43). Age shown on correlation chart as Trentonian-Edenian.

Named for Nashville.

†Nashville Slate[1]

Ordovician: Northwestern Georgia.

Original reference: W. Spencer, 1891, Georgia Geol. Survey 1st Rept. Prog., p. 112.

†Nasina Series[1] or Group[1]

Precambrian and Paleozoic: Eastern Alaska.

Original reference: A. H. Brooks, 1900, U.S. Geol. Survey 20th Ann. Rept., pt. 7, p. 465–467, 478, 483.

Occurs only on lower White River up to about mouth of Ladue Creek. [Nasina in Tanana native name for White River.]

Nassau Formation

Nassau Beds[1]

Lower Cambrian: Eastern New York and western Vermont.

Original reference: R. Ruedemann, 1914, New York State Mus. Bull. 169, p. 67–70.

Rudolf Ruedemann, 1942, New York State Mus. Bull. 327, p. 59, 60. Nassau quartzite, as well as basal quartzite of older areas in Appalachian geosyncline, is unfossiliferous. Nassau beds have yieded only *Oldhamia*, a worm trail. It is probable that Nassau quartzite and all basal quartzites throughout Appalachian geosyncline are Precambrian south from Random quartzite in Newfoundland. Burden iron ore is definite horizon between Nassau beds and Schodack beds.

Phillip Fowler, 1950, Vermont Geol. Survey Bull. 2, p. 38–46, pl. 2. Formation described in Castleton quadrangle where it is part of Taconic sequence. The 2,000- to 4,000-foot Taconic sequence crops out in Taconic Range and slate belt. Thick phyllite, quartzite, and grit that underlies Taconic Range was formerly considered Upper Ordovician and was called Berkshire schist. Because of its relation to Cambrian slates of slate belt and its similarity to Nassau formation of New York, it is here mapped as Nassau formation. Thickness at least 1,000 to 3,000 feet. Includes Bird Mountain grit as facies; main body of Bird Mountain is probably 500 feet thick. Presumably lies beneath Bomoseen grit. Recognized that Nassau formation of Castleton area probably includes, in addition to rocks equivalent to typical Nassau of eastern New York, strata not exposed but presumably underlying typical Nassau. Lowest beds in Nassau of Castleton area are probably those on eastern flank of Taconic Range. In general, it is thought that successively younger beds crop out in westerly direction until the Bomoseen and Mettawee are encountered. Probable that Nassau as mapped here includes younger rocks that are not sufficiently well exposed to be recognizable in the field. In addition to large mass of probable Normanskill formation differentiated on map in township of Middleton, there may be other undifferentiated strata of Normanskill age in the Nassau. Some Mettawee and Bomoseen have probably not been recognized in Nassau terrane. It is not likely that Nassau as mapped here includes Schodack, Eddy Hill, or Zion Hill strata. Probably late Precambrian.

Theodore Arnow, 1951, New York Water Power and Control Comm. Bull. GW-25, p. 8 (table 1), 9-11, pl. 2. Formation described in Columbia County where it consists chiefly of greenish or reddish and greenish shale, interbedded with thin layers of quartzite or grit; some massive greenish quartzite present. Thickness about 785 feet. Underlies Schodack formation. Lower Cambrian.

D. W. Fisher, 1956, Internat. Geol. Cong., 20th, Mexico, Cambrian Symposium, p. 337-338. Nassau beds (Ruedemann, 1914) were first distinguished by Dale (1904, U.S. Geol. Survey Bull. 242) as divisions A to E of Rensselaer County. Ruedemann (1932, New York State Mus. Bull. 285) placed formation wholly beneath Bomoseen grit implying that Nassau was older than any Lower Cambrian unit in Washington County. Later Ruedemann (1942) suggested that the Nassau, which has yielded no fossils except controversial *Oldhamia* represented late Precambrian and that local superjacent Burden iron ore was residual soil which accumulated during Lipalian interval. Interpretation proposed here is that Nassau is facies of Mettawee and Bomoseen and Burden iron ore is post-Lower Cambrian regolith. It is anomalous that no Nassau has been reported in Washington County and no Mettawee south of that county. This led to supposition that underlying reason may lie in contemporaneity of the two units. Also likely that some of what has been mapped as Nassau may be red and green shale facies (equivalent to red slates of Washington County) of Middle Ordovician Normanskill formation which has been thrust westward.

Named for exposures in Nassau, Rensselaer County, N.Y.

Natapoc Formation[1]

Eocene: Central Washington.

Original reference: E. Houghland, 1932, Northwest Sci., v. 6, no. 2, p. 68.

Occurs about 11 miles north of Leavenworth, Chelan County, and about 15 miles east of crest of Cascade Mountains, Natapoc Mountain.

Natchez Formation[1]

Pleistocene, lower: Southwestern Mississippi.

Original reference: T. C. Chamberlin, 1896, Am. Geologist, v. 17, p. 108-109.

M. M. Leighton and H. B. Willman, 1950, Jour. Geology, v. 58, no. 6, p. 614. Natchez formation is a Pleistocene valley-train deposit as interpreted by Chamberlain (1896), and Chamberlain and Salisbury (1906, Textbook of geology, v. 3). It is separate from and younger than Lafayette-type gravel.

H. N. Fish, 1951, Jour. Geology, v. 59, no. 4, p. 337 (fig. 3), 341. Elevations show that Natchez formation has been uplifted approximately 250 feet with respect to alluvial plain. Leighton and Willman did not give evidence from their study which permitted them to call Natchez a Pleistocene valley train or the particular glacial stage during which the formation was deposited. In this report, "Natchez formation" is considered sand facies of Bentley formation and the uplift has taken place since Yarmouth time.

Named for occurrences near Natchez, Adams County.

Natchez Pass Formation (in Star Peak Group)

Middle and Upper Triassic: North-central Nevada.

S. W. Muller, H. G. Ferguson, and R. J. Roberts, 1951, Geology of the Mount Tobin quadrangle, Nevada: U.S. Geol. Survey Geol. Quad. Map

[GQ-7]; 1951, Geology of the Winnemucca quadrangle, Nevada: U.S. Geol. Quad. Map [GQ-11]. Light- and dark-colored massive dolomite and limestone in varying proportions. About 200 feet of basic lava flow and volcanic breccia generally present about 400 feet above base. Locally massive dark-brown siliceous conglomerate with some siliceous massive slate about 200 feet below top. Thin lenses of clastic rocks in places. Thickness at type locality 1,650 feet; about 1,000 feet in Sonoma Range. Conformably overlies Prida formation (new); underlies Grass Valley formation.

R. E. Wallace and others, 1959, U.S. Geol. Survey Mineral Inv. Field Studies Map MF-220. Upper formation in Star Peak group. In Buffalo Mountain quadrangle, comprises lower and upper members. Lower member, predominantly massive gray limestone and dolomite in basal part and altered andesitic volcanic flows, tuff, and breccia, including argillite and siltstone in upper part, is 1,000 to 1,500 feet thick. Upper member, thin- to thick-bedded impure limestone in basal part and massive gray limestone in upper part, is about 1,000 feet thick. Overlies Prida formation; underlies Grass Valley formation. Middle and Upper Triassic.

Type locality: Natchez Pass, East Range, Winnemucca quadrangle.

Natick Arkose[1]

Carboniferous: Eastern Rhode Island.

Original reference: A. F. Foerste, 1899, U.S. Geol. Survey Mon. 33, p. 253-256, 375-376, 383-385.

Exposed along steep hill face from Natick, Kent County, for 2½ miles northward into Cranston, Providence County.

Natick Granite[1]

Lower Paleozoic(?): Massachusetts.

Original reference: W. O. Crosby, 1880, Boston Soc. Nat. History Occasional Papers 3.

Natick, Middlesex County.

National Sandstone[1]

Precambrian (Keweenawan): Northern Michigan.

Original reference: S. H. Broughton, 1863, Remarks on the mining interest and details of the geology of Ontonagon County, pamph. of 24 p., with map: Philadelphia, 1863, p. 21, map.

Well exposed in creek on National Location, Ontonagon County.

Nation River Formation[1]

Pennsylvanian(?): Central eastern Alaska.

Original reference: A. H. Brooks and L. M. Prindle, 1908, Geol. Soc. America Bull., v. 19, p. 294.

R. C. Moore and others, 1944, Geol. Soc. America Bull., v. 55, no. 6, p. 704, pl. 1. Largely terrigenous in origin.

Helmuth Wedow, Jr., 1954, U.S. Geol. Survey Circ. 316, p. 5, 6, pl. 1. Aggregate thickness of between 5,000 and 6,000 feet in Eagle-Nation area. Underlies Tankandit limestone.

Well exposed along Yukon River a few miles below Eagle and from Montauk Bluff to below mouth of Nation River.

Natsy Member (of Deese Formation or Group)

Pennsylvanian (Des Moines Series) : Central Oklahoma.

C. W. Tomlinson, 1937, Ardmore Geol. Soc. [Guidebook] Field Trip, March 13, p. 1–2, geol. map; C. W. Tomlinson and William McBee, Jr., 1959, *in* Petroleum geology of southern Oklahoma, v. 2: Tulsa, Okla., Am. Assoc. Petroleum Geologists, p. 6 (fig. 2), 35–36. Proposed to replace preoccupied name Hollis as used on map by Guthrey and Milner in 1933. Most distinctive bed of member comprises from 4 to 6 feet of impure silty ferruginous brown massive limestone; 40 to 50 feet above this bed is thinner bedded calcareous sandstone of similar thickness; at type locality, both units are partly conglomeratic, containing small variegated pebbles, chiefly of limestone. Overlies Williams member; underlies Confederate member of Hoxbar formation.

Type locality: On allotment of Natsy Noella in N½SW¼SW¼ and S½NW¼NW¼ sec. 27, T. 5 S., R. 2 E., Carter County.

Natural Bridge Limestone[1]

Age(?) : New York.

Original reference: W. W. Mather, 1843, Geology New York, v. 1, pl. 45.

Occurs from Monticello, Sullivan County, to Croton River near Bulls Bridge, Westchester County.

†Natural Bridge Limestone[1]

Middle and Upper Cambrian and Lower Ordovician: Central western Virginia.

Original reference: H. D. Campbell, 1905, Am. Jour. Sci., 4th, v. 20, p. 445–447.

Natural Corral Member[1] (in Belvidere Formation)

Lower Cretaceous (Comanche Series) : Central Kansas.

Original reference: W. H. Twenhofel, 1924, Kansas Geol. Survey Bull. 9, p. 31–32.

Exposed at Natural Corral, a box canyon about 5 miles southwest of Marquette, McPherson County, in NW¼ sec. 5, T. 18 S., R. 5 W.

Naturita Formation (in Dakota Group)

Lower to Upper Cretaceous: Southwestern Colorado.

R. G. Young, 1959, Rocky Mountain Assoc. Geologists 11th Field Conf., Symposium, p. 17, 21, figs. 2, 3; 1960, Am. Assoc. Petroleum Geologists Bull., v. 44, no. 2, p. 156–194. Carbonaceous unit consisting of conglomeratic sandstone, carbonaceous mudstone, carbonaceous shale, coal, littoral marine sandstone, and thin tongues of Mancos shale. Throughout much of the area, basal unit is a white to light-gray (on fresh surfaces), buff (on weathered surfaces) thin (5 to 15 feet) conglomeratic sandstone which disconformably overlies Cedar Mountain formation. In much of the area, a similar sandstone, about 20 feet thick, occurs higher in formation above as much as 45 feet of carbonaceous deposits. Upper part of formation of gray to black silty carbonaceous mudstone with lenses of conglomerate, sandstone, shale, and coal, about 100 feet thick. All of the formation in eastern part of the area is of Early Cretaceous age, but upper part in western part of the area is of Late Cretaceous age. Underlies Mancos shale.

Named for exposures near Naturita in southwestern Colorado. In Grand Junction area, Garfield, Mesa, and Delta Counties.

Naugatuck Sandstone (in Kanawha Formation)[1]

Pennsylvanian: Southern West Virginia.

Original reference: R. V. Hennen and D. B. Reger, 1914, West Virginia Geol. Survey Rept. Logan and Mingo Counties, p. 163.

Named for Naugatuck, Mingo County.

†Naugus Head Series[1]

Age(?) : Eastern Massachusetts.

Original reference: W. O. Crosby, 1877, Geol. map of eastern Mass.

Well developed on Naugus Head promontory on Marblehead shore, Boston region.

†Naushon Series[1]

Pleistocene: Southeastern Massachusetts.

Original reference: N. S. Shaler, 1888, U.S. Geol. Survey 7th Ann. Rept., p. 303–363, map.

Occurs on island of Naushon and also on Marthas Vineyard.

Navajo Sandstone (in Glen Canyon Group)[1]

Upper Triassic(?) and Jurassic: Northern Arizona, western Colorado, southeastern Nevada, northwestern New Mexico, and southeastern Utah.

Original reference: H. E. Gregory, 1915, Am. Jour. Sci., 4th, v. 40, p. 102, 112.

A. A. Baker, C. H. Dane, and J. B. Reeside, Jr., 1936, U.S. Geol. Survey Prof. Paper 183, p. 5–6, pls. Overlies Kayenta formation, lower boundary arbitrary; underlies Carmel formation of San Rafael group. Forms wedge with thick part to southwest in Nevada and thin edge in western Colorado. Not known to enter New Mexico. Thickness more than 2,000 feet in southeastern Arizona and adjacent Nevada. Believed that typical Nugget is equivalent to the Navajo.

H. E. Thomas and G. H. Taylor, 1946, U.S. Geol. Survey Water-Supply Paper 993, p. 20, 23–24, table facing p. 18. Described in Cedar City and Parawan Valleys, Utah. In Coal Creek Canyon, section is 1,100 feet thick and overlies Chinle formation. Between the shaly sandstones and sandy shales that are typical of the Chinle and the massive beds that are clearly identifiable as Navajo, there is a transition zone several hundred feet thick which might doubtfully be included in either formation. This transition zone, represented in Coal Creek Canyon section by beds 26 to 30, is assigned to Chinle; although the lower strata (bed 26 and much of bed 27) are quite similar to typical Navajo, the intervening shaly beds are not acceptable as part of that formation. As identified in Coal Creek Canyon the Navajo is thinner than in other parts of southern Utah. Underlies equivalent of Carmel formation.

R. K. Grater, 1948, Am. Jour. Sci., v. 248, no. 5, p. 311–318. Described in Zion National Park where it is about 2,100 feet thick; overlies Kayenta formation and underlies Carmel formation. Includes Temple Cap member (new) at top. Believed that basal Navajo and uppermost 200 feet, Temple Cap member, had their origin in water. Middle Jurassic(?).

H. E. Gregory, 1950, U.S. Geol. Survey Prof. Paper 220, p. 51 (table), 81–89. Described in Zion Park region where it is 1,200 to 2,200 feet thick. Overlies Kayenta formation with local unconformity, and unconformably underlies Carmel formation of San Rafael group. Consists of light-creamy-yellow, white, pinkish, and buff, highly crossbedded sandstone; Temple Cap member present at top. Jurassic(?).

H. J. Bissell, 1952, Am. Assoc. Petroleum Geologists Bull., v. 36, no. 4, p. 596–597, 598. In Strawberry Valley quadrangle, Utah, Navajo is 1,240 feet thick and underlies Twin Creek limestone. Unit can be mapped almost continuously from Duchesne River area into northeastern part of quadrangle. Jurassic.

S. J. Reber, 1952, Utah Geol. Soc. Guidebook 7, p. 105–106. Overlies Chinle in Beaver Dam Mountains, Utah.

W. H. Easton and others, 1953, Am. Assoc. Petroleum Geologists Bull., v. 37, no. 1, p. 145 (fig. 2). On correlation chart of recommended revision of stratigraphic units in Great Basin, Navajo sandstone replaces Aztec sandstone in southeastern Nevada.

Paul Averitt and others, 1955, Am. Assoc. Petroleum Geologists Bull., v. 39, no. 12, p. 2520, 2521. Base redefined in Cedar City area, Utah. In this area, Navajo includes Shurtz sandstone tongue (new), which lies 410 to 720 feet below base of Navajo sandstone as mapped by Thomas and Taylor (1946) and as accepted in this report. In section along Coal Creek measured by Thomas and Taylor, the Shurtz is designated as units 26 and 27 in the Chinle. In the section as republished by Gregory (1950, Utah Geol. and Mineralog. Survey Bull. 37) tongue appears as units 21 and 22 in the Chinle. Although Thomas and Taylor's section shows the Shurtz tongue as a separate unit lying below base of Navajo, Gregory mapped base of Shurtz as base of Navajo but did not note the change on republished section. In Kanab area, Navajo includes Lamb Point tongue (new), a name applied to rocks classified as Wingate by Gregory (1950); hence, term Wingate is eliminated in Kanab area. In their respective areas of outcrop, Shurtz and Lamb Point tongues are overlain by complementary tongues of Kayenta—Cedar City tongue (new) in Cedar City area and Tenney Canyon tongue (new) in Kanab area. Jurassic and Jurassic(?).

Extensively exposed in Navajo country. First described on Navajo Indian Reservation, Ariz.

†Navajo shales[1]

Upper Cretaceous: New Mexico.

Original references: C. R. Keyes, 1915, Iowa Acad. Sci. Proc., v. 22, p. 257; 1915, Conspectus of geologic formations of New Mexico. Des Moines, Robert Henderson, State Printer, p. 2, 10.

In San Juan region.

Navarro Group[1] or Formation

Upper Cretaceous (Gulf Series): Eastern Texas.

Original reference: B. F. Shumard, 1862, Boston Soc. History Proc., v. 8, p. 189.

L. W. Stephenson, 1941, Texas Univ. Bur. Econ. Geology Pub. 4101, p. 641, pls. Group comprises (ascending) Neylandville marl, Nacatoch sand, Corsicana marl, Kemp clay, and Escondido formation. Overlies Taylor marl; underlies Midway group. Discussion of larger invertebrate fossils of Navarro group.

D. L. Frizzell, 1954, Texas Univ. Bur. Econ. Geology Rept. Inv. 22, p. 49–53. Restricted to exclude Neylandville marl which is reallocated to Taylor group. As restricted group comprises (ascending) Nacatoch sand, Corsicana marl, Kemp clay, and Escondido clay. Foraminifera described.

Named for occurrence in Navarro County.

†Navasota Beds[1]

Miocene and Pliocene: Eastern Texas.

Original reference: W. Kennedy, 1893, Texas Geol. Survey 4th Ann. Rept. pt. 1, p. 9–15, 43–44.

Named for Navasota, Grimes County.

Navesink Formation (in Monmouth Group)

Navesink Marl (in Monmouth Group)[1]

Navesink Member (of Monmouth Formation)

Upper Cretaceous: New Jersey and Delaware.

Original references: W. B. Clark, 1894, New Jersey Geol. Survey Ann. Rept. 1893, p. 336–337; 1894, Jour. Geology, v. 2, p. 161–177.

W. B. Spangler and J. J. Peterson, 1950, Am. Assoc. Petroleum Geologists Bull., v. 34, no. 1, p. 8 (fig. 4), 40–49. Rank reduced to member status in Monmouth formation. In Monmouth County, N.J., attains thickness of 30 feet; in southern part of State only about 5 feet. Consists of black to green glauconite containing varying amounts of sand and clay. Base is marked by fossil zone which in places is distinctly divisible into three parts; an upper *Gryphaea*, a middle *Exogyra*, and a lower *Belemnitella;* at other places, zone is represented by a single bed. Toward the top, Navesink passes into darker layer which contains less glauconite and more sandy clay and is in some places micaceous. Transition into overlying Red Bank member gradual, though locally, top of Navesink is marked by conspicuous bed of large fossiliferous concretions. Stratigraphically above Mount Laurel member of Matawan formation. Geographically extended into Delaware where it is present in Chesapeake and Delaware Canal. It is believed that Carter (1937) identified Navesink beds as being Mount Laurel-Marshalltown in several of his sections in Canal.

S. K. Fox, Jr., and R. K. Olsson, 1955 [abs.] Jour. Paleontology, v. 29, no. 4, p. 736. Upper Cretaceous Navesink, Red Bank, and Tinton are formations with distinct microfaunas indicating time differences. Stratigraphic evidence indicates unconformity between Cretaceous and Tertiary formations. Hornerstown rests successively from northeast to southwest on Tinton, Red Bank, and Navesink.

H. W. Miller, Jr., 1956, Am. Assoc. Petroleum Geologists Bull., v. 40, no. 4, p. 722–736. Discussion of Cretaceous-Paleocene boundary in New Jersey. Presence of a "middle greensand" between Navesink (Cretaceous) and Hornerstown formation recognized; it is suggested that this is southwestward extension of Red Bank formation (Cretaceous).

R. K. Olsson, 1960, Jour. Paleontology, v. 34, no. 1, p. 2–3, 4 (fig. 2). Underlies Sandy Hook member of Redbank formation.

J. P. Minard and J. P. Owens, 1960, U.S. Geol. Survey Prof. Paper 400–B, p. B184, B185. Formation in Monmouth group. Overlies Mount Laurel sand; underlies Red Bank formation. Average dip SE 35 feet per mile. Thickness 10 to 40 feet. Thickens in outcrop to northeast.

Extensively developed throughout Navesink Highlands, Monmouth County, in vicinity of village of Navesink and along north bank of Navesink River.

Naylor Ledge Formation[1] or Limestone

Lower Ordovician: Northwestern Vermont, and southeastern Quebec, Canada.

Original reference: H. W. McGerrigle, [1931], Vermont State Geologist 17th Rept., p. 182, 184, 185.

J. A. Dresser and T. C. Denis, 1944, Quebec Dept. Mines Geol. Rept. 20, v. 2, p. 396, 399. Overlies Hastings Creek limestone; underlies Luke Hill limestone. Thickness 30 feet. Phillipsburg series. Beekmantown.

Exposed from northern part of St. Albans quadrangle, Vermont, across international border for about 20 miles into Quebec.

Nazlini shales[1]

Upper Triassic: Northeastern Arizona, Colorado, and Utah.

Original reference: C. R. Keyes, 1922, Pan-Am. Geologist, v. 38, p. 250, 337.

Charles Keyes, 1936, Pan-Am. Geologist, v. 65, no. 1, p. 63 (table). Underlies Leroux limestones; overlies Lukachukai sandstone.

Typically exposed on Nazlini Creek, south of Chinle and northwest of Fort Defiance, Ariz.

Neabsco Run Diorite[1]

Precambrian(?): Northeastern Virginia.

Original reference: J. T. Lonsdale, 1927, Virginia Geol. Survey Bull. 30.

Crops out 1 mile northeast of Minnieville post office and 5 miles northwest of Dumfries, along Neapsco [Neabsco] Run, Prince William County.

Neahga Shale[1] (in Clinton Group)

Middle Silurian: Western New York, and Ontario, Canada.

Original reference: J. T. Sanford, 1933, Geol. Soc. America Bull., v. 44, no. 1, p. 194.

Tracy Gillette, 1947, New York State Mus. Bull. 341, p. 34–36. Discussion of Clinton group of western and central New York. Neahga shale, in lower part of group, is about 6 feet thick at type locality. Upper 5½ feet consists of smooth slightly silty slightly calcareous green platy shale. Typical Neahga grades downward into silty sandy calcareous green shale. Overlies Thorold sandstone; underlies Reynales limestone. Was termed Furnaceville shale by Williams (1919).

D. W. Fisher, 1959, New York State Mus. Sci. Service Geol. Survey Map and Chart Ser. 1. Ontarian stage, Niagaran series, Middle Silurian.

Exposed in Niagara Gorge. Term Neahga means Niagara River.

Nealmont Limestone or Formation

Middle Ordovician (Trentonian): Central and south-central Pennsylvania, western Virginia, and eastern West Virginia.

G. M. Kay, 1941, (abs.) Geol. Soc. America Bull., v. 52, no. 12, pt. 2, p. 1969. Name applied to a limestone in Trenton group. Includes type Rodman, Lemont, and Center Hall. Thickness 65 to 135 feet; maximum in type section.

G. M. Kay, 1943, Econ. Geology, v. 38, no. 3, p. 191, 192, 195. Uppermost unit is Rodman member. Much of unit was previously termed Lowville.

Part was included in Lemont member of Carlim limestone in Tyrone district.

G. M. Kay, 1944, Jour. Geology, v. 52, no. 1, fig. 2; 1944, Jour. Geology, v. 52, no. 2, p. 97–109. Includes Oak Hall member (new) at base and redefined Center Hall member in middle. Two thick metabentonitic clays defining upper 20 feet of Oak Hall in western Penns Valley are only ones definitely placed in Nealmont of Pennsylvania. In type section, base is 3-foot ledge of dark coarse-textured impure limestone disconformably overlying Stover member of Benner limestone; top is thick ledge of dark-brown-weathering fossiliferous limestone underlying cobbly basal beds of Salona limestone. Upper contact is essentially conformable. Regional unconformity at base; unit overlies successively older units southeastward. In Bellefonte district, Oak Hall is absent and Center Hall fills channels in underlying Valentine member of Curtin limestone. Derivation of name.

Marshall Kay, 1956, Geol. Soc. America Bull., v. 67, no. 1, p. 78, 87–89, 95, 97, 103. Geographically extended to West Virginia and Virginia. Grades directly into Moccasin formation southeastward. Changes from dominantly argillaceous Moccasin facies in southeast to typical Nealmont limestone facies in northeast. Formation underlies Onego member (new) of Salona formation in West Virginia.

Type section: At Union Furnace, Huntingdon County, Pa. Named for village of Nealmont in Blair County, Pa., 2 miles east of Tyrone.

Nealmontian Stage

Middle Ordovician (Trentonian): Eastern North America.

Marshall Kay, 1948, Am. Assoc. Petroleum Geologists Bull., v. 32, no. 8, p. 1412. Stage in lower Trentonian. Extends from base of Trentonian. Equivalent to Rocklandian and Kirkfieldian stages.

Marshall Kay, 1960, Internat. Geol. Cong., 21st Copenhagen, pt. 7, p. 30. Suggested that term Nealmontian stage be applied to Rocklandian and Kirkfieldian substages and that succeeding stage be called Shermanian to include Shorehamian and Denmarkian substages.

Name derived from Nealmont, Blair County, Pa., for which Nealmont limestone is named.

Nealranch Formation

Permian (Wolfcamp Series): Southwestern Texas.

C. A. Ross, 1959, Washington Acad. Sci. Jour., v. 49, no. 9, p. 299, 300, 301; 1960, Cushman Foundation for Foraminiferal Research Contr., v. 11, no. 4, p. 120. Embraces upper part of beds originally called Wolfcamp by Udden (1917). Unconformably underlies Lenoxhills formation (new). In Wolf Camp Hills the Nealranch, 300 to 470 feet thick, unconformably overlies gray limestone and contains oldest *Schwagerina* and *Pseudoschwagerina* faunas thus far discovered in Glass Mountains. Boundary between Permian and Pennsylvanian systems is taken at this unconformity. [Name also spelled Neal Ranch.]

Type locality: In Wolf Camp Hills one-fourth mile west of Hill 5060, northeast of Marathon, Brewster County.

†Nebo[1] (Formation)

Lower Ordovician: Southern Oklahoma.

Original reference: C. E. Decker, 1930, Am. Assoc. Petroleum Geologists Bull., v. 14, no. 12, p. 1495.

C. C. Branson, 1957, Oklahoma Geology Notes, v. 17, no. 11, p. 108. Abandoned by Oklahoma Geological Survey. Name preoccupied. Unit now termed Oil Creek formation.

Named for village in Murray County.

Nebo Quartzite or **Sandstone** (in Chilhowee Group)[1]

Nebo Quartzite Member (of Erwin Formation)

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

Original reference: A. Keith, 1895, U.S. Geol. Survey Geol. Atlas, Folio 16, p. 3.

G. W. Stose and A. J. Stose, 1949, Geol. Soc. America Bull., v. 60, no. 2, p. 272–273. Precambrian Big Butt quartzite (new) is named from the Big Butt, northeast culmination of Bald Mountains, where massive white quartzite and interbedded green argillite and fine-grained arkosic quartzite are enclosed in syncline; Keith (1905, U.S. Geol. Survey Geol. Atlas, Folio 118) named the quartzite Nebo and the softer beds Murray shale, which are names that properly should be applied only to lower Cambrian formations.

S. S. Oriel, 1950, North Carolina Div. Mineral Resources Bull. 60, p. 12 (table 3). Two sets of formation names for Lower Cambrian clastic rocks are in use in eastern Tennessee and western North Carolina (table 3). Northeast Tennessee names, Unicoi, Hampton, and Erwin, are used in this report for same rocks which Keith (1904, U.S. Geol. Survey Geol. Atlas, Folio 90) and Stose and Stose (1947, Am. Jour. Sci., v. 245) named Cochran, Nichols, Nebo, Murray, and Hesse, all defined by Keith (1895) in Chilhowee Mountain area, Blount and Sevier Counties, Tenn. Hot Springs area lies midway between type localities for each group of names. Unicoi formation as used here includes Nebo quartzite.

John Rodgers, 1953, Tennessee Div. Geology Bull. 58, pt. 1, pls. 8, 13; pt. 2, p. 29. Because of poor base map on which he had to work Hayes (1895, U.S. Geol. Survey Geol. Atlas, Folio 20) made error in tracing units from Hiwassee River to Ocoee River; what he mapped as Nebo sandstone near Hiwassee River, he mapped as Cochran conglomerate near Ocoee River. The small area that Hayes mapped as Starr conglomerate on Little Mountain and Sugar Loaf near Parksville is white *Soclithus*-bearing quartzitic sandstone and belongs to either Nebo or Hesse sandstone. Nebo sandstone (Cambrian) is mapped in present report.

P. B. King and others, 1958, Geol. Soc. America Bull., v. 69, no. 8, p. 964. U.S. Geological Survey restricts beds classed as Cambrian to those for which paleontological data are available. Chilhowee group as a whole is classed as Cambrian and Precambrian(?). Helenmode formation at top of group is Cambrian and remaining unfossiliferous formations [including Nebo quartzite] are termed Precambrian(?).

R. B. Neuman and R. L. Wilson, 1960, U.S. Geol. Survey Geol. Quad. Map GQ–131. Nebo quartzite described in Blockhouse quadrangle, Tennessee, where it is 300 feet thick. Overlies Nichols shale; underlies Murray shale. Lower Cambrian(?).

P. B. King and H. W. Ferguson, 1960, US. Geol. Survey Prof. Paper 311, p. 28 (table), 33, 43. In northeasternmost Tennessee, considered basal member of Erwin formation. Consists of several beds of white or gray vitreous quartzite that, in most places, contain abundant *Scolithus*. Individual beds, 10 to 100 feet thick, are separated by shale similar to those in overlying Murray member. Lower Cambrian.

Named for Mount Nebo Springs on Chilhowee Mountain, Blount County, Tenn.

†Nebraska Beds[1]

Miocene: Nebraska.

Original reference: W. B. Scott, 1894, Geol. Soc. America Bull., v. 5, p. 594–595.

Named for State of Nebraska.

†Nebraska Conglomerate[1]

Precambrian (Keweenawan): Northern Michigan.

Original reference: A. C. Lane, 1911, Michigan Geol. and Biol. Survey Pub. 6, geol. ser. 4, p. 588, fig. 52.

Probably named for occurrence in old Nebraska mine (which later became the Caledonia mine), Ontonagon County.

Nebraska Till

Pleistocene (Nebraskan): Kansas.

J. C. Frye and A. B. Leonard, 1952, Kansas Geol. Survey Bull. 99, p. 52 (fig. 2), 53, 55, 56–58. In Kansas, deposits of Nebraskan stage are classed in three formations: David City, Nebraska till, and Blanco (which includes Holdrege and Fullerton members). At Iowa Point section, Doniphan County, Nebraska till is 7 feet thick; overlies David City formation and underlies Kansas till. Nebraska till is earliest recognized glacial deposit in Kansas. Nebraska uses Nebraskan till for till of same age in Nebraska.

Nebraskan Glaciation

Nebraska(n) Drift,[1] Till

Nebraskan Stage, Age

Nebraskan stage of glaciation[1]

Pleistocene: Mississippi Valley.

Original references: B. Shimek, 1909, Geol. Soc. America Bull., v. 20, p. 408; 1910 Science, new ser., v. 31, p. 75–76.

J. C. Frye and A. B. Leonard, 1952, Kansas Geol. Survey Bull. 99, p. 24 (fig. 1), 34, 38, 52 (fig. 2), 53, 55. Nebraskan is earliest age (stage). Followed by Aftonian age (stage). In Kansas, deposits of Nebraskan stage are classed in three formations: David City, Nebraska till, and Blanco (which includes Holdrege and Fullerton members). Term Grandian as used in Iowa and Illinois includes the Nebraskan and Aftonian.

H. R. Wanless, 1957, Illinois Geol. Survey Bull. 82, p. 128. Nebraskan stage poorly represented in area, Beardstown, Glasford, Havana, and Vermont quadrangles.

Name amended to Nebraskan Glaciation to comply with Stratigraphic Code adopted 1961.

Named for occurrence in Nebraska.

Nebraska City Limestone Member (of Wood Siding Formation)

Nebraska City Limestone[1]

Nebraska City Limestone Member (of Caneyville Limestone)

Pennsylvanian (Virgil Series): Southeastern Nebraska, northeastern Kansas, and northwestern Missouri.

Original reference: G. L. Smith, 1919, Iowa Acad. Sci. Proc. 1918, v. 25, p. 526.

G. E. Condra and E. C. Reed, 1943, Nebraska Geol. Survey Bull. 14, p. 43. Reallocated to member status in Wood Siding formation (new); basal unit of formation. Kansas Geological Survey classifies the Nebraska City as basal member of Caneyville limestone.

R. C. Moore and M. R. Mudge, 1956, Am. Assoc. Petroleum Geologists Bull., v. 40, no. 9, p. 2274 (fig. 1), 2275. Basal unit of Wood Siding formation. Underlies Plumb shale member (new); overlies French Creek shale member of Root shale (new).

Type section: Upper strata in brickyard shale pit, one-fourth mile south of Missouri River bridge at Nebraska City, Otoe County, Nebr.

Necedah Quartzite[1]

Precambrian (Huronian?): Central southern Wisconsin.

Original reference: R. D. Irving, 1877, Geology Wisconsin, v. 2, p. 523–524.

Occurs at foot of hill on which village of Necedah, Juneau County, is located.

Necessity Shale Member (of Graham Formation)[1]

Pennsylvanian: Central northern Texas.

Original reference: E. H. Sellards, 1933, Texas Univ. Bull. 3232, p. 104, 113, 114.

Derivation of name not stated.

Neda Formation[1]

Neda Member (of Maquoketa Shale)

Upper Ordovician: Southeastern Wisconsin and northeastern Iowa.

Original reference: T. E. Savage and C. W. Ross, 1916, Am. Jour. Sci., 4th, v. 41, p. 187–193.

W. H. Twenhofel and others, 1954, Geol. Soc. America Bull., v. 65, no. 3, chart 2 (column 50). Shown on correlation chart as shale member of Maquoketa formation; overlies Brainard member.

C. E. Brown and J. W. Whitlow, 1960, U.S. Geol. Survey Bull. 1123–A, p. 28–31, pl. 3. Described in Dubuque South quadrangle, Illinois-Iowa, where it is rank reduced to member status in Maquoketa shale. Comprises interlayered grayish-red soft shale, dolomitic dark-reddish-brown limonitic oolite, and grayish-green shale. Thickness 3 to 5 feet. Overlies Brainard member; underlies Mosalem member (new) of Edgewood dolomite.

Named from exposures in ore pit near Neda, Dodge County, Wis.

Nedrow Member (of Onondaga Limestone)

Middle Devonian: New York.

W. A. Oliver, Jr., 1954, Geol. Soc. America Bull., v. 65, no. 7, p. 627–628, 636, pl. 1. Consists of thin-bedded and shaly limestones marked in lower part by abundant platyceratid gastropods; upper part is more massive limestone with sparse fauna; beds are medium gray, very fine grained, and argillaceous. Thickness 10 to 14 feet. Westward from type locality passes into cherty limestone; and eastward into coarse limestone. Overlies Edgecliff member (new) with contact sharp; underlies Moorehouse member (new) with contact transitional. Onondaga in New York is generally considered lower Middle Devonian (Onesquethaw stage).

Type locality: One mile south of Nedrow, at Indian Reservation quarry, and U.S. Highway 11, just south of their intersection, South Onondaga, Tully quadrangle, Onondaga County.

Needle Mountains Group[1]

Precambrian: Southwestern Colorado.

Original reference: W. Cross and E. Howe, 1905, U.S. Geol. Survey Geol. Atlas, Folio. 131.

N. E. A. Hinds 1939, 6th Pacific Sci. Cong. Proc., v. 1, p. 290. Mentioned in discussion of Precambrian formations of western North America. Includes Vallecito conglomerate, 2,000 feet, overlain by Uncompahgran quartzite, 8,000 feet.

Named for occurrence in Needle Mountains, San Juan and La Plata Counties.

Needles Complex

Precambrian: Southern California.

W. J. Miller, 1944, California Jour. Mines and Geology, v. 40, p. 116–119, pl. 7. Chief constituents are diorite varying to metadiorite and more or less crudely foliated granite varying to granodiortie.

Outcrops occur in northwestern Mojave Mountains, and along and west of highway between 10 and 17 miles south of Needles, Riverside County.

Needles Range Formation

Eocene or Oligocene: Southwestern Utah and eastern Nevada.

J. H. Mackin, 1960, Am. Jour. Sci., v. 258, no. 2, p. 90 (table 1), 92 (fig. 2), 99–105. Consists primarily of crystal-rich ignimbrites. Commonly pink to dark red brown, but range widely from black in solidly welded vitrophyre phases that occur near base of some units to light gray in their almost incoherent uppermost parts. In many sections, formation includes two, and in some sections, three separate ignimbrites. At type locality, includes two members (ascending): Wah Wah Springs tuff and Minersville tuff (both new). Overlies Claron formation; underlies Isom formation (new). Thickness commonly less than 100 feet where formation overlies the Claron in Iron Springs district; in Wah Wah Range 1,000 to 1,500 feet where it lies on mature erosion surface cut in older rocks. Eocene or Oligocene, but cannot be dated closely in this span on basis of evidence available at present time. Discussion of ignimbrites of area.

E. F. Cook, 1960, Intermountain Assoc. Petroleum Geologists Guidebook 11th Ann. Field Conf., p. 140 (fig. 4). In Grant Range, Nev., overlies Windous Butte tuff (new) and underlies Shingle Pass tuff (new). Thickness 100 to 125 feet. Consists of two thin lightly to highly welded biotite crystal ignimbrites.

Type locality: East side of Needles Range at and south of Garrison-Milford Highway, Iron Springs district, Utah.

Needmore Shale

Needmore Shale (in Onondaga Group)

Needmore Shale Member (of Romney Shale or Onondaga Formation)

Middle Devonian: Central and south-central Pennsylvania, Maryland, northern and western Virginia, and eastern West Virginia.

Bradford Willard, 1939, Pennsylvania Geol. Survey, 4th ser., Bull. G–19, p. 141, 144, 148–150. Name proposed for dark- to medium-gray limy shale. Weathers greenish, olive, or olive drab. Limestone present as thin beds, lenses, and nodules; more plentiful in upper part. Contains Beaver Dam black shale member (new) near middle in western Mifflin County, Pa. Thickness generally 100 to 150 feet west of Susquehanna River. Disconformably overlies Oriskany group. Underlies Selinsgrove limestone with gradational contact and supplants it southward; distinguished from Selinsgrove by greater portion of argillaceous material. Assigned to Onondaga group. It is the Selinsgrove shale of White (1883).

H. P. Woodward, 1943, West Virginia Geol. Survey, v. 15, p. 278–306. Geographically extended to Maryland, Virginia, and West Virginia. In West Virginia, replaces "Selinsgrove (lower) shale" of previous reports. Thickness 83 to 207 feet. Overlies Ridgeley sandstone and underlies Marcellus shale.

F. G. Lesure, 1957, Virginia Polytech. Inst. Bull., Engineering Expt. Sta. Ser. 118, p. 53, 54–55, pl. 1. Rank reduced to lower member of Romney shale in western Virginia. Conformably underlies Millboro shale member; overlies Ridgeley sandstone.

Carlyle Gray and others, 1960, Geologic map of Pennsylvania (1:250,000): Pennsylvania Geol. Survey, 4th ser. Onondaga formation as mapped includes Needmore shale member in central Pennsylvania.

Named for exposures in southern Fulton County, Pa., between Needmore and Warfordsburg.

Neeley Formation

Neeley Lake Beds[1]

Pliocene, middle: Southern Idaho.

Original references: H. T. Stearns, 1932, Correlation chart of Idaho compiled by M. G. Wilmarth, dated Sept. 1, 1932; 1936, Jour. Geology, v. 44, no. 4, p. 434–439.

H. T. Stearns, Lynn Crandall, and W. G. Steward, 1938, U.S. Geol. Survey Water-Supply Paper 774, p. 32, 43, pls. 4, 6. Thickness about 100 feet with base concealed. Younger than Pillar Falls mud flow. Older than Eagle Rock tuff. Lower Pliocene(?).

U.S. Geological Survey currently classifies the Neeley as a formation and designates age as middle Pliocene on the basis of a study now in progress.

Exposed in bluffs of Snake River in vicinity of village of Neeley, Power County, 5 miles southwest of American Falls.

Neelytown Limestone[1]

Upper Cambrian: Eastern New York.

Original reference: W. Horton, 1839, New York Geol. Survey 3d Rept., p. 148.

D. W. Fisher, 1956, Internat. Geol. Cong., 20th, Mexico, Cambrian Symposium, pt. 2, p. 338. Early workers did not agree on age. Type locality has not been restudied; hence, age is in doubt.

Crops out in the crossroad a few hundred feet east of Neelytown Station, Orange County.

†Nefsy Shale Member (of Graneros Formation)[1]

Upper Cretaceous: Northeastern Wyoming.

Original reference: A. J. Collier, 1922, U.S. Geol. Survey Bull. 736, p. 82, table.

B. C. Petsch, 1949, South Dakota Geol. Survey Rept. Inv. 65, p. 8. In Black Hills region, Graneros formation is divided into five members (ascending): Skull Creek shale, Newcastle sandstone, Nefsy shale, Mowry shale, and Belle Fourche shale. In area of this report [north part of Whitewood anticline], the Nefsy cannot be distinguished from the Mowry.

Named for fact that large part of Nefsy townsite at Osage is underlain by this shale.

Negaunee Iron-Formation[1]

Precambrian: Northern Michigan.

Original reference: M. E. Wadsworth, 1893, Michigan Geol. Survey Rept. 1891 and 1892, p. 65–66.

A. K. Snelgrove, W. A. Seaman, and V. L. Ayres, 1944, Michigan Dept. Conserv. Geol. Survey Div. Prog. Rept. 10, p. 31, 32, 34. In Republic area, overlies Ajibik quartzite and conglomerate and unconformably underlies Goodrich quartzite. Middle Huronian.

S. A. Tyler and W. H. Twenhofel, 1952, Am. Jour. Sci., v. 250, no. 2, p. 128–138. In Marquette district overlies Siamo slate and underlies Goodrich formation. Thickness 0 to 1,000 feet.

Named for exposures at and south of Negaunee, Marquette County.

Negli Creek Limestone (in Chester Group)[1]

Mississippian: Southern Indiana and central western Kentucky.

Original reference: W. N. Logan, 1924, Indiana Dept. Conserv. Pub. 42, p. 11, 125.

C. A. Malott, 1952, Stratigraphy of the Ste. Genevieve and Chester formations of southern Indiana: Ann Arbor, Mich., The Edwards Letter Shop, p. 6. Replaced by Kinkaid limestone. Local Indiana names of upper Chester are dropped and formations given names of standard Chester column.

Named for exposures along Negli Creek a tributary of Little Deer Creek, 4 or 5 miles east of Tell City, Perry County, Ind.

Negra clay[1]

Miocene(?): California.

Original reference: C. R. Keyes, 1923, Pan-Am. Geologist, v. 40, p. 52, 61, 80.

Exposed in east wall of Furnace Canyon, beneath Mesa Negra, east of Death Valley, Inyo County.

Nehalem Formation

Eocene, upper, to Oligocene, lower: Northwestern Oregon.

M. L. Steere, 1955, Geol. Soc. Oregon Country News Letter, v. 21, no .10, p. 85. Variable sequence of sandstones, tuffaceous siltstone, mudstones, and one local basalt flow. Total thickness 500 to 600 feet. Beds were formerly considered to be in lower part of Keasey formation. Overlies Cowlitz formation. Name credited to R. J. Deacon (unpub. thesis).

Type locality: On Rock Creek about one-half mile downstream from Keasey Station, Columbia County.

Nehawka Limestone[1]

Pennsylvanian: Southeastern Nebraska.

Original reference: G. E. Condra and N. A. Bengston, 1915, Nebraska Acad. Sci. Pub., v. 9, no. 2, p. 6, 33.

G. E. Condra and O. J. Scherer, 1939, Nebraska Geol. Survey Paper 16, p. 5–6. Unconformity at base of what is supposed to be Stranger formation is marked by erosion extending locally through Weston shale and probably into upper part of Stanton formation. Iatan limestone, if it was deposited here, apparently was eroded. Nehawka limestone, a conglomeratic facies, which is thought to be correlative with Tonganoxie sandstone of Kansas Survey classification, lies on lowest eroded surface of this unconformity.

Exposed in bed of North Branch of the Weeping Water, 2 miles north of Nehawka, Cass County.

Neihart Porphyry[1]

Cretaceous(?): Central Montana.

Original reference: W. H. Weed, 1899, U.S. Geol. Survey Geol. Atlas, Folio 56.

Occurs on divide above Neihart, Cascade County, and on slopes drained by Snow and Mackey Creeks, Little Belt Mountains.

Neihart Quartzite[1]

Precambrian (Belt Series): Central western Montana.

Original reference: C. D. Walcott, 1899, Geol. Soc. America Bull., v. 10, p. 199–215.

C. P. Ross, 1949, (abs.) Washington Acad. Sci. Jour., v. 39, no. 3, p. 111, 112. Positively known only in its type locality (herein given), although name has also been applied to strata that underlie Prichard formation in Anaconda Range. Underlies Chamberlain shale and overlies gneiss at type locality.

Type locality: Near village of Neihart [Cascade County].

Nelagoney Formation[1]

Pennsylvanian (Virgil Series): Central northern and northeastern Oklahoma.

Original reference: C. N. Gould, 1925, Oklahoma Geol. Survey Bull. 35, p. 75.

U.S. Geological Survey has abandoned term Nelagoney. Members have been reassigned to other formations.

Type locality: Nelagoney, Osage County.

†Nelagoney Sandstone[1]

Pennsylvanian: Central northern Oklahoma.

Original reference: L. C. Snider, 1911, Oklahoma Geol. Survey Bull. 7, p. 221.

Named for Nelagoney, Osage County.

Nelchina Limestone[1]

Lower Cretaceous: Central southern Alaska.

Original reference: G. C. Martin, 1926, U.S. Geol. Survey Bull. 776, p. 313–315, table opp. p. 474.

J. T. Dutro, Jr., and T. G. Payne, 1957, Geologic map of Alaska (1:2,500,000): U.S. Geol. Survey. Appears on map legend.

Occurs in several isolated areas, mostly small, on hilltops at headwaters of Nelchina River and of Billy Creek, Matanuska district, Cook Inlet region.

Nellie Bly Formation[1] (in Skiatook Group)

Pennsylvanian (Missouri Series) : Northeastern and central Oklahoma.

Original reference: C. N. Gould, 1925, Oklahoma Geol. Survey Bull. 35, p. 74.

M. C. Oakes, 1940, Oklahoma Geol. Survey Bull. 62. Included in Skiatook group. Name is applied to shales and sandstones above Hogshooter formation and below Dewey limestone, or below unconformity at base of Chanute formation where Dewey is absent. Maximum thickness 180 feet. Type locality stated.

E. R. Ries, 1954, Oklahoma Geol. Survey Bull. 71, p. 64–68. In Okfuskee County, consists of 6 mappable sandstones and 7 mappable shales. Thickness 440 to 460 feet. Conformably overlies Hogshooter; conformably underlies Dewey formation.

W. F. Turner, 1956, Oklahoma Geol. Survey Bull. 74, p. 70–78, pls. 1, 2. In Seminole County, consists of shale, sandstone, siltstone, chert conglomerate, limestone and limestone conglomerate; only a single ledge, the basal (No. 1) sandstone, is continuous across county. Thickness 300 to 400 feet. Conformable above Coffeyville formation and below the Belle City; in northern part of county, apparently conformable below Hilltop formation; in Pontotoc County, truncated by Ada formation.

Type locality: On Nellie Bly Creek, in secs. 31, 32, 29, 28, T. 24 N., R. 13 E., Washington County.

Nellie Juan Granite[1]

Mesozoic(?) : Southeastern Alaska.

Original reference: U. S. Grant and D. F. Higgins, 1910, U.S. Geol. Survey Bull. 443, p. 37, 46.

Occurs in western part of Prince William Sound, on south shore of Port Nellie Juan.

Nelson Amphibolite

Carboniferous: Northeastern Nevada.

A. E. Granger, 1957, Nevada Bur. Mines Bull. 54, p. 116, pl. 14. Forms narrow band between Banner limestone and Mountain City formation (both new).

Type locality not stated. Text refers to Nelson mine near Mountain City. Geologic map shows Nelson Ranch also in Elko County.

Nelson Beds

Triassic: North-central North Carolina.

Grover Murray, Jr., 1938, Science, v. 87, no. 2261, p. 390. Incidental mention as equivalent to Lowes Grove beds (new).

Occurs in Durham Triassic basin, approximately three-fourths mile west of Nelson, Durham County.

Nelson Hill facies[1] (of Locust Point Formation)

Lower Mississippian: Southern Indiana.

Original reference: P. B. Stockdale, 1931, Indiana Dept. Conserv., Div. Geology Pub. 98, p. 77, 145–146.

J. M. Weller and others, 1948, Geol. Soc. America Bull., v. 59, no. 2, p. 127–128, pl. 1. Facies nomenclature discussed. In north to south direction, Locust Point formation comprises Belmont, Nelson Hill, Schooner Hill, and Spickert Knob facies.

Name derived from Nelson Hill which is crossed by State Highway 46 at boundary between Bartholomew and Brown Counties.

Nelson Mountain Quartz Latite (in Potosi Volcanic Group)

Nelson Mountain Quartz Latite (in Potosi Volcanic Series)[1]

Middle or late Tertiary: Southwestern Colorado.

Original reference: W. H. Emmons and E. S. Larsen, 1923, U.S. Geol. Survey Bull. 718.

Named for fact it is cap rock on Nelson Mountain, Creede district.

Nemaha Formation, Member, or Subgroup (in Wabaunsee Group)[1]

Pennsylvanian (Virgil Series) : Southeastern Nebraska, southwestern Iowa, eastern Kansas, northwestern Missouri, and northern Oklahoma.

Original reference: G. E. Condra and N. A. Bengston, 1915, Nebraska Acad. Sci. Pub., v. 9, no. 2, p. 8, 14, 26.

R. C. Moore, 1948, Am. Assoc. Petroleum Geologists Bull., v. 32, no. 11, p. 2036, 2037, (fig. 6) ; 1949, Kansas Geol. Survey Bull. 83, p. 177–179; G. E. Condra, 1949, Nebraska Geol. Survey Bull. 16, p. 15–16; F. C. Greene, and W. V. Searight, 1949, Missouri Geol. Survey and Water Resources Rept. Inv. 11, p. 20. Subgroups named (ascending) Sacfox, Nemaha, and Richardson by Condra (1935) have been included in interstate classification agreed upon by the State Geological Surveys of Iowa, Kansas, Missouri, Nebraska, and Oklahoma. As thus defined, Nemaha subgroup in standard section includes (ascending) Burlingame limestone, Soldier Creek shale, Wakarusa limestone, Auburn shale, Reading limestone, Harveyville shale, Elmont limestone, Willard shale, and Tarkio limestone. Nomenclature in the several States may deviate from this by combination or omission of terms where certain named rock units are not recognizable.

R. C. Moore and M. R. Mudge, 1956, Am. Assoc. Petroleum Geologists Bull., v. 40, no. 9, p. 2274 (fig. 1), 2277. Nemaha-Richardson boundary lowered to base of Tarkio limestone herein reduced to member status in Zeandale formation (new). This change has been agreed to by the Nebraska and Kansas Geological Surveys which are chiefly concerned. As herein redefined, Nemaha subgroup comprises four formations (ascending) : Bern limestone (with Burlingame limestone member at base), Auburn shale, Emporia limestone, and Willard shale.

Type locality: Big Nemaha Valley between south of Falls City and southeast of Rulo, Richardson County, Nebr.

Nemo Series[1] or System

Precambrian: Southwestern South Dakota.

Original reference: J. J. Runner, 1926, Chicago Univ. Abstracts of Theses, Sci. ser., v. 2, p. 229–234.

J. R. Berg, 1946, South Dakota Geol. Survey Rept. Inv. 52, p. 3, 4. Oldest system of Precambrian sedimentary rocks described in Black Hills.

Occupies oval-shaped area of about 5 square miles extent to west of village of Nemo, Lawrence County. In Black Hills.

Nenana Gravel[1]

Tertiary: Central Alaska.

Original reference: S. R. Capps, 1912, U.S. Geol. Survey Bull. 501, p. 30–34.

F. F. Barnes and others, 1951, U.S. Geol. Survey Bull. 963–E, p. 146 (table), 152, pl. 18. In Healy-Lignite area, overlies unnamed coal-bearing formation. Thickness about 4,200 feet.

Clyde Wahrhaftig, 1958, U.S. Geol. Survey Prof. Paper 293–A, p. 11–12, pls. 1, 2, 5. Consists largely or poorly consolidated moderately well-sorted conglomerate and sandstone. Thickness 4,000 feet east of Healy. Fossils collected from gravel exposed along Alaska Railroad about 3½ miles north of Browne Station indicate Oligocene or Miocene age, more likely Miocene than Oligocene. Mapped as Tertiary. Geographic distribution given.

Named for exposures on east bank of Nenana River between mouths of Healy and Lignite Creeks.

Nenzel Rhyolite Breccia[1]

Middle(?) Triassic: Northwestern Nevada.

Original reference: A. Knopf, 1924, U.S. Geol. Survey Bull. 762.

H. E. Wheeler, 1939, Jour. Paleontology, v. 13, no. 1, p. 106 (table 1). Nenzel rhyolite breccia overlies Rochester trachyte in which species of *Helicoprion* has been found. Units are referred to Anthracolithic time, which includes all late Paleozoic from base of Diantian stage (Mississippian) upward.

Forms summit of Nenzel Hill, Rochester district, Pershing County.

Neodesha Sandstone[1]

Pennsylvanian: Southeastern Kansas.

Original reference: Robert Hay, 1887, Kansas Acad. Sci. Trans., v. 10, p. 7, cross section.

Named for Neodesha, Wilson County.

Neosho Limestone[1]

Pennsylvanian: Central eastern Kansas.

Original reference: A. J. Smith, 1903 Kansas Acad. Sci. Trans., v. 18, p. 99.

Named for Neosho Rapids, Lyon County.

†Neosho Shale Member (of Garrison Shale)[1]

Permian: Eastern Kansas, southeastern Nebraska, and northern Oklahoma.

Original reference: C. S. Prosser, 1895, Jour. Geology, v. 3, p. 764–771, 799–800.

J. M. Jewett, 1941, Kansas Geol. Survey Bull. 39, p. 59. Terms Neosho and Garrison no longer used in Kansas stratigraphic nomenclature.

Named for outcrops in Neosho Valley, near Council Grove, Morris County, Kans.

†Neponset Conglomerate[1]

Devonian or Carboniferous: Eastern Massachusetts.

Original reference: W. W. Dodge, 1882 Boston Soc. Nat. History Proc., v. 21, p. 210–213.

Neroly Formation[1] or **Sandstone** (in San Pablo Group)

Neroly Stage or Substage

Miocene, upper: Central western California.

Original reference: B. L. Clark and A. O. Woodford, 1927, California Univ. Pubs. Geol. Sci. Bull., v. 17, p. 69.

K. A. Richey, 1940, (abs.) Geol. Soc. America Bull., v. 51, no. 12, pt. 2, p. 1885. Term Neroly has greater validity as faunal zone than as lithologic unit.

J. E. Eaton, U. S. Grant, and H. B. Allen, 1941, Am. Assoc. Petroleum Geologists Bull., v. 25, no. 2, p. 199–200. The Monterey comprises three substages (ascending): Briones, Cierbo, and Neroly. Substages can be recognized strandward by distinctive echinoderm faunas and by a number of more or less distinctive mollusks.

A. S. Huey, 1948, California Div. Mines Bull. 140, p. 16 (fig. 2), 42–47. Neroly formation of this report [Tesla quadrangle] was described as San Pablo formation by Anderson and Pack (1915, U.S. Geol. Survey Bull. 603). Consists of lower part, 50 to 700 feet thick, of blue sandstone, andesitic conglomerates and tuff; upper part, about 2,000 feet thick, shales, blue sandstones, and tuffs. Overlies Cierbo formation; underlies Livermore gravels. In northeast part of quadrangle, unconformably overlies Panoche formation and unconformably underlies Tulare formation. Upper formation in San Pablo group.

C. E. Weaver, 1949, Geol. Soc. America Mem. 35, p. 18 (table 3), 80–85, pls. Neroly sandstone described in Coast Ranges immediately north of San Francisco Bay region. Uppermost formation in San Pablo group. Overlies Cierbo formation. Derivation of name stated.

J. W. Durham, 1954, California Div. Mines Bull. 170, chap. 3, p. 24 (fig. 2), 25 (fig. 3). Listed as a megafaunal "stage" between Cierbo below and Jacalitos above.

C. A. Hall, Jr., 1958, California Univ. Pubs. Geol. Sci., v. 34, no. 1, p. 27–28, fig. 2, geol. map. Thickness about 600 feet in Pleasanton area. Overlies the Cierbo with contact gradational. In some areas, underlies Livermore gravels with angular discordance. Upper Miocene. Considered advisable to revise term San Pablo formation and designate the Neroly and Cierbo as members. No type section of formation has been adequately designated or described except for mention of type area by Weaver (1949).

Name derived from Neroly Station on Southern Pacific Railway in extreme northwest corner of Byron quadrangle northeast of Mount Diablo.

Neruokpuk Formation

Neruokpuk Schist[1]

Upper Devonian(?) or older: Northern Alaska.

Original reference: E. D. Leffingwell, 1919, U.S. Geol. Survey Prof. Paper 109, p. 103–105 map.

George Gryc, W. W. Patton, Jr., and T. G. Payne, 1951, Washington Acad. Sci. Jour., v. 41, no. 5, p. 163 (fig. 2). Age of formation shown as Precambrian(?) on columnar section.

M. D. Mangus, 1954, Geologic reconnaissance of the Kongakut River area [Alaska] *in* Preliminary geographical survey of the Kongakut-Firth River area, Alaska-Canada: U.S. Natl. Park Service, p. 52–53. In Kongakut River area, formation divided into two lithologic units; lower unit, thought to be pre-Middle Silurian to Middle Devonian, and upper unit, thought to be Upper(?) Devonian.

J. T. Dutro, Jr., and T. G. Payne, 1957, Geologic map of Alaska (1:2,500,000): U.S. Geol. Survey. Name appears on map legend under Paleozoic rocks undifferentiated.

Typically developed on three sides of Lake Peters, also near forks of Canning River. Neruokpuk is Eskimo name for Lakes Peters and Schrader.

Nescatunga Gypsum Bed or Member (of Blaine Formation)

Permian (Leonard Series): Southwestern Kansas and northern Oklahoma.

G. H. Norton, 1939, Am. Assoc. Petroleum Geologists Bull., v. 23, no. 12, p. 1794–1795, 1797. Gypsum bed in the Blaine formation between the Shimer gypsum bed above and the Medicine Lodge gypsum bed below. Thickness 3 to 9 feet.

R. C. Moore, J. C. Frye, and J. M. Jewett, 1944, Kansas Geol. Survey Bull. 44, pt. 4, p. 158. Member of Blaine formation. Underlies Shimer gypsum member; overlies Medicine Lodge gypsum member. Locally as much as 8 feet of red shale separates the gypsum from the next higher and lower gypsum beds.

Well exposed along lower reaches of Nescatunga Creek, Comanche County, Kans.

Neshoba Sand Member (of Tallahatta Formation)

Neshoba Sand (in Claiborne Group)

Eocene, middle: Southeastern Mississippi.

E. P. Thomas, 1942, Mississippi Geol. Survey Bull. 48, p. 24–28, fig. 1, pl. 2, profile C. Name applied to section of non-glauconitic to sparingly glauconitic sand heretofore considered to be lower Winona. Sands are typically well sorted, fine grained, and micaceous; massive to irregularly bedded and to crossbedded. When fresh, sands are white, but on outcrop they are commonly stained red, brown, yellow, purple, and mottled; gray clay abundant in form of pellets, partings, stringers, and lenses. Overlies Basic claystone member and is stratigraphic equivalent of part of type Basic claystone in Mississippi and of part of type Tallahatta section of Choctaw County, Ala. Overlain and underlain by typical Basic material in Newton and Lauderdale Counties. Neshoba and Basic facies are interlensed over wide area, and thickness of Neshoba fluctuates inversely with thickness of the Basic.

W. E. Belt and others, 1945, Geologic map of Mississippi (1:500,000): Mississippi Geol. Survey. Mapped as Neshoba sand in Claiborne group. Not recognized southeast of Newton County or north of Yalobusha River.

F. S. MacNeil, 1947, U.S. Geol. Survey Oil and Gas Inv. Prelim. Chart 29. Correlation chart shows Neshoba sand member at top of Tallahatta formation; overlies Basic City shale member; underlies Winona formation.

Type section: Above Basic claystone and below Winona greensand along highway through Neshoba, Neshoba County.

Neslen Formation (in Mesaverde Group)

Neslen Coal-Bearing Member (of Price River Formation)[1]

Neslen facies (of Price River Formation)

Upper Cretaceous: Central eastern Utah and central western Colorado.

Original reference: D. J. Fisher, 1936, U.S. Geol. Survey Bull. 852.

W. A. Cobban and J. B. Reeside, Jr., 1952, Geol. Soc. America Bull., v. 63, no. 10, pl. 1 facing p. 1011. Shown on correlation chart as formation with three members (ascending): Bluecastle sandstone, Thompson Canyon sandstone and Sulphur Canyon sandstone.

Teng-Chien Yen 1954, U.S. Geol. Survey Prof. Paper 254–B, p. 59, 60, 64. Listed in fossil collection locality data both as formation and as member of Price River formation.

R. G. Young, 1955, Geol. Soc. America Bull., v. 66, no. 2, p. 187–188, figs. 2, 3. Since this is a facies development which laterally crosses time lines, the use of a formational name would be inconsistent with the delimitation of more or less contemporaneous members. Name used to identify the facies. Rocks, which are predominantly shale and sandstone, are coal bearing. Shales largely nonmarine and gray to black. Sandstones of two types: thin lenticular buff sandstones of lagoonal deposits and massive buff littoral marine sandstones which are traceable for many miles. These sandstones used to subdivide rocks of facies into five members (ascending): Castlegate, Sego, Corcoran (new), Cozzette (new), and Cameo (new). Castlegate member belongs to both Neslen and Farrer facies. Each member consists of one or more basal sandstone tongues and associated lagoonal and barrier bar deposits and can be distinguished only where littoral marine sandstones are present. Rocks of facies range in thickness from about 100 feet near Woodside to about 1,000 feet near Colorado-Utah line. Terms Mount Garfield and Hunter Canyon formations dropped. Term Neslen facies applies to all coal-bearing rocks of Price River formation, and term Farrer facies applies to the non-coal-bearing rocks above Neslen facies. Montana age.

D. J. Fisher, C. E. Erdmann, and J. B. Reeside, Jr., 1960, U.S. Geol. Survey Prof. Paper 332, p. 11 (table), 17. Formation included in Mesaverde group in central Book Cliffs (Utah east of Green River). Includes Bluecastle sandstone member in upper part. Overlies Sego sandstone. underlies Farrer formation. Average thickness 350 feet. To the east, appears to be equivalent to part of Mount Garfield formation.

Named for Neslen Canyon, in which town of Sego is located, and near Thompsons, Utah. In Book Cliffs.

Nespelem Silt[1]

Nespelem Formation

Pleistocene: Northeastern Washington.

Original reference: J. T. Pardee, 1918, U.S. Geol. Survey Bull. 677.

F. C. Walker and W. H. Irwin, 1954, Am. Soc. Civil Engineers Proc., v. 80, Separate No. 515, p. 3–5. Referred to as a formation, predominantly a glacial-lacustrine deposit of varved clay type. Thickness about 800 feet at Grand Coulee Dam.

Present along Nespelem River and near village of Nespelem, Okanogan County.

Nesson Formation

Jurassic: Subsurface in North Dakota and Montana and Manitoba, Canada.

J. W. Nordquist, 1955, Billings Geol. Soc. Guidebook 6th Ann. Field Conf., p. 104–106, fig. 2. Proposed for sequence of carbonates and evaporates which underlies Tampico shale member (new) of Piper formation in Williston basin area; over most of basin, unconformably overlies Triassic(?) Spearfish formation. Thickness 260 feet. Includes (ascending) Poe evaporite, Picard shale, and Kline members. Formation pinches out by nondeposition on west side of Bowdoin dome; wedges out northeast of Big Snowy platform and has no equivalent in Piper type section on north flank of Big Snowy Mountains.

Typical section: Between depths of 5,730 to 5,990 feet in Amerada No. 1 Clarence Iverson well, center SW SW sec. 6, T. 155 N., R 95 W., Williams County, N. Dak. Named for development in Nesson anticline.

Nestucca Formation

Eocene, upper: Northwestern Oregon.

P. D. Snavely, Jr., and H. E. Vokes, 1949, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 97. Name proposed for formation consisting of brackish water and marine tuffaceous siltstone and claystone, sandstone, and intercalated volcanic material. Estimated thickness 7,000 to 8,000 feet. Overlies Siletz River volcanics and Burpee formation with angular unconformity; unconformably underlies Yaquina formation. Lithologically and stratigraphically, the interbedded volcanics resemble the Goble volcanics; in area to the north, the Nestucca is equivalent to upper part of Tillamook volcanic series and Cowlitz formation as mapped by Warren and others (1945).

E. M. Baldwin and others, 1955, U.S. Geol. Survey Oil and Gas Inv. Map OM–155. Described in Sheridan and McMinnville quadrangles where it unconformably overlies Yamhill formation (new). Here consists of more than 2,000 feet of tuffaceous shale and siltstone and thin-bedded sandstone with intercalated pillow basalt, breccia, and tuff.

Typically exposed along north bank of Salmon River from Otis to Three Rocks and in roadcuts along north side of Nestucca Bay, Tillamook County. Beds crop out along both eastern and western flanks of main anticlinal fold in area.

Neutral Formation or cyclothem (in Cherokee Group)

Pennsylvanian (Des Moines Series): Southeastern Kansas.

G. E. Abernathy, 1937, Kansas Geol. Soc. Guidebook 11th Ann. Field Conf., p. 18, 20, 21; 1938, Kansas Acad. Sci. Trans., v. 41, p. 193, 196. Cherokee group is divided into 15 cyclic formational units. The Neutral, second in sequence (ascending), occurs above the Riverton and below the Columbus cyclothem. Average thickness 26 feet. Includes coal here named Neutral. [For complete sequence see Cherokee Group.]

Type locality and derivation of name not given. Cherokee outcrop in Kansas covers an area of about 1,000 square miles and includes parts of Labette, Bourbon, Crawford, and Cherokee Counties.

Neva Glacial Stage

Pleistocene: North-central Colorado.

R. L. Ives, 1942, Geog. Review, v. 32, no. 3, p. 450 (table 1). Name appears only on table giving late Pleistocene chronology of Monarch Valley. Younger than Monarch glacial stage. Dated as 4,000 years pre-1900.

Monarch Valley, Grand County.

Neva Limestone (in Council Grove Group)

Neva Limestone Member (of Grenola Limestone)

Neva Limestone (in Wabaunsee Group)[1]

Permian: Eastern Kansas, southeastern Nebraska, and northern Oklahoma.

Original references: J. W. Beede, 1902, Kansas Univ. Sci. Bull., v. 1, p. 180; C. S. Prosser, 1902, Jour. Geology, v. 10, p. 709.

R. C. Moore and others, 1951, Kansas Geol. Survey Bull. 89, p. 47. Neva limestone member consists of four or five limestones separated by shales. Thickness 16 to 24 feet. Overlies Salem Point shale member; underlies Eskridge shale. Wolfcamp series.

H. D. Miser and others, 1954, Geologic map of Oklahoma (1:500,000): U.S. Geol Survey. Mapped as Neva limestone in Council Grove group.

P. B. Greig, 1959, Oklahoma Geol. Survey Bull. 83, p. 94–100. In Kansas and Nebraska the Neva is defined as top member of the Grenola and is underlain in turn by Salem Point shale, Burr limestone, Legion shale, and Sallyards limstone members. Only Neva member of Grenola can be identified with assurance in Pawnee County. Consists of upper and lower limestone members separated by 13 to 22 feet of blue-gray shale. Overall thickness 17 to 40 feet. Overlies Roca shale; underlies Eskridge shale.

M. R. Mudge and R. H. Burton, 1959, U.S. Geol. Survey Bull. 1068, p. 13 (table 2), 66–69, pls. Described in Wabaunsee County, Kans., where it is classified as member of Grenola limestone. Thickness 13½ to 16½ feet. Overlies Salem Point shale member; underlies Eskridge shale. Note on type locality.

Type locality: Near Neva Station, Cottonwood River valley, Chase County, Kans. Neva Station has been moved since limestone was named. Limestone was named from exposures near junction of Diamond Creek and Cottonwood River valleys in Chase County.

Nevada Formation

Nevada Limestone[1]

Lower and Middle Devonian: Eastern Nevada.

Original references: C. King, 1876, U.S. Geol. Expl. 40th Par. Atlas, map 4; Arnold Hague, 1883, U.S. Geol. Survey 3d Ann. Rept., p. 237–272; 1892, U.S. Geol. Survey Mon. 20, p. 63–84.

C. W. Merriam, 1940, Geol. Soc. America Spec. Paper 25, p. 14–16. Restricted to lower 2,448 feet of Devonian strata above Lone Mountain formation as exposed at Lone Mountain; upper 2,065 feet of Devonian strata exposed at Devils Gate and in Modoc Ridge are named Devils Gate formation. Lower limit of formation drawn at top of barren, more or less massive dolomites of Lone Mountain formation. Upper limit arbitrarily established at top of *Stringocephalus* zone. Lower and Middle Devonian. Type section designated.

T. B. Nolan, C. W. Merriam, and J. S. Williams, 1956, U.S. Geol. Survey Prof. Paper 276, p. 40–48. In vicinity of Eureka, subdivided into (ascending) Beacon Peak dolomite, Oxyoke Canyon sandstone, Sentinel Mountain dolomite, Woodpecker limestone, and Bay State dolomite members (all new). Overlies Lone Mountain formation; underlies Devils Gate limestone. Term was first used by King (1878 [1876]), but Hague provided better definition as result of mapping in Eureka district. In 1883, he in effect selected the entire State as type locality. Later (1892) he modified this broad designation by citation of Modoc Peak, Combs Peak, Atrypa Peak, Woodpeckers Peak, and Newark Mountain, all within area of original Eureka survey, as affording "typical sections." Merriam (1940) selected Modoc Peak, first of five localities cited by Hague, as suitable type locality. Preliminary observations made in present study, indicate that there is probably complete section of the Nevada exposed there. Section is cut by several minor faults and by at least two intrusive masses. In view of apparent priority given by Hague and of Merriam's subsequent designation, it is probably best to retain Modoc Peak as type locality, but it would be well to supplement Modoc Peak section by other more representative sections in Oxyoke Canyon on east, and Lone Mountain on northwest.

Donald Carlisle and others, 1957, Am. Assoc. Petroleum Geologists Bull., v. 41, no. 10, p. 2176–2177, 2178–2179 (fig. 2), 2180–2184. In Sulphur Springs and Pinyon Ranges, subdivided into (ascending) McColley Canyon, Union Mountain, and Telegraph Canyon members. Overlies Lone Mountain dolomite; underlies Devils Gate limestone.

M. S. Johnson and D. E. Hibbard, 1957, U.S. Geol. Survey Bull. 1021–K, p. 353–355, pls. 32, 33. Described in Atomic Energy Commission proving grounds. Total thickness 1,070 feet. Comprises three units, A through C in ascending order. Unit A consists of about 460 feet of dolomite, limestone, and quartzite. Unit B consists of about 260 feet of interbedded light-gray and black dolomite. Unit C is made up of about 350 feet of interbedded limestone and dolomite. Underlies Devils Gate(?) formation; overlies about 1,565 feet of undifferentiated Paleozoic dolomite. At Mine Mountains, the Nevada and overlying rocks have been thrust over Mississippian strata.

E. L. Winterer and M. A. Murphy, 1960, Jour. Geology, v. 68, no. 2, p. 134 (fig. 6), 135. In northern Simpson Range overlies Rabbit Hill formation (new).

Type section: Sequence exposed at Modoc Peak. Named for development in State of Nevada.

†Nevadan series[1]

Middle and Upper Devonian: Nevada.

Original reference: C. R. Keyes, 1923, Pan-Am. Geologist, v. 40, p. 52, 55, 80.

Neville Formation

Pleistocene, upper: Southwestern Texas.

C. C. Albritton, Jr., and Kirk Bryan, 1938, (abs.) Geol. Soc. America Bull., v. 49, no. 12, pt. 2, p. 1863. On basis of disconformities in valley-fill complex, the Quaternary (late Pleistocene) as been divided into (ascending) Neville, Calamity, and Kokernot formations.

C. C. Albritton, Jr., and Kirk Bryan, 1939, Geol. Soc. America Bull., v. 50, no. 9, p. 1430–1434, 1443, 1449, 1452. At type locality, consists of calcareous silt and conglomerate; materials are poorly sorted; silty beds contain quantities of clay, sand, pebbles, cobbles, phenoclasts of conglomerates are set in matrix of silty sandstone; contains large amounts of secondary calcite diffused as caliche and in form of white nodules; in some areas, formation is reddish-brown ferruginous and calcareous silty clay; contains mammoth remains. Thickness at type locality 11 feet. Disconformably underlies Calamity formation; northward from type locality, abuts against Tertiary igneous rock; to the south, intersected by younger alluvium.

C. B. Hunt, 1952, U.S. Geol. Survey Bull. 996–A, p. 6. Proposed Pleistocene-Recent boundary would be at unconformity between Neville and Calamity formations.

Type locality: West bank of Calamity Creek 1 mile northwest of Neville's ranchhouse, Brewster County.

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Newala Limestone,[1] **Formation,** or **Dolomite** (in Knox Group)

Lower Ordovician: Northern Alabama, northwestern Georgia, and eastern Tennessee.

Original reference: C. Butts, 1926, Alabama Geol. Survey Spec. Rept. 14, p. 95, map.

Charles Butts and Benjamin Gildersleeve, 1948, Georgia Geol. Survey Bull. 54, p. 18, 19–22, 52, geol. map. Geographically extended into northwestern Georgia. Estimated thickness 250 to 300 feet. Overlies Longview limestone; underlies Murfreesboro limestone; locally underlies Rockmart slate. Newala of Georgia is basal member of typical Chickamauga limestone named by Hayes (1891).

John Rodgers, 1953, Tennessee Div. Geology Bull. 58, pt. 2, p. 55, 56 (table 5), pls. Geographically extended into Tennessee. Where Kingsport and Mascot formations cannot be separated they are classed together as Newala formation. Knox group.

J. M. Cattermole, 1960, U.S. Geol. Survey Geol. Quad. Map CQ–126. Newala formation as used in this report [Bearden quadrangle] includes all dolomite and limestone between Longview dolomite and unconformity at top of Knox group. In some parts of eastern Tennessee, strata included in Newala can be divided into Kingsport formation and Mascot dolomite. Subdivision into these formations depends upon recognition of chert matrix sandstone about 2 inches thick; this sandstone is difficult to locate. Approximate thickness 650 to 890 feet.

Named for Newala post office, Shelby County, Ala.

New Albany Shale[1]

Upper Devonian: Indiana and north-central Kentucky.

Original reference: W. W. Borden, 1874, Indiana Geol. Survey 5th Ann. Rept., p. 150, 152, 158, 172.

Guy Campbell, 1946, Geol. Soc. America Bull., v. 57, no. 9, p. 829–908. New Albany shale in Indiana consists of Devonian Blocher and Blackiston formations (both new), 90 feet thick, and Mississippian Sanderson, Underwood, and Henryville formations (all new), 11 feet thick. This classification is based on floral and faunal content. Underwood contains Hamburg oolite fauna. These divisions continue through Kentucky, Ohio, and Tennessee. In eastern Kentucky, the Trousdale, a correlate of the Blocher, is underlain by Tully Portwood formation (new), which contains three coeval facies; the Underwood and Henryville are replaced by the Bedford and Sunbury. In Ohio, the Blackiston was contemporaneous with the Chagrin, and the Sanderson is equivalent to the Cleveland as restricted. The Olentangy is basal Blackiston and Upper Devonian in age. The Chattanooga in central Tennessee contains equivalents of all the Indiana New Albany divisions. The Blackiston and Sanderson are represented in Alabama. In Indiana, New Albany shale rests on limestone of Hamilton age, and in Clark County, rests on different levels of the Silver Creek, Swanville, or Beechwood formation. Underlies Jacobs Chapel formation (new). Outcrops of the New Albany in southern tier of counties in central Kentucky are adjacent to outcrops of Chattanooga shale in central Tennessee and are treated as part of the Chattanooga. New names are proposed for some of the Chattanooga beds.

Named for exposures at New Albany, Floyd County, Ind.

New Arcadian Amygdaloid[1] (in Central Mine Group)

Precambrian (Keweenawan) : Northern Michigan.

Original reference: B. S. Butler and W. S. Burbank, 1929, U.S. Geol. Survey Prof. Paper 144 (chart compiled by M. G. Wilmarth).

Named for occurrence in New Arcadian mine, Houghton County.

New Arcadian Flow[1]

Precambrian (Keweenawan) : Northern Michigan

Original reference: B. S. Butler and W. S. Burbank, 1929, U.S. Geol. Survey Prof. Paper 144 (chart compiled by M. G. Wilmarth).

Probably named for occurrence in New Arcadian mine, Houghton County.

Newark Granite[1]

Devonian: Northeastern Vermont.

Original reference: E. J. Foyles and C. H. Richardson, 1929, Vermont State Geologist 16th Rept., table opposite p. 288.

Quarried in eastern part of Newark Township, Caledonia County.

Newark Group[1]

Upper Triassic: Massachusetts to North Carolina.

Original references: W. C. Redfield, 1856, Am. Jour. Sci., 2d, v. 22, p. 357; 1856, Am. Assoc. Adv. Sci. Proc., v. 10, p. 181.

G. W. Stose and A. I. Jonas, 1939, Pennsylvania Geol. Survey, 4th ser., Bull. C–67, p. 106–120. In southern Pennsylvania, the Newark is divided into New Oxford formation below and Gettysburg shale. This broad division can be recognized northeastward to eastern Pennsylvania southwestward into Maryland, but dividing line between them is more or less arbitrary and varies somewhat in stratigraphic position from one area to another.

D. B. McLaughlin and Bradford Willard, 1949, Pennsylvania Acad. Sci. Proc., v. 23, p. 34–43. Newark group in Delaware Valley has been differentiated into Stockton, Lockatong, and Brunswick formations. If these units were a series in normal superposition, maximum thickness could be 14,600, the minimum 11,800 feet. As interpreted in this report, the Newark is not a group of three distinct formations successively deposited, but rather a series of interfingering, in part contemporaneously formed continental facies.

P. D. Krynine, 1950, Connecticut Geol. Nat. History Survey Bull. 73, p. 27–69. Includes (ascending) New Haven arkose, Meriden formation, and Portland arkose.

J. L. Stuckey and S. G. Conrad, 1958, North Carolina Div. Mineral Resources Bull. 71, p. 40–42. Rocks of Newark group occupy two belts in North Carolina. One, commonly known as Deep River basin, lies along eastern edge of Piedmont Plateau and extends from Anson County on southwest to near Oxord [Oxford], Granville County, on northeast. Other belt lies in north-central part of Piedmont Plateau and consists of Davie County basin and Dan River basin. In Deep River basin, includes (ascending) Pekin, Cumnock, and Sanford formations.

E. P. Lehmann, 1959, Connecticut Geol. Nat. History Survey Quad. Rept. 8, p. 9–25. In Middletown quadrangle, Newark group comprises (ascending) New Haven arkose, Talcott basalt, Shuttle Meadow formation (new), Holyoke basalt, East Berlin formation (new), Hampden basalt, and Portland arkose.

R. W. Schnabel, 1960, U.S. Geol. Survey Geol. Quad. Map GQ–134. In Avon quadrangle, Connecticut, the group includes (ascending) New Haven arkose, Talcott basalt, Shuttle Meadow formation, Holyoke basalt, East Berlin formation, Hampden basalt, and Portland arkose.

W. T. Parrott and R. S. Young, 1960, Virginia Acad. Sci. Geol. Field Trip May 14, geol. map. In Chesterfield County, includes Otterdale sandstone.

Named for occurrence at and around Newark, N.J.

Newark Canyon Formation

Lower Cretaceous: Central Nevada.

T. B. Nolan, C. W. Merriam, and J. S. Williams, 1956, U.S. Geol. Survey Prof. Paper 276, p. 68–70. Proposed for beds of Lower Cretaceous age that include almost all strata mapped by Hague (1883, 1892), as Weber conglomerate. Lithologically heterogeneous to an extreme. Made up of fresh-water limestones, conglomerates that contain both siliceous and limestone boulders, silts, sandstones, and grits. These are dense porcellaneous rocks, with a high content of silt and locally of organic matter that weather to a light blue gray in most places, although locally brownish tints prevail. In some places, they contain small angular fragments of chert and grade into chert-pebble conglomerates. Silts, sandstone, and grits probably form greater part of sequence. The deep red-colored soil developed on formation is one of most characteristic features. Thickness 1,800 feet in Newark Canyon. Rests with angular unconformity on earlier formations from Pogonip group up to Carbon Ridge formation (new). Overlain unconformably by Tertiary(?) and Quaternary sediments and by volcanic rocks.

T. E. Eakin, 1960, Nevada Dept. Conserv. Nat. Resources Rept. 1, p. 26. In list showing generalized stratigraphy of Newark Valley and vicinity, Newark Canyon, Lower Cretaceous, occurs below Eocene Illipah formation (new) of Humphrey and above Permian Carbon Ridge formation.

Best exposures in Newark Canyon where they extend from above Hunter's Ranch to Newark Summit on west side of Diamond Mountains. Beds extensively developed in two main bands south and east of Eureka.

Newaukum Series[1]

Pre-Tertiary(?): Southwestern Washington.

Original reference: H. E. Culver, 1919, Washington Geol. Survey Bull. 19, p. 18–33.

P. D. Snavely Jr., and others, 1958, U.S. Geol. Survey Bull. 1053, p. 22–23. Dark shale and arkosic sandstone described by Culver (1919) as part of Newaukum series are mapped as McIntosh formation in this report [Centralia-Chehalis district]. The conglomerate, graywacke, and breccia in Culver's Newaukum series are probably equivalent to a part of Northcraft formation.

Typically exposed in channel of North Fork of Newaukum River, in sec. 19, T. 14 N., R. 1 E., Lewis County.

†New Bedford Gneiss[1]

Lower Paleozoic (pre-Devonian): Southeastern Massachusetts.

Original reference: E. Hitchcock, 1833, Rept. geol., min., bot., and zool. of Massachusetts, p. 389–390.

Occurs at New Bedford, Bristol County.

Newbern Shale (in Sumner Group)[1]

Newbern Shale Member (of Donegal Limestone)

Permian: Northeastern Kansas.

Original reference: R. C. Moore, 1936, Kansas Geol. Soc. 10th Ann. Field Conf. Guidebook, p. 12 (graphic section).

G. E. Condra and E. C. Reed, 1943, Nebraska Geol. Survey Bull. 14, p. 30. Term Wellington is used for section between top of Herington limestone and base of Ninnescah shale. Of the 10 subdivisions listed, Strickler limestone and Newbern shale members of Donegal limestone (Moore, 1936) are not very persistent; name Donegal limestone is not well founded.

Type locality and derivation of name not stated.

Newberry formation

Precambrian (Grand Canyon Series): Northern Arizona.

Charles Keyes, 1938, Pan-Am. Geologist, v. 70, no. 2, p. 107 (chart), 109–110. Amygdaloidal lava flow. Thickness about 100 feet. Overlies Hotauta conglomerate; underlies Bass limestone.

Name derived from Newberry Butte opposite which formation is best exposed; Grand Canyon region.

Newberry Lava Flow

Newberry Obsidian Flow

Recent: Southwestern Oregon.

E. T. Hodge, 1925, Oregon Univ. Pub., v. 2, no. 10, p. 37, 57–58, 60 (fig. 44), 62, 80 (fig. 64). Discussion of Mount Multnomah ancient ancestor of the Three Sisters. Flow on south slope of South Sister. Largest of recent trachytic flows. Covers 0.6 square mile. Named for J. S. Newberry who visited it in 1854–55.

Howel Williams, 1944, California Univ. Pub., Dept. Geol. Sci. Bull. 27, no. 3, p. 58, pl. 7(a), geol. map. Newberry obsidian flow mentioned in discussion of volcanoes of Three Sisters region. May be among youngest rocks of region.

South Sister Mountain is in eastern part of Lane County.

Newberry Pumice

Newberry Crater Pumice

Pleistocene: Southwestern Oregon.

B. N. Moore, 1934, Jour. Geology, v. 42, no. 4, p. 360 (fig. 1). Newberry Crater pumice shown on map showing distribution of pumice sheets of Crater Lake region.

Howel Williams, 1942, Carnegie Inst. Washington Pub. 540, p. 70 (fig. 16). Newberry pumice shown on map showing distribution and thickness of Crater Lake pumice.

I. S. Allison, 1945, Geol. Soc. America Bull., v. 56, no. 8, p. 789–808. On basis of lacustrine sedimentation, eruption of Newberry pumice took place about 10,500 years ago. Younger than Mount Mazama pumice and main Crater Lake pumice.

H. P. Hansen, 1946, Am. Jour. Sci., v. 244, no. 10, p. 713. Mentioned as Newberry pumice and Newberry Crater pumice in report on post-glacial forest succession and climate in Oregon Cascades. Newberry pumice is stratigraphically above Mount Mazama pumice.

H. P. Hansen, 1947, (abs.) Geol. Soc. America Bull., v. 58, no. 12, pt. 2, p. 1252. Position of Newberry pumic above Crater Lake pumice in Summer

Lake basin reveals that Newberry Crater erupted after Mount Mazama, but before late Wisconsin lakes had become entirely dissected. It is dated between 9,000 and 8,000 years ago.

Newberry volcano is north and east of Crater Lake.

New Bremen Granite (in Diana Syenite Complex)

Precambrian: Northeastern New York.

A. F. Buddington, 1939, Geol. Soc. America Mem. 7, p. 84. A typical augen gneiss. Discussed under heading of Diana syenite complex.

Occurs near New Bremen, Lewis County.

Newburg Limestone[1]

Pennsylvanian: Western Kentucky.

Original reference: D. D. Owen, 1856, Kentucky Geol. Survey, v. 1, pl.

At Newburg, Henderson County.

Newburgh Limestone[1]

Lower Cambrian to Middle Ordovician: New York.

Original reference: W. W. Mather, 1840, New York Geol. Survey 4th Rept. of 1st district, p. 257.

D. W. Fisher, 1956, Internat. Geol. Cong., 20th, Mexico, Cambrian Symposium, pt. 2, p. 329, 343. Name rejected. Synonymous with Stockbridge.

Occurs at Newburgh, Orange County.

New Burnside Coal Member (of Spoon Formation)

Pennsylvanian: Southeastern Illinois.

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 32, 45 (table 1), 65, pl. 1. Name applied to member in lower part of Spoon formation (new) in southeastern Illinois. Overlies Bidwell coal member (new); stratigraphically below Curlew limestone member. Thickness 3 feet. Presentation of new rock-stratigraphic classification of Pennsylvanian of Illinois. Cyclical classification is retained but is entirely independent if rock-stratigraphic classification.

Type locality: SE¼SE¼SW¼ sec. 5, T. 11 S., R. 4. E., Johnson County. Upper of two coals mined in vicinity of village New Burnside.

Newbury Granite Gneiss[1]

Cambrian: Northeastern Vermont.

Original reference: E. J. Foyles and C. H. Richardson, 1929, Vermont State Geologist 16th Rept., table opposite p. 288.

Probably named for village or township in Woodsville quadrangle, eastern part of Orange County.

Newbury Volcanic Complex[1] or **Formation**

Upper(?) Silurian or Lower(?) Devonian: Northeastern Massachusetts.

Original references: B. F. McDaniel, 1884, Essex Inst. Bull., v. 16, p. 165; B. K. Emerson, 1917, U.S. Geol. Survey Bull. 597.

M. P. Billings, 1956, Geology of New Hampshire, pt. 2, Bedrock geology: Concord, New Hampshire State Plan. Devel. Comm., p. 105. Age of volcanics given as probably Upper Silurian or Lower Devonian.

U.S. Geological Survey currently designates the age of Newbury Volcanic Complex or Formation as Upper(?) Silurian or Lower(?) Devonian on basis of study now in progress.

Occurs in towns of Rowley and Newbury, Essex County.

Newburyport Quartz Diorite[1]

Precambrian or Upper Ordovician: Northeastern Massachusetts and southeastern New Hampshire.

Original reference: B. K. Emerson, 1917, U.S. Geol. Survey Bull. 597, p. 177–178, map.

M. P. Billings *in* M. P. Billings, John Rodgers, and J. B. Thompson, Jr., Guidebook for field trips in New England: Geol. Soc. America, p. 25, 29. Exposures in New Hampshire considered comagmatic with Salem-Dedham magma series in Massachusetts, but may possibly belong to New Hampshire magma series. Precambrian.

M. P. Billings, 1955, Geologic map of New Hampshire (1:250,000): U.S. Geol. Survey. Precambrian or Upper Ordovician.

M. P. Billings, 1956, Geology of New Hampshire, pt. 2, Bedrock geology: Concord, New Hampshire State Plan. Devel. Comm., p. 45–46, 105–106. Age considered Precambrian or Lower Paleozoic.

Named for occurrence at Newburyport, Essex County, Mass.

Newby Formation

Triassic-Jurassic(?): Northwestern Washington.

J. D. Barksdale, 1948, Northwest Sci., v. 22, no. 4, p. 165, 167–169. Series of black shales, tuffs, and breccias, and metalavas of andesitic and possibly basaltic composition. Lowest exposed part of formation composed of approximately 2,000 feet of marine black shale. Base of formation not recognized. Tentative total thickness 14,000 feet. In fault contact with Leecher and Methow gneisses (both new) in central part of quadrangle. Intruded by Chelan batholithic complex on southwest. Marked angular unconformity between Newby and overlying Virginian Ridge formation (new).

Type locality: Along Lookout Ridge from forest lookout tower west to Black Pine Lake, Methow quadrangle. Name taken from Newby Ridge, since the name Lookout is previously used.

Newby Glauconitic Sand Member (of Reklaw Formation)

Eocene, middle: Eastern Texas.

H. B. Stenzel, 1938, Texas Univ. Bur. Econ. Geology Pub. 3818, p. 20 (table), 65–71. In some areas, consists of light-yellow or pink and only slightly ferruginous friable sandstone with many layers of red-brown harder crinkly-bedded highly ferruginous glauconitic sandstone partings; elsewhere consists of alternating thin layers of slightly glauconitic sand, glauconitic brown shale, and brown clay-ironstone layers. Thickness about 20 feet. Gradationally underlies Marquez shale member (new); overlies Carrizo sand, boundary (in Leon County) placed where first highly ferruginous glauconitic and fossiliferous sandstones of Newby appear above less ferruginous nonglauconitic and nonfossiliferous sandstones of the Carrizo.

H. B. Stenzel, 1953, Texas Univ. Bur. Econ. Geology Pub. 5305, p. 34–78, pl. 1. Described in Henrys Chapel quadrangle.

First described in Leon County.

Newcastle Lens (in Newcastle Formation)

Upper Cretaceous: Northeastern Wyoming.

R. M. Grace, 1952, Wyoming Geol. Survey Bull. 44, p. 14–15. Composed of thick layers of sandstone interbedded with thin layers of shale, siltstone, and bentonite. Has lateral extent of 25 miles along outcrop extending from Clifton where it is 2 feet thick, to Pedro, where it is 10 feet thick; maximum thickness 85 feet at Newcastle. A point in sec. 31, T. 46 N., R. 62 W., near Pedro, is arbitrarily taken as division between Newcastle and Osage lens (new).

Named for Newcastle, Weston County.

Newcastle Sandstone

Newcastle Sandstone Member (of Colorado Shale)

Newcastle Sandstone Member (of Graneros Shale)[1]

Newcastle Sandstone Member (of Omadi Formation)

Newcastle Sandstone Member (of Skull Creek Formation)

Lower Cretaceous: Northeastern Wyoming, southeastern Montana, western Nebraska, and western South Dakota.

Original reference: E. T. Hancock, 1920, U.S. Geol. Survey Bull. 716, p. 39, 42, 96.

G. E. Condra and E. C. Reed, 1943, Nebraska Geol. Survey Bull. 14, p. 15 (fig. 7). Shown on columnar section as uppermost member of Omadi sandstone (new). Overlies Skull Creek member; underlies Graneros shale.

J. B. Reeside, Jr., 1944, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 10. Rank raised to formation. Underlies Mowry shale; overlies Skull Creek shale. Upper Cretaceous.

A. J. Crowley, 1951, Am. Assoc. Petroleum Geologists Bull., v. 35, no. 1, p. 83–107. Newcastle sandstone, formerly regarded as member of Graneros shale, is herein assigned to Lower Cretaceous. Table 1 shows Newcastle sandstone member in Skull Creek group, above Skull Creek shale and below Mowry shale. Area of report, Black Hills of Wyoming and South Dakota.

W. A. Cobban, 1951, Am. Assoc. Petroleum Geologists Bull., v. 35, no. 10, p. 2196, 2197 (fig. 2). Formations in Black Hills that are equivalent to Colorado shale are Fall River sandstone, Skull Creek shale, Newcastle sandstone, Mowry shale, Belle Fourche shale, Greenhorn formation, Carlile shale, and Niobrara formation. The Nawcastle of northern Black Hills consists of about 40 feet of lenticular sandstones, dark-gray shale, bentonite, and lignite. In central and northwestern Montana, equivalent rocks, 300 to 430 feet thick, are largely gray-weathering sandy shale, with numerous thin layers of bentonite. Greenish-gray glauconitic sandstone beds are conspicuous feature on Sweetgrass arch. Lower Cretaceous.

R. M. Grace, 1952, Wyoming Geol. Survey Bull. 44, p. 5–44. Formation studied on west, north, and east flanks of Black Hills. Name Newcastle sandstone is misleading because unit referred to comprises a shale-siltstone facies and a sandstone facies; hence, term formation is used. Two phases of formation distinguished, a carbonaceous one on west and northwest flanks of Black Hills and a noncarbonaceous one on east flank. Formation changes laterally from a sandstone to a shale-siltstone facies. Formation is also lenslike in that its total thickness decreases in both directions along outcrop from points of maximum thickness. Thickens into lenses in both directions along outcrop from points of maximum thickness. Thickens into lenses in seven of areas studied. These lenses are named, in clockwise order, Newcastle, Osage, New Haven, Little Missouri, Tilford, Rapid City, and Hermosa; the first four are in Wyoming, and the others are in South Dakota. Maximum thickness reported 86 feet; minimum 11½. Underlies Mowry shale; overlies Skull Creek shale. Upper Cretaceous.

R. K. Hose, 1955, U.S. Geol. Survey Bull. 1027–B, p. 58. Newcastle sandstone, in Johnson County, Wyo., is about 40 feet thick. Overlies Skull Creek shale; underlies Mowry shale. In southern part of Powder River Basin and elsewhere, the unit has been called Muddy sandstone or Muddy sandstone member of Thermopolis shale.

Herbert Skolnick, 1958, Am. Assoc. Petroleum Geologists Bull., v. 42, no. 4, p. 787–815. Member of Skull Creek formation. Thicknesses: 93 feet at type section; about 12 feet, Butte County, S. Dak.; 16¾ feet, Custer County, S. Dak.; about 12 feet, Meade County, S. Dak. Lower Cretaceous. Faunal and mineralogical evidence indicates that physically and spatially the Skull Creek shale, Newcastle sandstone, and lower Mowry shale are sufficiently related to be considered one unit.

G. R. Wulf, 1959, Dissert. Abs., v. 20, no. 5, p. 1747. In eastern Montana and western North Dakota, a blanket type sand herein named Dynneson has been called Newcastle.

W. J. Mapel, C. S. Robinson, and P. K. Theobald, 1959, U.S. Geol. Survey Oil and Gas Inv. Map OM–191. On northern and western flanks of Black Hills, Newcastle sandstone is 0 to 80 feet thick and consists of discontinuous beds of light-gray sandstone, siltstone, and dark-gray shale or claystone and a few beds of impure lignite and bentonite. Overlies Skull Creek shale; underlies Mowry shale. Lower Cretaceous.

W. A. Pettyjohn, 1960, (abs.) South Dakota Acad. Sci. Proc. v. 38, p. 34–38. Dakota controversy discussed. Suggested that term Dakota group be used to include Lakota, Fuson, Fall River, Skull Creek, and Newcastle formations.

Type section (Skolnick): NW¼NW¼ sec. 28, T. 45 N., R. 61 W., exposed on northwest side of cut on U.S. Highway 85, 0.4 mile northeast of junction with U.S. Highway 16, 1 mile east of Newcastle, Weston County, Wyo.

New Chapel Chert Bed (in Silver Creek Limestone)[1]

Middle Devonian: Southeastern Indiana.

Original reference: G. I. Whitlatch and J. W. Huddle, 1932, Indiana Acad. Sci. Proc., v. 41, p. 363–371.

Guy Campbell, 1942 Geol. Soc. America Bull.. v. 53, no. 7, p. 1062. The two facies of upper bed of the Silver Creek more or less merge in central Clark County and contain layers of bedded chert and chert nodules. Name New Chapel chert bed (Whitlatch and Huddle, 1932) is only local and perhaps of secondary origin, and it does not identify bed as a whole or at all localities; therefore, term seems unnecessary.

Named from small country church in SW¼SE¼ sec. 37, Clark Grant, Clark County.

Newcomb Sandstone (in Slatestone Group)

Pennsylvanian (Pottsville Series): Eastern Tennessee.

C. W. Wilson, Jr., J. W. Jewell, and E. T. Luther, 1956, Pennsylvanian geology of the Cumberland Plateau: Tennessee Div. Geology [folio], p. 6, 19, pls. 2, 3, 4. Includes both massive and thin facies. Thickness as much as 60 feet; comonly 20. Occurs in upper part of group; overlies a shale interval 40 to 120 feet thick that in turn overlies Sand Gap sandstone (new); underlies shale and Jellico coal that underlie Indian Bluff group (new).

Named from Newcomb, Campbell County.

New Corydon Limestone[1]

Silurian (Niagaran): Northeastern Indiana and west-central Ohio.

Original reference: E. R. Cumings and R. R. Schrock, 1928, Indiana Dept. Conserv., Div. Geol. Pub. 75, p. 53, 54, 113–117.

D. A. Busch, 1939, (abs.) Geol. Soc. America Bull., v. 50, no. 12, pt. 2, p. 1976. New Corydon formation and underlying Huntington dolomite (restricted) are now known to extend into west-central Ohio.

J. B. Sangree, Jr., 1960, Dissert, Abs., v. 21, no. 6, p. 1528. Revision of Silurian stratigraphy of northern Indiana proposed. New Corydon and Liston Creek formations are tentatively considered cherty facies of Mississinewa formation.

Named for exposures in vicinity of New Corydon, Jay County, Ind.

New Design Group

Mississippian (Chester Series): Eastern and southern Illinois, northern Kentucky, and eastern Missouri.

J. M. Weller, 1939, Kansas Geol. Soc. Guidebook 13th Ann. Field Conf., p. 131, 134. Name applied to lower part of Chester series in standard section of the Mississippian. Underlies Homberg group (new). In southern Illinois, includes (ascending) Renault limestone, Bethel sandstone, and Paint Creek formation; in Mississippi River counties, includes Aux Vases sandstone, Renault limestone, Yankeetown chert, and Paint Creek limestone.

J. M. Weller and A. H. Sutton, 1940, Am. Assoc. Petroleum Geologists Bull. v. 24, no. 5, p. 766 (fig. 1), 823–829. In Kentucky, includes Girkin limestone.

Named for New Design Township, Monroe County, Ill.

New Egypt Formation

Cretaceous-Eocene: Eastern New Jersey.

R. K. Olsson, 1959, Dissert Abs., v. 19, no. 8, p. 2063–2064. Five units were studied: Navesink, Redbank, Tilton, New Egypt, and Hornerstown formations. Of these, the New Egypt formation of outcrop area is a lateral equivalent of Tinton formation and in subsurface represents both the Tinton and Hornerstown. Cretaceous-Tertiary boundary is marked by spheroidal weathering at surface in northern part of outcrop area (Tinton and Hornerstown formations), but apparently lies within a lithic unit in the subsurface (New Egypt sand); deposition appears to have been unbroken here. Paleocene-Eocene boundary also lies within a lithic unit (Hornerstown and New Egypt formations).

Occurs in New Jersey Coastal Plain in area of New Egypt and Sewell.

Newett Limestone (in middle member of Belden Formation)

Newett Limestone Member (or Weber? Formation)[1]

Pennsylvanian: Central Colorado.

Original reference: D. B. Gould, 1935, Am. Assoc. Petroleum Geologists Bull., v. 19, no. 7, p. 973–1009.

K. G. Brill, Jr., 1952, Geol. Soc. America Bull., v. 63, no. 8, p. 835. Newett limestone is in lower part of middle shale and limestone member of

Belden formation. Rocks of unnamed middle shale and limestone member formerly assigned to Weber(?) formation by Gould.

Named for abandoned town of Newett, in sec. 3, T. 14 S., R. 77 W., near which limestone is exposed. In Park and Chaffee Counties.

New Fork Tongue (of Wasatch Formation)

Eocene: Southwestern Wyoming.

J. H. Donavan, 1950, Wyoming Geol. Assoc. Guidebook 5th Ann. Field Conf., p. 60, 61, 64. Composed of variegated red, brick-brown, purple, yellow-brown, green, and gray clay shales: fine arkosic conglomerates; and coarse-grained cross-laminated sandstones. Overlies Knight member; interfingers with Fontenelle member (new) of Green River formation. Thickness as much as 325 feet.

W. H. Bradley, 1959, Am. Assoc. Petroleum Geologists Bull., v. 43, no. 5, p. 1072. Interfingers with Fontenelle, here considered tongue of Green River formation. New Fork and Fontenelle tongues are approximate stratigraphic equivalents of Cathedral Bluffs and Tipton tongues farther east.

Typically exposed in buttes overlooking Green River-New Fork River junction, Sublette County.

†Newfoundland Quartzite[1] or Grit[1]

Middle Devonian (Onondaga): Northern New Jersey and southeastern New York.

Original reference: E. C. Edkel, 1902, New York State Mus. 54th Ann. Rept., pt. 1, p. r148.

Named for occurrence at Newfoundland, Morris County, N.J.

New Galilee Clay Shale (in Conemaugh Formation)[1]

Pennsylvanian: Western Pennsylvania.

Original reference: F. W. DeWolf, 1929, Pennsylvania Topog. and Geol. Atlas 5, p. 30, 31, pl. 6.

Named for occurrence 1 mile east of New Galilee, Beaver County.

New Glarus Member (of Pecatonica Formation)

Middle Ordovician: Northern Illinois.

J. S. Templeton and H. B. Willman, 1952, Tri-State Geol. Soc. Guidebook 16th Ann. Field Conf., p. 41, figs. 3, 10, 15A, 16. Thick-bedded limestone 3 to 6 feet thick. Shown on columnar section as underlying Medusa member (new) and overlying Dane member (new).

Occurs in Dixon-Oregon area.

New Hampshire Plutonic Series

New Hampshire Magma Series[1]

Upper Devonian(?): New Hampshire and east-central Vermont.

Original reference: M. P. Billings, 1934, Science, v. 79, no. 2038, p. 55–56.

M. P. Billings, 1935, Geology of the Littleton and Moosilauke quadrangles: Concord, New Hampshire State Plan. Devel. Comm., p. 26–28, geol. maps. Subdivided in Littleton and Moosilauke quadrangles, New Hampshire. New units named are Moulton diorite, Remick tonalite, Sugar quartz monzonite, French Pond granite, Moody Ledge granite, and Pond Hill granite.

R. W. Chapman, 1935, Am. Jour. Sci.. 5th ser., v. 30, no. 179, p. [404], 405–406. Represented by Berlin gneiss and a quartz diorite in Percy area, New Hampshire.

David Modell, 1936, Geol. Soc. America Bull., v. 47, no. 12, p. 1892–1894, pl. 1. Represented by Chatham group, Meredith porphyritic granite, and pegmatites in Belknap area, New Hampshire.

Katharine Fowler-Lunn and Louise Kingsley, 1937, Geol. Soc. America Bull., v. 48, no. 10, p. 1368–1373, pl. 3. Concord granite assigned to series in Cardigan quadrangle, New Hampshire.

Alonzo Quinn, 1937, Geol. Soc. America Bull., v. 48, no. 3, p. 377, 378, 400. Redefined Winnipesaukee quartz diorite included in series in Red Hill area, New Hampshire.

A. P. Smith, 1938, Geologic map and structure sections of the Mount Chocorua quadrangle, New Hampshire (1:62,500): New Hampshire Highway Dept. Map legend shows Tamworth granite (new) and Norway quartz monzonite (new) included in series. Age shown as post-Lower Devonian and probably Upper Devonian.

J. B. Hadley and others, 1938, Geologic map and structure sections of the New Hampshire portion of the Mount Cube quadrangle (1:62,500): New Hampshire Highway Dept. Includes Haverhill granodiorite (new).

R. W. Chapman, 1946, (abs.) Geol. Soc. America Bull., v. 57, no. 12, pt. 2, p. 1187. Represented by Long Mountain granite (new) in Percy quadrangle, New Hampshire.

R. W. Chapman, 1948, Geol. Soc. America Bull., v. 59, no. 11, p. 1075–1077, 1079–1081. Restricted. Berlin gneiss abandoned and now unnamed unit assigned to Oliverian magma series.

Katharine Fowler-Billings, 1949, Geol. Soc. America Bull., v. 60, no. 8, p. 1265–1270, pl. 1. Occurs as large intrusive bodies in Monadnock region, New Hampshire. Oldest unit is Kinsman quartz monzonite, next youngest is Spaulding quartz monzonite (new), and youngest is Concord granite.

Jacob Freedman, 1950, Geol. Soc. America Bull., v. 61, no. 5, p. 464–467. Includes Exeter diorite, quartz diorite, quartz monzonite, binary granite, and microcline granite in Mount Pawtuckaway quadrangle, New Hampshire. Winnipesaukee gneiss no longer recognized in area.

W. S. White and M. P. Billings, 1951, Geol. Soc. America Bull., v. 62, no. 6, p. 662–667, pl. 1. Includes Ryegate granodiorite (new). Geographically extended to Vermont.

M. P. Billings, 1952, *in* M. P. Billings, John Rodgers, and J. B. Thompson, Jr., Geol. Soc. America Guidebook for Field Trips in New England, p. 25, 45. Ayer granodiorite assigned to series in southeastern New Hampshire. Newburyport quartz diorite in same area may possibly belong to series.

M. P. Billings, 1956, Geology of New Hampshire, pt. 2, Bedrock geology: Concord, New Hampshire State Plan. Devel. Comm., p. 53–65, 106–107, 125–129, 146–147, 186. Summary discussion of plutonic series. Characterized by presence of biotite and muscovite, generally gray color, less intense granulation than in Oliverian plutonic series, and white pegmatites. Upper Devonian(?); younger than Lower Devonian and older than Mississippian(?). Derivation of name.

J. H. Eric and J. G. Dennis, 1958, Vermont Geol. Survey Bull. 11, p. 28, pl. 1. Map bracket shows plutonic series includes Moulton diorite and Kirby quartz monzonite (new) in Littleton quadrangle.

Type area: Littleton and Moosilauke quadrangles, New Hampshire. Named for extensive development in New Hampshire.

New Harmony Sandstone (in McLeansboro Formation)

Pennsylvanian: Southwestern Indiana and southeastern Illinois.

J. A. Culbertson, 1932, The paleontology and stratigraphy of the Pennsylvanian strata between Caseyville, Kentucky, and Vincennes, Indiana: Urbana, Ill., Illinois Univ., Abs. Thesis, p. 8. Massive sandstone. Unconformably overlies clayey shale above Lawrenceville shale (new); underlies New Haven limestone.

Well developed along Wabash River, just below New Harmony, Ind.

New Haven Arkose (in Newark Group)

Upper Triassic: Central Connecticut.

P. D. Krynine, 1941, (abs.) Geol. Soc. America Bull., v. 52, no. 12, pt. 2, p. 1919. Fluvial deposit. Underlies Meriden formation.

P. D. Krynine, 1950, Connecticut Geol. Nat. History Bull. 73, p. 30–31, 32, 37–57. At base is a light-gray conglomerate and conglomeratic arkose. Above, a lower and an upper division are recognized. In south-central Connecticut, lower division includes coarse white, gray, or mottled arkose with conglomerate and many fragments of metamorphic rocks; upper division includes coarse pink arkose with numerous conglomerate lenses forming two main horizons near base and top. In both divisions are subordinate layers of micaceous shaly sandstones and shales. In central Connecticut, the lower division west of Meriden consists of coarse grayish arkose with subordinate black shales; upper division includes fine-grained red micaceous feldspathic sandstone west of Meriden, and coarse pinkish-gray arkose with conglomerate layers east of Meriden. Maximum thickness about 7,500 feet. Newark group. More than one type locality designated because of facies variations.

E. P. Lehmann, 1959, Connecticut Geol. and Nat. History Survey Quad. Rept. 8, p. 8 (table 1), 10, pl. 1. Oldest formation in Newark group. Underlies and is exposed in small area along central part of west margin of map [Middleton quadrangle]. Thickness about 10 feet where best exposed. Underlies Talcott basalt.

R. W. Schnabel, 1960, U.S. Geol. Survey Geol. Quad. Map GQ–134. Underlies most of western half of Avon quadrangle, Connecticut. Buried over nearly all of this area by deposits of glacial drift, talus, and alluvium. Thickness probably at least 5,000 feet. Upper contact exposed in three areas. In these exposures, the New Haven conformably underlies Talcott basalt.

Type localities: In south-central Connecticut: western slope of West Rock ridge, northern end of Whitney Avenue in Hamden, on Hartford Turnpike next to New Haven Country Club, and in quarries of Fair Haven. In central Connecticut: at Roaring Brook, and at Hanover Pond south of Meriden.

New Haven Clay[1]

Pleistocene, upper: South-central Connecticut.

Original reference: R. F. Flint, 1933, Geol. Soc. America Bull., v. 44, no. 5, p. 965–987.

P. D. Krynine, 1937, Am. Jour. Sci., 5th ser., v. 33, no. 194, p. 135–136. Described as red or brownish varved clay. Underlies buff or pink sand. Probably of lacustrine origin.

Occurs at and north of New Haven.

New Haven Coal Member (of Modesto Formation)

Pennsylvanian: Southeastern and southwestern Illinois.

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 37, 50 (table 1), pl. 1. Uppermost member of Modesto formation (new). In southeastern area, occurs above Chapel (No. 8) coal member (new); in southwestern area, occurs above Macoupin limestone member. Coal named by Kosanke (1950, Illinois Geol. Survey Bull. 74). Presentation of new rock-stratigraphic classification of Pennsylvanian strata in Illinois.

Type locality: NW¼ sec. 19, T. 7 S., R. 10 E., New Haven quadrangle, Gallatin County.

New Haven Lens (in Newcastle Formation)

Upper Cretaceous: Northeastern Wyoming.

R. M. Grace, 1952, Wyoming Geol. Survey Bull. 44, p. 14, 15. Entirely sandstone. Maximum thickness 44 feet near New Haven; 34 feet 3 miles south of New Haven.

Named for New Haven, Crook County.

New Haven Limestone (in McLeansboro Group)

New Haven Limestone Member (of McLeansboro Formation)[1]

Middle and Upper Pennsylvanian: Southeastern Illinois.

Original reference: A. H. Worthen, 1875, Illinois Geol. Survey, v. 6, p. 67.

C. L. Cooper, 1946, Illinois Geol. Survey Bull. 70, p. 16 (fig. 2). Shown on correlation chart as limestone in McLeansboro group; occurs below Flannigan cyclothem and above Trivoli limestone.

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 55 (table 3). Replaced by Shoal Creek limestone member of Bond formation (new).

Probably named for New Haven, Gallatin County.

Newkirk Limestone[1]

Permian: Central nothern Oklahoma.

Original reference: L. L. Hutchison, 1911, Oklahoma Geol. Survey Bull. 2, p. 205–206.

C. C. Branson, 1957, Oklahoma Geology Notes, v. 17, no. 11, p. 102. Abandoned by Oklahoma Geological Survey.

Exposed at Newkirk, Kay County.

Newland Limestone[1] **or Formation** (in Piegan Group)

Precambrian (Belt Series): Central western Montana.

Original reference: C. D. Walcott, 1899, Geol. Soc. America Bull., v. 10, p. 199–215.

Russell Gibson, W. F. Jenks, and Ian Campbell, 1941, Geol. Soc. America Bull., v. 52, no. 3, p. 371. Term Wallace instead of Newland used for formation younger than Ravalli and older than Striped Peak in Libby and Trout Creek quadrangles, northwestern Montana and northern Idaho.

D. A. Andrews, G. S. Lambert, and G. W. Stose, 1944, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 25, sheet 1. Included in Siyeh group on map legend.

C. P. Ross, D. A. Andrews, and I. J. Witkind, 1955, Geologic map of Montana (1:500,000): U.S. Geol. Survey. Newland limestone included in Piegan group. Dark-bluish-gray argillaceous dolomitic limestone with some argillite, locally schistose. In central and western Montana, Newland and Wallace formations have been treated as essentially synonymous terms by some authors.

W. H. Nelson and J. P. Dobell, 1959, U.S. Geol. Survey Misc. Geol. Inv. Map I–296. In Bonner quadrangle, Montana, Newland limestone underlies Miller Peak argillite. Piegan group.

Type locality: On Newland Creek, 10 miles north of White Sulphur Springs, Meagher County, between Big Belt and Little Belt Mountain.

New Lisbon Member[1] (of Tully Formation)

Middle Devonian: East-central New York.

Original reference: G. A. Cooper and J. S. Williams, 1935, Geol. Soc. America Bull., v. 46, p. 809.

G. A. Cooper and others, 1942, Geol. Soc. America Bull., v. 53, no. 12, pt. 1, p. 1787, chart 4. Middle Devonian.

R. E. Stevenson, 1948, New York State Sci. Service Rept. Inv. 1, p. 2, 4. Further described as dominantly argillaceous sandstone with some interbeds of fine-grained storm-roller sandstone.

R. E. Stevenson and W. S. Skinner, 1949, Pennsylvania Acad. Sci. Proc., v. 23, p. 29–30. Basal member of Tully. Consists of thin-bedded platy sandstone with some sandy shale. Underlies Laurens member.

Well exposed along first south tributary to Stony Creek, 1½ miles east of New Lisbon, Otsego County.

Newlon Limestone and Shale (in Kanawha Formation[1] or Group)

Pennsylvanian: Northern West Virginia.

Original reference: D. B. Reger, 1918, West Virginia Geol. Survey Rept. Barbour and Upshur Counties, p. 281.

H. R. Wanless, 1939, Geol. Soc. America Spec. Paper 17, p. 96. In lower part of Kanawha here considered a group.

Type locality not given but occurs east of Newlon, Upshur County.

New London Granite

New London Granite Gneiss[1]

Carboniferous, upper, or post-Carboniferous(?): Southeastern Connecticut.

Original reference: H. E. Gregory, 1906, Connecticut Geol. Nat. History Survey Bull. 6, p. 115, 149, 152, map.

W. G. Foye, 1949, Connecticut Geol. Nat. History Survey Bull. 74, p. 61. Redescribed as granite, pink to light gray, fine grained to medium grained, and even grained.

Typical exposures in and about New London.

Newman Limestone[1] or Formation

Mississippian: Eastern Tennessee, eastern Kentucky, and southwestern Virginia.

Original reference: M. R. Campbell, 1893, U.S. Geol. Survey Bull. 111, p. 28, 38.

John Rodgers, 1953, Tennessee Div. Geology Bull. 58, pt. 2, p. 108–110, pt. 1, pls. Mississippian limestone sequence, here called Newman limestone, has been subdivided into five or six formations in southwestern Virginia, northwestern Georgia, and northern Alabama; the same units are certainly present in eastern Tennessee, but studies are not yet far enough advanced to make it feasible to show the units separately on present map. In general, limestone units equivalent to the Warsaw, St. Louis, and Ste. Genevieve, together with the lower part of Chester group, and the middle part of Chester group of Upper Mississippi Valley States can be recognized. The Newman varies in character across area. Thickness 600 to more than 2,800 feet. Overlies Grainger formation; underlies Pennington formation.

R. B. Neuman and R. L. Wilson, 1960, U.S. Geol. Survey Geol. Quad. Map GQ-131. In Blockhouse quadrangle, Tennessee, rocks formerly referred to as Newman are renamed Greasy Cove formation.

Type locality: Newman Ridge, Hancock County, Tenn.

†Newman Sandstone Lentil (in Newman Limestone)[1]

Mississippian: Northeastern Tennessee.

Original reference: A. Keith, 1897, U.S. Geol. Survey Geol. Atlas, Folio 40.

Name derived from type locality of Newman limestone at Newman Ridge, Hancock County.

New Market Limestone (in St. Paul Group)

Middle Ordovician: Western Virginia, central Maryland, southern Pennsylvania, and eastern West Virginia.

B. N. Cooper and G. A. Cooper, 1946, Geol. Soc. America Bull., v. 57, no. 1, p. 71–74. Proposed for succession of predominantly dense fine-grained limestone above the Beekmantown and below the dark-gray limestones of the *Dinorthis atavoides* zone (Lincolnshire limestone). Where typically developed, consists mainly of dove-gray high-calcium limestone. At type section, two divisions are recognizable: lower zone, composed mainly of thin-bedded dove-gray calcilutite, in many places with a few feet of limestone- and dolomite-pebble conglomerate at base; and an upper zone which is thick to massive and nearly free of insoluble matter. Thickest and most characteristically developed on west side of Massanutten syncline where it has maximum thickness of 250 feet, 4 miles west of Edinburg; in most sections west of Massanutten Mountain, thickness is 75 to 100 feet. Thinner and locally absent east of Massanutten syncline; twofold division less distinct, and average thickness considerably less than 50 feet. Thickness at type section 83½ feet. New Market is essentially same as unit identified by Butts as Mosheim in most parts of northern Virginia.

R. B. Neuman, 1951, Geol. Soc. America Bull., v. 62, no. 3, p. 286–298, pl. 2. Included in St. Paul group (new). Geographically extended into Maryland, Pennsylvania, and West Virginia. Redescribed at type section, and thickness given as 144 feet; discrepancy between this and published 85 feet [83½] feet is due to inclusion of dolomitic beds intercalated with limestone at base of section; therefore, formation at type locality consists predominantly of dove vaughanite with some strata of darker fine-grained limestone, and includes beds of dolomitic and argillaceous limestone in lower part. Strata are traced continuously from type section into southern Pennsylvania. The New Market at Tumbling Run, Vaucluse, and Stephens City, Va., points intermediate between type section, and area of this report [Maryland], is underlain by Beekmantown dolomite and overlain by Lincolnshire limestone. From Winchester, Va., northward, formations that enclose New Market change; in absence of Lincolnshire, Edinburg or Chambersburg, limestone rests directly on New Market. Northeastward from Bessemer, W. Va., Row Park limestone (new) intervenes between Beekmantown and New Market. New Market thickens north of Martinsburg, W. Va., to maximum of 710 feet at Welsh Run, Pa. Maintains average thickness of 150 feet from Kernstown, Va., to Hainsville, W. Va.; in that distance, has minimum thickness of 90 feet at Kernstown and maximum thickness of 185 feet at Bessemer.

G. A. Cooper, 1956, Smithsonian Misc. Colln., v. 127, pt. 1, p. 79–80. To northeast of type section New Market thickens and its stratigraphy becomes complex. Neuman (1951) amplified New Market and identified the so-called "Lowville" underlying Chambersburg formation (Shippensburg of Craig) as New Market. Cooper and Cooper (1946, p. 69) identified the New Market underneath an 800-foot sequence of "Stones River" which immediately underlies the "Lowville." The New Market of Cooper and Cooper near Marion, Pa., fingers at the base with dolomites as it does at New Market. Newman named the 800-foot sequence of "Stones River" the Row Park formation. Cooper and Cooper (1946) had previously identified this sequence at Whistle Creek on basis of contained fossils. Below the New Market of Cooper and Cooper, Neuman discovered lime stone containing abundance of *Rostricellula*. The seemingly conflicting identification of New Market by Cooper and Cooper and Neuman can be interpreted as facies condition. It is postlulated here that both identifications of New Market are correct, but that the Row Park is a partial facies of the New Market and also the Whitle Creek. The New Market is sandwiched between *Rostricellula* beds of the Row Park at the base and the main body of the Row Park. It interfingers with main mass of Row Park and overlies it as it does near Marion, Pa.

F. M. Swartz and R. R. Thompson, 1958, Pennsylvania State Univ. Mineral Industries Expt. Sta. Bull. 71, p. 12–14. Overlies Brown Mills limestone member (new) of Row Park formation in Franklin County, Pa.

Type section: In Madden quarry, near New Market, Shenandoah County, Va.

New Mass Amygdaloid[1] (in Central Mine Group)

Precambrian (Keweenawan): Northern Michigan.

Original reference: W. H. Weed, 1925, The Mines Handb., p. 1008–1049.

Occurs on property of Mass Consolidated Mining Co. in Ontonagon County.

New Mass Flow[1]

Precambrian (Keweenawan): Northern Michigan.

Original reference: B. S. Butler and W. S. Burbank, 1929, U.S. Geol. Survey Prof. Paper 144 (chart compiled by M. G. Wilmarth).

Copper district of Keweenaw Point.

New Milford Formation (in Chemung Group)

New Milford Group (in Catskill Formation)[1]

New Milford parvafacies

Upper Devonian: Northeastern Pennsylvania.

Original reference: I. C. White, 1881, Pennsylvania 2d Geol. Survey Rept. G_5, p. 68–70.

Bradford Willard, 1936, Geol. Soc. America Bull., v. 47, no. 4, p. 571, 588–593. Formation assigned to Chemung group. Includes (ascending) Kingsley red shale, Lanesboro, and Luthers Mills coquinite members (all new).

K. E. Caster, 1938, Jour. Paleontology, v. 12, no. 1, p. 45 (fig. 7), 46. New Milford upper, middle, and lower sandstone (White, 1881) are included in Lanesboro formational suite. Wellsburg monothem; New Milford lower sandstone is here named Drinker Creek sandstone member (of Lanesboro formational suite). Kingsley member of New Milford is classed as member of Wellsburg monothem. Figure 7 shows New Milford parvafacies as part of Chemung stage.

Named for exposures in New Milford part of Susquehanna County.

New Milford Sandstone[1] or Shale[1]

Upper Devonian: Northeastern Pennsylvania.

Original reference: I. C. White, 1881, Pennsylvania Geol. Survey Rept. G_5, p. 68–70.

Well exposed in New Milford part of Susquehanna County.

New Oxford Formation (in Newark Group)[1]

Upper Triassic: Southern Pennsylvania and western Maryland.

Original reference: A. I. Jonas, 1928, Maryland Geol. Survey Carroll County, geol. map.

D. B. McLaughlin and R. C. Gerhard, 1953, Pennsylvania Acad. Sci. Proc., v. 27, p. 136–137. Termed subarkosic lithofacies in Lebanon and Lancaster Counties, southeastern Pennsylvania. Contains some beds of true arkose, much subarkose, and extensive interbeds of red sandstone poor in feldspar, as well as some red shale. Interfingers with Gettysburg sandstone lithofacies and is the southern, and to a considerable extent, lower and older unit. Transition marked by extensive interbedding of feldspathic and nonfeldspathic sandstones.

Named for exposures at New Oxford, Adams County, Pa.

†Newport Conglomerate[1]

Carboniferous: Southern Rhode Island.

Original reference: E. Hitchcock, 1861, Am. Jour. Sci., 2d, v. 31, p. 377.

Type locality: Purgatory Rocks, southern part of Narragansett Basin.

Newport Formation[1]

Pleistocene: Northwestern Oregon.

Original reference: W. D. Smith, 1926, Oregon Univ. Commonwealth Rev., v. 8, p. 269.

Typically exposed at Newport, Lincoln County.

Newport Granite[1]

Devonian: Northeastern Vermont.

Original reference: C. H. Richardson, 1908, Vermont State Geologist 6th Rept.

Newport is in Memphremagog quadrangle, Orleans County.

Newport Group

Precambrian: Northeastern Washington and western Idaho.

M. C. Schroeder, 1952, Washington Div. Mines and Geology Bull. 40, p. 7 (chart), 9, 19, pl. 1. Name applied to about 29,000 feet of argillaceous sandstones, argillite, quartzitic sandstones, quartzites, and carbonate rocks cropping out in area. Comprises (ascending) Bead Lake formation, No Name argillite, and Skookum formation. Neither base nor top of group observed in map area.

Named for exposures near Newport, Pend Oreille County, Wash.

Newport Limestone[1]

Upper Devonian: Central Pennsylvania.

Original reference: J. P. Lesley, 1892, Pennsylvania 2d Geol. Survey Summ. Final Rept., v. 2, p. 1594.

Well exposed opposite furnace at Newport, Perry County, and 1 mile east, on bank of Juniata River.

Newport Shales and Sandstones[1]

Upper Devonian: Central southern Pennsylvania.

Original reference: F. Platt, 1881, Pennsylvania 2d Geol. Survey Rept. T., p. 28.

On Juniata River, Perry County.

Newport Neck Shale[1]

Precambrian: Southeastern Rhode Island.

Original reference: A. F. Foerste, 1899, U.S. Geol. Survey Mon. 33, p. 316–318, 383.

Occurs along west shore of Newport Neck.

New Providence Shale

New Providence Formation (in Borden Group)

New Providence Shale (in Osage Group)[1]

Lower Mississippian (Osage Series): Southern Indiana, eastern and northern Kentucky, and Tennessee.

Original reference: W. W. Borden, 1874, Indiana Geol. Survey 5th Ann. Rept., p. 161.

C. W. Wilson, Jr., and E. L. Spain, Jr., 1936, Am. Assoc. Petroleum Geologists Bull., v. 20, no. 6, p. 805–809. In study of early Mississippian rocks of central Tennessee, Bassler (1912, U.S. Natl. Mus. Proc., v. 41, no. 1851) divided strata between overlying Fort Payne chert and underlying Maury shale member of Chattanooga shale into two formations; upper was correlated with New Providence shale and local type locality given as Whites Creek Springs, Davidson County; lower was named Ridgetop shale. In present report, local use of New Providence shale is accepted but strata designated as Ridgetop are considered a phase of the New Providence.

P. B. Stockdale, 1939, Geol. Soc. America Spec. Paper 22, p. 76–77, 79, 99–135, pls. 6, 8. New Providence formation is basal unit of Borden group in Indiana and Kentucky. In Indiana, overlies Rockford limestone or New Albany black shale and underlies Locust Point formation; in Kentucky overlies New Albany-Ohio black shale unit, except in northeastern part of outcrop belt where Bedford-Berea-Sunbury wedge separates it from Ohio shale and it rests directly on Sunbury; underlies Brodhead formation (new). Thickness in Kentucky ranges from 50 feet in Pulaski County to 350 feet at Kentucky-Ohio border. Misunderstanding exists regarding New Providence in Kentucky. This has arisen chiefly from claim by Butts (1922, Kentucky Geol. Survey, ser. 6, v. 7) that overlying Keokuk rocks thin rapidly from Jefferson County southeastward, eastward, and northeastward around outcrop belt that borders Lexington Plain and that New Providence gradually thickens to comprise entire clastic unit of shale and sandstone, over 550 feet thick, between underlying Ohio shale, or Sunbury shale, and overlying Warsaw or younger beds. In this interpretation, Butts considered New Providence "group" of Kentucky equivalent to combined Cuyahoga and Logan formations of Ohio. Butts' usage of New Providence group for strata in Kentucky is abandoned. Present study indicates that New Providence consists of only lower part of clastic Mississippian strata of Kentucky and is equivalent only to Cuyahoga formation. Includes the following facies (in order of occurrence along outcrop belt around Lexington Plain from Indiana to Ohio): Silver Hills, Keith Knob, Junction City, Forbush Creek, Dicks River, Boone Gap, Stanton, Bluestone, and Vanceburg. Comprises the following members (not in sequence): Beaver Creek, Buena Vista siltstone, Churn Creek shale, Clay City siltstone, Farmers siltstone, Gum Sulphur siltstone, Henley shale, Kenwood sandstone, Rarden shale, and Vanceburg siltstone. Osage series.

J. E. Conkin, 1957, Bulls. Am. Paleontology, v. 38, no. 168, p. 110–124. Further subdivided in area of Silver Hills facies into (ascending) Coral Ridge (new), Button Mold Knob (new), and Kenwood sandstone members.

Named for New Providence, now Borden, Clark County, Ind.

New Richmond Sandstone[1] (in Prairie dù Chien Group)

New Richmond Sandstone Member (of Prairie du Chien Formation)

Lower Ordovician: Central western Wisconsin, northern Illinois, northeastern Iowa, and southeastern Minnesota.

Original reference: L. C. Wooster, 1878, Wisconsin Geol. Survey Ann. Rept. 1877, p. 36–41.

G. M. Schwartz, 1936, Minnesota Geol. Survey Bull. 27, p. 41–42. Discussion of geology of Minneapolis-St. Paul area. Use of term New Richmond is continued here, but it is suggested that in eventual revision of nomenclature term be dropped for this area because the sandstone is thin and at places entirely missing.

C. R. Stauffer and G. A. Thiel, 1941, Minnesota Geol. Survey Bull. 29, p. 59–62. In southeastern Minnesota, term New Richmond is replaced by Root Valley sandstone (new). Importance of Root Valley horizon in stratigraphy cannot be ignored, even though interpretation of sandy beds commonly called New Richmond sandstone, or Root Valley horizon, remains unsatisfactory. Indications are that this sandy phase is basal part of Shakopee and probably a distinct member of that formation.

J. N. Payne *in* H. B. Willman and J. N. Payne, 1942, Illinois Geol. Survey Bull. 66, p. 59–60, pl. 18. Crops out more or less continuously along Fox River south of Sheridan from about center of sec. 5 to NE cor. sec. 18, T. 35 N., R. 5 E., LaSalle County. Appears to be conformable on Oneota dolomite below and with Shakopee formation which overlies it in normal sequence. However, major unconformity occurs above New Richmond along southwest limb of Kanakee arch in LaSalle and Kendall Counties and along narrow strips in Grundy and Livingston Counties where pre-St. Peter erosion removed Shakopee formation so that New Richmond is overlain directly by St. Peter sandstone. Thickness (based on well data) 160 to 190 feet. Prairie du Chien series. General classification of geologic time (p. 191, 192) discusses New Richmond stage of Prairie du Chien epoch.

H. B. Willman and J. S. Templeton, 1951, Illinois Acad. Sci. Trans., v. 44, p. 111 (fig. 2), 119–120. New exposure noted in Illinois. Overlies Oneota formation, also exposed in this area.

J. S. Templeton and H. B. Willman, 1952, Tri-State Geol. Soc. Guidebook 16th Field Conf., fig. 3. Columnar section for Dixon-Oregon area, Illinois, shows New Richmand sandstone in Prairie du Chien group above Oneota formation and below Shakopee formation.

R. L. Heller, 1956, Geol. Soc. America Guidebook Minneapolis Mtg.. Field Trip 2, p. 29–39. Rank reduced to member status in the Prairie du Chien herein considered formation. Member is represented by fine- to medium-grained quartzose sandstone and fine- to medium-grained light brownish-gray to buff arenaceous dolomite. Relatively thin throughout most of area. Locally, as at Martel, Wis., and in area around Fillmore, Houston, and Winona Counties, Minn., member is massive sandstone unit. Ranges in thickness from 5 feet in vicinity of type locality along Willow River in Wisconsin, to maximum of 45 feet at Lanesboro. Not well exposed in Minnesota River valley except at Mankato where it is about 8 feet thick. Overlies Oneota dolomite member; underlies Shakopee dolomite member. Studies indicate that New Richmond sandstone and Root Valley sandstone are same stratigraphic unit. Name New Richmond has priority and term Root Valley should be suppressed.

Named for exposures in vicinity of village of New Richmond, St. Croix County, Wis.

†New River coal series[1]

Mississippian: West Virginia.

Original reference: C. A. Ashburner, 1877, Am. Philos. Soc. Proc., v. 16, p. 519–560.

New River Formation (in Pottsville Group)

New River Group[1]

New River Series[1]

Lower Pennsylvanian: West Virgina and southwestern Virginia.

Original reference: W. M. Fontaine, 1874, Am. Jour. Sci., 3d, v. 7, p. 463.

David White, 1943, U.S. Geol. Survey Prof. Paper 197–C, p. 137. Referred to as New River formation in description of Lower Pennsylvanian flora.

R. C. Moore and others, 1944, Geol. Soc. America Bull., v. 55, no. 6, chart 6 (columns 11, 12). Shown on correlation chart as New River group, above Pocahontas group and below Kanawha group, Pottsville series. In southern West Virginia, includes strata from base of Fire Creek coal to top of Upper Nuttall sandstone; in northern West Virginia, extends from unconformity at base of Sharon conglomerate at top of Connoquenessing sandstone.

M. G. Cheney and others, 1945, Am. Assoc. Petroleum Geologists Bull., v. 29, no. 2, p. 140 (chart 2), 144–145. Middle Pottsville has generally been referred to as New River formation or group in much of Appalachian region. Upper and lower boundaries are restricted and division defined as series. Division should extend from base of Lower Raleigh sandstone to base of Upper Nuttall sandstone of southern West Virginia. Correlative Sharon conglomerate, Olean conglomerate, Rockcastle conglomerate, Lower Caseyville conglomerate, and lower conglomerate of Lookout formation seem to mark natural boundary of series in other parts of Appalachian region. Base of Lower Connoquenessing sandstone, Corbin conglomerate, Upper Caseyville conglomerate, and base of Upper Nuttall sandstone are interpreted as marking unconformity that serves as boundary between New River series and succeeding Kanawha series. In some reports, this middle Pottsville division has been called Sewell group.

C. B. Read and S. H. Mamay, 1960, U.S. Geol. Survey Prof. Paper 400–B, p. B381. Lower Pennsylvanian on basis of plant fossils.

Named for exposures along New River, W. Va.

†New River System[1]

Mississippian: Pennsylvania and West Virginia.

Original reference: F. Platt, 1877, Pennsylvania 2d Geol. Survey Rept. H_2, p. xxiii–xxx.

New Rochelle Serpentine[1]

Precambrian: Southeastern New York.

Original reference: F. J. H. Merrill, 1898, New York State Mus. 15th Ann. Rept., v. 1, p. 21–31.

Occurs at Davenport's Neck at New Rochelle, Westchester County.

New Salem Aplite[1]

Upper Carboniferous or post-Carboniferous: Northern central Massachusetts.

Original reference: B. K. Emerson, 1917, U.S. Geol. Survey Bull. 597, p. 244, map.

Extends up from Enfield through Prescott, Hampshire County, and New Salem, Franklin County.

†New Salem Serpentine[1]

Upper Carboniferous or post-Carboniferous: Northern central Massachusetts.

Original reference: B. K. Emerson, 1898, U.S. Geol. Survey Mon. 29, p. 55.

Occurs on west slope of Rattlesnake Hill, Berkshire County.

New Scotland Limestone (in Helderberg Group)[1]

New Scotland Member (of Helderberg Limestone)

Lower Devonian: Eastern New York, western Maryland, Mississippi, New Jersey, eastern Pennsylvania, Virginia, and northern West Virginia.

Original reference: J. M. Clarke and C. Schuchert, 1899, Science, new ser., v. 10, p. 874–878.

F. M. Swartz, 1930, U.S. Geol. Survey Prof. Paper 158–C. Includes Healing Springs sandstone member (new) in Virginia.

W. C. Morse, 1936, Mississippi Geol. Survey Bull. 32, p. 11, 14, 16, 17. Formation exposed in Tishomingo State Park. Upper 40-foot interval is massive hard gray limestone. Lower half of this 40 feet is very fossiliferous. Underlies Island Hill formation. Helderbergian series. Most of New Scotland will be submerged when Pickwick Dam is completed.

F. M. Swartz, 1939, Pennsylvania Geol. Survey, 4th ser., Bull. G–19, p. 55–62. In parts of Monroe County, eastern Pennsylvania, the New Scotland is similar to that of eastern New York. Composed largely of somewhat calcareous, fossiliferous shale. At base is impure siliceous and argillaceous limestone which contains interbedded dark chert and corresponds in position to Kalkberg member in Hudson River valley. In central Pennsylvania, consists of finely crystalline gray limestone and interbedded chert, commonly in layers 2 to 4 or 6 inches thick. At Clarks Mill and Falling Springs, Perry County, cherty limestone is displaced by medium-bedded solid calcareous sandstone herein named Falling Springs sandstone member. Overlies Coeymans limestone and in some areas such as Monroe County, Stormville sandstone member. Underlies Becraft limestone in eastern Monroe County; sandstone of probable Oriskany age in Carbon County; Mandata shale and chert new in central Pennsylvania. Thicknesses: 160 feet at Nearpass quarries, New Jersey; 80 feet in eastern Monroe County; 40 feet near Palmerton; 10 to 30 feet in central Pennsylvania. Helderberg group.

Charles Butts, 1940, Virginia Geol. Survey Bull. 52, pt. 1. p. 276–279. In areas where Helderberg limestone is best developed in Virginia, New Scotland limestone member succeeds Coeymans limestone member and is limited above either by Becraft limestone member or by Oriskany sandstone. Thickness 72 to 150 feet. In Bath and Alleghany Counties, includes basal sandstone named Healing Springs by Swartz.

G. H. Chadwick, 1940, New York State Geol. Assoc. 16th Ann. Mtg., Field Guide Leaflets, Trip A, C, and E; 1943, New York State Mus. Bull. 336, p. 44, 67, 71 [1946]. New Scotland beds comprise Kalkberg cherty limestone below and Catskill shaly limestone above. Underlies Becraft limestone; overlies Coeymans limestone.

H. P. Woodward, 1948, West Virginia Geol. Survey, v. 15, p. 82–95. Overlies Coeymans limestone; underlies Port Ewen limestone.

Ernst Cloos, 1951, Maryland Dept. Geology, Mines and Water Resources [Rept. 14] Washington County, p. 83. In Maryland, New Scotland member of Helderberg consists of lower limestone containing several layers of white chert which replace the limestone, and an upper bed of drab soft fissile shale. Thickness 12 to 43 feet. Overlies Coeymans member; underlies Becraft member.

F. G. Lesure, 1957, Virginia Polytechnic Inst. Bull., Engineering Expt. Station Ser. 118, p. 48. Names New Scotland and Becraft limestones as used by Butts (1940) do not seem justified, and in this report [Clifton Forge iron district] term Licking Creek limestone is used to include all limestone beds above Healing Springs sandstone and below Ridgeley sandstone.

H. H. Arndt and others, 1959, Geol. Soc. America Guidebook Field Trips Pittsburgh Mtg., p. 4, 13. From top to bottom, the Helderberg members are Mandata shale, New Scotland limestone (notably cherty) and Coeymans limestone. Members are separable on faunal basis but not defined clearly enough for mapping purposes. Thickness of New Scotland member 8 feet at Bald Hill roadcut, 2 miles east of Hollidaysburg. Consists of gray to light-gray thick- to medium-bedded finely crystalline limestone containing diagnostic brachiopod *Eospirifer macropleurus*.

Named for exposures at town of New Scotland, Albany County, N.Y.

Newsom Shaly Clay[1] or Shale

Middle Silurian: Western Tennessee.

Original reference: A. F. Foerste, 1901, Geol. Soc. America Bull., v. 12, p. 397, 402.

R. W. Morris and B. L. Hill, 1952, Bulls. Am. Paleontology, v. 34, no. 142, p. 5–16. Newsom shale, as exposed in vicinity of its type section, is a soft calcareous shale which upon weathering breaks down into a yellowish clay. Contains megafossil fauna which is closely related to that of Waldron shale of Indiana.

Named for Newsoms Station, Davidson County.

Newspaper Rock Sandstone (in Chinle Formation)

Upper Triassic: Northeastern Arizona.

H. R. Stagner *in* L. H. Daugherty, 1941, Carnegie Inst. Washington Pub. 526, p. 10, 11–12. Gray and quite massively bedded sandstone. Upper part finer in texture and more thinly bedded than lower part, and many layers have fine ripple foreset-type crossbedding, ripple marks, sun cracks, and fossil tracks. Upper part, greenish-gray on fresh surface, soon weathers to chocolate or reddish brown, and apparently hardens considerably in the process. Occasionally similar fine-bedded layers found within more massive lower part. About 30 feet thick at Newspaper Rock; thins southward at expense of its base and separated into from two to five or six beds by wedges of greenish-gray argillaceous very fine-textured shale. Lies between lower and upper bentonitic shale zone both in Chinle formation.

Typically developed at Newspaper Rock, sec. 16, T. 18 N., R. 24 E., from which it takes its name, Blue Forest area, Petrified Forest National Monument.

Newton cyclothem (in McLeansboro Group)

Newton cyclothem (in Mattoon Formation)

Pennsylvanian: Southeastern Illinois.

W. A. Newton and J. M. Weller, 1937, Illinois Geol. Survey Rept. Inv. 45, p. 9, 24–25. Occurs above Bogota cyclothem (new) and below Greenup cyclothem (new). Includes Newton limestones.

H. R. Wanless and Raymond Siever, 1956, Illinois Geol. Survey Circ. 217, pl. 1. Included in McLeansboro group. Type locality given.

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 52 (table 2), pl. 1. In Mattoon formation (new). Occurs above Woodbury cyclothem. Presentation of new rock-stratigraphic classification of Pennsylvanian strata in Illinois; cyclical classification is independent of rock-stratigraphic classification.

Type locality: Along Crooked Creek, in secs. 15, 16, 22 and 27, T. 7 N., R. 10 E., about 4 miles east and a little north of Newton, Jasper County.

Newton Limestone (in McLeansboro Group)

Pennsylvanian: Southeastern Illinois.

W. A. Newton and J. M. Weller, 1937, Illinois Geol. Survey Rept. Inv. 45, p. 9, 24–25. A limestone in Newton cyclothem.

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 41, 55 (table 3). Replaced by Reisner limestone member (new) of Mattoon formation (new). Name Newton preempted. Presentation of new rock-stratigraphic classification of Pennsylvanian strata in Illinois; cyclical classification is independent of rock-stratigraphic classification.

Type locality (of cyclothem). Along Crooked Creek, about 4 miles east and a little north of Newton, Jasper County.

Newton Sandstone Member (of Crab Orchard Mountains Formation)

Newton Member (of Lee Group)

Newton Sandstone (in Crab Orchard Mountains Group)

Newton Sandstone (in Pottsville Group)[1]

Lower Pennsylvanian: Eastern Tennessee.

Original reference: W. A. Nelson, 1925, Tennessee Div. Geology Bull. 33-A, p. 50–51.

H. R. Wanless, 1939, (abs.) Geol. Soc. America Bull., v. 50, no. 12, pt. 2, p. 1941. Listed as member of Lee formation.

C. W. Wilson, Jr., J. W. Jewell, and E. T. Luther, 1956, Pennsylvania geology of the Cumberland Plateau: Tennessee Div. Geology [folio], p. 4, 19, pls. 2, 3, 4, 12–B. Assigned to Crab Orchard Mountains group (new). In type area, massive, medium grained, crossbedded, and locally conglomeratic; over most of outcrop area, fine to medium grained, massive, friable. Attains maximum thickness, 110 feet, in type area; thins abruptly along a northeast-southwest line. Underlies Vandever formation; overlies Whitwell shale, local unconformity. Conglomeratic phase of the Newton sandstone in southern Cumberland and northern Bledsoe Counties was the type "Herbert conglomerate" erroneously considered by Nelson (1925) to be older than the Newton; the shale thought to be between the sandstones and named "Eastland shale" is actually Whitwell shale. "Herbert conglomerate" and "Eastland shale" discarded.

U.S. Geological Survey currently classifies Newton Sandstone as member of Crab Orchard Mountains Formation on basis of study now in progress.

Type area: Vicinity of Newton, Cumberland County.

Newton Sandstone Member (of Everton Formation)[1]

Middle Ordovician: Northern Arkansas.

Original reference: E. T. McKnight, 1935, U.S. Geol. Survey Bull. 853.

E. E. Glick and S. E. Frezon, 1953, U.S. Geol. Survey Circ. 249, p. 4–6. Further described in Newton County. Overlies a sequence of limestone, dolomite, and sandstone, 245 feet thick in some areas, in lower part of formation; separated from overlying Jasper member by sequence of dolomite, sandy dolomite, and dolomitic sandstones about 90 feet thick. Middle Ordovician.

Named for prominent occurrences in northern Newton County.

Newton Creek Limestone (in Traverse Group)

Newton Creek Limestone Member (of Alpena Limestone)

Middle Devonian: Northeastern Michigan.

G. A. Cooper and A. S. Warthin, 1941, Washington Acad. Sci. Jour., v. 31, no. 6, p. 260. Brown, bituminous and crystalline limestone 25 feet thick. Underlies Alpena limestone.

A. S. Warthin, Jr., and G. A. Cooper, 1943, Am. Assoc. Petroleum Geologists Bull., v. 27, no. 5, p. 579 (fig. 3), 584–585. At type locality, underlies Alpena limestone (restricted to exclude unit now termed Newton Creek) and overlies Genshaw formation.

G. V. Cohee, 1947, U.S. Geol. Survey Oil and Gas Inv. Prelim. Chart 28, footnote 23. Considered a member of Alpena limestone by Michigan Geological Survey.

Type locality: Quarry of Michigan Alkali Company SW¼ sec. 13, T. 31 N., R. 8 E., Alpena County. Exposed as far west as Afton, Cheboygan County.

Newton Hamilton Formation (in Onondaga Group)

Middle Devonian: Central Pennsylvania.

F. M. Swain, 1958, Am. Assoc. Petroleum Geologists Bull., v. 42, no. 12, p. 2860 (fig. 2), 2864 (fig. 3), 2865–2869. Proposed for widespread shaly facies of Onondaga group in central Pennsylvania. Typically greenish gray shale, weathering light gray in contrast to the sooty black, silvery-weathering Marcellus shales above. Thickness about 100 feet in Mount Union quadrangle, but because of poor exposures and possible shearing along western flank of Stone Mountain and Jacks Mountain precise thickness uncertain. Includes Hares Valley limestone and shale member (new) above and Beaverdam shale member (new) below. Overlies and parallels exposures of Ridgeley sandstone of Oriskany group.

Type section: Along Pennsylvania Railroad ½ to ¾ mile northeast and 1 mile west of Newton Hamilton, Mount Union quadrangle.

Newton Hills Sand

Pleistocene: Southwestern South Dakota.

J. K. Baird, 1957, (abs.) South Dakota Acad. Sci. Proc., v. 37, p. 116. Thick section of sand and clay. Considered by some early workers to be Tertiary in age and by others to be Pleistocene; probably interglacial. Present study indicates it is Pleistocene, interglacial.

Exposed in Big Sioux Valley bluffs from eastern boundary of Newton Hills State Park almost to Fairview, Lincoln County.

Newton Mine Volcanics (in Amador Group)

Jurassic: East-central California.

G. R. Heyl and J. H. Eric, 1948, California Div. Mines Bull. 144, pt. 1, p. 51, 52, 53, pl. 7. Series of schists and greenstone in Newton mine area (near Jackson, Amador County), tentatively correlated with Jurassic Amador group described by Taliaferro (1942) is subdivided into four formations (descending) Mountain Spring volcanics, Dufrene slate, Newton Mine volcanics, and Sunnybrook volcanics. Newton Mine volcanics consist chiefly of pale-green chlorite schist with lesser amounts of pale-green fine-grained bedded tuff, and blue-gray slate. Approximate thickness 752 feet. Measured section, along Mountain Spring Creek from Mariposa slate eastward, dips steeply to east; relation of beds to Mariposa slate suggests that section is overturned and is on west limb of an overturned anticline or its faulted equivalent.

Name derived from Newton mine, about 6 miles west of Jackson, Amador County.

†Newtonville Limestone[1]

Upper Mississippian: Central Ohio.

Original reference: E. B. Andrews, 1870, Ohio Geol. Survey Rept. Prog. 1869, p. 93.

Named for Newtonville (now called White Cottage), Muskingum County.

New Ulm Conglomerate[1]

Cambrian(?): Southwestern Minnesota.

Original reference: F. W. Sardeson, 1908, Geol. Soc. America Bull., v. 19, p. 221–242.

Crops out on left side of Minnesota River opposite New Ulm, 1½ miles above Redstone, Brown County.

Newville Group

Upper Jurassic (Knoxville): Northern California.

F. M. Anderson, 1943, California Div. Mines Bull. 118, pt. 2, p. 184 (fig. 68) [preprint]. Shown as uppermost group in Knoxville series. Overlies Grindstone group (new); underlies Paskenta group of Shasta series.

F. M. Anderson, 1945, Geol. Soc. America Bull., v. 56, no. 10, p. 929–932. Described in type area as predominantly dark argillaceous shales that contrast greatly with sandstones and conglomerates of Grindstone group as found in its type district. Maximum thickness (near Chrome) about 4,000 feet, farther south, group diminishes in thickness. owing chiefly to an overlap on its eastern border by beds of Shasta series. Extends both longitudinally and laterally beyond limits of older Knoxville groups (Grindstone and Elder Creek) and rests unconformably upon pre-Knoxville terrains in distinct overlaps, which in many areas are emphasized by basal conglomerates. Strata of this group occur in many areas, both within and outside the Great Valley. A number of these areas are discussed.

Type area: Well exposed near Newville, Glenn County.

†New York System[1]

Cambrian, Ordovician, Silurian, and Devonian: New York.

Original reference: E. Emmons, 1842, Geology New York, pt. 2, div. 4, Geol. 2d dist., p. 99, 429.

New York City Group

Precambrian or Paleozoic (pre-Upper Devonian): Southeastern New York and western Connecticut.

D. M. Scotford, 1956, Geol. Soc. America Bull., v. 67, no. 9, p. 1158–1159, pl. 1. Poundridge area, Westchester County, is underlain by Poundridge and Siscowit granites and New York City group comprising Fordham gneiss, Inwood marble, and Manhattan formation. Group is a conformable sequence either of entirely Precambrian or Paleozoic (pre-Upper Ordovician) age. Name New York City group credited to J. J. Prucha (ms. in preparation).

J. J. Prucha, 1956, Am. Jour. Sci., v. 254, no. 11, p. 672–674. Proposed for sequence of metamorphic rocks consisting of (ascending) Fordham gneiss, Inwood marble, and Manhattan formation. Name Manhattan schist is considered inappropriate for highest formation of group because much of formation is not schist. Name Manhattan group has long been applied to these formations (Stevens, 1897; Merrill, 1890, Am. Jour. Sci., 3d, v. 39) although in late years term has been little used. It is convenient to retain a group name for these formations, but use of the same name for group as for formation within the group violates the code of American Commission on Stratigraphic Nomenclature. Although term Manhattan group was proposed before Manhattan as formation name, the latter use is more firmly established; therefore, it is proposed that term Manhattan group be abandoned and unit be renamed New York City group. Age of New York City group has never been determined definitely. Recognition of Fordham gneiss as part of the group, and the nonexistence of "Lowerre quartzite" invalidate any correlation based upon presumed similarities in stratigraphic sequences between New York City group and Cambro-Ordovician series north of Hudson Highlands. It seems likely that a correlation will have to be made by way of Connecticut, Massachusetts, and Vermont rather than directly across the Highlands.

J. W. Clarke, 1956, (abs.) Geol. Soc. America Bull., v. 67, no. 12, pt. 2, p. 1812; 1958, Connecticut Geol. and Nat. History Survey Quad. Rept. 7, p. 4, 15–16, geol. map. Geographically extended into Danbury and Bethel quadrangles, Connecticut. To east and south of group is Hartland formation. In fault contact with units of Precambrian highlands which include gneissic granite and trondhjemite; hornblende gneiss and amphibolite; and Danbury augen granite.

Name proposed for area south of Hudson Highlands, in southeastern New York. Area includes Manhattan, Bronx, Westchester, and Putnam Counties.

Neylandville Marl (in Navarro Group)[1]

Neylandville Marl (in Taylor Group)

Upper Cretaceous (Gulf Series): Northeastern Texas.

Original reference: L. W. Stephenson and W. S. Adkins, 1933, Texas Univ. Bull. 3232, p. 488, 516.

L. W. Stephenson, 1941, Texas Univ. Bur. Econ. Geology Pub. 4101, p. 17–20. Consists of 150 to 300 feet of gray sandy, calcareous clay or marl that unconformably overlies Taylor marl, and underlies Nacatoch sand.

D. L. Frizzell, 1954, Texas Univ. Bur. Econ. Geology Rept. Inv. 22, p. 48–49. Reallocated to Taylor group. Reallocation made on basis of Foraminifera, which are herein discussed.

Type exposures are along Bankhead Highway between Liberty School and Neylandville, 3 to 6 miles in airline northeast of Greenville, and in first cut of Texas Midland Railway, west of Neylandville Station, Hunt County.

Ngardok (Galdog) Beds

Ngardok Member (of Aimeliik Formation)

Eocene: Caroline Islands (Babelthuap)

Risaburo Tayama, 1935, Tohoku Univ. Inst. Geology and Paleontology in Japanese Language, p. 13, 17, 39–40 [English translation in library of U.S. Geol. Survey, p. 20, 46]; 1939, Japanese Jour. Geology and Geography Trans. and Abs., nos. 1–2, p. 29; 1952, Coral reefs in the South Seas: Japan Hydrog. Office Bull., v. 11, p. 64–65, table 4 [English translation in library of U.S. Geol. Survey, p. 76–77]. Thick complex of well-bedded greenish-colored tuffaceous shales and sandstones. Overlies Babelthuap formation with contact probably faulted.

U.S. Army Corps of Engineers, 1956, Military geology of Palau Islands, Caroline Islands: U.S. Army Corps of Engineers, Far East, p. 44, 45, pls. 4, 8, 9. Uppermost member of Aimeliik formation. Andesitic-basaltic tuff, lapilli tuff, and volcanic breccia. Tuff is well bedded: beds range from 1 inch to 40 feet in thickness. Overlies Ngarsul member.

Exposed in vicinity of Nagardok Lake.

Ngarekeukl Limestone

Recent: Caroline Islands (Peleliu).

Risaburo Tayama, 1939, Correlation of the strata of the South Sea Islands: Geol. Soc. Japan Jour., v. 46, no. 549 (correlation chart) [English translation in library of U.S. Geol. Survey]; 1951, Tohoku Univ. Inst. Geology and Paleontology Short Papers no. 3, p. 103, 105; 1952, Coral reefs in the South Seas: Japan Hydrog. Office Bull., v. 11, p. 67, table 4 [English translation in library of U.S. Geol. Survey, p. 80]. Ngarekeukl (Garukiyoku or Galkyoku) composed mainly of coral limestone with erect reef-building corals. Cannot be distinguished from older Pelelilu limestone on basis of lithology.

Typically developed on coast of Ngarekeukl, Peleliu.

Ngaremlengui Formation

See Almongui Agglomerate.

Ngarsul Member (of Aimeliik Formation)

Eocene: Caroline Islands (Palau).

U.S. Army Corps of Engineers, 1956, Military geology of Palau Islands, Caroline Islands: U.S. Army Corps of Engineers, Far East, p. 42–44, pl. 8. Consists of andesitic-basaltic volcanic breccia, tuff breccia, and tuff, including interbedded Galap tuff submember (new). Predominating rock types are light- to dark-colored fine to coarsely crystalline andesites and basalts. Constitutes greater part of formation which is about 2,000 feet thick (overlying Ngardok member probably not more than 500 feet thick). Overlies Babelthuap formation.

Occurs extensively in northeastern, eastern, and southern Babelthuap, and western part of Koror.

Ngeremlengui Formation

Eocene, upper or Oligocene: Caroline Islands (Palau).

U.S. Army Corps of Engineers, 1956, Military geology of Palau Islands, Caroline Islands: U.S. Army Corps of Engineers, Far East, p. 45–49, pls. 4, 8, 9. Consists of andesitic and dacitic volcanic breccia together with tuffs, flows, conglomerates, and related sediments. Thickness 2,000 to 4,000 feet. Consists of (ascending) Nghemesed, Medorm, and Arakabesan members (all new). Overlies Aimeliik formation; stratigraphically below Palau limestone.

Type locality: In Ngeremlengui municipality in vicinity of Rois Mlungi, 1½ miles north-northeast of Karamado Bay, Babelthuap.

Nghemesed Member (of Ngeremlengui Formation)

Eocene, upper, or Oligocene: Caroline Islands (Palau).

U.S. Army Corps of Engineers, 1956, Military geology of Palau Islands, Caroline Islands: U.S. Army Corps of Engineers, Far East, p. 46–47. Consists chiefly of volcanic breccia and flow breccias. Thickness about 350 feet at type location. Grades upward into Medorm member; overlies Aimeliik formation.

Type locality: At Nghemesed pier at east entrance to Karamado Bay.

Niagara Group,[1] Limestone,[1] or Dolomite[1]

Niagara Series

Niagaran Group, Series

Middle Silurian: New York, Illinois, Indiana, Iowa, Michigan, Ohio, and Wisconsin.

Original references: J. Hall, 1842, Am. Jour. Sci., 1st ser., v. 42, p. 52, 57–62; 1843, Geology of New York, pt. 4.

Tracy Gillette, 1940, New York State Mus. Bull. 320, p. 26–101. From time of earliest State report, term Niagaran has been in every classification of New York Silurian, but its meaning has not been constant. At times it has been limited to single formation such as Niagara limestone or Niagara shale. In other instances, it has been enlarged to include whole Silurian section from base of Queenston to lowest layers of the Salina. According to Silurian classification by Hall (1843), name Niagara should be used as group term covering formations from top of Clinton to base of Onondaga salt group. In this report, term Niagaran series is used to include Lockport dolomite above and Clinton group (includes strata from base of Thorold sandstone to top of Rochester shale). Formations constituting series are a well-marked lithologic unit of limestones and shales, which are distinct from Medinan sandstones and sandy shales beneath and Cayugan salt and gypsum-bearing shales above. Niagaran is represented by fossiliferous shales and limestones of normal marine period. Thus, Niagaran is a lithologic, a stratigraphic, and a faunal unit.

C. K. Swartz and others, 1942, Geol. Soc. America Bull., v. 53, no. 3, chart 3. Silurian comprises (ascending) Albion, Niagaran, and Cayugan series.

D. W. Fisher, 1954, Am. Assoc. Petroleum Geologists Bull., v. 38, no. 9, p. 1979–1996. Silurian system exclusive of Cayugan divided into (ascending) Medina(n), Clinton(ian), and Niagara(n) groups, the three comprising the Ontarian series. In New York, the Niagaran group includes the Lockport and Guelph interval.

D. W. Fisher, 1959, New York State Mus. Sci. Service Geol. Survey Map and Chart Ser. No. 1. New York Silurian, standard reference section for United States, is divided into two series Niagaran (older) and Cayugan. Niagaran series divided into four stages (ascending) Lewiston(ian), Ontario(an), Tonawanda(n), and Lockport(ian).

Named for exposures in Niagara County, N.Y.

†Niagara Limestone[1]

Silurian: New York.

Original reference: L. Vanuxem, 1839, New York Geol. Survey 3d Rept., p. 248.

†Niagara Sandstone[1]

Silurian: Western New York.

Original reference: T. A. Conrad, 1837, New York Geol. Survey 1st Rept., p. 166–172.

Developed in course of Niagara River.

†Niagara Shale[1]

Silurian: New York.

Original reference: T. A. Conrad, 1839, Philadelphia Acad. Nat. Sci. Jour., v. 8, pt. 1, p. 228–235.

Niagara Gulch Latite (in Silverton Volcanic Series)[1]

Miocene: Southwestern Colorado.

Original reference: W. Cross and E. Howe, 1905, U.S. Geol. Survey Geol. Atlas, Folio 120.

Named for Niagara Gulch, east of Eureka, San Juan County.

Niakogon Tongue (of Chandler Formation)

Upper Cretaceous: Northern Alaska.

George Gryc, W. W. Patton, Jr., and T. G. Payne, 1951, Washington Acad. Sci. Jour. v. 41, no. 5, p. 164, figs. 2, 3. Upper part of nonmarine Chandler formation (new). Thickness in southern part of outcrop area about 1,700 feet; wedges out northward. A persistent conglomerate bed, characterized by greater percentage of white quartz pebbles than is found in other conglomerates in region, forms top bed of tongue. Underlies Seabee member (new) of Schrader Bluff formation (new); overlies Topagoruk member (new) of Umiat formation (new). Lower(?) Cretaceous.

R. L. Detterman *in* George Gryc and others, 1956, Am. Assoc. Petroleum Geologists Bull., v. 40, no. 2, p. 240–241, figs. 3, 4, 5. Upper of two major nonmarine tongues of formation. Separated everywhere from Killik tongue (new) (formerly the Hatbox tongue) by at least a thin section of marine Ninuluk formation (new). Entire tongue grades northeastward into Ninuluk formation. Lithologically similar to Killik tongue [great abundance of thick-bedded sandstones], predominantly of "salt-and-pepper" type. Upper part of tongue contains considerable amount of yellow-red highly iron-stained sandstone. Thin stringers of conglomerate associated with some sandstone in upper part. Bentonite present in upper part. Siltstone, silt shale, and clay shale constitute about 50 percent of entire section. Referred to basal Upper Cretaceous.

Type locality: Niakogon Buttes, between Chandler and Anaktuvuk Rivers, in Northern Foothills section of Arctic Foothills province.

Nicely Shale (in Mowich Group)

Lower Jurassic: East-central Oregon.

R. L. Lupher, 1951, Geol. Soc. America Bull., v. 52, no. 2, p. 227 (table 1), 229, 239, 242. Consists of fairly uniform dark-gray to black sandy shale with occasional spheroidal black calcareous concretions, some as much as 2 feet in diameter. Thickness 134 to 228 feet; pinches out beneath younger formations. Conformably overlies Suplee formation (new); overlain by Colpitts group (new) in type area and by Hyde formation (new) eastward in South Fork Valley.

Type area: Along headwaters of South Fork of Beaver Creek, 7 miles southeast of Suplee post office, in secs, 26, 27, 28, and 29, T. 18 S., R. 26 E. Named for old Nicely homestead on upper Beaver Creek, in sec. 29, T. 18 S., R. 26 E., Crook County.

Nicely Run Siltstone and Shale (in Kittanning Formation)

Pennsylvanian: Western Pennsylvania.

R. R. Dutcher and others, 1959, Geol. Soc. America Guidebook for Field Trips Pittsburgh Mtg., p. 73 (table 1), 87 (fig. 15), 88 (fig. 16). Shown on stratigraphic sections in Kittanning formation above what is termed Middle Kittanning complex. Includes Nicely Run coal at top. Overlies Middle Kittanning coal.

Exposed northeast of Hamilton, Jefferson County, and east of Luthersburg, Clearfield County.

Nicholas Limestone Member (of Cynthiana Formation)[1]

Middle Ordovician: North-central Kentucky and southwestern Ohio.

Original reference: A. F. Foerste, 1909, Denison Univ. Sci. Lab. Bull. 14, p. 209, 210, 294, 297.

A. C. McFarlan and W. H. White, 1948, Am. Assoc. Petroleum Geologists Bull., v. 32, no. 8, p. 1641. Division of the Cynthiana. Medium- to coarse-grained medium- to comparatively heavy-bedded quarry rock, typically developed in Nicholas County, Ky., where it is 35 feet thick, and overlies Millersburg limestone. Widespread facies and includes quarry rock at Cynthiana, River Quarry beds at Cinncinnati, and probably upper and greater part of railroad cut at Greendale Station. On the south, grades into argillaceous rock. Underlies Rogers Gap and partly included in it. Pre-Cincinnatian.

D. K. Hamilton, 1950, Kentucky Geol. Survey, ser. 9, Bull. 5, p. 18. All subdivisions of interval between top of Benson limestone and base of Eden formation should be referred to as members of Cynthiana. This includes lithologic and paleontologic units heretofore defined as Brannon, Woodburn, Greendale, Millersburg, Nicholas, Rogers Gap, Bromley, and Gratz.

L. H. Lattman, 1954, Am. Jour. Sci., v. 252, no. 5, p. 260, 265. Suggested that lowest occurrence of *Cryptolithus tesselatus* marks base of Nicholas member; top of Nicholas is marked by first appearance of *Eridorthis nicklesi*. Beds below *Cryptolithus tesselatus* zone carry a typical Greendale fauna; it is suggested that name Greendale be applied to these beds. Cincinnati series should be extended downward to embrace Cynthiana formation.

Named for Nicholas County, Ky., where it is well exposed southwest of Pleasant Valley.

Nichols Shale
Nichols Slate[1] } (in Chilhowee Group)

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

Original reference: A. Keith, 1895, U.S. Geol. Survey Geol. Atlas, Folio 16, p. 3.

G. W. Stose and A. J. Stose, 1947, Am. Jour. Sci., v. 245, p. 628–629 (fig. 1). Included in Cochran quartzite in Hot Springs area, North Carolina.

S. S. Oriel, 1950, North Carolina Div. Mineral Resources Bull. 60, p. 12, 13 (table 3), 18. Rocks mapped by Keith (1904, U.S. Geol. Survey Geol. Atlas, Folio 116) as quartzite lentil and lower part of Nichols slate as Cochran conglomerate are included in Unicoi formation in this report [Hot Springs Window area].

John Rodgers, 1953, Tennessee Div. Geology Bull. 58, pt. 2, p. 35 (table 3), 38–39; pt. 1, pls. Nichols shale described and mapped in eastern Tennessee where it is 800 to 1,000 feet thick. Overlies Cochran conglomerate; underlies Nebo sandstone. Keith (1895) called the unit Nichols shale but lated referred to it as slate. Lower Cambrian.

R. B. Neuman and R. L. Wilson, 1960, U.S. Geol. Survey Geol. Quad. Map GQ–131. Described in Blockhouse quadrangle, Tennessee, where it consists of gray fissile argillaceous siltstone and fine-grained sandstone 100 to 600 feet thick. Overlies Cochran formation; underlies Nebo quartzite. Lower Cambrian(?).

Named for Nichols Branch of Walden Creek at eastern end of Chilhowee Mountain, Sevier County, Tenn.

Nicholville Conglomerate Member (of Potsdam Sandstone)

Upper Cambrian: Northeastern New York.

A. W. Postel, A. E. Nelson, and D. R. Wiesnet, 1959, U.S. Geol. Survey Quad. Map GQ-123. Friable red quartz-pebble conglomerate with intercalated sand lenses; crossbedding and local unconformities common. Underlies and probably interfingers with unnamed upper member. Base not exposed; believed to unconformably overlie Precambrian.

Type section: Gorge of St. Regis River, at Nicholville, Nicholville quadrangle, St. Lawrence County. Crops out in a reentrant in Precambrian boundary.

Nickwacket or Nickwackett Graywacke

See **Nickwaket Graywacke.**

Nickwaket Graywacke[1]

Nickwaket Member (of Mendon Formation)

Precambrian: Western Vermont.

Original reference: Arthur Keith, 1932, Washington Acad. Sci. Jour., v. 22, p. 362, 394.

G. W. Bain, 1938, New England Intercollegiate Geol. Assoc. [Guidebook] 34th Ann. Field Mtg., p. 12, 13. Nickwackett graywacke included as uppermost formation in Mendon series in Castleton quadrangle.

Phillip Fowler, 1950, Vermont Geol. Survey Bull. 2, p. 13, 15. Age of Nickwacket graywacke designated either Precambrian or Lower Cambrian.

W. F. Brace, 1953, Vermont Geol. Survey Bull. 6, p. 30, 33, 34. Nickwacket reduced to member status in Mendon formation. Overlies Forestdale member. Thickness 25 to 800 feet in Rutland area.

P. H. Osberg, 1959, New England Intercollegiate Geol. Assoc. Guidebook 51st Ann. Mtg., p. 47. Included in Pinnacle formation of this report [Coxe Mountain area, Vermont].

Well exposed on Nickwaket Mountain in southwestern corner Rochester quadrangle, Rutland County.

Nicollet Creek Member (of St. Lawrence Formation)

Upper Cambrian (St. Croixian): Southeastern Minnesota.

C. R. Stauffer, G. M. Schwartz, and G. A. Thiel, 1939, Geol. Soc. America Bull., v. 50, no. 8, p. 1238 (table 2), 1239–1240. Glauconitic dolomite, probably 30 to 40 feet thick; includes shales and conglomerates below quarry beds at old type section of St. Lawrence formation. Underlies Lodi member; overlies Bad Axe member of Franconia. [Probably replaces name Judson member.]

C. R. Stauffer and G. A. Thiel, 1941, Minnesota Geol. Survey Bull. 29, p. 30, 45. Type section designated.

C. A. Nelson, 1956, Geol. Soc. America Bull., v. 67, no. 2, p. 171. Term Black Earth dolomite used for basal member of St. Lawrence; this follows usage of Ulrich (1916). Examination of type section of Nicollet Creek shows that all but the upper 10½ feet is uppermost Franconia. Suggests that Nicollet Creek be abandoned on grounds of stratigraphy and priority.

Type section: Along Nicollet Creek which enters Minnesota River from north, nearly opposite village of Judson, Nicollet County.

Nigger Canyon Volcanics

Pleistocene: Southern California.

J. F. Mann, Jr., 1955, California Div. Mines Spec. Rept. 43, p. 3, 9, 15, pl. 1. Series of tuffs, agglomerates, dikes, and flows. Thickness as much as 100 feet. Considered younger than Pauba formation (new).

Occurs near mouth of Nigger Canyon in Elsinore fault zone in western Riverside County.

Niguel Formation

Pliocene: Southern California.

J. G. Vedder, 1956, *in* Pacific Petroleum Geologist, v. 10, no. 2, p. 3. Incidental mention.

J. G. Vedder, R. F. Yerkes, and J. E. Schoellhamer, 1957, U.S. Geol. Survey Oil and Gas Inv. Map OM–193. In type area, composed mainly of light-gray friable micaceous sandstone with interbedded gray sandy siltstone; breccia and conglomerate locally present at or near base of formation; upper part of formation may be nonmarine in origin. Maximum thickness about 350 feet. Unconformably overlies both Capistrano formation and Monterey shale; underlies Quaternary terrace deposits.

Type area: Immediately west of Galivan Overpass on U.S. Highway 101 about 4½ miles north of San Juan Capistrano, Orange County. Named for Niguel land grant on San Juan Capistrano quadrangle.

Nikolai Greenstone[1]

Nikolai Formation

Permian and Triassic(?): Eastern Alaska.

Original reference: O. Rohn, 1900, U.S. Geol. Survey 21st Ann. Rept., pt. 2, p. 425–432.

H. E. Wheeler, 1939, 6th Pacific Sci. Cong. Proc., p. 374. Represents 4,000 feet or more of altered basic lavas in Mount Wrangell district. Permian.

J. T. Dutro, Jr., and T. G. Payne, 1957, Geologic map of Alaska (1:2,500,000): U.S. Geol. Survey. Appears on map legend.

In Nizina-Tanana region

Nikolai Creek Glaciation

Pleistocene (late Wisconsin): Central southern Alaska.

D. B. Krinsley *in* T. L. Péwé and others, 1953, U.S. Geol. Survey Circ. 289, p. 6, 13 (table 1). Southwest part of Kenai Peninsula glaciated three or more times during Quaternary period. Nikolai Creek succeeded Naptowne glaciation. Prominent moraine is evidence of glacial advance. Drift of the glaciation is thin; till generally coarse grained and contains numerous granite boulders.

Moraine is near Nikolai Creek at Tustumena Lake and can be traced south along eastern flanks of Caribou Hills and southwest along northwest bluffs of Kachemak Bay to within 10 miles of Homer.

Niland Tongue (of Wasatch Formation)

Eocene, lower: Southwestern Wyoming.

G. N. Pipiringos, 1955, Wyoming Geol. Assoc. Guidebook 10th Ann. Field Conf., p. 100, 101 (chart), 102. Sequence of coal beds, clay shale, siltstone, sandstone, and low-grade oil shale. In type area, contains four coal zones (ascending) Kelley, Luman, Hay, and Bush. Thickness in type area about 400 feet; thins westward to about 325 feet in Luman Butte area. Underlies Tipton tongue and overlies Luman tongue (new), both of Green River formation, with conformable contacts. Intertongues with Battle Spring formation (new) to north.

Type area: SW¼ T. 24 N., R. 95 W., and SE¼ T. 24 N., R. 96 W., Sweetwater County. Named for rocks which crop out at southern margin of structural basin called Niland Basin and along north side of Lost Creek Flat. Named from Niland's Spring in sec. 23, T. 25 N., R. 96 W.

Niles Canyon Formation

Lower Cretaceous: Northern California.

C. A. Hall, Jr., 1956, Dissert. Abs., v. 16, no. 12, p. 2426. Incidental mention; overlies Claremont shale; underlies Del Valle formation (new).

C. A. Hall, Jr., 1958, California Univ. Pubs. Geol. Sci., v. 34, no. 1, p. 8–11, fig. 2, geol. map. Consists of sandstone, sandy shale, and some conglomerate stringers. Two members are distinguishable at certain localities. Lower member, which comprises greater part of formation and is well exposed in Niles, Stonybrook, and Sinbad Canyons, is principally shale or siltstone with interbedded sandstone and a few lenses of conglomerate; interbedded sandstone is fine to coarse grained, well indurated, massive, but is commonly thinly bedded; massive beds are 10 or more feet thick, whereas thinly bedded sandstone is in layers 2 to 12 inches thick. Upper member lacks shale and siltstone and cannot be traced into Niles Canyon area. Thickness in question because of faulting, overturning, and folding; approximately 4,000 feet in Main-Pleasanton Ridge area; about 5,500 feet in Niles Canyon; north of Niles Canyon, a 7,500-foot section lies between eastern branch of Mission fault and Stonybrook fault. Conformably overlies Oakland conglomerate; underlies Del Valle formation in Sunol Ridge area; unconformably underlies Claremont shale in Niles quadrangle; underlies Briones and Sobrante sandstones with slight angular discordance. Rocks here referred to Niles Canyon formation were originally assigned to Chico formation by earlier workers. Crittenden (1951) stated that rocks in Pleasanton and San Jose quadrangles were not a part of Chico and renamed them Berryessa formation. Neither name is considered appropriate; hence, Niles Canyon is herein proposed.

Type locality: In Niles Canyon along Alameda Creek, between Niles and Stonybrook Road, secs. 15, 10, 11, T. 4 S., R. 1 W., Alameda County; neither stratigraphic top or base exposed. Formation has continuous northwest-southeast trend for approximately 8 miles along Walpert Ridge and other ridges to Niles Canyon: also exposed from Niles Canyon to border of area near Calaveras Reservoir.

Nilkoka Group[1]

Precambrian: Eastern Alaska.

Original reference: A. H. Brooks, 1900, U.S. Geol. Survey 20th Ann. Rept., pt. 7, p. 472, 480, 483.

Exposed on bluffs of lower Tanana River between Nilkoka Creek and Baker Creek.

Nimrod Limestone (in Cisco Group)[1]

Pennsylvanian: Central northern Texas.

Original reference: F. B. Plummer, 1919, Am. Assoc. Petroleum Geologists Bull., v. 3, p. 136.

Named for exposures near Nimrod, Eastland County.

Nimrod Shale (in Pueblo Formation)[1]

Pennsylvanian: Central northern Texas.

Original reference: F. Bradish, 1929, Texas Bur. Econ. Geology, geol. map.

In Shackelford, Stephens, and Eastland Counties, Brazos River region.

Ninemile Formation (in Pogonip Group)

Lower Ordovician: Central Nevada.

T. B. Nolan, C. W. Merriam, and J. S. Williams, 1956, U.S. Geol. Survey Prof. Paper 276, p. 27–28, pl. 2. Platy and thin-bedded fine-grained to porcellaneous limestone of medium-gray color, which, on fresh fracture, exhibits an olive-green or greenish-blue cast. Shale and limy-shale partings likewise show this distinctive color. Includes beds of light-gray crystalline sandy limestone and limy sandstone. Ranges in thickness from less than 200 feet to more than 500 feet in Antelope Valley area; about 540 feet thick at type locality. Contacts with overlying Antelope Valley limestone (new) and underlying Goodwin limestone are gradational.

Type locality: Mouth of Ninemile Canyon, where unit is well exposed and from which it gets its name, on west side of Antelope Range near its north end, vicinity of Eureka, Eureka County.

Nineveh Limestone Member (of Greene Formation)[1]

Permian: Eastern Ohio, western Pennsylvania, and northern West Virginia.

Original reference: I. C. White, 1891, U.S. Geol. Survey Bull. 65, p. 22, 32–33.

Wilber Stout, Karl Ver Steeg, and G. F. Lamb, 1943, Ohio Geol. Survey, 4th ser., Bull. 44, chart facing p. 108. Shown on generalized section of Ohio as 8 feet of limestone. Separated from overlying Nineveh sandstone by 10 feet of shale and Nineveh coal; separated from underlying Fish Creek sandstone by Hostetter and Fish Creek coals.

R. L. Nace and P. P. Bieber, 1958, West Virginia Geol. Survey Bull. 14, p. 17 (table 2). Listed in summary of stratigraphic section of Dunkard group in Harrison County, W. Va. Underlies unnamed shale below Nineveh coal; overlies unnamed shale above Burton sandstone.

Type locality and derivation of name not given.

Nineveh Sandstone Member (of Greene Formation)[1]

Permian: Eastern Ohio, western Pennsylvania, and northern West Virginia.

Original reference: I. C. White, 1891, U.S. Geol. Survey Bull. 65, p. 22, 32.

Wilber Stout, Karl Ver Steeg, and G. F. Lamb, 1943, Ohio Geol. Survey, 4th ser., Bull. 44, chart facing p. 108. Shown on generalized section of Ohio as 52 feet of sandstone underlying Gilmore limestone and separated from underlying Nineveh limestone by Nineveh coal.

R. L. Nace and P. P. Bieber, 1958, West Virginia Geol. Survey Bull. 14, p. 17 (table 2). Listed in summary of stratigraphic section of Dunkard group in Harrison County, W. Va., as sandstone 20 to 25 feet thick.

Named for exposures near Nineveh, Greene County, Pa.

Ninnescah Shale (in Sumner Group)

Ninnescah Shale Member (of Harper Sandstone)

Permian: Southern Kansas and northern Oklahoma.

G. H. Norton, 1937, (abs.) Am. Assoc. Petroleum Geologists Bull., v. 21, no. 12, p. 1557. Basal member of Harper. Underlies Stone Corral member; overlies Milan limestone member of Wellington shale. Near Oklahoma line, lower three-fourths of Ninnescah shale, which totals 290 to 390 feet, grades irregularly and rapidly into sandstones and conglomerates of the Garber of Oklahoma.

G. H. Norton, 1939, Am. Assoc. Petroleum Geologists Bull., v. 23, no. 12, p. 1667–1773. Rank raised to formation. Constitutes basal formation of Cimarron redbeds. Composed largely of red shale; minor amount of gray shale beds and thin impure limestone beds, and beds of calcareous sandstone and sand, which maintain their lithologic character in a wide area; seven of these beds are scarp-forming. About 425 feet thick near Oklahoma line; thins to 280 feet 50 miles farther north. At northernmost outcrop, topmost bed is Runnymede sandstone (new).

R. C. Moore, J. C. Frye, and J. M. Jewett, 1944, Kansas Geol. Survey Bull. 52, pt. 4, p. 159–160. Ninnescah shale assigned to Sumner group, Leonard series.

Named for exposures on both forks of Ninnescah River in south-central Reno and north-central Kingman Counties, Kans.

Ninole Tuff

Pliocene(?): Hawaii Island, Hawaii.

C. K. Wentworth, 1938, Hawaiian Volcano Observatory 3d Spec. Rept., p. 37–38, 134. Thickness 12 feet at type locality of Ninole formation where it occurs about 500 feet below top of a 1,000-foot exposure.

D. A. Davis and G. A. Macdonald *in* Jacques Avias and others, 1956, Lexique Strat. Internat., v. 6, Océanie, fasc. 2, p. 119. Now included in Ninole volcanic series. Pliocene(?).

Interbedded with Ninole basalt on south slope of Mauna Loa.

Ninole Volcanic Series

Ninole Basalt[1]

Pliocene(?): Hawaii Island, Hawaii.

Original reference: H. T. Stearns, 1926, Geol. Soc. America Bull., v. 37, p. 150.

H. T. Stearns and G. A. Macdonald, 1946, Hawaii Div. Hydrography Bull. 9, p. 62 (table), 64 (table), 65 (fig. 17), 66–68. Term Ninole volcanic series replaces older term Ninole basalt. Mostly basaltic lava flows, predominantly massive pahoehoe, with a few beds of aa, as much as 75 feet thick but mostly thinner; bed of plagonitic tuff 2 to 12 feet thick 500 feet below top. Thickness more than 2,100 feet; base not exposed. Overlain with erosional unconformity by Kahuku and Kau volcanic series (both new).

D. A. Davis and G. A. Macdonald *in* Jacques Avias and others, 1956. Lexique Strat. Internat., v. 6, Océanie, fasc. 2, p. 120. Pliocene(?).

Type section: In walls of Ninole Valley, at Puu Enuhe, north of Hilea in Kau district. Crops out in hills between Qaiohinu and Wood Valley, a distance of 15 miles, on southeast slope of Mauna Loa.

Ninos schist[1]

Precambrian: Central northern New Mexico.

Original references: C. R. Keyes, 1915, Iowa Acad. Sci. Proc., v. 22, p. 257–259; 1915, Conspectus of geologic formations of New Mexico: Des Moines, Robert Henderson, State Printer, p. 4, 10.

In Solitario Mountain region, northwest of Las Vegas, San Miguel County. Derivation of name not given.

Ninuluk Formation (in Nanushuk Group)

Upper Cretaceous: Northern Alaska.

R. L. Detterman *in* George Gryc and others, 1956, Am. Assoc. Petroleum Geologists Bull., v. 40, no. 2, p. 241–244, figs. 4, 5. Greenish gray siltstone, silt shale, and dark blue-gray clay shale constitute about 60 percent of sequence. Coarse clastics account for most of remainder. Several thick sandstone units present near top of formation. Stringers and lenses of grit-pebble conglomerate present at intervals throughout coarser clastic units. Sandstone grades from "salt-and-pepper" through various shades of gray and yellow-red. Most have distinct greenish cast. Thickness at type locality 657 feet, and in addition 261 feet of interfingering nonmarine Niakogon tongue of Chandler formation are well exposed in about middle of entirely marine Ninuluk formation. Unconformably underlies Seabee formation; conformably overlies Grandstand formation (new) and nonmarine Killik tongue (new) of Chandler formation.

Type locality. On right bank of Colville River at Ninuluk Bluffs 20 miles downstream from junction of Killik and Colville Rivers, lat 69°08′ N., long 153°18′ W.

Niobrara Formation,[1] **Limestone,**[1] **Shale,** or **Chalk** (in Colorado Group)
Niobrara Shale Member (of Mancos Shale or Cody Shale)

Upper Cretaceous: Nebraska, Colorado, Kansas, Minnesota, Montana, New Mexico, North Dakota, South Dakota, and Wyoming.

Original reference: F. B. Meek and F. V. Hayden, 1862, Philadelphia Acad. Sci. Proc., v. 13, p. 419–422.

W. W. Rubey, 1930, U.S. Geol. Survey Prof. Paper 165. Subdivided into Sage Breaks shale and Beaver Creek chalky members.

R. L. Griggs, 1948, New Mexico Bur. Mines Mineral Resources Ground-Water Rept. 1, p. 30–33. In Colfax County, N. Mex., formation is about 950 feet thick, conformably overlies Carlile shale and conformably underlies Pierre shale. Comprises Fort Hays limestone and Smoky Hill marl members. Fort Hays limestone believed to be equivalent to part of Timpas limestone of previous usage, and Smoky Hill marl approximately equivalent to Apishapa shale.

C. H. Dane, 1948, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 78. In Rio Arriba County, N. Mex., Niobrara is considered member of Mancos shale. Thickness about 600 feet. Overlies Carlile shale member; underlies an unnamed shale member at top of Mancos.

W. A. Cobban, 1951, Am. Assoc. Petroleum Geologists Bull., v. 35, no. 10, p. 2170, 2187, 2192–2195, 2196–2198; W. A. Cobban and J. B. Reeside, Jr., 1952, Am. Assoc. Petroleum Geologists Bull., v. 36, no. 10, p. 1948–1949. Formations in Black Hills that are equivalent to Colorado shale of central and northwestern Montana are (ascending) Fall River sandstone, Skull Creek shale, Newcastle sandstone, Mowry shale, Belle Fourche shale, Greenhorn formation, Carlile shale, and Niobrara formation. In northern Black Hills, Niobrara consists chiefly of gray chalk marl that weathers creamy, pale yellow, or orange; thin layers of bentonite abundant; dark-gray noncalcareous shale partings present near base and top of formation. Sage Breaks shale reallocated to member status in Carlile shale.

As corollary to above action, U.S. Geological Survey has abandoned the term Beaver Creek chalky member of Niobrara; hence Niobrara in some areas is undifferentiated.

P. W. Richards and C. P. Rogers, Jr., 1951, U.S. Geol. Survey Oil and Gas Inv. Map OM–111. In Hardin area, Big Horn and Yellowstone Counties, Mont., Niobrara is considered shale member of Cody shale. Thickness 409 feet. Underlies Telegraph Creek member; overlies Carlile shale member.

W. A. Cobban and J. B. Reeside, Jr., 1952, Geol. Soc. America Bull., v. 63, no. 10, chart 10b (column 21). In Raton region, New Mexico, formation includes (ascending) Timpas limestone and Apishapa shale members. Overlies Carlile shale and underlies Pierre shale.

A. B. Shaw, 1957, Rocky Mountain Assoc. Geologists Guidebook to the geology of North and Middle Park Basin, Colorado, p. 49 (fig. 1), 50. Correlation chart shows various relationships: North Park, Colo., Niobrara formation comprises lower unnamed shale member and Smoky Hill member; overlies Frontier formation; Laramie basin, formation comprises (ascending) lower shale member, lower chalky member, upper shale member, and upper chalky member; overlies Wall Creek sandstone member of Frontier formation; underlies Steel shale; northern Front Range, formation comprises Timpas limestone and Apishapa shale members; overlies Benton shale.

M. A. Jenkins, Jr., 1957, Rocky Mountain Assoc. Geologists Guidebook to the geology of North and Middle Park Basin, Colorado, p. 53, pl. 1. Formation described in Red Dirt area, Grand County, Colo., where it is divided into Fort Hays and Smoky Hill members. Believed that names Fort Hays and Smoky Hill have priority over terms Timpas and Apishapa; use of former terms would help standardize Niobrara terminology in west-central Colorado.

W. J. Mapel, 1959, U.S. Geol. Survey Bull. 1078, p. 48–49. Described in Buffalo-Lake De Smet area, Johnson and Sheridan Counties, Wyo., where it is classified as member of Cody shale. Thickness 985 feet. Overlies Carlile shale member; underlies unnamed sandstone and shale member.

J. M. Jewett, 1959, Graphic column and classification of rocks in Kansas: Kansas Geol. Survey. Chart shows Niobrara chalk in Colorado group comprises (ascending) Fort Hays limestone and Smoky Hill chalk members. Underlies Sharon Springs shale member of Pierre shale and overlies Codell sandstone member of Carlile shale.

H. E. Simpson, 1960, U.S. Geol. Survey Prof. Paper 328, p. 12 (table 1), 21–29, pl. 1. Formation described in Yankton area, South Dakota and Nebraska, where it is 182 feet thick and comprises Fort Hays limestone and Smoky Hill chalk members. Overlies Carlile shale; underlies Pierre shale.

Named for exposures along Missouri River near mouth of Niobrara River, Knox County, Nebr.

†Niobrara Group[1]

Miocene, Pliocene, and later(?): Northern Nebraska, eastern Colorado, and eastern Wyoming.

Original reference: O. C. Marsh, 1875, Am. Jour. Sci., 3d, p. 51–52, pl. 9.

Niobrara River cuts through typical strata for more than 200 miles.

Niobrara River Channel Sands (in Valentine Formation)

Pliocene: Northwestern Nebraska.

M. K. Elias, 1942, Geol. Soc. America Spec. Paper 41, p. 137. Name applied to channel sands from which Niobrara fauna of Stirton and McGrew (1935, Am. Jour. Sci., 5th ser., v. 29, no. 170) was collected. Age of fauna is regarded as transitional from Miocene to Pliocene with some emphasis to Miocene relations; however, geologists and paleontologists of Nebraska prefer to place the Miocene-Pliocene boundary at base of Valentine formation.

Fauna was collected from the so-called Railroad quarries, on south side of Niobrara River, south of Valentine, Cherry County.

Niobrara River Formation[1]

Pliocene: Nebraska, Colorado, and Wyoming.

Original reference: H. F. Osborn, 1918, Am. Mus. Nat. History Mem., new ser., v. 2, pt. 1, p. 9, 23, 25.

P. O. McGrew and G. E. Meade, 1938, Am. Jour. Sci., 5th ser., v. 36, no. 213, p. 197–207. Discussion of bearing of Valentine area, Nebraska, in continental Miocene-Pliocene correlation. Evidence is presented which supports retention of names Niobrara River, Burge, and Valentine.

F. W. Johnson, 1938, Am. Jour. Sci., 5th, v. 36, no. 213, p. 215–219. Proposed to consider Fort Niobrara and Niobrara River as obsolete and incompatible to good geologic nomenclature. Name Valentine beds should be retained and applied to lower 175 to 225 feet of unconsolidated sands of Ogallala formation in Valentine area, Nebraska.

Type area: On Niobrara River, near Fort Niobrara, Cherry County, Nebr.

Nipper Formation

Upper Cretaceous to Tertiary: Southeastern Arizona.

F. F. Sabins, 1957, Geol. Soc. America Bull., v. 68, no. 10, p. 1323, 1325, pl. 1. Lower half of formation is thick conglomerate of mafic volcanic rocks. The poorly sorted well-rounded cobbles and boulders range up to several feet in diameter, and are tightly cemented in matrix of graywacke sandstone. Very dark purple and green dominant colors. South of Nippers, a 20-foot bed of Paleozoic limestone conglomerate is interstratified with this sequence. Light-weathering aphanitic andesite flows comprise much of upper part of formation. Underlies Faraway formation; overlies Bisbee group at some localities and unconformably overlies upper Paleozoic strata at others.

Type locality: At the Nippers and other hills south of Blue Mountain in southwest corner of Vanar quadrangle, Cochise County. Also forms ridge between Whitetail and Indian Creeks in sec. 20, T. 16 S., R. 30 E., and occurs southwest of Cochise Head, Cochise County.

Nippewalla Group

Permian: Southern Kansas.

G. H. Norton, 1939, Am. Assoc. Petroleum Geologists Bull., v. 23, no. 12, p. 1782–1793. Proposed for group of related formations (ascending): Harper sandstone (restricted), Salt Plain formation, Cedar Hills sandstone, and Flowerpot shale. Lies between Stone Corral formation below and Blaine formation above. Cimarron series.

R. C. Moore, J. C. Frye, and J. M. Jewett, 1944, Kansas Geol. Survey Bull. 52, pt. 4, p. 157–159. Includes (ascending) Harper sandstone, Salt Plain formation, Cedar Hills sandstone, Flowerpot shale, Blaine formation, and Dog Creek shale. Thickness approximately 930 feet. Overlies Sumner group; underlies Whitehorse sandstone. Leonardian.

Named for township of Nippewalla, T. 33 S., Rs. 11 and 12 W., Barber County.

Nipsachuck Gneiss

Precambrian(?): Northeastern Rhode Island.

G. M. Richmond *in* G. M. Richmond and W. B. Allen, 1951, Rhode Island Port and Indus. Devel. Comm. Geol. Bull. 4, p. 10, 11, pl. 1. Light-gray medium-grained equigranular gneiss. Thin quartzite layers locally interbedded. Maximum thickness 1,400 feet. Underlies Absalona formation (new), contact gradational.

Named from exposures on hills southwest of Nipsachuck swamp, Georgiaville quadrangle, Providence County.

Nishnabotna Sandstone[1]

Upper Cretaceous: Southwestern Iowa.

Original reference: C. A. White, 1867, Am. Jour. Sci. 2d, v. 44, p. 27, 31.

Named for East Nishnabotna River.

Nisky Limestone[1]

Middle Ordovician: Eastern Pennsylvania.

Original reference: E. T. Wherry, 1909, Science, new ser., v. 30, p. 416.

Quarried near Nazareth, Northampton County. Derivation of name not stated.

Nittany Dolomite (in Beekmantown Group)[1]

Lower Ordovician: Central Pennsylvania, western Maryland, Tennessee, and western Virginia.

Original reference: E. O. Ulrich, 1911, Geol. Soc. America Bull., v. 22, p. 552, 658, pl. 27.

E. O. Ulrich and G. A. Cooper, 1938, Geol. Soc. America Spec. Paper 13, p. 25. Term Nittany limestone should be abandoned because the three formations constituting it—Longview, Jefferson City, and Cotter—are distinguishable. Middle and Upper Canadian.

B. N. Cooper, 1939, Virginia Geol. Survey Bull. 55, p. 17–20, pls. 1, 3. In Draper Mountain area, formation is composed of light-gray limestone, dolomitic limestone, and dolomite. Consists of two distinct and persistent lithologic types, upon basis of which formation is divided into members: Oglesby marble below and Draper dolomite above. Thickness about 550 feet. Overlies Conococheague formation. In most places directly underlies Mosheim formation; in some areas, a thin representative of Bellefonte formation is present between Nittany and Mosheim. Canadian.

C. E. Prouty, 1948, Am. Assoc. Petroleum Geologists Bull., v. 32, no. 8, p. 1607–1609. Discussion of Trenton and sub-Trenton stratigraphy of northwest belts of Virginia and Tennessee and use of terms Nittany dolomite and Longview limestone in this area. Longview is largely limestone in type region (Alabama). Northwest of Clinch Mountain, Longview equivalent is largely dolomite and has often been referred to Nittany dolomite. In Pennsylvania, Stonehenge limestone underlies and Axemann limestone overlies the Nittany. The Stonehenge, partially homotaxial with the Chepultepec, apparently becomes dolomitic southwestward and shows indefinite relationship with that formation. Presence of Axemann in Virginia and Tennessee has not been established. In Alabama, the Newala limestone overlies the Longview, and, though probably a partial equivalent of post-*Lecanospira* dolomites of Tennessee and Virginia, it has different lithologic characteristics and indefinite boundaries in latter area. Appears best to dispense with the term Nittany in areas where relationships with Stonehenge and Axemann (Bellefonte in local absence of Axemann) are indefinite and to dispense with term Longview where definite relationship with Newala is unknown. A new formation name is needed in northeast Tennessee and southwest Virginia since redefinition of Longview or Nittany in that area would not clarify relationships to type areas of these units. Thickness of Nittany 275 feet along Bird Creek, Norris Reservoir region, Tennessee.

Name for exposures in Nittany Valley, Centre County, Pa.

†Nittany Valley Limestone[1]

Ordovician: Central Pennsylvania.

Original reference: H. M. Chance, 1880, Pennsylvania 2d Geol. Survey Rept. G_4, p. 17–24.

Exposed in Nittany Valley, Clinton County.

Niverton Shale (in Conemaugh Formation)[1]

Pennsylvanian: Southern Pennsylvania and western Maryland.

Original reference: C. K. Swartz, 1922, Maryland Geol. Survey, v. 11, p. 67, 114, pl. 6.

Well exposed on west bank of Castleman River, 1.3 mile south of Niverton, Pa.

Nix Porphyrite

Carboniferous: California.

O. P. Jenkins, 1938, Geologic map of California (1:500,000): California Div. Mines, sheet 4. Shown on map legend.

Nizina Limestone[1]

Upper Triassic: Eastern Alaska.

Original reference: O. Rohn, 1900, U.S. Geol. Survey 21st Ann. Rept., pt.2, p. 429, 431, 435.

J. T. Dutro, Jr., and T. G. Payne, 1957, Geologic map of Alaska (1:2,500,000): U.S. Geol. Survey. Appears on map legend.

In Nizina Tanana region.

Noah Dolomite Member (of Bluebell Formation)

Silurian: Central Utah.

Paul Billingsley *in* J. M. Boutwell, 1933, 16th Internat. Geol. Cong. [United States] Guidebook 17, Excursion C–1, p. 110 (fig. 14). Name appears on stratigraphic column of Tintic district. Uppermost member of formation; overlies Dora member (new); underlies Victoria quartzite.

T. S. Lovering and others, 1949, Econ. Geology Mon. 1, p. 7 (table 1). Upper 70 feet massive blue-gray dolomite, lies on well-bedded gray and blue-gray dolomite containing shaly-bedded planes at base. Thickness 290 feet.

H. J. Bissell, 1959, Utah Geol. Soc. Guidebook 14, p. 144, 145. Noah dolomite of Bluebell formation is equivalent to Simonson dolomite. Proposed that term Simonson dolomite be used in central Utah.

Type locality and derivation of name not stated.

Noah Parker horizon[1]

Lower Cambrian: Northwestern Vermont.

Original reference: G. E. Edson, 1906, Vermont State Geologist 5th Rept., p. 133–135.

Type locality: On farm of Noah Parker, west of highway passing Chase's corners, in Georgia, Franklin County.

Noatak Sandstone

Noatak Formation[1]

Devonian and Mississippian: Northern Alaska.

Original reference: P. S. Smith, 1913, U.S. Geol. Survey Bull. 536, p. 55, 69, 74, map.

T. G. Payne and others, 1951, U.S. Geol. Survey Oil and Gas Inv. Map OM–126, sheet 1. More than 5,000 feet thick on Arctic slope. Top 900 feet is black marine shale with ferruginous limestone at top, argillaceous limestone 150 feet below top, and 160 feet of ferruginous quartz sandstone at base. Of Mississippian age.

J. T. Dutro, Jr., 1953, (abs.) Geol. Soc. America Bull., v. 64, no. 12, pt. 2, p. 1415. Subdivided into five units. Three of these formations occur in western Brooks Range: an Upper Devonian siltstone-shale, Noatak formation (restricted) (Upper Devonian and Lower Mississippian), and a Lower Mississippian ferruginous calcarenite. In central Brooks Range, Upper Devonian siltstone-shale is overlain by thick chert conglomerate, approximately equivalent to Noatak formation (restricted).

J. T. Dutro, Jr., and T. G. Payne, 1957, Geologic map of Alaska (1:2,500,000): U.S. Geol. Survey. Noatak sandstone appears on map legend under both Upper Devonian rocks and Mississippian rocks (lower part).

Type locality: Western part of Noatak Valley between Nimiuktuk and Kugururok Rivers. Occurs most extensively in central and western parts of Noatak Basin.

Noblesville Dolomite[1]

Silurian (Niagaran): Central Indiana.

Original reference: E. M. Kindle, 1904, Indiana Dept. Geology and Nat. Resources 28th Ann. Rept. 407.

Named for Nobleville Township, Hamilton County.

†Nodaway Limestone (in Shawnee Formation)[1]

Pennsylvanian: Northwestern Missouri.

Original reference: J. A. Gallaher, 1898, Missouri Bur. Geology and Mines Bienn. Rept., p. 53.

Named for exposures at Nodaway, Andrew County.

Noel Shale[1]

Noel Shale Member (of Chattanooga Formation)

Upper Devonian and Lower Mississippian: Southwestern Missouri, northwestern Arkansas, and northeastern Oklahoma.

Original reference: J. A. Gallaher, 1898, Missouri Bur. Geology and Mines p. 24.

E. B. Branson, 1938, Missouri Univ. Studies, v. 13, no. 3, p. 8 (fig. 2). Correlation chart gives age as Devonian.

G. G. Huffman and J. M. Starke, Jr., 1960, Oklahoma Geology Notes, v. 20, no. 7, p. 159, 160–163. Geographically extended into northeastern Oklahoma. Assigned to member status in Chattanooga formation. Fissile carbonaceous pyritic bituminous black shale; thin bed of phosphatic sandstone present a few feet above base in some sections. Thickness ranges from few inches near Bunch to more than 65 feet near Spavinow. Conformably overlies Sylamore sandstone member; where Sylamore is absent, the Noel lies with unconformity upon beds ranging in age from Early Ordovician Cotter to Devonian Sallisaw. Equivalent to black shale member of Chattanooga of Tennessee, New Albany of Indiana and Kentucky, Woodford of Oklahoma, Ohio black shale, and the Antrim of Michigan. On basis of conodonts, appears to be Late Devonian and Early Mississippian.

M. G. Mehl, 1960, Denison Univ. Jour. Sci. Lab., v. 45, art. 5, p. 89–92. Includes Roaring River sandstone member (new) at base. In Missouri, from its maximum thickness of about 35 feet in McDonald County, the Noel thins rapidly toward north and east. Unconformably overlies Cotter dolomite in southwestern Missouri; in Barry County, over limited areas, overlies Middle Devonian Fortune formation. Unconformably overlain by Mississippian strata ranging in age from oldest Kinderhookian to early Osagean. Upper Devonian. Type locality designated.

Type locality: About one-half mile south of Noel, McDonald County, Mo.

†Nogal Formation[1]

Permian: Southeastern New Mexico.

Original reference: A. G. Fiedler and S. S. Nye, 1933, U.S. Geol. Survey Water-Supply Paper 639.

Named for occurrence in vicinity of Nogal Canyon, Roswell artesian basin.

No-Ho-Co Formation (in Hoxbar Group)

Pennsylvanian (Missouri Series): Oklahoma (subsurface).

B. H. Harlton, 1960, Am. Assoc. Petroleum Geologists Bull., v. 44, no. 2, p. 210, 213 (fig. 3), 216–217, 218 (fig. 4). Proposed for formation at top of Hoxbar group. Composed of an upper and lower carbonate unit and shale and sandstone interbeds. Upper carbonate unit consists of black ostracodal limestone that is commonly underlain by 10 to 15 feet of fine to coarsely oolitic, sandy limestone: lower limestone, about 20 to 30 feet thick is fine to coarsely oolitic and sandy; intercalated sandstone body which occurs near middle of the two limestones is 20 to 100 feet thick and is mostly calcareous, with scattered very fine to fine brown oolites; locally interdigitates into finely oolitic, sandy limestone. Thickness 120 to 185 feet; locally less than 100 feet.

Name derived from Amerada's No-Ho-Co No. 1, in SW¼SE¼ sec. 2, T. 5 N., R. 10 W., Caddo County.

Noisy Brook Gneiss

Age not stated: West-central Maine.

Kern Jackson, 1953, Maine State Geologist Rept., 1951–1952, p. 53, 62–66. Includes two facies. Central zone consists of coarse-grained crudely banded gneiss. Gneiss grades into marginal facies of silvery blue-gray micaceous schist. Intruded by granite complex. Contains small bodies of aplite and pegmatite.

Named for exposures along Noisy Brook, a small tributary of Swift River 1½ miles north of village of Roxbury, Oxford County. Exposed almost continuously upstream from Highway 17 for 2 miles.

Noix Oolite Member (of Edgewood Limestone)[1]

Noix oolite facies (of Cyrene Member of Edgewood Formation)

Lower Silurian: Northeastern Missouri and southwestern Illinois.

Original reference: C. R. Keyes, 1898, Iowa Acad. Sci. Proc., v. 5, p. 59, 62.

T. J. Laswell, 1957, Missouri Geol. Survey and Water Resources Rept. Inv. 22, p. 18, 19. Rank reduced to facies of Cyrene member of Edgewood formation.

Named for exposures along Noix Creek at Louisiana, Pike County, Mo.

Nolans Limestone (in Chase Group)

Nolans Limestone (in Sumner Group)[1]

Permian: Northwestern Kansas.

Original references: R. C. Moore, 1936, Jour. Geology, v. 44, no. 1, p. 5–9; 1936, Kansas Geol. Soc. 10th Ann. Field Conf. Guidebook, p. 12.

J. M. Jewett, 1941, Kansas Geol. Survey Bull. 39, p. 89–91; R. C. Moore and others, 1951, Kansas Geol. Survey Bull. 89, p. 41. Reallocated to Chase group. Reallocation made on basis of redefinition of Leonard-Wolfcamp boundary; base of Leonard in Kansas is arbitrarily placed at top of Nolans formation which is top of Herington limestone member. Formation includes (ascending) Krider limestone, Paddock shale, and Herrington limestone member. Underlies Wellington shale; overlies Odell shale. Wolfcamp series.

Name derived from Nolans, a railway siding near Emmons, Washington County.

Nolichucky Shale[1] (in Conasauga Group)

Upper Cambrian: Eastern Tennessee, western North Carolina, and southwestern Virginia.

Original reference: A. Keith, 1896, U.S. Geol. Survey Geol. Atlas, Folio 27, p. 2.

John Rodgers, 1943, Geologic map of Copper Ridge district, Hancock and Grainger Counties, Tennessee (1:24,000): U.S. Geol. Survey Strategic Minerals Inv. Prelim. Map; John Rodgers and D. F. Kent, 1948, Tennessee Div. Geology Bull. 55, p. 14–15. Thickness 790 feet in Hawkins County, Tenn. Includes Maynardville limestone member near top.

Overlies Maryville limestone; underlies Copper Ridge dolomite of Knox group.

John Rodgers, 1953, Tennessee Div. Geology Bull. 58, pt. 1 (plates); pt. 2, p. 49–53. In eastern Tennessee the Conasauga varies in lithology, and three phases are recognized. In central phase, group consists of six formations of which Nolichucky is fifth in sequence (ascending). Underlies Maynardville limestone; overlies Maryville limestone. Thickness 400 to 750 feet. In southeastern phase, sequence includes (ascending) Honaker dolomite, Nolichucky shale, and Maynardville limestone.

J. M. Cattermole, 1958, U.S. Geol. Survey Geol. Quad. Map GQ–115. In Knoxville quadrangle, consists of two phases: northeastward from Third Creek, mainly shale with thin limestone beds interlayered in lower part and two or three limestone lenses, 20 to 50 feet thick, in upper part of shale; southwest of Third Creek, lower part contains higher proportion of interbedded limestone, and upper part is almost entirely blue-gray limestone which thickens southwestward to a maximum development in adjacent Bearden quadrangle. Thickness 1,040 to 1,400 feet. Underlies Maynardville limestone; overlies Maryville limestone.

J. W. Bryan, 1960, (abs.) Virginia Jour. Sci., v. 11, new ser., no. 4, p. 214. The Nolichucky is largely limestone and dolomite in Virginia, and usage of term Nolichucky shale is somewhat misleading.

P. B. King and H. W. Ferguson, 1960, U.S. Geol. Survey Prof. Paper 311, p. 55. Described in northeasternmost Tennessee where it is 200 to 250 feet thick. Overlies Honaker dolomite; underlies Conococheague limestone. Conasauga group.

Named for exposures along Nolichucky River, Greene County, Tenn.

Nome Group[1]

Lower Paleozoic or older: Northwestern Alaska.

Original reference: A. H. Brooks, G. B. Richardson, and A. J. Collier, 1901, Reconn. Cape Nome and Norton Bay regions, Alaska, in 1900. U.S. Geol. Survey Spec. Pub., p. 29, map.

R. M. Moxham and W. S. West, 1953, U.S. Geol. Survey Circ. 265, p. 2, 3. Two units of group, in Serpentine-Kougarok area, of Ordovician and Silurian age (ascending) undifferentiated limestone, slate, and schist; and Port Clarence limestone, probably mostly Silurian in age.

Most typically developed to south of Kigluaik Mountains and Bendeleben Mountains, Seward Peninsula.

Nome River Glaciation

Pleistocene: West-central Alaska.

D. M. Hopkins, 1953, *in* T. L. Péwé and others, U.S. Geol. Survey Circ. 289, p. 10, 13 (table 1). Four Quaternary glaciations recognized on Seward Peninsula. Succeeded Iron Creek glaciation (new); preceded Salmon Lake glaciation (new). End moraines found 1 or 2 miles beyond northern and western margins of Bendeleben Mountains and 5 to 10 miles beyond their south fronts. Glacial topography (valley and cirque walls and lateral and end moraines) thoroughly modified by subsequent frost-riving, creep, and stream erosion.

D. M. Hopkins, F. S. MacNeil, and E. B. Leopold, 1960, Internat. Geol. Cong., 21st, Copenhagen, pt. 4, p. 46–57. Discussion of coastal plain at Nome. Three marine stratigraphic units (Submarine Beach, Third Beach-Intermediate Beach, and Second Beach) record at least three distinct intervals during which sea level stood as high or higher than at present and during which sea temperatures were warmer than at present. A fourth interval of high sea level may be representd by "Fourth Beach" at inner edge of coastal plain. Glacial drift of the Iron Creek (Nebraskan or Kansan) glaciation and of Nome River (Illinoian) glaciation separates the three units. Outwash, alluvium, colluvium, windblown silt, and peat that accumulated during Wisconsin and Recent time cover the glacial drift and youngest of marine sediments.

Deposits distributed widely and studied in detail in Nome River valley, southwestern part of Seward Peninsula. Most valleys in York, Kigluaik, Bendeleben, and Darby Mountain were occupied by ice. Glaciers also were present in cirques throughout uplands south and west of Kigluaik Mountains.

Nomlaki Tuff Member (of Tehama and Tuscan Formations)[1]

Nomlaki Tuff

Pliocene, upper: Northern California.

Original reference: R. D. Russell and V. L. Vander Hoof, 1931, California Univ. Pubs., Dept. Geol. Sci. Bull., v. 20, no. 2, p. 12–15.

C. A. Anderson and R. D. Russell, 1939, California Jour. Mines and Geology, v. 35, no. 3, p. 243–247, pl. 3. Referred to as both Nomlaki tuff and Nomlaki tuff member of Tehama formation. Interbedded with both Tuscan and Tehama formations. Exposed for a distance of 40 miles along west side of Sacramento Valley; southerly exposure is in Stone Valley, NE cor. T. 20 N., R. 5 W., [Glenn County], where it is 15 feet thick. Thickness 42 feet at type locality, base not exposed; as much as 300 feet thick in Redding quadrangle where it unconformably overlies Chico formation. Upper Pliocene. Type locality noted.

Type locality: At former headquarters of old Nomlaki Indian Reservation about 6 miles northeast of Paskenta, Tehama County.

Nonada Sandstone Member (of Domengine Formation)

Eocene: Central California.

M. B. Payne, 1951, California Div. Mines Spec. Rept. 9, p. 3, 15, 21, 22–23, pl. 4. Friable gray fine-grained sandstone; on northeastern flank of Panoche Hills includes two calcareouss fossiliferous pebble "reefs." Thickness about 68 feet. Underlies Capita shale member (new); unconformably overlies Lodo formation in some areas and in others, as Chaney Ranch Canyon, unconformably overlies Laguna Seca formation (new).

Spanish word meaning low and flat (Nonada) is given to hill 200 feet north and 800 feet west of SW cor. sec. 13, T. 14 S., R. 11 E., Fresno County.

No Name Argillite (in Newport Group)

Precambrian: Northeastern Washington.

M. C. Schroeder, 1952, Washington Div. Mines and Geology Bull. 40, p. 7 (table), 11–13, pl. 1. Predominantly dark-gray argillite with occasional argillaceous sandstone beds and limestone lenses. Thickness about 4,200 feet. Gradationally underlies Skookum formation (new), transition zone about 400 feet thick; gradationally overlies Bead Lake formation (new), transition zone about 200 feet thick.

Named after No Name Peak, Pend Oreille County.

Nonesuch Shale (in Oronto Group)[1]

Precambrian: Northern Michigan and northeastern Wisconsin.

Original reference: R. D. Irving, 1883, U.S. Geol. Survey Mon. 5, p. 221–224, pls. 17, 18.

S. A. Tyler and others, 1940, Geol. Soc. America Bull., v. 51, no. 10, p. 1474. Nonesuch shale lies stratigraphically above and is continuous with Outer conglomerate.

W. S. White and H. R. Cornwall, 1953, U.S. Geol. Survey Geol. Quad. Map GQ–27. Described in Ahmeek quadrangle, Michigan, where it overlies Cooper Harbor conglomerate and underlies Freda sandstone.

W. S. White and J. C. Wright, 1954, Science, v. 119, no. 3089, p. 354. At White Pine Copper deposit, Ontonagon County, Mich., Nonesuch is about 600 feet thick and composed largely of gray siltstone. Overlies Copper Harbor conglomerate.

Named for occurrence at Nonesuch mine, Gogebic County, Mich.

Nonewaug Granite

Paleozoic: Western Connecticut.

R. M. Gates, 1953, New England Intercollegiate Geol. Conf. [Guidebook] 40th [Ann. Mtg.] Field Trip B, p. 4–6. One of several intrusives in Hartland formation. A lenticular, east-west trending body in northern third of Woodbury quadrangle and southeastern part of Litchfield quadrangle. Characterized by fine- to coarse-textural-layering, graphic granite crystals locally in great quantity which range up to 2 feet across in a matrix of relatively fine-grained granite, and plumose muscovite in plumes up to 18 inches long.

R. M. Gates, 1954, Connecticut Geol. Nat. History Survey Quad. Rept. 3, p. 3, 6–7, 15–19, geol. map. Nonewaug granite was originally included with Thomaston granite by earlier workers. It has also been called Woodbury granite. Change to Nonewaug was made to avoid confusing it with Woodbury granite in Vermont.

Named for Nonewaug River in Woodbury and Bethlehem, Litchfield County.

Nooksack Formation or Group

Upper Jurassic and Lower Cretaceous: North-central Washington.

E. D. McKee and others, 1956, U.S. Geol. Survey Misc. Geol. Inv. Map I–175, p. 2, 5 (table 2). In thick conformable sequence of predominantly dark siltstone in northern Cascade Mountains, fossils have been found that date part of these marine beds as Kimmeridgian and possibly Oxfordian. Peter Misch has named these rocks the Nooksack formation, the highest part of which is early Cretaceous.

W. R. Danner, 1958, Dissert. Abs., v. 18, no. 1, p. 195. Referred to as Nooksack group.

W. P. Popenoe, R. W. Imlay, and M. A. Murphy, 1960, Geol. Soc. America Bull., v. 71, no. 10, p. 1533, chart 10e (column 57). Nooksack group shown on correlation chart. Term was proposed by Peter Misch in letters to Vernon Swanson, dated November 15, 1954. Term was published by McKee and others, 1956. Misch notes that lower 4,000 feet of group contains Late Jurassic megafossils, and upper 1,000 feet contains Early Cretaceous fossils of probable Valanginian age.

Exposed in Nooksack River area north of Mount Baker, Whatcom County.

Noonday Dolomite

Precambrian: Southern California.

J. C. Hazzard, 1937, California Jour. Mines and Geology, v. 33, no. 4, p. 279 (fig. 3e), 300–301. A light creamy-gray to cream-colored algal dolomite which weathers to a pale creamy-buff color. Thickness 1,500 to 2,000 feet. Basal Cambrian of region; separated by marked angular unconformity from rocks of Archean and Algonkian age; underlies Johnnie(?) formation.

D. F. Hewett, 1948, California Div. Mines Bull. 129, p. 199. Described in Kingston Range, San Bernardino County, where it is about 2,000 feet thick near the iron deposits; decreases in thickness steadily eastward and is not known east of Mesquite Valley. On northwest slope of range, is nearly conformable with underlying Pahrump series, Kingston Peak formation, but on northeast and east slopes is highly unconformable. North and east of Kingston Range the dolomite is overlain successively by Prospect Mountain quartzite and Pioche shale of Cambrian age and Goodsprings dolomite of Upper Cambrian to Devonian(?) age.

C. R. Longwell, 1952, Washington Acad. Sci. Jour., v. 42, no. 7, p. 212. Suggestion made that Johnnie formation, Noonday dolomite, Deep Springs formation, and Reed dolomite of Inyo region be carried under heading "age unknown" because there is no firm basis for drawing a lower boundary of Cambrian in Death Valley region.

B. K. Johnson, 1957, California Univ. Pub. Geol. Sci., v. 30, no. 5, p. 369–372, 379 (fig. 7), fig. 3. Described in Manly Peak quadrangle, Death Valley region, where it ranges in thickness from 800 to 1,000 feet. Underlies Johnnie formation; overlies Kingston Peak formation with disconformity or slight angular unconformity. Considered correlative of Sentinel dolomite, Radcliff formation, and Redlands dolomite limestone of Murphy's (1932 [1933]) Telescope group. Algal structures, common in lower part of Noonday in Manly Peak quadrangle, were noted by Hazzard (1937) in type area; algal structures occur in Sentinel dolomite described by Murphy as exposed in Sour Dough Canyon above Panamint City; no other fossils have been found in Noonday and its equivalents. Murphy tentatively assigned all rocks above Panamint metamorphic complex to Lower Paleozoic. All other published reports on Death Valley region equate base of Cambrian with unconformable base on Noonday. In this report base of Cambrian is defined faunally; since base of Noonday is 9,000 feet stratigraphically below frst occurrence of *Olenellus* entire formation is regraded as late Precambrian.

Well exposed in extreme southern portion of Nopah Range, cropping out in a belt of variable width which extends from about 1¼ miles north of Gunsight mine to nearly 2 miles southeast of Noonday mine, Nopah-Resting Springs area, Inyo County.

Nopah Formation

Upper Cambrian: Southeastern California and western Nevada.

J. C. Hazzard, 1937, California Jour. Mines and Geology, v. 33, no. 4, p. 276 (fig. 3b), 320–322. Consists principally of dolomite, light gray, gray, or creamy buff. Thickness 1,740 feet. Shown on columnar section as underlying Pogonip(?) dolomite and overlying Cornfield Springs formation.

J. F. McAllister, 1952, California Div. Mines Spec. Rept. 25, p. 9–10, pls. 1, 2. Described in Quartz Spring area where it is 1,600 feet thick and conformably overlies Racetrack dolomite (new) and conformably underlies Pogonip formation.

A. L. Brown, 1954, (abs.) Geol. Soc. America Bull., v. 65, no. 12, pt. 2, p. 1235. Geographically extended into Nye County, Nev. In Cambrian sequence, underlies Highland Peak formation.

A. R. Palmer and J. C. Hazzard, 1956, Am. Assoc. Petroleum Geologists Bull., v. 40, no. 11, p. 2494–2513. Paleontologic evidence shows that names Cornfield Springs and Bonanza King were misapplied in Nopah Range by Hazzard (1937). Units formerly designated by these names in Nopah Range should be considered as unnamed upper and lower divisions, respectively, of Bonanza King formation. Hence, Nopah formation overlies Bonanza King formation in this area.

H. R. Cornwall and F. J. Kleinhampl, 1960, U.S. Geol. Survey Field Studies Map MF–239. Mapped in Bare Mountain quadrangle, Nye County, Nev., where it overlies Bonanza King formation and underlies Pogonip group. Upper Cambrian.

Named for exposures in northern half of Nopah Mountains, Inyo County, Calif.

Nora Limestone[1]

Nora Member (of Shellrock Formation)

Upper Devonian: Central northern Iowa.

Original reference: A. O. Thomas, 1913, Science, new ser., v. 37, p. 459.

M. A. Stainbrook, 1944, Illinois Geol. Survey Bull. 68, p. 182 (table), 187. Shellrock formation consists of lithographic and dolomitic limestones and thin shales; includes (ascending) Mason City, Rock Grove, and Nora members.

Named for exposures in an abandoned quarry near Nora Junction, Floyd County.

Nordheimer Formation[1]

Carboniferous (?): Northwestern California.

Original reference: O. H. Hershey, 1906, Am. Jour. Sci., 4th, v. 21, p. 58–66.

Nordheimer Creek valley, Klamath Mountains.

Norfleet Limestone Member (of Lenapah Limestone)

Pennsylvanian (Des Moines Series): Eastern Kansas, western Missouri, and northeastern Oklahoma.

J. M. Jewett, 1941, Kansas Geol. Survey Bull. 38, pt. 11, p. 337, 338–339, pl. 1. Defined to include all limestone and shale beds of the Lenapah below Perry Farm shale member (new). Where best developed, member comprises a few inches of dark-bluish-gray dense limestone overlain by shale which is mostly black and has maximum thickness of about 5 feet; locally upper part is very calcareous but also black and platy; at top of member is a limestone which is a few inches to about 3 feet thick. Overlies Nowata shale.

J. M. Jewett, 1945, Kansas Geol. Survey Bull. 58, p. 69. Discussed as cyclothem in Lenapah megacyclothem.

F. C. Greene and W. V. Searight, 1949, Missouri Geol. Survey and Water Resources Rept. Inv. 11, p. v. (fig. 1), 9. Geographically extended into northwestern Missouri where it underlies Perry Farm shale member and overlies Warrenburg sandstone member of Nowata formation.

C. M. Cade 3d, 1953, Tulsa Geol. Soc. Digest, v. 21, p. 134, 135. Geographically extended into northeastern Oklahoma.

Type exposure: On Norfleet Farm along Pumpkin Creek in SE¼ sec. 35, T. 32 S., R. 18 E., northeast of Mound Valley, Labette County, Kans.

†Norfolk Formation[1]

Pliocene(?) and Pleistocene: Southeastern Virginia.

Original reference: W. B. Clark and B. L. Miller, 1906, Virginia Geol. Survey Bull. 2, pt. 1, p. 20.

Named for Norfolk County, Va., where the deposits have been recognized in deep cutting in Dismal Swamp Canal.

†Norfolk Basin Series[1]

Carboniferous: Southeastern Massachusetts.

Original reference: G. R. Mansfield, 1960, Harvard Coll. Mus. Comp. Zoology Bull., v. 49, Geol. ser., v. 8, no. 4, p. 91–271.

Normal Drift

Pleistocene (Wisconsin): Northern Illinois.

H. B. Willman and others, 1942, Illinois Geol. Survey Bull. 66, p. 212. Incidental mention.

Leland Horberg, 1950, Illinois Geol. Survey Bull. 75, pt. 1, p. 29. In Peoria area, Normal drift is listed as younger than Metamora drift.

Probably named for occurrence near Normal, McLean County.

†Norman division[1]

Permian: Central Oklahoma.

Original reference: C. N. Gould, 1902, Oklahoma Geol. Survey 2d Bienn. Rept., p. 42, 43.

Occurs on east slope of Gypsum Hills.

Norman Sandstone[1]

Permian(?): Central Oklahoma.

Original reference: C. T. Kirk, 1904, Oklahoma Dept. Geology and Nat. History 3d Bienn. Rept., p. 10.

Well exposed on hilltops 6 miles southeast of Norman, Cleveland County, and on bluffs at Purcell, Indian Terr. (now McClain County).

Normandy Limestone[1]

Middle and Upper Ordovician: Central Tennessee.

Original reference: M. R. Campbell, 1899, U.S. Geol. Survey Geol. Atlas, Folio 53, p. 2.

Named for Normandy, Bedford County.

Normanskill Shale[1]

Middle Ordovician: Eastern New York, northwestern Massachusetts, and southwestern Vermont.

Original reference: R. Ruedemann, 1901, New York State Mus. Bull. 42, p. 489–568.

D. M. Larrabee, 1939, Eng. Mining Jour., v. 140, no. 12, p. 48 (fig. 2), 49 (fig. 3), 51–52. Near Poultney, Vt., Normanskill consists of grits, graywacke, red slate, quartzite, and chert. "Calciferous" shale referred to by Dale, (1899, U.S. Geol. Survey 19th Ann. Rept., pt. 3) not noted in this area, and the Normanskill overlies Zion Hill quartzite. Thickness about 1,500 feet. Zion Hill quartzite placed at base of Ordovician.

Rudolf Ruedemann, 1942, New York State Mus. Bull. 331, p. 88–116. Formation, usually termed shale, consists of chert, grit, and shale, the first predominating. In Catskill quadrangle, two belts present: western grit belt and eastern chert belt. Comprises two members: Mount Merino chert and shale and Austin Glen grit and shale. Eastern part of chert belt adjoins Lower Cambrian belt, and western grit belt adjoins Snake Hill formation, north and south of Catskill quadrangle. Where Deepkill shale is exposed, it is either infolded with Mount Merino beds, as at Mount Merino, or found in strips between the Mount Merino bed and Schodack beds as west of Blue Hill on iron ore ridge, or west of Bingham Mills and southeast of Viewmonte.

E. P. Kaiser, 1945, Geol. Soc. America Bull., v. 56, no. 12, pt. 1, p. 1079–1098. Rocks in Taconic thrust sheet called Normanskill are characterized by marked banding, medium grain, generally calcareous cement, and hardness. Beds of ferruginous calcareous quartzite common. Thickness about 300 feet. Overlies Zion Hill quartzite.

B. N. Cooper and G. A. Cooper, 1946, Geol. Soc. America Bull., v. 57, no. 1, p. 60–62. Discussion of range of Normanskill graptolites. There is no longer any reason to regard the Normanskill as Chazyan. It can no longer be assumed that all Appalachian formations below the supposed Lowville are necessarily Chazyan or older.

Phillip Fowler, 1950, Vermont Geol. Survey Bull. 2, p. 38 (table 2), 55–57. In Castleton quadrangle, Normanskill beds are certainly exposed, but presence of underlying Schagticoke shale and Deepkill shale is problematical. No fossils from Ordovician of area have been found, and all rocks above Cambrian are herein mapped as Normanskill. Several rock types are recognized, and all are in lenticular bodies. In a few places, one type grades into another. No stratigraphic succession can be established. Isoclinal folding of the Normanskill does not facilitate interpretation. Dale's figure (1899, U.S. Geol. Survey 19th Ann. Rept., pt. 3) for thickness of Normanskill, 1,250 feet, is accepted here. Nearly half of this thickness is made up of grit; red and green slates are probably 100 feet thick; remainder of Normanskill is dark slate, chert, and quartzite with aggregate thickness of 500 feet or more. Unconformity separates Normanskill from Zion Hill quartzite which in this report is Cambrian. Black River-Trenton(?).

G. A. Cooper, 1956, Smithsonian Misc. Colln., v. 127, pt. 1, p. 33–34. Bulk of formation consists of shale, but grit, sandstone, chert, arkose, and conglomerate, ranking in order named, are present. Estimated thickness about 2,000 feet. Includes Mount Merino chert and shale member below and Austin Glen grit and shale above. Underlies Rysedorf conglomerate. Porterfield-Wilderness stages.

George Theokritoff, 1959, New England Intercollegiate Geol. Conf. Guidebook 51st Ann. Mtg., p. 56. In Taconic sequence, Thorn Hill and Granville quadrangles, unnamed Normanskill graywackes and black shales overlie Indian River formation.

J. G. Elam, 1960, Dissert. Abs., v. 21, no. 6, p. 1524. Discussion of Troy South and East Greenbush quadrangles, New York. Stratigraphic section divided into four groups, and previously described dominant formational names elevated to group status. Groups are Bull (Lower Cambrian), West Castleton (upper Lower Cambrian-Upper Cambrian), Poultney (Lower Ordovician), and Normanskill (Middle Ordovician).

Normans Kill, a tributary entering Hudson River just south of Albany at Kenwood.

Norphlet Formation

Norphlet Tongue (of Eagle Mills Formation)

Jurassic: Subsurface in Arkansas, Louisiana, and Texas.

R. W. Imlay, 1940, Arkansas Geol. Survey Inf. Circ. 12, p. 4 (table 2), 8. Name Norphlet tongue applied to upper red beds in Eagle Mills formation. Jurassic. Name credited to Shreveport Geological Society.

R. T. Hazzard, W. T. Spooner, and B. W. Blanpied, [1947], Shreveport Geol. Soc. 1945 Reference Rept., v. 2, p. 483, 484, 488, 490 (table 5). Term Norphlet tongue, as formerly used, is replaced by Norphlet formation. In type well, underlies Smackover formation; overlies Louann salt. Consists of red clays, gray clays, reddish and gray sands, with or without gravel. Maximum thickness about 150 feet. By inference, an unconformity is placed at base of Norphlet where it rests on Louann salt, and it is concluded that this is the Mesozoic-Paleozoic contact in Tri-State area. Jurassic.

Type section: Gulf Refining Co.'s No. 49 L. Werner Saw Mill Co. well, Union County, Ark.

Norrie Ferruginous Chert Member (of Ironwood Iron-Formation)[1]

Precambrian (Animikie Series): Northwestern Michigan and northwestern Wisconsin.

Original reference: W. O. Hotchkiss, 1919, Eng. Mining Jour., v. 108, p. 501, 504.

N. K. Huber, 1959, Econ. Geology, v. 54, no. 1, p. 104 (table 10), 106 (table 11), 107 (fig. 6). Underlies Pence member; overlies Yale member. Thickness (taken from drill holes), 115 and 117 feet.

Named for Norrie mine, east of Ironwood, Gogebic County, Mich.

Norris Basic Flows

Tertiary: Southwestern Montana.

D. B. Andretta and S. A. Alsup, 1960, Billings Geol. Soc. 11th Ann. Field Conf., p. 187. Consists of several basic flows. Finely crystalline, almost glassy rock. Maximum thickness of flow 50 feet. These flows are listed as "Tertiary volcanics" on Montana State Geological map and apparently rest on both Precambrian rock and mid-Cenozoic strata.

Flows cap hills in vicinity of Norris, Madison County.

Norris Limestone (in Allegheny Formation)[1]

Pennsylvanian: Southeastern Ohio.

Original reference: E. Orton, 1878, Ohio Geol. Survey, v. 3, p. 889, 897, pls. opposite p. 889, 900, 912, 921.

In Hocking Valley. Named for proximity to Norris coal.

Norristown Sandstone (in Newark Group)[1]

Upper Triassic: Southeastern Pennsylvania.

Original reference: E. V. d'Invilliers, 1883, Pennsylvania 2d Geol. Survey Rept. D_3, v. 2.

Montgomery County.

†Norristown Shale (in Newark Group)[1]

Upper Triassic: Southeastern Pennsylvania.

Original reference: B. S. Lyman, 1893, Pennsylvania Geol. Survey geol. and topog. map of Bucks and Montgomery Counties; 1895, Pennsylvania 2d Geol. Survey Summ. Final Rept., v. 3, pt. 2, p. 2589–2638.

Named for exposures at Norristown, Montgomery County.

†Norristown Stage[1]

Pennsylvanian: Western Arkansas and central eastern Oklahoma.

Original reference: A. Winslow, 1896, New York Acad. Sci. Trans., v. 15, p. 51–52.

Probably named for Norristown, Pope County, Ark., just across river from Dardanelles.

North Amygdaloid[1] (in Central Mine Group)

Precambrian (Keweenawan): Northern Michigan.

Original reference: B. S. Butler and W. S. Burbank, 1929, U.S. Geol. Survey Prof. Paper 144 (chart compiled by M. G. Wilmarth).

Copper district of Keweenaw Point.

North Flow[1]

Precambrian (Keweenawan): Northern Michigan.

Original reference: B. S. Butler and W. S. Burbank, 1929, U.S. Geol. Survey Prof. Paper 144 (chart compiled by M. G. Wilmarth).

Copper district of Keweenaw Point.

†North Amherst Granite[1]

Late Carboniferous or post-Carboniferous: Central Massachusetts.

Original reference: B. K. Emerson, 1898, U.S. Geol. Survey Mon. 29, p. 323.

Named for occurrence in hills southeast and west of North Amherst Station, Hampshire County.

North Boulder Group or **Formation**

Precambrian (Belt Series): Southwestern Montana.

C. P. Ross, 1949, (abs.) Washington Acad. Sci. Jour., v. 39, no. 3, p. 111, 113. Proposed for heretofore unnamed components of Belt series in isolated exposures near Jefferson River, southeast of Butte. Relations between this group and units farther north not clear. Group is believed to rest directly on pre-Belt complex of metamorphic rocks; lies without angular discordance beneath Middle Cambrian Flathead quartzite. Has coarse conglomerate at base, with arkose, some conglomerate, and sandy and silty strata above. Total thickness 6,000 feet or more. May include three or possibly four subdivisions of formational rank. May be equivalent in age to some part of Missoula group or to part of that group and part of Piegan group.

Strata extend eastward along and north of Jefferson River from vicinity of North Boulder to point southeast of Sappington.

Northbrae Rhyolite[1]

Pliocene: Western California.

Original reference: A. C. Lawson, 1914, U.S. Geol. Survey Geol. Atlas, Folio 193.

Named for occurrence in Northbrae district, near Berkeley, Alameda County.

Northbridge Granite Gneiss[1]

Precambrian: South-central Massachusetts and northwestern Rhode Island.

Original reference: B. K. Emerson, 1898, U.S. Geol. Survey Mon. 29, p. 18.

A. W. Quinn, 1953, New York Acad. Sci. Trans., ser. 2, v. 15, no. 8, p. 266. Older gneisses of Georgiaville quadrangle, Rhode Island, include, from oldest to youngest, Nipsachuck gneiss, Absalona formation, and Woonasquatucket formation. In part, they may be correlated with Northbridge granite gneiss of Massachusetts.

Named for occurrence at Northbridge, Worcester County, Mass.

North Butler Amygdaloid[1] (in Central Mine Group)

Precambrian (Keweenawan): Northern Michigan.

Original reference: B. S. Butler and W. S. Burbank, 1929, U.S. Geol. Survey Prof. Paper 144 (chart compiled by M. G. Wilmarth).

Probably named for its occurrence north of Butler.

North Butler Flow[1]

Precambrian (Keweenawan): Northern Michigan.

Original reference: B. S. Butler and W. S. Burbank, 1929, U.S. Geol. Survey Prof. Paper 144 (chart compiled by M. G. Wilmarth).

Copper district of Keweenaw Point.

Northcraft Formation

Eocene, upper: Southwestern Washington.

P. D. Snavely, Jr., and others, 1951, U.S. Geol. Survey Coal Inv. Map C–8, sheet 1. Name proposed for series of lava flows, pyroclastic rocks, breccia, and tuffaceous sedimentary rocks approximately 700 to 1,000 feet thick. Conformably overlies McIntosh formation; unconformably underlies Skookumchuck formation (new).

P. D. Snavely, Jr., and others, 1954, Science, v. 119, no. 3091, p. 419. Andesitic flows of Northcraft formation extruded during early part of late Eocene.

P. D. Snavely, Jr., and others, 1958, U.S. Geol. Survey Bull. 1053, p. 22–26, pl. 1. Culver (1919) described sequence of rocks consisting of conglomerate, breccia, graywacke, and black siliceous shale which crops out along Newaukum River. He named these beds Newaukum series and considered them to be pre-Puget and probably pre-Tertiary in age. Dark shale and arkosic sandstone described by Culver are mapped as McIntosh formation in this report [Centralia-Chehalis district]. Conglomerate, graywacke, and breccia in Culver's Newaukum series are probably equivalent to part of Northcraft formation. Overlies McIntosh formation; underlies Skookumchuck formation. Late Eocene.

E. A. Roberts, 1958, U.S. Geol. Survey Bull. 1062, p. 12 (table), 13–14, pl. 1. Northcraft is oldest unit exposed in Toledo-Castle Rock coal district. Thickness about 200 feet; base not exposed. Underlies Cowlitz formation.

Typically exposed in vicinity of Northcraft Mountain and along road that parallels Salmon Creek in sec. 2 and the NW¼ sec. 1, T. 15 N., R. 1 W., Willamette meridian, Thurston County.

North Creek Formation

Tertiary-Quaternary: Eastern Nevada.

J. C. Young, 1960, Intermountain Assoc. Petroleum Geologists Guidebook 11th Ann. Field Conf., p. 160, 163, 165. Comprises conglomerates unconformably overlying Kalamazoo volcanics (new). Apparently grades upward into present-day alluvium. Maximum thickness not known; may be greater than 1,000 feet.

Recognized only in Duck Creek valley, Schell Creek Range, Ely quadrangle.

North Creek Member (of Yazoo Clay)

Eocene, upper: Eastern Mississippi and western Alabama.

G. E. Murray, 1947, Am. Assoc. Petroleum Geologists Bull., v. 31, no. 10, p. 1838 (fig. 6), 1839 (footnote). North Creek (clay) member proposed for an average of 40 feet of green or gray slightly glauconitic, fossiliferous clay, underlain by Moodys sand and overlain by Pachuta marl member (new) or Cocoa sand.

L. D. Toulmin, P. E. LaMoreaux, and C. R. Lanphere, 1951, Alabama Geol. Survey Special Rept. 21, p. 121, 124, pl. 3. In Choctaw County, Ala., consists of greenish-gray plastic calcareous sparsely fossiliferous clay with white lime nodules and thin white sand streaks; base marked by a calcareous sandstone 2 to 12 inches thick. Thickness 50 to 60 feet.

Type locality: Exposures on west side of North Creek in SW¼ sec. 1, T. 3 N., R. 12 E., Jasper County, Miss., 2 miles southwest of Rose Hill on State highway to Gridley and Turnersville.

†North Denison Sand[1]

Lower Cretaceous (Comanche Series): Northeastern Texas and southeastern Oklahoma.

Original reference: R. T. Hill, 1894, Geol. Soc. America Bull., v. 5, p. 302, 303, 328–330, 334, pl. 13.

Named for exposures in northern half of Denison, Grayson County, Tex.

Northeast Shale[1]

Northeast Shale Member (of Canadaway Formation)

Upper Devonian: Northwestern Pennsylvania and western New York.

Original reference: G. H. Chadwick, 1923, Geol. Soc. America Bull., v. 34, p. 69.

I. H. Tesmer, 1954, Hobbies, v. 35, no. 2, p. 30, 32; 1955, New York State Mus. Sci. Service Circ. 42, p. 10 (fig. 1), 16. Uppermost member of Canadaway formation. Thickness about 470 feet. Overlies Shumla siltstone member; underlies Dexterville member of Chadakoin formation. Girard shale (White, 1881) here included in Northeast member.

Named from township in Erie County, Pa.

Northfield Conglomerate[1]

Lower Ordovician: Northeastern Vermont.

Original reference: C. H. Richardson, 1919, Vermont State Geologist 11th Rept.

Northfield Township, Washington County.

Northfield Slate[1]

Middle Silurian: Central and northeastern Vermont.

Original reference: C. H. Richardson, 1906, Vermont State Geologist 5th Rept., p. 95.

L. W. Currier and R. H. Jahns, 1941, Geol. Soc. America Bull., v. 52, no. 9, p. 1492, 1501–1506. Redefined to include, in general, beds previously mapped in central Vermont as "Memphremagog slates." Is mainly light- to dark-gray slate with scattered lenses and very thin beds of dense bluish-gray limestone and dolomitic limestone. Contains conglomerate at base ("Northfield conglomerate" of Richardson). Thin platy limestone beds above the conglomerate and two prominent zones of small siliceous nodules occur in lower part. Thickness 450 to 2,300 feet. Conformably underlies Waits River limestone; overlies Shaw Mountain formation (new) unconformably. Ordovician(?). Derivation of name given.

P. H. Osberg, 1952, Vermont Geol. Survey Bull. 5, p. 116 (fig. 16). Middle Ordovician.

W. M. Cady, 1956, U.S. Geol. Survey Geol. Quad. Map GQ–79. Silurian(?).

W. M. Cady, 1960, Geol. Soc. America Bull., v. 71, no. 5, p. 551, pl. 3. Discussion of stratigraphic and geotectonic relationships in northern Vermont and southern Quebec. Where Shaw Mountain formation is absent, Northfield slate lies directly, and to all appearances conformably, on Moretown formation. Middle Silurian.

Named for village of Northfield, Barre quadrangle, near which slate was formerly extensively quarried.

North Fork Shale (in Pottsville Group)[1]

North Fork Shale (in Pocahontas Group)

Pennsylvanian: Southern West Virginia.

Original reference: R. V. Hennen and R. M. Gawthrop, 1915, West Virginia Geol. Survey Rept. Wyoming and McDowell Counties, p. 239.

H. R. Wanless, 1939, Geol. Soc. America Spec. Paper 17, p. 96. Thin marine shale in Pocahontas group.

Exposed in N. & W. Railway grade at North Fork, McDowell County.

North Haven Greenstone[1]

Cambrian(?): Central southern Maine.

Original reference: G. O. Smith, 1896, Geology of Fox Islands, Maine, p. 12, 13–19.

Named for development on North Haven Island, Penobscot Bay.

North Hill Formation

North Hill Group

North Hill Member[1] (of Hampton Formation)

Mississippian (Kinderhook Series): Southeastern Iowa and northwestern Illinois.

Original reference: L. R. Laudon, 1931, Iowa Geol. Survey, v. 35, p. 344, 347, 366–371.

L. R. Laudon, 1935, Kansas Geol. Soc. 9th Ann. Field Conf. Guidebook, p. 246. North Hill member excluded from redefined Hampton. [This apparently makes North Hill a formation although Laudon did not so state.]

L. E. Workman and Tracey [Tracy] Gillette, 1956, Illinois Geol. Survey Rept. Inv. 189, p. 8 (fig. 1), 28. Considered a group in northwestern

Illinois. Includes (ascending) McCraney limestone, Prospect Hill siltstone, and Starrs Cave limestone (new).

Named for exposures on North Hill in city of Burlington, Des Moines County, Iowa.

North Hogback Tongue (of Point Lookout Sandstone)

Upper Cretaceous: Northwestern New Mexico.

P. T. Hayes and A. D. Zapp, 1955, U.S. Geol. Survey Oil and Gas Inv. Map OM-144, sheet 1. A northeasterly thickening wedge of Point Lookout sandstone overlies a correspondingly thinning wedge of basal Menefee formation for a distance of about three-fourths mile along the outcrop. Contacts are relatively sharp. As a result of this intertonguing, the top of Point Lookout sandstone is about 65 feet high stratigraphically to the north. This sandstone wedge is here named the North Hogback tongue.

Observed only in secs. 10 and 11, T. 30 N., R. 16 W., San Juan County.

North Horn Formation

Upper Cretaceous and Paleocene: Central Utah.

S. L. Schoff, 1938, Ohio State Univ. Abs. Doctors' Dissert. 25, p. 379. Name applied to variegated beds with reptile and mammal remains between Price River formation and Flagstaff limestone. Rocks identified as North Horn underlie large areas in west-central and northern parts of Cedar Hills and consist of varied assemblage of nonmarine sandstones, conglomerates, shales, and fresh-water limestones. Maximum thickness 6,700 feet. Upper and lower contacts conformable, involving intertonguing of lithologic types. Name credited to E. M. Spieker.

C. L. Gazin, 1941, U.S. Natl. Mus. Proc., v. 91, no. 3121, p. 6. Name should have been restricted to either Cretaceous or Paleocene beds and not both. Since U.S. Geological Survey has adopted the more inclusive definition for North Horn, the name Joes Valley is proposed as member to include Paleocene part of formation.

E. M. Spieker, 1946, U.S. Geol. Survey Prof. Paper, 205-D, p. 132-134. Thickness 1,650 feet at type locality; four units recognized; unit 1 and 3 show characteristics of lake deposits; unit 2 and 4 are typical flood-plain and channel deposits. Grades downward into Price River formation; passes transitionally upward into Flagstaff limestone. In Green River Canyon, underlies Colton formation and overlies Tuscher(?) formation. In western Wasatch Plateau, formation consists of former lower Wasatch exclusive of basal conglomerate which is now placed in Price River formation.

Type locality: On North Horn Mountain, in Tps. 18 and 19 S., R. 6 E., Salt Lake meridian, Wasatch Plateau.

North Keys Sand

Miocene(?): Southern Maryland.

J. T. Hack, 1955, U.S. Geol. Survey Prof. Paper 267-A, p. 8-10, pl. 1. Bed of fine yellowish-orange sand which rests conformably on top clay bed of Calvert formation, and in Brandywine area, underlies gravel of Brandywine formation. Sand similar to the North Keys in some places is interbedded with the Brandywine; in others, the Brandywine is separated from the North Keys by sharp, irregular erosional contact; the top of the North Keys is placed at base of lowest gravel in local sequence. Thickness in Brandywine area 20 to 60 feet; maximum thickness in central part of area near Baden. North Keys sand is lithologically unlike Choptank formation as it is exposed in Calvert Cliffs, where it contains sandy clay and clay beds at several horizons; either North Keys represents an overlap of sandy beds of the Choptank, on eroded Calvert formation, or it [North Keys] becomes younger to south and overlaps Choptank as well as Calvert. Unit has been mapped as part of overlying formations and in Brandywine area has been included in Brandywine and Sunderland formations.

Type locality: Vicinity of North Keys, a hamlet on road from Brandywine to Naylor, in Prince Georges County. Crops out on eastern flank of upland, caps many hills between the upland and Patuxent River, and is exposed in many roadcuts.

North Lake zone (in Negaunee Formation)[1]

Precambrian (middle Huronian): Northern Michigan.

Original reference: J. L. Adler, 1935, Jour. Geology, v. 43, no. 2, p. 113–132.

Type locality not stated, but map shows it around North Lake, Marquette County.

North Leon Limestone Member (of Graham Formation)[1]

North Leon Formation (in Graham Group)

Upper Pennsylvanian: Central northern Texas.

Original reference: F. Reeves, 1922, U.S. Geol. Survey Bull. 736–E, p. 117.

M. G. Cheney, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 1, p. 66 (fig. 1); R. C. Moore and others, 1944, Geol. Soc. America Bull., v. 55, no. 6, chart 6 (column 38). Shown on correlation chart as formation in Graham group; occurs below Bunger formation and above Gonzales formation.

Exposed on North Fork of Leon River, Eastland County.

North Meadow Creek Flows

Tertiary: Southwestern Montana.

D. B. Andretta and S. A. Alsup, 1960, Billings Geol. Soc. 11th Ann. Field Conf., p. 187. Name applied to large mass of volcanic rocks that crop out south of North Meadow Creek. Rests on Precambrian rocks.

North Meadow Creek flows through Madison County, area of this report.

North Mound Conglomerate and Quartzite[1]

Precambrian (upper Huronian): Central northern Wisconsin.

Original reference: S. Weidman, 1907, Wisconsin Geol. Natl. History Survey Bull. 16, p. 371.

Forms North Mound about 5 miles northwest of Babcock, Wood County.

North Park Formation[1]

Miocene, upper, and Pliocene(?): Northern Colorado and southern Wyoming.

Original reference: C. King, 1876, U.S. Geol. Expl. 40th Par. Atlas, Map 1.

John de la Montagne and W. C. Barnes, 1957, Rocky Mountain Assoc. Geologists Guidebook to the geology of North and Middle Park Basins, Colorado, p. 56–59. In North Park basin, occupies center of North Park syncline. About 400 feet thick at west end of syncline but increases to about 1,800 feet at Owl Mountains. Overlies White River (used here as equivalent of Chadron) formation of early Oligocene age. Formation fills Saratoga Valley, a structural trough that continues northwest trend of North Park basin for distance of 75 miles. North of Saratoga, Wyo., more than 1,300 feet thick. Conformably overlies Browns Park formation of middle Miocene age at north end of Saratoga Valley but unconformably overlies Precambrian through Paleocene rocks throughout most of area. Late Miocene.

T. A. Stevens, 1960, U.S. Geol. Survey Bull. 1082–F, p. 336 (table 1), 352–354, pl. 12. Described in Northgate district, Colorado, where it consists of impure silts, sands, and stream gravels. Unconformably overlies White River formation. Pliocene(?) and Miocene.

W. J. Hail, Jr., and G. E. Lewis, 1960, U.S. Geol. Survey Prof. Paper 400–B, p. B259–B260. Probably late Miocene. Age determination made on basis of fossil vertebrates found at type locality of formation. Beekly's (1915 U.S. Geol. Survey Bull. 596) redefinition of the North Park has generally been followed by subsequent workers. In type area south of Walden, Jackson County, Colo., formation is at least 2,000 feet thick and at different places lies on White River formation of Oligocene age and on Coalmont formation of Paleocene and Eocene age. Formation of type area is not continuous with rocks mapped as North Park 20 to 30 miles farther north in Saratoga basin of northern Colorado and southern Wyoming (McGrew, 1951, Wyoming Geol. Assoc. Guidebook 6th Ann. Field Conf.; Montagne and Barnes, 1957). In Saratoga basin area, the North Park lies on rocks as old as Precambrian.

Named for occurrence in North Park, northern Colorado.

North Peak Porphyritic Syenite

Age not stated: Central Montana.

R. N. Miller, 1959, Montana Bur. Mines and Geology Mem. 37, p. 22, 23. Name applied to porphyritic syenite which characterizes North Peak. Moderate brownish gray to dark brownish gray on weathered surfaces. Dense stony matrix; dark gray to moderate black on fresh surface. Abundant light-gray phenocrysts of sanidine, and lesser amounts of pale-yellow tabular feldspar altering to a clay mineral. No quartz or ferromagnesian minerals discerned megascopically.

Named for occurrence on North Peak in South Moccasin Mountains, Fergus County.

North Point Member[1] (of Milwaukee Formation)

Middle Devonian: Southeastern Wisconsin.

Original reference: G. O. Raasch, 1935, Kansas Geol. Soc. 9th Ann. Field Conf., p. 262, 263, 266.

G. A. Cooper and others, 1942, Geol. Soc. America Bull., v. 53, no. 12, pt. 1, chart 4. North Point member shown on correlation chart above Lindwurm member.

Type locality: North Point, Intake Tunnel, Milwaukee County.

Northport Limestone[1]

Middle Cambrian(?): Northeastern Washington.

Original reference: C. E. Weaver, 1920, Washington Geol. Survey Bull. 20, p. 75, map.

C. D. Campbell, 1947, Geol. Soc. America Bull., v. 58, no. 7, p. 611. Remapping of northeastern Stevens County and discovery of Cambrian and Ordovician fossils are thought to justify adoption there of formation names established by Park and Cannon (1943) for Metaline quadrangle. Part of Weaver's Northport limestone is correlative with Metaline limestone and part is correlative with Maitlen phyllite.

Charles Deiss, 1955, U.S. Geol. Survey Bull. 1027–C, p. 122, 126, pl. 14. Restricted to lower, thicker unit (main mass) of Weaver's Northport. As restricted, underlies rather than interbeds with Weaver's Mission argillite. In mapped area, Northport is all dolomite, about 629 feet thick, and is intruded by at least nine dikes of medium-grained trachytic lamprophyre.

Occurs near Marble, Stevens County. Dolomite is part of southwest limb of anticlinorium that extends northeastward along valley of Columbia River from Marble to beyond Northport.

North Ridge Agglomerate[1] or Formation

Upper Jurassic: Northern California.

Original reference: C. H. Crickmay, 1933, Geol. Soc. America Bull., v. 44, no. 1, p. 81.

R. W. Imlay, 1952, Geol. Soc. America Bull., v. 63, no. 9, chart 8C (column 93). Shown on correlation chart as North Ridge formation above Hinchman formation and below Foreman formation.

Occurs on Hinchman Ridge and Ravine, north ridge of Mount Jura.

Northrip Member (of Yegua Formation)

Eocene: Southern Texas.

H. D. McCallum, 1947, South Texas [Geol. Soc. Guidebook] 14th Ann. Mtg. Field Trip, p. 5. Noted on road log as in contact with Christine member (new).

Type locality not stated but Christine member occurs near Christine, Atascosa County.

North Shore Volcanics or Volcanic Complex (in Keweenawan Group)

Precambrian: Northeastern Minnesota.

H. M. Gehman, 1958, Minnesota Univ. Center for Continuation Study, Gen. Ext. Div., Inst. of Lake Superior Geology, Apr. 21–22, p. 1. North Shore volcanic complex is intruded by gabbros of Beaver Bay complex. On basis of A^{40}/K^{40} dating (Goldich and Nier, p. 11, this report), group is considered middle late Precambrian. Middle Keweenawan.

F. F. Grout, R. P. Sharp, and G. M. Schwartz, 1959, Minnesota Geol. Survey Bull. 39, p. 13 (table 1), 30–40. Described in Cook County as North Shore volcanics in Keweenawan group. Volcanic group comprises rocks which consist predominantly of basalt and rhyolite flows with interbedded tuffs, shales, conglomerates, and breccias. Flows and associated rocks occupy about one-half of Cook County. Principal belt lies between coast of Lake Superior and upper contact of Duluth gabbro complex.

Occurs in Lake and Cook Counties.

North Star Conglomerate[1] (in Central Mine Group)

Precambrian (Keweenawan): Northern Michigan.

Original reference: A. R. Marvine, 1873, Michigan Geol. Survey, v. 1, pt. 2, p. 80, chart.

Named for occurrence in old North Star mine, Houghton County.

†North Valley Hill Sandstone[1]

Lower Cambrian: Southeastern Pennsylvania.

Original reference: J. P. Lesley, 1892, Pennsylvania 2d Geol. Survey Summ. Final Rept., v. 1, p. 79, 165, 166.

Crops out through Chester and Montgomery Counties. Exposed for miles along North Valley Hill, Chester County.

North Vernon Limestone[1]

Middle Devonian: Southeastern Indiana.

Original reference: W. W. Borden, 1876, Indiana Geol. Survey 7th Ann. Rept., p. 148.

J. B. Patton and T. A. Dawson *in* H. H. Murray, 1955, Indiana Geol. Survey Field Conf. Guidebook 8, p. 41, pl. 1. Term North Vernon includes entire Hamilton sequence. Name Sellersburg in its original sense was nearly in synonymy with North Vernon, although its author failed to account for lowest rocks of Hamilton age. Names North Vernon and Sellersburg can both be used to advantage in describing Hamilton rocks in southeastern Indiana. Sellersburg, as defined by Kindle (1899) and modified by later workers, is present in Clark County and southern Scott County—that is, throughout area where Hamilton rocks are readily divisible into Beechwood, Silver Creek, and Speed lithologies—but is not applicable in Bartholomew and Jennings Counties and most of Jefferson County. A name other than Sellersburg is useful where reference is made to undifferentiated limestones of this area. Name North Vernon as set forth by Borden (1876) is meaningful when applied to relatively homogeneous Hamilton limestones of Bartholomew, Jennings, and Jefferson Counties. If only one name is to be retained, it should be North Vernon on grounds of both priority and inclusiveness. At present, Indiana Geological Survey uses both terms North Vernon and Sellersburg as formation names that include all limestones of Hamilton age of southeastern Indiana outcrop.

Named for North Vernon, Jennings County.

Northview Shale[1]

Northview Formation (in Chouteau Group)

Northview Member (of Chouteau Formation)

Mississippian: Southwestern Missouri.

Original reference: S. Weller, 1901, Jour. Geology, v. 9, p. 140.

E. B. Branson, 1944, Missouri Univ. Studies, v. 19, no. 3, p. 184 (fig. 28), 193–196. Rank reduced to member status in Chouteau formation. Overlies Compton member; underlies Pierson member. Seems to be about middle of Lower Mississippian.

C. P. Kaiser, 1950, Am. Assoc. Petroleum Geologists Bull., v. 34, no. 11, p. 2154–2157. Formation ranges in thickness from a trace to 77 feet, which was observed in vicinity of Northview, Webster County. Present throughout central part of area of present report [southwestern Missouri]. In most of area of occurrence, conformably overlies Chouteau limestone. The Chouteau pinches out southward before the Northview. Thus, in southern part of area of its occurrences, the Northview unconformably overlies Sylamore sandstone or rocks of Ordovician age. Conformably overlain by Sedalia dolomite.

E. L. Clark and T. R. Beveridge, 1952, Kansas Geol. Soc. Guidebook 16th Field Conf., p. 71, 72 (fig. 1), 74, 77 (reprinted as Missouri Geol. Survey and Water Resources Rept. Inv. 13). Top formation of the Chouteau, herein redefined as group. Where formation is thick, consists of two members: upper predominantly siltstone interbedded with subordinate shales and lower predominantly shale with minor siltstone lenses. Underlies Pierson formation; at type section, overlies Compton formation. North of type section lower Northview changes facies laterally and becomes Sedalia formation of west-central Missouri; uppermost Northview is attenuated as thin bed of shaly siltstone which overlies Sedalia as far north as Missouri River and eastward into Cooper and Howard Counties; southward to Arkansas-Missouri line, Northview persists as thin limey shale. Top of Northview is considered top of Kinderhook series. Type locality proposed.

C. H. Behre, Jr., and A. V. Heyl, Jr., 1958, Deutsche Geol. Gesell. Zeitschr., v. 110, pt. 3, p. 517 (fig. 2). Northview shale shown on chart below Boone formation. Thickness 0 to 20 feet.

Type section: A composite of section along old and new lanes of U.S. Highway 66, 2 miles northwest of Northview, Webster County. Entire Northview with exception of uppermost beds is exposed along old or south lane of U.S. Highway 66 in SW¼SW¼SW¼ sec. 23, and S½ SE¼SE¼ sec. 22, T. 30 N., R. 19, W. Contact with overlying Pierson is exposed in cut in relocated or north lane in NE¼SW¼SE¼ sec. 22, T. 30 N., R. 19 W.

North Warren Shale Member[1] (of Cattaraugus Formation)

North Warren Shale Member (of Venango Formation)

Upper Devonian: Northwestern Pennsylvania.

Original reference: K. E. Caster, 1933, Geol. Soc. America Bull., v. 44, pt. 1, p. 203.

Bradford Willard, 1939, Pennsylvania Geol. Survey, 4th ser., Bull. G–19, p. 14, 243. Member of Venango. Overlies Bimber Run conglomerate member; underlies Pope Hollow conglomerate member. The three units comprise Salamanca formational suite of Caster (1934). Upper Devonian.

Named for occurrence between Asylum quarries at North Warren and Tanner's Hill quarries (now Warren reservoir) on Tanner's Hill, at Warren, Warren County.

Northwestern Formation[1]

Precambrian: Southwestern South Dakota.

Original reference: J. O. Hosted and L. B. Wright, 1923, Eng. and Min. Journal-Press, v. 115, p. 793–799, 836–843, maps.

T. A. Dodge, 1942, Geol. Soc. America Bull., v. 53, no. 4, p. 563. In Lead district, unconformably underlies Flag Rock formation (new) and overlies Ellison formation. Thickness as much as 4,000 feet.

J. R. Berg, 1946, South Dakota Geol. Survey Rept. Inv. 52, p. 6, 13. In Galena-Roubaix district, overlies Ellison formation and underlies Garfield formation.

Named for exposures in cuts of Chicago and Northwestern Railroad between Lead and Blacktail, Lawrence County.

Norton Formation

Norton Formation (in Pottsville Group)[1]

Middle Pennsylvanian: Southwestern Virginia and southeastern Kentucky.

Original reference: M. R. Campbell, 1893, U.S. Geol. Survey Bull. 111, p. 28, 34.

J. B. Eby, 1923, Virginia Geol. Survey Bull. 24, p. 63, 67. Includes McClure sandstone member near middle.

H. R. Wanless, 1946, Geol. Soc. America Mem. 13, p. 69–72, 147. Underlies Gladeville sandstone; overlies Lee formation; includes several named coals from Norton (at top) to and including Tiller at base. Formation is discussed under heading "strata of Briceville age in Virginia".

Named for Norton, Wise County, Va.

Norton Limestone Member (of Tribes Hill Formation)

Lower Ordovician: East-central New York.

R. R. Wheeler, 1941, (abs.) Geol. Soc. America Bull., v. 52, no. 12, pt. 2, p. 1938. Named as member of Tribes Hill.

R. R. Wheeler, 1942, Am. Jour. Sci., v. 240, no. 7, p. 518, 522, 523. Basal unit of formation in Champlain and Hudson Valleys. Described at Whitehall as mottled dolomitic limestone with uncertain amount of crossbedded sandstone at base. Thickness about 45 feet. Underlies Fort Ann limestone member; overlies Skene dolomite member of Whitehall formation. Represents division C–2 and upper part of C–1 of Brainerd and Seely's "Calciferous" (1890, Geol. Soc. America Bull., v. 1, p. 501–506).

D. W. Fisher, 1954, Geol. Soc. America Bull., v. 65, no. 1, p. 74. Name preoccupied. Subdivisions of Tribes Hill formation in Champlain Valley poorly defined and can not be used in Mohawk Valley.

Occurs at Whitehall and Fort Ann, Washington County.

†Norton zone (in Niobrara Formation)[1]

Upper Cretaceous: Northwestern Kansas.

Original reference: F. W. Cragin, 1896, Colorado Coll. Studies, v. 6. p. 51.

Named for Norton and Norton County.

Nortonville Shale Member (of Kreyenhagen Formation)

Nortonville Shale

Eocene, upper: Western California.

P. P. Goudkoff, 1943, California Div. Mines Bull. 118, pt. 2, p. 248 (fig. 99a) [preprint 1941]. Correlation chart of west side of San Joaquin Valley oil fields shows Nortonville claystone, 15 to 50 feet thick, in Coalinga oil field. Occurs below Kreyenhagen shale.

Ralph Stewart, 1949, U.S. Geol. Survey Oil and Gas Inv. Prelim. Chart 34. Rank reduced to member status in Kreyenhagen formation. Foraminiferal and radiolarian shale about 300 feet thick. Underlies Markley sandstone member. Type locality stated.

N. L. Taliaferro, 1951, California Div. Mines Bull. 154, p. 137. Upper Eocene in Bay region is divided into three units: Domengine sand, at base, Nortonville shale, and Markley formation. In central Napa County, along Conn Creek northeast of Rutherford, are small downfaulted remnants of Nortonville shale. These have maximum thickness of 600 feet and are either vertical or stand at high angles.

C. V. Fulmer, 1954, (abs.) Geol. Soc. America Bull. 65, no. 12, pt. 2, p. 1341. Formation, at type section, is tripartite lithologic unit composed of two chocolate-brown marine silty clay shales with an intervening argillaceous feldspathic sandstone lentil. Underlies Markley formation. Upturned edges of these two formations are exposed in lenticular, elongate outcrop striking northwest with regional dip to northeast. Faunules correlated with Ulatisian and Narizian stages.

Type locality: In roadcuts and along ridge between Nortonville sand mine on Kirker Creek and Somersville cemetery, north of Mount Diablo, Contra Costa County.

Norwalk Sandstone Member (of Jordan Sandstone)[1]

Upper Cambrian: Western Wisconsin and southeastern Minnesota.

Original reference: F. T. Thwaites, 1923, Jour. Geology, v. 31, no. 7, p. 547.

Josiah Bridge, 1937, U.S. Geol. Survey Prof. Paper 186–L, p. 236 (table 2). Table shows Norwalk as basal member of Jordan sandstone; underlies upper unnamed sandstone member. Overlies Lodi shale member of St. Lawrence formation.

C. R. Stauffer, G. M. Schwartz, and G. A. Thiel, 1938, (abs.) Geol. Soc. America Bull., v. 49, no. 12, pt. 2, p. 1902; 1939, v. 50, no. 8, p. 1238 (table 2), 1240. Underlies Van Oser member (new).

C. R. Stauffer and G. A. Thiel, 1941, Minnesota Geol. Survey Bull. 29, p. 48–49. Described in southeastern Minnesota where it is about 55 feet thick in type section of Jordan sandstone. Underlies Van Oser member; overlies Lodi member of St. Lawrence formation.

Well exposed at Norwalk, Monroe County, Wis.

Norway Limestone[1]

Precambrian: Northern Michigan.

Original reference: C. Rominger, 1881, Michigan Geol. Survey, v. 4, pt. 2, p. 182.

Menominee iron region.

Norway Quartz Monzonite (in New Hampshire Magma Series)

Upper Devonian(?): East-central New Hampshire.

A. P. Smith and others, 1938, Geologic map and structure sections of the Mount Chocorua quadrangle, New Hampshire (1:62,500): New Hampshire Highway Dept. Medium- to coarse-grained pink quartz monzonite, usually gneissic. Belongs to New Hampshire magma series whose age is post-Lower Devonian and probably Upper Devonian.

A. P. Smith, Louise Kingsley, and Alonzo Quinn, 1939, Geology of the Mount Chocorua quadrangle, New Hampshire: Concord, New Hampshire State Plan. Devel. Comm., p. 6, 15. Older than Tamworth granite and younger than Kinsman quartz monzonite. Type locality cited.

Type locality: Rapids on Avalanche Brook in northwestern corner of Mount Chocorua quadrangle.

Norway Point Formation[1] (in Traverse Group)

Middle Devonian: Northeastern Michigan.

Original reference: A. S. Warthin, Jr., and G. A. Cooper, 1935, Washington Acad. Sci. Jour., v. 25, no. 12, p. 524–526.

A. S. Warthin, Jr., and G. A. Cooper, 1943, Am. Assoc. Petroleum Geologists Bull., v. 27, no. 5, p. 579 (fig. 3), 589–590. Described in Thunder Bay region where it underlies Potter Farm formation and overlies Four Mile Dam formation. Thickness at type section about 34 feet; neither top nor bottom visible. Included in Traverse group.

Type section: Exposures on banks and in bed of Thunder Bay River below Norway Point Dam, NE¼ sec. 12, T. 31 N., R. 7 E., Alpena County. This dam is also known as Six Mile or Seven Mile Dam.

Norwich Conglomerate[1]

Precambrian (Keweenawan): Northern Michigan.

Original reference: S. H. Broughton, 1863, Remarks on the mining interest and details of geology of Ontonagon County, p. 17–18, map.

Exposed at Norwich mine, Ontonagon County.

Norwood Shale

Middle Devonian: Northern Michigan.

[G. M. Ehlers], 1938, Michigan Acad. Sci., Arts, and Letters Sec. Geology and Mineralogy [Guidebook] 8th Ann. Field Excursion, p. 3,[figs. 1–3] after p. 8. Top of section. Shown to overlie Squaw Bay.

Occurs in Alpena district.

Norwood Tuff

Norwood Tuff (in Salt Lake Group)

Oligocene: Central Utah.

A. J. Eardley, 1944, Geol. Soc. America Bull., v. 55, no. 7, p. 845–846, pl. 1; 1955, Utah Geol. Soc. Guidebook 10, p. 38, fig. 9. Dominantly light-colored tuff with lenses of volcanic conglomerate. Inlaid in Knight(?) formation of lower East Canyon and Morgan Valley and in Henefer formation (new) of Little East Canyon. Separated by unconformity from underlying beds. Rests in synclinal valley (Morgan Valley) on beds of Wasatch group and in anticlinal valley (Little East Canyon) on Henefer formation. Has yielded vertebrate fossils. Lower Oligocene. Probably contemporaneous with Park City volcanics (new). Included in Salt Lake group by Hayden (1869).

Neal Smith, 1953, Intermountain Assoc. Petroleum Geologists Guidebook 4th Ann. Field Conf., p. 75 (fig. 2). Composite stratigraphic column shows Norwood tuff at base of Salt Lake group. Stratigraphically below Collingston conglomerate (new). Thickness 50 to 2,000 feet. Lower Oligocene.

A. J. Eardley, 1959, Intermountain Assoc. Petroleum Geologists Guidebook 10th Ann. Field Conf., p. 167. Term Norwood abandoned and name Fowkes applied to all Norwood outcrops.

C. L. Gazin, 1959, Intermountain Assoc. Petroleum Geologists Guidebook 10th Ann. Field Conf., p. 137. Although Norwood tuff was referred to Oligocene by Eardley (1944) as result of vertebrate fossils identified as *Allops marshi* and *leptomeryx* sp., a lower jaw belonging to upper Eocene agriochoerid *Protoreodon* cf. *pumilus* has been found in these beds in Norwood Canyon. Possibly two horizons are represented. In any case, the Norwood Canyon specimen is not likely as young as Oligocene.

Named for exposures in Norwood Canyon, Morgan County.

Nosoni Formation[1]

Nosoni Formation (in Bollibokka Group)

Permian: Northern California.

Original reference: J. S. Diller, 1906, U.S. Geol. Survey Geol. Atlas, Folio 138.

A. H. Coogan, 1957, (abs.) Geol. Soc. America Bull., v. 68, no. 12, pt. 2, p. 1821. At type locality Nosoni formation consists of 16,200 [6,200] feet of basic pyroclastics, flows, and interbedded sediments. Lowest member, conformably overlying McCloud limestone, is about 150 feet of black, medium-bedded chert. Second member is 1,495 feet thick and is primarily of bedded green tuff, tuffaceous conglomerate, and sandstone. Third member is 3,265 feet of purple medium-bedded or massive tuffaceous conglomerate, tuffaceous sandstone, tuff breccia, fissile red shale, and black fossiliferous shale. Fourth member is 1,440 feet and consists largely of black medium-bedded silty shale, which is richly fossiliferous in places. Andesitic flows occur throughout formation. Underlies Dekkas formation. As originally mapped much of type Dekkas is lateral equivalent of type Nosoni. Fossils show formation to be of early Guadalupian age.

A. H. Coogan, 1960, California Univ. Pubs. Geol. Sci., v. 36, no. 5, p. 243–255. Described in Bollibokka area where it is lower unit in Bollibokka group (new). Name was given to basic tuff, tuffaceous conglomerate, flows, and associated partly fossiliferous sedimentary rocks conformably overlying McCloud limestone. The Nosoni thus includes the McCloud shales of Fairbanks (1894) and at least part of the Carboniferous shales of Smith's (1894, Jour. Geology, v. 2) Pitt formation. Formation is more than 6,200 feet thick. Lower part consists of green and red, bedded, lithic crystal lapilli tuff, tuff breccia, tuffaceous conglomerate, sandstone, and shale. Interbedded with these rocks are andesite basalt and scattered beds of chert. Above the lower pyroclastic sequence, as well as sparsely interbedded with it, are black shale and slate, locally rich in fossils. There is no easily recognizable division between Nosoni and Dekkas. In Bollibokka area, contact is placed at top of highest black shale unit below the first massive green tuff breccia. In Bollibokka area, consists of four units characterized by different dominant lithologic components. Diller (1906) mapped a "Nosoni sediments" member of the formation in Bollibokka area. His usage and mapping are not followed in present study because unit is inconsistently defined. At Chatterdown Creek, it equals dominant sedimentary Member Four, but on Nosoni Creek it includes Member Four and about half of dominantly volcanic Member Three.

Named for exposures on Nosoni Creek, Shasta County.

Notch Peak Limestone[1]

Upper Cambrian: Western Utah.

Original reference: C. D. Walcott, 1908, Smithsonian Misc. Colln., v. 53, no. 1084, p. 9.

H. E. Wheeler and Grant Steele, 1951, Utah Geol. Soc. Guidebook 6, p. 32 (fig. 5). Thickness 1,490 feet. Overlies Orr and Weeks formations. Underlies Chokecherry(?).

L. F. Hintze, 1951, Utah Geol. and Mineralog. Survey Bull. 39, p. 12. Underlies House limestone (new) of Pogonip group (restricted and redefined).

C. B. Bentley, 1958, Brigham Young Univ. Research Studies, Geology Ser., v. 5, no. 6, p. 24–25, pls. 1, 2. Described in area from Wah Wah Range northward to Silver Island Range where it overlies Dunderberg shale, geographically extended. Thickness 978 to 1,939 feet. Chokecherry dolomite is divided into two distinct lithic types separated by major time boundary; proposed here that Cambrian part of Chokecherry be renamed Notch Peak.

D. K. Powell, 1959, Brigham Young Univ. Research Studies, Geology Ser., v. 6, no. 1, p. 21–25, geol. map. Described in southern House Range. Walcott's and Wheeler-Steele's stratigraphic section of Notch Peak amended on basis of lithology, fauna, and redefinition of Cambrian-Ordovician contact. Amended Notch Peak 1,939 feet thick; conformably underlies House limestone; conformably overlies Dunderberg shale. However, it is believed that thickness may be as much as 2,700 feet.

Type locality: Upper part of main mass of Notch Peak, House Range, Millard County.

Nottely Quartzite[1]

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

Original reference: A. Keith, 1907, U.S. Geol. Survey Geol. Atlas, Folio 143, p. 5.

G. W. Stose and A. J. Stose, 1949, Geol. Soc. America Bull., v. 60, no. 2, p. 286–290. Nottely quartzite is thin but prominent ridge-making quartzite which occurs in contact with Murphy marble only in main belt from Ellijay, Ga., northeastward; from Mineral Bluff, Ga., northeastward to Tomotla, N.C., it is exposed continuously for more than 24 miles. Quartzite dips steeply southeast to vertical; in places it is folded with the marble, but for most part it lies southeast of the marble and northeast of Valleytown formation. Where Nottely quartzite is not present and Murphy marble lies adjacent to Valleytown formation, as in Tate area, Georgia, it is assumed that the Nottely is absent because of nondeposition. Locally in Murphy syncline, the Nottely is cut out by faults and in some areas is in fault contact with Nantahala slate and Great Smoky quartzite. Cambrian(?). Discussion of structural relationships of area in detail.

G. W. Crickmay, 1952, Georgia Geol. Survey Bull. 58, p. 27. Included in Talladega series believed to be Precambrian.

V. J. Hurst, 1955, Georgia Geol. Survey Bull. 63, p. 54–56. In Mineral Bluff quadrangle, underlies Mineral Bluff formation (new); contact gradational.

Named for exposures along Nottely River, Cherokee County, N.C.

Nounan Limestone[1]

Nounan Dolomite

Middle and Upper Cambrian: Southeastern Idaho and northeastern Utah.

Original reference: C. D. Walcott, 1908, Smithsonian Misc. Colln., v. 53, no. 1804, p. 6.

Charles Deiss, 1938, Geol. Soc. America Bull., v. 49, no. 7, p. 1109–1116, 1117 (fig. 4), 1122–1123. Walcott's Blacksmith Fork section redescribed. Consists of light-gray and some dark-gray dolomite; lower part contains more than 150 feet of white-gray cliff-forming limestone. Thickness 900 feet. Overlies Bloomington limestone, base arbitrarily drawn at base of cliffs above upper slope of Bloomington; underlies St. Charles formation. May be late Middle or early Upper Cambrian in age, but evidence not conclusive; considered Middle Cambrian as stated by Walcott.

G. B. Maxey, 1958, Geol. Soc. America Bull., v. 69, no. 6, p. 651, 660, 673 (fig. 3). Overlies Calls Fort shale member (new) of Bloomington formation.

U.S. Geological Survey currently considers Nounan Limestone to be Middle and Upper Cambrian in age.

Type locality: East slope of Soda Peak, west of Nounan, Bear Lake County, Idaho. Nounan Canyon cuts through formation.

Nova Formation

Miocene, upper, or Pliocene, lower: Southern California.

R. H. Hopper, 1947, Geol. Soc. America Bull., v. 58, no. 5, p. 414–415. Beds of Tertiary fanglomerate with intercalated layers of volcanic material. At least 3,000 feet thick. Unconformably overlies Precambrian and Paleozoic basement; contact poorly exposed, but in Nemo Canyon fanglomerate lies with depositional contact upon Precambrian. Fanglomerate and lava dip to east and southeast.

C. W. Jennings, 1958, Geologic map of California Death Valley Sheet (1:250,000): California Div. Mines. Mapped with Plio-Pleistocene nonmarine sedimentary units.

Occurs on west flank of Panamint Range, between Wildrose Canyon and Towne's Pass, Death Valley region, Inyo County. Well exposed in Nova Canyon, whence the name.

Novato Conglomerate

Cretaceous(?): Northwestern California.

C. E. Weaver, 1949, Geol. Soc. America Mem. 35, p. 18 (table 3), 45, pl. 10. Thick-bedded conglomerate composed of well-rounded cobbles and pebbles of quartzite, quartz porphyry, quartz diorite, and white quartz. Thickness about 1,300 feet. Surrounded by alluvium except for about a mile along west boundary where it rests on serpentine associated with Franciscan group and is in fault contact with Sonoma volcanics; has been downthrown along east side of Burdell Mountain fault for an undetermined distance.

Exposed in Petaluma quadrangle on west side of San Pablo Bay just west of mouth of Petaluma Creek, in Coast Ranges north of San Francisco Bay. Confined to elongate area of about 3½ square miles.

Nowadaga[1] Member (of Utica Formation)

Ordovician: Eastern New York.

Original reference: R. Ruedemann and G. H. Chadwick, 1935, Science, new ser., v. 81, no. 2104, p. 400.

G. M. Kay, 1937, Geol. Soc. America Bull., v. 48, no. 2, p. 282. Nowadaga shale has been defined by Ruedemann and Chadwick (1935) as lower Utica or zone of *Climacograptus typicalis* (Hall) and includes black hard somewhat calcareous mud shale of typical Utica appearance that directly overlies the Canajoharie. Underlies Loyal Creek member. Thickness 200 feet on Nowadaga Creek; 500 feet in Otsquago Creek section near Fort Plain.

Well exposed on Nowadaga Creek, Herkimer County.

Nowata Shale[1] (in Marmaton Group)

Pennsylvanian (Des Moines Series): Northeastern Oklahoma, southwestern Iowa, southern Kansas, and western Missouri.

Original reference: D. W. Ohern, 1910, Oklahoma State Univ. Research Bull. 4, p. 23.

J. M. Jewett, 1941, Kansas Geol. Survey Bull. 38, pt. 11, p. 292, 335. Includes Walter Johnson sandstone member (new). Overlies Altamont limestone; underlies Lenapah limestone. Thickness 600 feet near Tulsa; 175 feet at Nowata; about 50 feet at Kansas-Oklahoma line; thins rapidly northward. Marmaton group.

M. C. Oakes, 1952, Oklahoma Geol. Survey Bull. 69, p. 33–36, pl. 11. In type locality, lies between Altamont limestone member of Oologah formation below and Lenapah limestone above. Locally, south of type locality, overlain unconformably by Seminole formation. Maximum thickness about 200 feet. Owing to failure to recognize unconformity at base of Seminole formation and to assumption by Ohern that Dawson coal is southward equivalent of Lenapah limestone, term Nowata has unwittingly been made to include lower part of Seminole formation from south part of T. 25 N., southward, and in addition Holdenville (Memorial) shale and Lenapah limestone from latitude of Tulsa southward. As result, the Nowata has been erroneously assigned thickness of 600 feet or more in latitude of Tulsa.

J. R. Faucette, 1944, Tulsa Geol. Soc. Digest, v. 23, p. 247–248. Section of Nowata at type locality incompletely exposed; more complete section suggested for type section. Thickness at this section approximately 100 feet.

W. B. Howe, 1959, Missouri Geol. Survey and Water Resources Rept. Inv. 9, p. 8–10, strat. sections. Geographically extended into western Missouri. Overlies Altamont formation; underlies Norfleet member of Lenapah formation. Average thickness between 10 and 15 feet. Includes Walter Johnson sandstone member.

H. G. Hershey and others, 1960, Iowa Highway Research Board Bull. 15, p. 30, fig. 5. Section of shales and sandstones beneath Cooper Creek limestone of Lenapah and above Worland limestone of Altamont is here called Nowata although it may include part of overlying Lenapah as used in Missouri. In Iowa, there is no obvious break in sedimentation that would justify differentiation. Thickness in Madison County about 50 feet.

Type locality: T. 26 N., R. 16 E., latitude of Nowata. Type section: SW¼ sec. 10, T. 27 N., R. 16 E., Nowata County. Section measured on south bank of Verdigris River. Named from Nowata, Nowata County, Okla.

Nowood Member (of Phosphoria Formation)

Permian: Northern Wyoming.

J. J. McCue, 1955, (abs.) Wyoming Univ. Pubs., v. 19, no. 2, p. 82. Incidental mention.

Present in southeastern part of Big Horn Basin.

Noxie Sandstone Lentil or Member (of Chanute Formation)

Pennsylvanian (Missouri Series): Northern Oklahoma and southern Kansas.

R. C. Moore and others, 1937, Kansas Geol. Soc. Guidebook 11th Ann. Field Conf., p. 40, 43, 104. Sandstone lentil forming base of Chanute shale in Chautauqua arch area. Underlies Thayer coal.

M. C. Oakes, 1940, Oklahoma Geol. Survey Bull. 62, p. 61, pl. 1. Has maximum thickness of 60 feet in vicinity of Noxie. Consists of massive coarse-grained crossbedded buff to reddish brown sandstone. Upper part overlaps Nellie Bly beds along south side of pre-Chanute erosion channel.

R. C. Moore, J. C. Frye, and J. M. Jewett, 1944, Kansas Geol. Survey Bull. 52, pt. 4, p. 190. Commonly fills channels that extend as low as Stark shale or lower; locally contains limestone conglomerate at base. Average thickness 40 feet; in southern Kansas, may be as much as 100 feet, locally. Underlies unnamed clay shale; disconformable above Drum limestone.

Named for outcrops in vicinity of Noxie, NW cor. sec. 30, T. 29 N., R. 15 E., Nowata County, Okla.

Noxubee Sand

Eocene (Wilcox): Mississippi.

F. F. Mellen, 1950, Mississippi Geol. Survey Bull. 69, p. 9, 10–11. Lower Tertiary stratigraphy shows cyclic sedimentation to prevail. Normal cycle consists of basal transgressive sand member, median clay or shale member of inundated phase, and superior regressive silt or fine sand member. Second cycle of the Wilcox, Ackerman formation, is most conspicously developed cycle in lower Tertiary. Its basal sand exhibits evidence of orogenic developments in region by coarseness of its grain, sporadic presence of pebbles, cobbles, and boulders (up to 905 pounds) of quartz and quartzite, local concentration of large muscovite flakes, its thickness (up to 475 feet in subsurface, Jasper County) and its widespread lateral extent. Name Noxubee is applied to this basal sand.

Type locality and derivation of name not stated.

Nugget Sandstone[1]

Lower Jurassic: Southwestern Wyoming, southeastern Idaho, and northeastern Utah.

Original reference: A. C. Veatch, 1907, U.S. Geol. Survey Prof. Paper 56, p. 56, chart, map.

J. D. Love and others, 1945, U.S. Geol. Survey Oil and Gas Inv. Prelim. Chart 14. Nugget sandstone has been included in Chugwater formation by some geologists; in Lost Soldier district and in Steamboat Butte field where oil was found in it [Nugget], it is called lower Sundance sand. This sandstone is called Wyopo formation by some geologists. Nugget sandstone, as here defined [central Wyoming], is the red and gray massive to coarsely bedded sandstone overlying Popo Agie member of Chugwater and underlying a Middle Jurassic sequence of gypsum, red shale, and dolomite beds throughout most of Wind River basin except in southeastern part. There the gypsiferous rocks are absent and the Nugget is overlain by younger fine-grained gray marine sandstones and green shales. Thickness 500 feet at southwest margin of Wind River basin, thins to north and east, and is absent in most places north of Owl Creek Mountains and along eastern margin of basin.

H. D. Thomas and M. L. Krueger, 1946, Am. Assoc. Petroleum Geologists Bull., v. 30, no. 8, pt. 1, p. 1273, 1275, strat. sections. In western Uinta and central Wasatch Mountains, overlies Stanaker formation (new) which includes some strata classed as Nugget by Boutwell (1912, U.S. Geol. Survey Prof. Paper 77). Underlies Twin Creek limestone. Thickness 1,183 to 1,293 feet. Nugget persists eastward but is called Navajo beyond Whiterocks Canyon.

J. D. Love and others, 1947, Wyoming Geol. Survey Bull. 38, p. 23, 33, 34, 43–44, 50–51, 59. Stratigraphic sections in central Wyoming show Nugget underlying Gypsum Spring formation and overlying Popo Agie member of Chugwater.

G. R. Mansfield, 1952, U.S. Geol. Survey Prof. Paper 238, p. 35–36, pl. 1. Described in Ammon and Paradise Valley quadrangles, Idaho, where it is estimated to be 1,000 to 1,500 feet thick. Overlies Wood shale; underlies Twin Creek limestone. Lower Jurassic.

G. N. Pipiringos, 1953, Wyoming Geol. Assoc. Guidebook 8th Ann. Field Conf., p. 36 (chart), 37, correlation chart. Expanded at base to include 50 feet of strata formerly included in Jelm as originally defined.

H. R. Wanless, R. L. Belknap, and Helen Foster, 1955, Geol. Soc. America Mem. 63, p. 47–48. In northwestern Wyoming, overlies Deadman limestone or upper Popo Agie beds; unconformably underlies Gypsum Spring formation. Thickness 54 to 354 feet.

G. N. Pipiringos, 1957, Wyoming Geol. Survey Bull. 47, p. 8–10, 12 (table 2), 13, 17–19, pl. 5. Type Nugget, 1,900 feet thick, overlies the Thaynes and underlies the Twin Creek. It is divided into two members which Veatch (1907) mapped separately. Boutwell (1907) applied name Ankareh to a 1,300-foot sequence in Park City mining district, Utah, whose stratigraphic position is identical to that of original Nugget (resting on Thaynes and overlain by Twin Creek). Subsequent workers [see bibliography this report] in adjacent and intervening areas have tried to retain both names, not as equivalents, but by restricting name Ankareh to basal redbed unit of original Ankareh and Nugget formations, and by restricting name Nugget to the overlying thick sandstone unit. These workers did not agree as to where Nugget-Ankareh boundary should be drawn; hence, there is little agreement as to what names to use for subdivisions in sequence overlying the Thaynes and underlying the Twin Creek. Presumably Nugget sandstone (upper member of Nugget formation of Veatch) is similar to Nugget of central Wyoming as described by Love and others (1945, 1947). Term Nugget sandstone is here applied [Laramie basin] to those rocks overlying Jelm formation and underlying Sundance formation. Sandstone grades, within a few feet, downward into upper conglomeratic member of Jelm and is overlain by Canyon Springs member of Sundance. The Nugget of this paper constitutes upper part of original Jelm formation and is here correlated with upper part of Nugget sandstone of central Wyoming and with so-called Entrada of northern part of Colorado Front Range. Thickness 40 to 110 feet.

R. E. Skinner, 1960, Wyoming Geol. Assoc. Guidebook 15th Ann. Field Conf., p. 129–130. Stratigraphically restricted above to exclude unit here named Kendall sandstone member of Gypsum Spring formation.

Named for Nugget Station on Oregon Short Line, Lincoln County, Wyo.

Nulato Formation[1] (in Shaktolik Group)

Lower Cretaceous: Central western and central Alaska.

Original reference: W. H. Dall, 1892, U.S. Geol. Survey Bull. 84, p. 247, 276, 331, pl. 3.

R. M. Imlay and J. B. Reeside, Jr., 1954, Geol. Soc. America Bull., v. 65, no. 3, pl. 1 facing p. 246. Age given as Lower Cretaceous on correlation chart.

T. G. Payne, 1955, U.S. Geol. Survey Misc. Geol. Inv. Map I–84. Marine formation included in Shaktolik group in Koyukuk geosyncline and Hogatza uplift areas.

Typically exposed in northwest bank of Yukon for 2 to 10 miles above village of Nulato. In Nulato-Norton Bay district, Lower Yukon River region, and Koyukuk River region.

Nulhegan Quartz Monzonite

Age not stated: Northwestern Vermont.

B. K. Goodwin, 1959, Dissert. Abs., v. 20, no. 5, p. 1740. Granitic rocks occupy about two-thirds of map area. Three major granitic bodies are present. Averill granite, Nulhegan quartz monzonite, and Echo Pond granitic complex (new). Nulhegan is comparatively uniform.

Report discusses geology of Island Pond area, located between Green Mountain anticlinorium and Connecticut River.

†Nunda Group[1]

Upper Devonian: New York and Pennsylvania.

Original reference: L. Vanuxem, 1842, Geology New York, pt. 3, p. 172.

Named for exposures along banks of Genesee River in district formerly included in town of Nunda, now Portage, Livingston County, N.Y.

Nunda Sandstone Member (of West Falls Formation)

Nunda Sandstone[1]

Upper Devonian: Western and west-central New York.

Original reference: J. M. Clarke and D. D. Luther, 1908, New York State Mus. Bull. 118, p. 61.

W. H. Bradley and J. F. Pepper, 1938, U.S. Geol. Survey Bull. 899–A, p. 15, pl. 3. Underlies Pipe Creek shale member of Wiscoy sandstone; overlies West Hill formation. Name used in place of High Point sandstone.

J. F. Pepper and Wallace de Witt, Jr., 1950, U.S. Geol. Survey Oil and Gas Inv. Prelim. Chart 37. Underlies Pipe Creek shale herein reallocated to member status in Hanover shale; interfingers with upper part of Angola shale.

J. F. Pepper, Wallace de Witt, Jr., and G. W. Colton, 1956, U.S. Geol. Survey Oil and Gas Inv. Chart OC–55. Nunda sandstone of Clarke and Luther (1908) redesignated as sandstone member of West Falls formation (new). Thickness 2 to 225 feet; in western Wyoming County occupies interval of 28 feet but is divided into two parts by tongue of Angola shale member. In Genesee River valley-Letchworth Park area, overlies West Hill member and underlies Hanover shale (Pipe Creek member); in Naples-Hammondsport area, overlies West Hill member and underlies Wiscoy sandstone.

Exposed in town of Nunda, Livingston County.

Nunkoweap sandstone (in Kwaguntan series)

Precambrian: Northern Arizona.

Charles Keyes, 1938, Pan-Am. Geologist, v. 70, no. 2, p. 107 (chart), 114. Massive sandstones. Highest beds exposed in Protozoic section. Thickness 200 feet. Overlies Walhalla formation (new).

Grand Canyon region.

Nunn Member (of Lake Valley Formation)

Mississippian (Osage): Southwestern New Mexico.

L. R. Laudon and A. L. Bowsher, 1949, Geol. Soc. America Bull., v. 60, no. 1, p. 11, 13, 28, 61, figs. 4, 29. Soft blue-gray marls and nodular crinoidal limestone beds. Thickness varies from 100 feet in Santa Rita area to 1 foot in Sacramento Mountains. Rapid lateral variation in thickness common in Sacramento Mountains where biohermal structures occur. Absent in southern part of range because of nondeposition. Overlies Alamogordo member (as redefined); underlies Tierra Blanca member (new). Beds previously included in Alamogordo member.

V. C. Kelley and Caswell Silver, 1952, New Mexico Univ. Pubs. in Geology 4, p. 31, 83–84, fig. 3. Thin-bedded nodular light-gray- to pinkish-gray-weathering crinoidal limestone and shale unit as much as 30 feet thick in Caballo Mountains, where it unconformably overlies Percha formation or rests on Alamogordo member and unconformably underlies limestone of Magdalena group.

Type section: On Apache Hill at type section of Lake Valley formation near Lake Valley, NE¼NW¼ sec. 21, T. 18 S., R. 7 W., Sierra County. Named for Pryor Nunn Ranch on Tierra Blanca Creek where there are excellent exposures.

Nushagak Formation[1]

Miocene or Pliocene: Southern Alaska.

Original reference: J. E. Spurr, 1900, U.S. Geol. Survey 20th Ann. Rept., pt. 7, p. 173–174, 184.

Forms eastern shore of Nushagak Bay and around Cape Etolin to Bristol Bay.

Nussbaum Formation[1]

Pliocene(?): Eastern Colorado.

Original reference: G. K. Gilbert, 1897, U.S. Geol. Survey Geol. Atlas, Folio 36.

T. S. Lovering and E. N. Goddard, 1950, U.S. Geol. Survey Prof. Paper 223, p. 19, pl. 1. On plains, just east of Front Range, Mount Morrison surface underlies gravels of Nussbaum formation, whose age is probably Pliocene.

Named for Nussbaum Spring, east of Pueblo, Pueblo County.

Nuttall (lower) Sandstone (in Pottsville Group)[1]

Pennsylvanian: Southern West Virginia.

Original reference: C. E. Krebs and D. D. Teets, Jr., 1916, West Virginia Geol. Survey Rept. Raleigh and western parts of Mercer and Summers Counties, p. 112, 139, 210, 330, 355.

Nuttall Sandstone Member (of New River Formation)

Nuttall Sandstone (in New River Group)

Nuttall Sandstone Member (of Sewell Formation)[1]

Lower Pennsylvanian: Southern West Virginia and southwestern Virginia.

Original reference: M. R. Campbell, 1902, U.S. Geol. Survey Geol. Atlas, Folio 77.

R. V. Hennen and R. M. Gawthrop, 1915, West Virginia Geol. Survey Rept. Wyoming and McDowell Counties, p. 180–183. Nuttall (Dotson) sandstone, 110 feet thick at type locality, is divided into two ledges in Wyoming and McDowell Counties. Each ledge attains thickness of over 100 feet. Upper ledge holds name Nuttall and basal member is designated Lower Nuttall sandstone. Upper stratum seems to correlate with Dotson sandstone and Bearwallow conglomerate of Campbell 1897 [1898]. The two ledges are separated by the Douglas coal. Lower Nuttall overlies Douglas shale (new). Sandstone is topmost member of New River group.

R. V. Hennen and others, 1919, West Virginia Geol. Survey Rept. Fayette County, p. 295–298. Nuttall sandstone of Campbell, constituting top member of New River group at type locality of latter, in area of this report, and coalesced into one cliff rock just below Hawks Nest, 175 to 200 feet thick, is generally represented in Fayette County by two separate ledges of practically same thickness, generally separated by 5 to 20 feet of dark, sandy shales and sometimes a thin—6 to 18 inches—coal bed (Iaeger "B"). In this report, name Upper Nuttall sandstone is applied to upper ledge and Lower Nuttall sandstone to lower ledge. The former occurs from a few inches to 15 feet below Lower Douglas coal. It appears now that Panther sandstone or conglomerate, originally described on pages 185–186 of Wyoming-McDowell report, correlates with Upper Nuttall ledge, instead of the latter representing Dotson sandstone.

P. H. Price and E. T. Heck, 1939, West Virginia Geol. Survey [Rept.] Greenbrier County, p. 223–224. In Greenbrier County, Upper Nuttall sandstone is 50 to 70 feet thick, and Lower Nuttall is about 30 feet thick.

R. C. Moore and others, 1944, Geol. Soc. America Bull., v. 55, no. 6, chart 6 (column 12). Correlation chart shows Lower and Upper Nuttall sandstones in New River group.

U.S. Geological Survey currently classifies Nuttall Sandstone as member of New River Formation on basis of study now in progress.

Named for Nuttallburg, Fayette County, W. Va.

Nutwood Member (of Maple Mill Formation)

Mississippian (Kinderhook Series): West-central Illinois.

L. E. Workman and Tracey [Tracy] Gillette, 1956, Illinois Geol. Survey Rept. Inv. 189, p. 8 (fig. 1), 27, pl. 1. Proposed for a dark-brown to black facies of the Maple Mill formation. A silty slightly calcareous to noncalcareous dark-brown to black sporanites-bearing shale; grades laterally and vertically into Maple Mill gray shale; locally replaces gray shale entirely and is directly overlain by Chouteau limestone. Thickness varies from featheredge to as much as 40 feet, somewhat inverse to variations in thickness of underlying Glen Park formation. Where Glen Park is absent, directly overlies some unit of Champ Clark group (new).

Named from exposures along creek that flows through "The Narrows" just northeast of Nutwood in SE¼NE¼ sec. 33 and SW¼NW¼ sec. 34, T. 8 N., R. 13 W., and in bluff behind Tenneriffe School, NW cor. sec. 9, T. 7 N.. R. 13 W., Jersey County. Occupies limited area on Ozark uplift and Vandalia arch, extending northeastward from Mississippi River to Christian County.

†Nutzotin Series[1]

Carboniferous and older and Jurassic: Southeastern Alaska.

Original reference: A. H. Brooks, 1900, U.S. Geol. Survey 21st Ann. Rept., pt. 2, p. 359.

Probably named for Nutzotin Mountains.

Nuuanu Volcanics[1] (in Honolulu Volcanic Series)

Pleistocene, upper: Oahu Island, Hawaii.

Original reference: H. T. Stearns, 1935, Hawaii Div. Hydrography Bull. 1.

G. A. Macdonald and D. A. Davis *in* Jacques Avias and others, 1956, Lexique Strat. Internat., v. 6, Océanie, fasc. 2, p. 120–121. Lava flows and associated cinder cones and palagonitized tuff. Upper flow is columnar jointed melilite-nepheline basalt 17 to 22 feet thick; next lower flow, commonly a little more than 50 feet thick, is nepheline basalt with only a little melilite. Additional flows interfingering with alluvium and cinder appear to be present deeper in section. Overlies weathered alluvium resting on Koolau volcanic series.

Named for occurrence in Nuuanu Valley. Exposed over about 2 square miles along valley behind and in city of Honolulu, on southside of Koolau Range 12 miles west of Makapuu Head.

Nuwok Formation

Pliocene: Northern Alaska.

W. H. Dall, 1919, Report of the Canadian Arctic expedition 1913–1918, v. 8, pt. A, p. 26A. Briefly mentioned as the Pliocene formation which in Alaska underlies Gubik sand in many places.

F. S. MacNeil, 1957, U.S. Geol. Survey Prof. Paper 294–C, p. 100–101. Name appears on original field labels accompanying both Martin's and Leffingwell's fossil collections, but never formally adopted by U.S. Geological Survey. Name used only for fossiliferous beds making up upper 266 feet of an estimated 7,000-foot thick section containing silty shale, sandstone, and mudstone.

Occurs along, and in county adjacent to Carter Creek near Camden Bay.

Nye Mudstone

Nye Shale[1]

Miocene, lower: Northwestern Oregon.

Original reference: W. D. Smith, 1926, Oregon Univ. Commonwealth Rev., v. 8, p. 269.

H. E. Vokes, Hans Norbisrath, and P. D. Snavely, Jr., 1949, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 88. Described in Newport area as sequence of approximately 2,500 feet of black massive mudstones. Disconformably overlies Yaquina sandstone; unconformably underlies Astoria formation.

Type locality: (Schenck, 1928) At town of Newport and Nye Beach, in NW¼ sec. 5, T. 11 S., R. 11 W., Lincoln County.

Oacoma Beds or zone (in Sully Member of Pierre Formation)

Upper Cretaceous: Central South Dakota.

W. V. Searight, 1937, South Dakota State Geol. Survey Rept. Inv. 27, p. 23, pls. 2, 3. Medial zone in Sully member (new). Consists of banded bentonite shales with manganese-iron concretions.

D. R. Crandell, 1950, Am. Assoc. Petroleum Geologists Bull., v. 34, no. 12, p. 2340 (table 1), 2341, 2343. Abandoned. Agency-Oacoma zones redefined as DeGrey member of Pierre shale.

Exposed along Missouri River below the Great Bend and southward. Town of Oacoma is in Lyman County.

Oak Creek Beds[1]

Lower Cretaceous: Northeastern Wyoming and western South Dakota.

Original reference: W. P. Jenney, 1899, U.S. Geol. Survey 19th Ann. Rept., pt. 2, p. 593, fig. 122, map.

Occur along Oak Creek, Crook County, Wyo.

Oak Creek Formation

Pliocene: Central southern South Dakota.

Original reference: E. L. Troxell, 1916, Am. Jour. Sci., 4th, v. 42, p. 345–348.

J. T. Gregory, 1942, California Univ., Dept. Geol. Sci. Bull., v. 26, no. 4, p. 315. Name Oak Creek formation, proposed by Troxell for these deposits [Pliocene] in South Dakota, is preoccupied. Relationship of these deposits to recently named Valentine and Ash Hollow formations of Nebraska is not clear (time range of both being indicated in South Dakota without corresponding changes of lithology). Hence, it is inadvisable to attempt to extend these formations into this area [Big Spring Canyon]. Therefore these beds [Oak Creek] are referred to Ogallala group without formal formational designation.

Named for Oak Creek, eastern part of Mellette County.

Oak Creek Member (of Supai Formation)

Pennsylvanian: East-central Arizona.

R. L. Jackson, 1951, Plateau, v. 24, no. 2, p. 88, 91, figs. 2 and 3. Shown on figure as member of Supai formation, consisting of siltstone and mudstone. Overlies Packard Ranch member (new) and underlies Big "A" sand facies of Supai. Westward it grades into sandstone of Supai and eastward it intertongues with a limestone.

At Fossil Creek.

Oak Creek Quartz Latite Tuff

[Tertiary?]: Southwestern New Mexico.

A. M. Alper and Arie Poldervaart, 1957, Econ. Geology, v. 52, no. 8, p. 954, 963, 965. Slightly older than intrusive rocks of Animas stock. Thins away from stock in all directions, from a maximum of 1,500 feet or more.

Surrounds and partly roofs the Animas stock, which is about 4 miles long and from less than one-fourth mile to over 2½ miles wide, located in the Animas Range in north-central part of Walnut Wells quadrangle, Hidalgo County.

Oak Creek Sandstone (of Iles Formation)

Upper Cretaceous: Northwestern Colorado.

R. E. Kucera, 1959, Rocky Mountain Assoc. Geologists 11th Field Conf., Symposium, p. 43–44, fig. 3. Light-gray medium-grained crossbedded sandstone which forms prominent ledge 100 feet thick and 920 feet above base of formation. Has relatively smooth well-defined top and gradational base.

Forms prominent ledge on west side of Oak Creek near Haybro.

Oakdale Quartzite[1]

Carboniferous: Central Massachusetts, northeastern Connecticut, and south-central New Hampshire.

Original reference: B. K. Emerson, 1917, U.S. Geol. Survey Bull. 597, p. 59, 60–62, 76–78.

Jacob Freedman, 1950, Geol. Soc. America Bull., v. 61, no. 5, p. 487–488. Discussion of stratigraphy and structure of Mount Pawtuckaway quadrangle, New Hampshire, and correlation problems with other areas. Previous correlation could be in error. Worcester phyllite which overlies Oakdale, may be Pennsylvanian; but the Oakdale may be older and an unconformity may separate the two formations. Possibility that the Oakdale may be considerably older than the Worcester furnishes best possibility of setting up correlation that would fit evidence from other areas.

Named for village of Oakdale in township of Sterling, Worcester County, Mass., where it is well exposed.

Oakfield Limestone or Dolomite

Middle Silurian (Lockportian), Western New York.

D. W. Fisher, 1959, New York State Mus. Sci. Service Geol. Survey Map and Chart Ser., no. 1. Proposed for dolomitic limestone with normal type Lockport fauna. Underlies Oak Orchard dolomite; overlies Devils Hole dolomite (new).

Type section: Along Oak Orchard Creek, at Shelby, Orleans County.

Oak Grove Limestone Member[1] (of Carbondale Formation)

Oak Grove Beds (in Carbondale Group)

Pennsylvanian: Northern, central, and western Illinois.

Original reference: H. R. Wanless, 1931, Illinois Geol. Survey Bull. 60, p. 192.

H. R. Wanless, 1957, Illinois Geol. Survey Bull. 82, p. 50 (fig. 22), 90 (fig. 36), 91–94, 197. Oak Grove beds consist of series of thin marine limestone and shale beds, each characterized by more or less distinctive lithology and fauna; 14 members have been differentiated, and some are given informal names. Overlie Jake Creek sandstone; underlie Purington shale. Included in Liverpool cyclothem. Type section and derivation of name given.

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 35, 47 (table 1), 55 (table 3), 66–67, pl. 1. Limestone member of Carbondale formation (redefined). Occurs above Lowell coal member and below Purington shale member. Replaces name Oak Grove beds. Complex unit consisting of interbedded limestone and shale but designated as limestone because most distinctive elements are limestone and it occurs at position in cyclical sequence normal for limestone. Presentation of new rock-stratigraphic classification of Pennsylvanian strata in Illinois.

Type locality: Small ravine north of Oak Grove School, SW¼SE¼ sec. 6, T. 5 N., R. 3 E., Havana quadrangle, Fulton County.

Oak Grove Sand Member (of Shoal River Formation)

Oak Grove Sand (in Alum Bluff Group)[1]

Oak Grove facies (of Alum Bluff Stage)

Miocene, middle: Northwestern Florida.

Original reference: W. H. Dall and J. S. Brown, 1894, Geol. Soc. America Bull., v. 5, p. 166, 170.

C. W. Cooke, 1945, Florida Geol. Survey Bull. 29, p. 137, 169, 173. Rank reduced to member status in Shoal River formation. Type locality stated.

H. S. Puri, 1953, Florida Geol. Survey Bull. 36, p. 26–27. Facies in basal part of Shoal River facies of Alum Bluff stage.

Type locality (member): Bed and bank of Yellow River, 400 feet below bridge at Oak Grove in secs. 16 or 17, T. 5 N., R. 23 W., Okaloosa County.

Oak Hall Member (of Nealmont Limestone)

Middle Ordovician (Mohawkian): Central Pennsylvania.

G. M. Kay, 1944, Jour. Geology, v. 52, no. 1, p. 3 (fig. 2); no. 2, p. 97, 101 (table 7). Columnar section shows Oak Hall as basal member of Nealmont formation. Underlies Centre Hall member; overlies Valentine member of Curtin formation. Heavy ledged limestone, with metabentonites 18 feet from top and at top. Thickness up to 60 feet.

Type section: Along Highway 322, 1 mile west of Tusseyville, 3 miles south of Centre Hall, and 6 miles east of Oak Hall. Named from Oak Hall, a village east of State College, Centre County.

Oak Hill Clay (in Allegheny Formation)[1]

Oak Hill clay or underclay member

Pennsylvanian (Allegheny Series): Southeastern Ohio.

Original reference: Wilber Stout, 1916, Ohio Geol. Survey, 4th ser., Bull. 20, p. 19, 27, 252.

N. K. Flint, 1951, Ohio Geol. Survey, 4th ser., Bull. 48, p. 47, 48, table 1. Member of Strasburg cyclothem, Allegheny series. In Perry County, underlies Strasburg coal; overlies nonpersistent Hamden limestone; where Hamden is missing, is either in contact with Lower Kittanning coal or separated from it by shale and (or) sandstone. Thickness 3 to 10½ feet.

M. T. Sturgeon and others, 1958, Ohio Geol. Survey Bull. 57, p. 48 (table 7), 66–68. Oak Hill underclay member of Strasburg cyclothem in report on Athens County. Thickness 4 to about 10 feet. Occurs above Hamden limestone member and below Strasburg coal member. Allegheny series.

Named for occurrences in vicinity of Jackson County.

Oak Hill Member (of Naheola Formation)

Oak Hill Beds (in Naheola Formation)

Paleocene: Western Alabama.

Lyman Toulmin, Jr., 1944, Alabama Acad Sci. Jour., v. 16, p. 42. Naheola formation comprises (ascending) "Matthews Landing marl," "Oak Hill beds," and "Coal Bluff beds."

L. D. Toulmin, P. E. LaMoreaux, and C. R. Lanphere, 1951, Alabama Geol. Survey Spec. Rept. 21, p. 42–45, pl. 3, geol. map. Predominantly gray laminated carbonaceous clay, sandy clay, and micaceous silt, alternating with crossbedded sand; locally sandy clay is thin bedded; at some localities member contains massive beds of very fine-grained micaceous sand, generally silty or clayey enough to be compact and tough; laminated sand and shale contains, at top, one or more lignite beds as much as 5 feet thick. Thickness 100 to 125 feet. Unconformably underlies Coal Bluff member; overlies Matthews Landing marl member of Porters Creek formation.

W. F. Roux, Jr., 1958, Dissert. Abs., v. 19, no. 5, p. 1056. Naheola formation in west-central Alabama and Mississippi comprises (ascending) Matthews Landing, Oakhill, and Kemper (new) members.

Type locality: In roadcut on State Highway 10, one-half mile west of Oakhill post office, Choctaw County.

Oak Hill Slate[1] or Series

Precambrian(?) and Lower Cambrian: Southern Quebec, Canada, and northwestern Vermont.

Original reference: T. H. Clark, 1931, Geol. Soc. America Bull., v. 42, no. 1, p. 225–226.

T. H. Clark, 1934, Geol. Soc. America Bull., v. 45, no. 1, p. 4, 6, 9, 10. Includes (ascending) Call Mill slate, Pinnacle graywacke, White Brook dolomite, Western Sutton slate, Gilman quartzite, Dunham dolomite, Oak Hill slate, Scottsmore quartzite, Sweetsburg slate, and Vail slate. Series is in Oak Hill slice bounded on the west by Oak Hill thrust. Overlies Precambrian Tibbitt Hill schist. Geologic map (fig. 2) shows extension into Vermont.

V. H. Booth, 1950, Geol. Soc. America Bull., v. 61, no. 10, p. 1135–1151. Oak Hill slate of Clark is herein designated as Parker slate.

Type locality: Oak Hill, Sutton quadrangle, Quebec.

Oakland Conglomerate

Oakland Conglomerate Member (of Chico Formation)[1]

Upper Cretaceous: Western California.

Original reference: A. C. Lawson, 1902, Science, new ser., v. 15, p. 416 (table).

M. D. Crittenden, Jr., 1951, California Div. Mines Bull. 157, p. 22 (fig. 4), 31–33, pl. 1. Described in San Jose-Mount Hamilton area. Thickness 3,000 to 7,000 feet. Underlies Berryessa formation (new); overlies Knoxville. Name Oakland conglomerate is applied following usage of Lawson (1914, U.S. Geol. Survey Geol. Atlas, Folio 193) who mapped conglomerates of identical character in Hayward and Concord quadrangles. Name as used by Lawson was "Oakland conglomerate member" of Chico formation. This designation not adopted here because fossil evidence suggests Lower Cretaceous age and because term "Chico" has been so broadly applied that it no longer has reasonable stratigraphic significance. Lithologic identity of conglomerates in San Jose and Oakland areas seems sufficient to warrant use of Lawson's term, whatever the stratigraphic significance may ultimately prove to be.

G. D. Robinson, 1956, U.S. Geol. Survey Geol. Quad. Map GQ–88. Described in Hayward quadrangle as Oakland conglomerate. Locally 1,000 feet thick, but commonly thinner and in many places missing. Overlies Knoxville; underlies Chico formation restricted to exclude Oakland. Lower Cretaceous.

C. A. Hall, Jr., 1958, California Univ. Pubs. Geol. Sci., v. 34, no. 1, p. 7–8, fig. 2, geol. map. Oakland conglomerate occurs along eastern side of Pleasonton-Main Ridge, in an isolated outcrop about 1 mile north of Calaveras Reservoir on west side of Calaveras-Alameda Creek, north of town of Niles. Average thickness of conglomerate beds approximately 400 feet. Southwest of Dublin, conglomerate crops out as three belts separated from one another by 200 to 450 feet of siltstone. This intervening siltstone unit is here included as part of formation. Conglomerate-siltstone unit generally dips steeply to west and has maximum thickness of about 1,400 feet, unless faulting has exaggerated it. Conformably underlies Niles Canyon formation (new); contact gradational; north of Niles unconformably underlies Claremont shale; overlies Knoxville(?)

shale. Lawson (1914) mapped 100 to 1,000 feet of conglomerate as basal member of Chico formation. Term "Chico" is not used in present report, and rocks previously referred to as "Chico formation" are recognized as constituting Niles Canyon and Del Valle formations.

Named for type exposure at city of Oakland.

Oakland Limestone[1]

Oligocene: Southwestern Oregon.

Original reference: J. S. Diller, 1898, U.S. Geol. Survey Geol. Atlas, Folio 49.

Occurs in three small areas, one a mile north of Oakland, another at head of Green Valley, and third on Starr's Ranch, about 4 miles northeast of Umpqua Ferry, Roseburg quadrangle.

Oak Orchard Dolomite (in Lockport Group)

Oak Orchard Member (or Lockport Formation)

Middle Silurian: Western New York.

B. F. Howell and J. T. Sanford, 1947, Wagner Free Inst. Sci. Bull., v. 22, no. 4, p. 33–34. Name proposed to replace preoccupied name Shelby of Clarke and Ruedemann (1903). Uppermost member of formation. Overlies Eramosa member. Represents limited and discontinuous dolomite facies within formation. Described as fine-grained light-gray limestone at Rochester. Termed formation on plate 1.

D. W. Fisher, 1959, New York State Mus. Sci. Service Geol. Survey Map and Chart Ser. No. 1. Referred to as Oak Orchard dolomite in Lockport group. Overlies Oakfield limestone or dolomite (new).

Named for outcrop along Oak Orchard Creek in western part of Orleans County.

Oakridge Sandstone[1]

Jurassic(?): Western California.

Original reference: C. F. Tolman, Jr., 1915, Nature and science on Pacific Coast: San Francisco, Elder and Co., p. 45.

M. D. Crittenden, Jr., 1951, California Div. Mines Bull. 157, p. 15. Incidental mention in discussion of Franciscan formation in San Jose-Mount Hamilton area.

Occurs at Corral Hollow near Livermore, Alameda County.

Oaks Shale Bed (in Hamlin Shale Member of Janesville Shale)

Oaks Shale[1] Member (of Hamlin Shale)

Permian: Northeastern Kansas and southeastern Nebraska.

Original reference: R. C. Moore and G. E. Condra, Oct. 1932, Revised classification chart of Pennsylvanian rocks of Kansas and Nebraska.

R. C. Moore, 1936, Kansas Geol. Survey Bull. 22, p. 50 (fig. 12). Permian.

R. C. Moore and M. R. Mudge, 1956, Am. Assoc. Petroleum Geologists Bull., v. 40, no. 9, p. 2274 (fig. 1). Rank reduced to bed in Hamlin shale herein reduced to member status in Janesville shale (new). Wolfcamp series.

Type locality: Oak Farm southwest of Salem, NE¼ sec. 9, T. 1 N., R. 15 E., Richardson County, Nebr.

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Oak Spring Group

Oak Spring Formation

Eocene to Pliocene or younger: Southern Nevada.

M. S. Johnson and D. E. Hibbard, 1957, U.S. Geol. Survey Bull. 1021–K, p. 367–369, pls. 32, 33. White and light-colored tuff with interbedded and capping layers of dark-colored rhyolite, dacite, latite, and basalt. Few sedimentary rocks near base which include some fanglomeratic deposits, well-cemented gravels, and cream to light-gray marly limestone beds. Thickness at Oak Spring Butte about 2,000 feet; thicker sections to south.

C. M. Tschanz, 1960, U.S. Geol. Survey Prof. Paper 400–B, p. B293–B295. Upper part of basal limestone of Oak Spring in Nye County contains fossil fish, *Fundulus*, that is restricted to Pliocene and Quaternary. The fish occurs 150 feet above base of exposed sequence. Lower part of this limestone is similar to Miocene limestone in Lincoln County and contains poorly preserved gastropods which have been dated as late Tertiary, possibly Miocene. This suggests that limestone of Oak Spring may be partly Miocene and partly Pliocene and that lower part is correlative with widespread Miocene limestone in Lincoln and Clark Counties.

U.S. Geological Survey currently classifies the Oak Spring as a group and designates age as Eocene to Pliocene or younger on basis of study now in progress.

Named from exposures at Oak Spring Butte, Atomic Energy Commission Nevada proving grounds area, Nye and Clark Counties.

Oakville Sandstone[1]

Oakville Formation (in Fleming Group)

Miocene: Southwestern Texas.

Original reference: E. T. Dumble, 1894, Jour. Geology, v. 2, p. 556–559.

B. C. Renick, 1936, Texas Bur. Econ. Geology Pub. 3619, p. 75, 80, table 2. Formation consists of lower Oakville, 65 feet thick, and middle Oakville, 20 to 60 feet thick, with Moulton sandstone member (new) at base. Overlies Catahoula formation.

A. W. Weeks, 1945, Am. Assoc. Petroleum Geologists Bull., v. 29, no. 12, p. 1722–1724. Formation included in Fleming group. Unconformably overlies Catahoula formation; unconformably underlies Cuero formation (new). Miocene, probably upper.

J. H. Quinn, 1952, Texas Univ. Bur. Econ. Geology Rept. Inv. 14, p. 5–6. Fauna apparently Arikareean.

Named for Oakville, Live Oak County.

Oat Gulch Shale

Upper Cretaceous: Western California.

L. I. Briggs, 1953, California Div. Mines Bull. 167, p. 31. Mentioned in discussion of Panoche formation in Ortigalito Peak quadrangle. Name credited to Bennison (1941, unpub. map of late Upper Cretaceous deposits south of San Luis Creek, Merced and Fresno Counties).

Oberlin Formation

Pleistocene: Southwestern Louisiana.

J. A. Doering, 1956, Am. Assoc. Petroleum Geologists Bull., v. 40, no. 8, p. 1830–1831. Name given to the Pleistocene formation, intermediate in age between the Lissie and Eunice (new). Unit has been referred to as the lower Beaumont.

Covers surface of physiographic unit extending northeastward from Kinder, through Oberlin and Oakdale, La., to edge of Red River Valley.

Obispo Breccia[1]

Age(?): Panamá.

Original reference: E. Howe, 1908, Am. Jour. Sci., 4th, v. 26, p. 213.

Obispo Limestone[1] or Formation

Oligocene: Panamá.

Original reference: E. Howe, 1907, Isthmian Canal Comm. Ann. Rept. 1907, p. 108–138.

S. M. Jones, 1950, Geol. Soc. America Bull., v. 61, no. 9, p. 894 (chart), 898 (table). Thickness of formation 2,500 feet in Gatun Lake area where it underlies Las Cascadas formation and base is not exposed. Underlain by Gatuncillo formation west of Madden basin only.

W. P. Woodring, 1957, U.S. Geol. Survey Prof. Paper 306–A, p. 31. Volcanic rocks now included in Bas Obispo formation and Las Cascadas agglomerate were named Obispo formation or breccia by Howe (1907). Emendation to Bas Obispo formation and splitting off of younger part as Las Cascadas agglomerate were proposed by MacDonald (1913, Isthmian Geology, Isthmian Canal Comm. Ann. Rept. 1913, App. S., p. 564–582).

Northern Gaillard Cut area, Canal Zone.

Obispo Tuff Member (of Monterey Formation)

Miocene, lower: Southern California.

M. N. Bramlette, 1946, U.S. Geol. Survey Prof. Paper 212, p. 22–23, pl. 2. Name applied to tuff bed forming basal part of the Monterey in San Luis Obispo and Santa Barbara Counties. Tuff, which is several hundred feet thick, is composed chiefly of vitric shards. Overlies a dark mudstone (Rincon formation?).

Well exposed on east side of San Luis Obispo Creek about 4 miles south of San Luis Obispo, San Luis Obispo County.

Obregon Formation (in Thrifty Group)

Pennsylvanian (Cisco Series): North-central Texas.

M. G. Cheney, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 1, p. 66 (fig. 1), 91. Name applied to the 125 feet (more or less) of shales with lenticular limestone, sandstone, conglomerate, and coal members underlying Pennsylvanian-Permian boundary (herein placed at disconformity in Harpersville formation above Waldrip-Newcastle coal zone and below *Schwagerina*-bearing "Waldrip limestone No. 3") and overlying Chaffin formation redefined. "Harpersville" beds below systemic boundary are assigned to Obregon and Chaffin formations of Thrifty group and those above boundary to Saddle Creek formation of expanded Pueblo group.

Named from Obregon Switch on the Gulf, Colorado, and Santa Fe Railroad, 6 miles east of Santa Anna, Coleman County.

O'Brien Creek Formation

Eocene(?): Northeastern Washington.

Hunting Geophysical Services, Inc., 1960, *in* Washington Div. Mines and Geology Rept. Inv. 20, p. 5, 6. Formation is what Umpleby (1910, Washington Geol. Survey Bull. 1) called dacite flow conglomerate and Calkins and others (1959, U.S. Geol. Survey open-file map) called tuffaceous shale, sandstone, and conglomerate. In many places tuffaceous sandstone contains black argillite chips; some conglomerate contains granodiorite boulders presumably from Cretaceous(?) batholith. Calkins and others (1959) have assigned Eocene(?) age to this formation. Republic quadrangle and part of Aeneas quadrangle were mapped by Muessig and Quinlan (1959, U.S. Geol. Survey open-file map).

Report discusses parts of Okanogan and Ferry Counties.

Observatory Hill Quartz Porphyry[1]

Precambrian (pre-Huronian?): Central southern Wisconsin.

Original reference: R. D. Irving, 1877, Geology Wisconsin, v. 2, p. 519.

Occurs 6 miles north of outcrop of Marcellon quartz porphyry, in SE¼ sec. 7, town of Buffalo, Marquette County.

Oatka Beds[1]

Oatka Shale or Waterlime (in Bertie Group)

Upper Silurian: Western New York.

Original reference: G. H. Chadwick, 1917, Geol. Soc. America Bull., v. 28, p. 173–174.

D. W. Fisher, 1959, New York State Mus. Sci. Service Geol. Survey Map and Chart Ser. 1. Oatka shale, or waterlime, is basal formation of Bertie group. Underlies Falkirk dolomite; overlies Camillus shale. Eastern equivalent of Oatka waterlime not certain. Shown on chart as representing more calcareous and dolomitic phase of upper Camillus though it is equally as probable that the Oatka may be facies of the Fiddlers Green. Should latter relationship prove correct, the Oatka should form base of Murderian stage (new). Note on occurrence.

Known only from Murder Creek at Akron, Tonawanda Creek at Indian Falls (Medina quadrangle), Black Creek at Morganville (Albion quadrangle), and Oatka Creek at North Leroy (Bergen quadrangle).

Oatka Creek Shale Member (of Marcellus Shale)[1]

Middle Devonian: Central and western New York.

Original reference: G. A. Cooper, 1930, Am. Jour. Sci., 5th, v. 19, p. 130–131.

R. G. Sutton, 1951, Rochester Acad. Sci. Proc., v. 9, nos. 5–6, p. 357–358, pl. 1. Named by Cooper as upper member of Marcellus from Cayuga Lake westward to Seneca Lake, being overlain by Mottville member of Skaneateles shale, and underlain by Cherry Valley limestone member of Marcellus. To west of Seneca Lake, comprises all of Marcellus. In Batavia quadrangle only upper part of member is exposed. Underlies Stafford limestone member of Skaneateles.

Type section: Below Main Street bridge over Oatka Creek at LeRoy, Genesee County.

Oatman Andesite[1]

Tertiary, middle or upper: Northwestern Arizona.

Original references: F. L. Ransome, 1923, U.S. Geol. Survey Bull. 743; Carl Lausen, 1931, Arizona Bur. Mines Bull. 131, Geol. Ser. 6, p. 31, map.

Exposed north of Oatman, Mohave County.

Oatman Creek Granite[1]

Precambrian: Central Texas.

Original reference: H. B. Stenzel, 1932, Geol. Soc. America Bull., v. 43, no. 1, p. 144.

V. E. Barnes, [1952?], Geologic map of the Hilltop quadrangle, Gillespie, Llano, and Mason Counties, Texas (1.31,680): Texas Univ. Bur. Econ. Geology. Granite provisionally classed at Oatman Creek crops out in northeastern part of quadrangle and has been intruded between Packsaddle schist and Town Mountain granite.

Virgil Barnes, Frederick Romberg, and W. A. Anderson, 1954, Internat. Geol. Cong., 19th, Algiers 1952, Comptes rendus, sec. 9, pt. 9, p. 153. Town Mountain granite invaded already deformed metasediments [Valley Spring gneiss and Packsaddle schist] and was followed by Oatman Creek granite, Siximile granite, and Llanite, latter being youngest.

Occurs on Llano uplift, Mason County.

†Ocala Group[1]

Eocene: Florida and Georgia.

Original reference: W. H. Dall, 1892, U.S. Geol. Survey Bull. 84, p. 331. Type locality: Ocala, Fla.

Ocala Limestone[1] (in Jackson Group)

Ocala Group

Eocene, upper: Northern and northwestern Florida, southern Alabama, and southern and western Georgia.

Original reference: W. H. Dall, 1892, U.S. Geol. Survey Bull. 84, p. 103, 157, 331.

C. W. Cooke and H. K. Shearer, 1918, U.S. Geol. Survey Prof. Paper 120–C, 51–56. Includes Tivola tongue.

P. L. Applin and E. R. Applin, 1944, Am. Assoc. Petroleum Geologists Bull., v. 28, no. 12, p. 1683–1686. Two-fold faunal division recognized. Upper member is typical Ocala seen at outcrop on Ocala uplift. Lower member, not known on outcrop, is light cream-colored limestone, commonly harder than upper member, generally highly calcitic and ordinarily composed of molds of small miliolids. Overlies Avon Park limestone (new). Upper Eocene.

C. W. Cooke, 1945, Florida Geol. Survey Bull. 29, p. 56. Ocala transgresses beveled surface of Avon Park, Tallahassee, and Lake City limestones. Top of Ocala was land surface before younger marine deposits were laid down. Ocala is overlain by Marianna limestone, Byram limestone, and Suwannee limestone, or Hawthorn formation.

R. O. Vernon, 1951, Florida Geol. Survey Bull. 33, p. 156–171. Restricted by separation of thickness of about 80 feet from base, which is Moodys Branch formation. Underlies Suwannee limestone. As restricted in this report, includes marine limestone of peninsular Florida of upper Jackson age that contains high percentage of specimens of larger foraminifers, *Lepidocyclina*, *Heterostegina*, and various camerinids, as developed in Polk and adjacent counties in well penetrations. Base of this interval is exposed at type locality where formation is massive coquina. Thickest exposure is at Crystal River Rock Co., quarry in SW¼ T. 19 S., R. 18 E., Citrus County, where minimum of 107.9 feet of unit is exposed.

W. C. Holland, L. W. Hough, and G. E. Murray, 1952 Louisiana Dept. Conserv., Geol. Bull. 27, pl. 13. Ocala group used on diagram to include Moodys Branch and Ocala (restricted) of Vernon.

H. S. Puri, 1953, (abs.) Jour. Sed. Petrology, v. 23, no. 2 p. 130. Rank raised to group. Includes all calcareous sediments of Jackson stage in

Florida. Comprises (ascending) Inglis, Williston, and Crystal River (new) formations.

H. S. Puri, 1957, Florida Geol. Survey Bull. 38, 248 p. Group comprises (ascending) Inglis, Williston, and Crystal River formations. Because "Ocala limestone" at type locality has been quarried and type section destroyed and exposures in vicinity of Ocala represent only about 40 feet of sediments (basal section in most pits belongs to Williston member) cotype locality is herein designated. Thickness about 70 feet at cotype locality. Foraminifera described. Faunizones listed.

J. F. L. Connell, 1958, Southwestern Louisiana Jour., v. 2, no. 4, p. 321, 323, 327, 329-336. Described in Georgia where it is basal unit of Jackson group. Underlies Barnwell formation. In this report, Tivola is classed as a member of the Ocala.

W. J. Carr and D. C. Alverson, 1959, U.S. Geol. Survey Bull. 1092, p. 8–9. Ocala limestone, as used in this report, includes all rocks of late Eocene age in west-central Florida. Average thickness on outcrop 150 feet.

Type locality: Ocala, Marion County, Fla. Cotype locality: Zuber pit of Cummer Lime and Manufacturing Co., in SE¼NW¼ sec. 11, T. 14 S., R. 21 E., Marion County, Fla.

O'Carroll Member (of Martin Limestone)

Devonian: West-central Arizona.

S. L. Tainter, 1948, U.S. Bur. Mines Rept. Inv. 4293, p. 5. Referred to only as the O'Carroll bed, lowest member of Martin limestone.

In Banner mining district, T. 4 S., R. 16 E., southwestern corner of Gila County.

†Ocate Sandstone

Jurassic: Northeastern New Mexico and southeastern Colorado.

G. O. Bachman, 1953, U.S. Geol. Survey Oil and Gas Inv. Map OM–137. Gray medium to massive somewhat cross-laminated sandstone about 50 feet thick; overlies Naranjo formation (new). Underlies Wanakah formation.

G. H. Wood, Jr., R. B. Johnson, and G. H. Dixon, 1957, U.S. Geol. Survey Bull. 1051, p. 15–16. Geographically extended into Las Animas County, Colo. Thickness 30 to 60 feet in Sangre de Cristo Mountains. Conformably overlies Sangre de Cristo formation; underlies Wanakah(?) formation.

R. B. Johnson, 1959, U.S. Geol. Survey Bull. 1071–D, p. 95. Name abandoned in northeastern New Mexico and southeastern Colorado. Name Entrada used for unit throughout area.

Named for exposures on Ocate Creek about 1½ miles east of Octate, Mora County, N. Mex.

Occoquan Granite[1]

Precambrian: Northeastern Virginia.

Original reference: J. T. Lonsdale, 1927, Virginia Geol. Survey Bull. 30.

Exposed on Occoquan Run, from Occoquan village to forks of Bull Run, Prince William County.

Oceana Limestone (in Kanawha Formation[1] or Group)

Pennsylvanian: Southern West Virginia.

Original reference: R. V. Hennen and R. M. Gawthrop, 1915, West Virginia Geol. Survey Rept. Wyoming and McDowell Counties, p. 164.

H. R. Wanless, 1939, Geol. Soc. America Special Paper 17, p. 62, 97. In lower part of Kanawha group.

Exposed one-half mile north of Oceana, Oceana district, Wyoming County.

†Ocheesee Beds[1]

Miocene, lower: Western Florida.

Original reference: W. H. Dall, 1892, U.S. Geol. Survey Bull. 84, p. 105, 112, 157, 158, 331.

Well developed at Ocheesee, Jackson County.

Ochelata Group

Ochelata Formation[1]

Ochelata Member[1] (of Ramona Formation)

Pennsylvanian (Missouri Series): Northeastern, central northern, and central Oklahoma.

D. W. Ohern, 1910, Oklahoma State Univ. Research Bull. 4, p. 38, table, geol. map. Term Ochelata is applied to middle member of Ramona formation. Consists largely of shale, but persistent sandstone, varying in thickness from 5 to 12 feet, lies somewhat above middle of shale. Average thickness about 85 feet. Overlies Dewey limestone member; underlies Avant limestone member.

R. C. Moore and others, 1937, Kansas Geol. Soc. Guidebook 11th Ann. Field Trip, p. 40 (table), 42–43. Name Ochelata was introduced as stratigraphic term by Ohern (1910) for beds between Dewey and Avant limestones; subsequent usage (Gould, 1925, Oklahoma Geol. Survey Bull. 35) has extended its application to include all strata above Dewey and beneath Nelagoney formation. Since base of Nelagoney coincides with Missouri-Virgil boundary, Ochelata beds comprise upper Missouri deposits of northern Oklahoma. Term Ochelata is here used as group, and its application extended slightly into Kansas on north and to northeastern flank of Arbuckle Mountains on south. Lower boundary defined at base of Chanute shale, which corresponds to top of Drum limestone where this rock is present; in places where Drum is absent, basal Chanute sandstone may extend downward a varying distance below Drum horizon. Upper boundary is defined to coincide with Missouri-Virgil disconformity. Disconformable above Skiatook group.

M. C. Oakes, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 4, p. 718 (fig. 3), 720 (table 1), 725–730. In Oklahoma, group comprises (ascending) Chanute shale, Iola formation, Wann formation (revived, restricted, redefined), Torpedo sandstone, shale, Birch Creek limestone, and strata tentatively referred to Weston shale of Kansas section. Overlies Skiatook group.

M. C. Oakes, 1952, Oklahoma Geol. Survey Bull. 69, p. 74–95, pl. 1; 1959, Oklahoma Geol. Survey Bull. 81, p. 28–42. Group includes (ascending) Chanute formation, Iola formation, Wann formation, Barnsdall, and Tallant formations. It was clearly the intent of Moore and others (1937) that Ochelata group extend up to base of Virgil series, wherever that might be. Specifically, they extended it up only to base of Nelagoney formation, whose basal member, according to Gould (1925), is Bigheart sandstone, and base of Bigheart was then thought to be base of Virgil series in northern Oklahoma. Recent studies have shown that base of Virgil is higher in section, and Bigheart sandstone is here included in Ochelata group as basal member of

Tallant formation. Tallant formation is unconformably overlain by basal Virgil rocks. Across Osage County, Tallant is overlain by Cheshewalla sandstone, basal member of Vamoosa formation.

Named for Ochelata, Washington County.

Ochoa Series

Upper Permian: New Mexico and Texas.

J. E. Adams and others, 1939, Am. Assoc. Petroleum Geologists Bull., v. 23, no. 11, p. 1676–1677. Proposed for fourth and uppermost division of Permian. Series is designated to include all upper Permian sediments of post-Guadalupe age. Consists largely of evaporites and attains subsurface thickness of more than 4,000 feet. Four subdivisions recognized: Lower Castile, Upper Castile, Rustler, and Dewey Lake. Lower Castile is confined to Delaware basin, where it rests on Delaware Mountain sandstone. Basal conglomerate present in places. Outside Delaware basin, upper Castile overlaps onto and rests unconformably on beds of Guadalupe age.

P. B. King, 1942, Am. Assoc. Petroleum Geologists Bull., v. 26, no. 4, p. 662–663, pl. 2. Tessey limestone included in Ochoa series.

J. E. Adams, 1944, Am. Assoc. Petroleum Geologists Bull., v. 28, no. 11, p. 1596–1625. Formations included in Ochoa are (ascending) Castile, Salado, Rustler, and Dewey Lake.

G. V. Cohee, 1960, Am. Assoc. Petroleum Geologists Bull., v. 44, no. 9, p. 1578–1579. U.S. Geological Survey has adopted a two-fold subdivision of the Permian (Lower and Upper series and Early and Late epochs). These subdivisions coincide as nearly as possible with those recognized in type Permian and are drawn according to existing concepts of biotic correlation with type sequence. Reference sequence for United States is Permian outcrops of northwestern Trans-Pecos Texas where approximate faunal boundary is taken as that between Cherry Canyon and Bell Canyon formations which are encompassed by Guadalupe series. Boundary also falls between Word and Capitan formations as recognized in Glass Mountains area. Ochoa series is Upper Permian.

Named for Ochoa post office in T. 24 S., R. 34 E., Lea County, N. Mex. Outcrops of beds of Ochoa age are found in Eddy County, N. Mex., and Culberson County, Tex.; these outcrops are not representative of thick sequence found in subsurface type locality. Type section has been penetrated by many wells.

Ochoco Formation, Andesites or Lavas

Pliocene, upper, or later: Central Oregon.

W. D. Wilkinson, [1939], Geologic map of Round Maintain quadrangle (1:96,000): Oregon Dept. Geology and Mineral Industries. Name used to designate series of lava flows which lie disconformably above Rattlesnake(?) formation. Described as andesites and gray olivine basalts. Lavas were poured out over Columbia River basalts, Mascall and Rattlesnake(?) formations.

E. T. Hodge, 1940, Oregon State Coll. Studies in Geology, Mon. 3, p. 21–22. Thickness 10 to 50 feet.

Occurs throughout eastern and northeastern part of Round Mountain area, Crook County, and in Dayville quadrangle along flank of Wolf Mountain.

Ochre Mountain Limestone[1]

Upper Mississippian: Western Utah.

Original reference: T. B. Nolan, 1930, Washington Acad. Sci. Jour., v. 20, no. 17, p. 421–432.

J. M. Weller and others, 1948, Geol. Soc. America Bull., v. 59, no. 2, p. 135, chart 5 (column 30). Meramecian and Chesterian. Occurs above Woodman limestone and below Manning Canyon shale.

H. R. Cramer, 1954, Dissert. Abs., v. 14, no. 10, p. 1681. Discussion of coral zones in Mississippian of Great Basin area. Great Blue limestone, which is stratigraphically and lithologically similar to more properly though later named Ochre Mountain limestone, is dropped.

As originally defined included Herat Shale Member.

Named for exposures on Ochre Mountain, Gold Hill region.

Ocoee Series

Ocoee Group[1]

Precambrian: Eastern Tennessee, northwestern Georgia, and western North Carolina.

Original reference: J. M. Safford, 1856, Geol. reconn. Tennessee, 1st Rept., p. 149, 151–152.

G. W. Stose and A. J. Stose, 1944, Am. Jour. Sci., v. 242, no. 8, p. 401–416. Ocoee series, as interpreted in this paper, forms continuous belt which extends from southwest end of Buffalo Mountain, Tenn., southwestward across southern Tennessee, North Carolina, and Georgia. Length of belt to Alabama State line is about 250 miles. It varies in width from 2½ miles at northeast end to maximum of 25 miles in area southeast of Chilhowee Mountains. Talledega series of Alabama is correlated with entire belt of Ocoee series as defined in this paper. Late Precambrian.

G. W. Stose and A. J. Stose, 1946, (abs.) Geol. Soc. America Bull., v. 57, no. 12, pt. 2, p. 1233; 1949, Geol. Soc. America Bull., v. 60, no. 2, p. 267–320. Ocoee series divided into four major units which are correlated from northern North Carolina to western Georgia, with a fifth formation present only in Murphy syncline. Units are (ascending) Hurricane graywacke (new), Great Smoky quartzite, Nantahala slate, Big Butt quartzite, and Valleytown formation. Series does not resemble Lower Cambrian Chilhowee group which it overrides nor any other Lower Cambrian facies. Series is stratigraphically overlain by Lower Cambrian Unicoi formation and is late Precambrian.

P. B. King, 1949, Am. Jour. Sci., v. 247, no. 8, p. 627, 629 (fig. 8), 631 (table 4), 632–643. Series was named by Safford (1856). Keith, in his subsequent folio work in area did not use term and preferred to speak of sequence in terms of component formations. However, term Ocoee is desirable, because whole unit is more distinctive than its component parts and because it differs greatly in its gross features from adjacent rock units. In this report, Ocoee is classed as a provincial series, probably belonging to late Precambrian. It is comparable to such other Precambrian provincial series as Keweenawan, Belt, and Grand Canyon. Can be subdivided locally into a number of formations. Tentative interpretation of sequence in northeast part of Great Smoky Mountains includes (1) fine-grained sandstone, with interbedded siltstone and slate; (2) Great Smoky conglomerate; (3) Nantahala slate (in mountain area) and Pigeon siltstone (north of mountains); and (4) Sandsuck shale. Base not exposed in Great Smoky Mountains; equivalent beds near Big Pigeon River rest on Max Patch granite and Cranberry gneiss. Underlies Chilhowee group of which Cochran conglomerate is lowest formation.

Pigeon siltstone is here used for Stose and Stose's term Hurricane graywacke.

P. B. King and others, 1958, Geol. Soc. America Bull., v. 69, no. 9, p. 947–966. Series, in Great Smoky Mountains, is probably 30,000 feet or more thick. Lies unconformably on basement of earlier Precambrian granitic and gneissic rocks, and on northwest side of mountains is overlain by Cochran formation, or basal unit of Chilhowee group, which is of Cambrian and Precambrian(?) age. South of mountains, series is overlain by rocks of Murphy marble belt; here, top of series is placed tentatively at base of Nantahala slate. Series is divisible into three broad units of regional extent and contrasting lithologic character, which are herein designated groups and named Snowbird, Great Smoky, and Walden Creek (new). Groups consist of local intergrading and intertonguing formations and have complex stratigraphic and structural relations. Series is split by major thrust faults into three sequences, a southern, central, and northern, none of which contains more than two groups of the series. Series also includes unclassified formations, Cades sandstone, Rich Butt sandstone (new), and rocks of Webb Mountain and Big Ridge.

J. L. Stuckey and S. G. Conrad, 1958, North Carolina Div. Mineral Resources Bull. 71, p. 32–37; J. L. Stuckey, 1958, Geologic map of North Carolina (1:500,000): North Carolina Div. Mineral Resources. Series in North Carolina divided into (ascending) Snowbird formation, Great Smoky conglomerate, Nantahala slate, and Sandsuck shale. Age designation of Nantahala questionable, but it is mapped in Ocoee series because present knowledge of formation in North Carolina does not warrant assigning it to Cambrian.

Named for exposures along narrows of Ocoee River, Polk County, Tenn.

Oconee Creek zone[1]

Precambrian: Northwestern South Carolina.

Original reference: E. Sloan, 1905, South Carolina Geol. Survey geognostic map of South Carolina, advance copies; published in 1908 in South Carolina Geol. Survey, ser. 4, Bull. 2; 1907, Summary of mineral resources of South Carolina, p. 6, 8, 12.

Named for exposures on Oconee Creek.

Ocotillo Conglomerate

Pliocene, upper, or Pleistocene, lower: Southern California.

T. W. Dibblee, Jr., 1954, California Div. Mines Bull. 170, chap. 2, p. 23 (fig. 2), 24, pl. 2. Composed of gray granitic-pebble conglomerate. Overlies Borrego lacustrine clays, and, together with Brawley lake bed facies into which the conglomerate grades, forms youngest unit of Cenozoic in Imperial Valley. At type section, about 800 feet thick and conformable upon Borrego clays; near Ocotillo and eastward on south flank of San Felipe Hills anticlinorium, about 1,000 feet thick and conformable upon Borrego clays; northeastward from Ocotillo, overlaps Palm Spring and Imperial formations. In Mecca Hills south of San Andreas fault conglomerate ranges in thickness from knife edge to 900 feet and is unconformable on older formations; west of fault, about 2,500 feet thick and overlies Palm Spring red beds; in Indio Hills, about 2,100 feet thick and lies unconformably on Canebrake (new), Palm Spring, and Imperial formations and shows northwestward overlap.

Type section: In northern part of Borrego Badlands northeast of Borrego, Imperial County. Named for exposures near Ocotillo.

Ocotillo Silt Member (of Tansill Formation)

Permian (Guadalupe): New Mexico and Texas.

West Texas Geological Society, 1940, West Texas Geol. Soc. Guidebook Fall Field Trip, Sept. 1940, p. 7, 14, fig. 2; R. K. DeFord and G. D. Riggs, 1941, Am. Assoc. Petroleum Geologists Bull., v. 25, no. 9, p. 1717, 1718, 1719, 1722. Consists of sand marl, buff-gray magnesium limestone, and silt in upper part of formation. Thickness 13½ feet at type locality of Tansill.

Named from Ocotillo Hills, prominent topographic feature northwest of Carlsbad, N. Mex. Member traceable over long distance on surface and in subsurface.

†Ocoya Creek Beds[1]

Miocene, middle: Southern California.

Original references: H. W. Turner, 1894, Am. Geologist, v. 13, p. 239; 1894, U.S. Geol. Survey 14th Ann. Rept., pt. 2, p. 461.

Occur on Ocoya or Pose Creek, Kern County.

†Octoraro Schist[1] of Phyllite

Paleozoic(?): Southeastern Pennsylvania.

Original reference: F. Bascom, 1909, U.S. Geol. Survey Geol. Atlas, Folio 162.

E. H. Watson, 1957, Geol. Soc. America Guidebook Atlantic City Mtg., p. 158, 161, 164. Wissahickon (Octoraro) phyllite is here considered probably Paleozoic.

Named for exposures in banks of Octoraro Creek between Lancaster and Chester Counties.

Oddie Rhyolite[1]

Pliocene(?): Central Nevada.

Original reference: J. E. Spurr, 1905, U.S. Geol. Survey Prof. Paper 42, p. 49, map.

H. G. Ferguson, S. W. Muller, and S. H. Cathcart, 1953, Geology of Coaldale quadrangle, Nevada: U.S. Geol. Survey Geol. Quad. Map [GQ–23]. Described in Coaldale quadrangle where it consists of intrusive masses, dikes, and flows of rhyolite, quartz-latite, and dacite approximately contemporaneous with Esmeralda formation. Thickness of flows nowhere over a few hundred feet. As used here, formation includes Brougher dacite of Spurr. Lower Pliocene(?).

H. G. Ferguson and S. H. Cathcart, 1954, Geology of the Round Mountain quadrangle, Nevada: U.S. Geol. Survey Geol. Quad. Map [GQ–40]. Described in Round Mountain quadrangle, where it consists of rhyolite and quartz latite intrusive into sediments of Esmeralda formation and flows overlying Esmeralda. In Manhattan report (Ferguson, 1924, U.S. Geol. Survey Bull. 723), intrusive rhyolite cutting the Esmeralda was described as Maris rhyolite and quartz latite flow conformably above the sediments as uppermost member of Esmeralda, but, because these accord closely in lithology and age relations with Oddie rhyolite (including Brougher dacite) of Tonopah district (Spurr, 1905), older name is retained. Pliocene(?).

Makes up Mount Oddie and Rushton Hill, Tonopah district.

Odee Formation

Pleistocene: Southern Kansas and northern Oklahoma.

H. T. U. Smith, 1940, Kansas Geol. Survey Bull. 34, p. 100–108. Composed principally of silt and clay, or of their indurated equivalents; numerous thin beds of fine sand are present, some locally cemented to form a hard rock, and fewer beds of sand and gravel; contains a single bed of diatomaceous marl. Maximum exposed thickness about 300 feet; thickness at typical exposure in sec. 35, T. 34 S., R. 29 W., 94 feet, beds are essentially horizontal and undisturbed and base in concealed. Formation seems to represent alluvial or lacustrine fill in an irregular basin, partly erosional partly deformational, in the Ogallala. Underlies Quaternary beds, locally with angular unconformity with dips as steep as 27°

J. C. Frye and C. W. Hibbard, 1941, Kansas Geol. Survey Bull. 38, p. 413. Odee formation has not proved to be satisfactory unit for field mapping and is here included in Meade formation (redefined).

C. W. Hibbard, 1949, Michigan Univ. Mus. Paleontology Contr., v. 7, no. 4, p. 77–79. Restricted to scattered deposits of basin filling of local origin; study of vertebrate fossils from these deposits indicates age is post-Crooked Creek. Smith did not state type locality; hence, it is here designated.

J. C. Frye and A. B. Leonard, 1952, Kansas Geol. Survey Bull. 99, p. 110. Included in list of locally named units which are properly classed at least in part as Sanborn formation.

Type locality: In sec. 35, T. 34 S., R. 29 W., Cimarron Township, Meade County, Kans. Also exposed along Cimarron Valley in northern Beaver County, Okla.

Odell Shale (in Chase Group)

Odell Shale (in Sumner Group)[1]

Permian: Southeastern Nebraska and eastern Kansas.

Original reference: G. E. Condra and J. E. Upp. 1931, Nebraska Geol. Survey Bull. 6, 2d ser., p. 59.

R. C. Moore, J. C. Frye, and J. M. Jewett, 1944, Kansas Geol. Survey Bull. 52, p. 163. Reallocated to Chase group. Underlies Krider limestone member of Nolans limestone; overlies Cresswell limestone member of Winfield limestone. Thickness 20 to 40 feet, average 30 feet. Wolfcamp series.

Type locality: Ravines and highway cuts one-eighth mile south and 2¼ miles east of Odell, Gage County, Nebr.

Odenville Limestone[1]

Lower Ordovician: Northern central Alabama.

Original reference: Charles Butts, 1926, Alabama Geol. Survey Spec. Rept. 14, p. 99, map.

W. H. Twenhofel and others, 1954, Geol. Soc. America Bull., v. 65, no. 3, chart 2 (column 41). Shown on correlation chart above Newala limestone and below Mosheim limestone.

Well exposed on north side of Seaboard Air Line Railway about one-third mile east of Odenville, St. Clair County.

Ogallala Formation[1]

Ogallala Group

Pliocene: Western Nebraska, northeastern Colorado, western and central Kansas, eastern New Mexico, western Oklahoma, northwestern Texas, and southeastern Wyoming.

Original reference: N. H. Darton, 1898, U.S. Geol. Survey 19th Ann. Rept., pt. 4, p. 732–742.

F. W. Johnson, 1936, Am. Jour. Sci., 5th, v. 31, p. 467–473. Formation divisible into "cap rock bed," Burge sands, and Valentine beds.

A. L. Lugn, 1938, Am. Jour. Sci., 5th, v. 36, no. 213, p. 220–227. Group in Nebraska comprises (ascending) Valentine formation, 175 to 225 feet; Ash Hollow formation, 100 to 250 feet; Sydney gravel, 15 to 50 feet; Kimball formation (new), 30 to 40 feet. Unconformably overlies Hemingford group (new). Pliocene.

H. T. U. Smith, 1940, Kansas Geol. Survey Bull. 34, p. 39–94. Unit herein named Rexroad has been mapped as Ogallala, and some beds are indistinguishable from Ogallala.

J. C. Frye and C. W. Hibbard, 1941, Kansas Geol. Survey Bull. 38, pt. 13, p. 404–410. Formation is 60 to 375 feet thick in Meade basin. Overlies Laverne formation; underlies Meade formation. Middle Pliocene. Beds called Rexroad by Smith (1940) are herein designated Rexroad member of Ogallala.

R. C. Moore and others, 1951, Kansas Geol. Survey Bull. 89, p. 20. Formation, in Kansas, comprises (ascending) Valentine, Ash Hollow, and Kimball members. Maximum thickness 350 feet. Overlies Pierre shale; underlies Meade formation in some areas and in others Sanborn formation.

J. C. Frye and A. B. Leonard, 1957, Texas Univ. Bur. Econ. Geology Rept. Inv. 32, p. 7–20; 1959, Texas Univ. Bur. Econ. Geology Rept. Inv. 39, p. 443. In Texas High Plains, Armstrong and Howard Counties, Pliocene Ogallala formation consists of fluviatile deposits, predominantly of sand but with some silt and local lenses of coarse gravel, resting on erosional topography with several hundred feet of relief, developed on bedrock. Distinctive fossil seeds permit correlation of floral zones as far south as Howard County with subdivisions (Valentine, Ash Hollow, and Kimball) recognized to north in Kansas and Nebraska. Formation becomes thin and discontinuous to south where upland surface of High Plains merges with Edwards Plateau, broken by remnants of still higher surface developed on Cretaceous limestones. Formation is distinguished at top by complex "Caprock" limestone. Unconformably underlies Blanco formation. Neogene.

A. J. Myers, 1959, Oklahoma Geol. Survey Bull. 80, p. 51–54. Formation, in Harper County, consists of beds of moderately well-sorted to poorly sorted sand and gravel, some of which are partly cemented by calcium carbonate. Thickness 0 to 35 feet. Overlies Laverne formation, but in no place is it in contact; underlies Meade group. Middle (Hemphillian) Pliocene.

H. E. Simpson, 1960, U.S. Geol. Survey Prof. Paper 328, p. 43–45, pl. 1. Formation in Yankton area is as much as 125 feet thick in Knox County, Nebr., but north of Missouri River is commonly less than 10 feet thick. Divided into two subunits: lower consists chiefly of sand, fine gravel, and orthoquartzite; and upper is composed chiefly of silty clay. Overlies Mobridge member of Pierre shale; separated from overlying deposits of Pleistocene age by sharp unconformity.

Named for exposures around Ogallala, Keith County, Nebr.

Ogan Clay (in Allegheny Formation)[1]

Ogan underclay member

Pennsylvanian (Allegheny Series) : Southeastern Ohio.

Original reference: Wilber Stout, 1927, Ohio Geol. Survey, 4th ser., Bull. 31, p. 175–181.

N. K. Flint, 1951, Ohio Geol. Survey, 4th ser., Bull. 48, p. 40, 42. Included in Ogan cyclothem (Allegheny series). Not present in area of this report, Perry County.

M. T. Sturgeon and others, 1958, Ohio Geol. Survey Bull. 57, p. 49 (table 7), 55. Underclay member of Ogan cyclothem in report on Athens County. Poorly exposed. Thickness about 1 foot. Occurs above Ogan shale and (or) sandstone member and below Ogan coal and below Zaleski marine member. Allegheny series.

Named for exposure on Ogan farm, sec. 14, Elk Township, Vinton County.

Ogan cyclothem

Pennsylvanian (Allegheny Series) : Ohio.

N. K. Flint, 1951, Ohio Geol. Survey, 4th ser., Bull. 48, p. 40, 42. Includes (ascending) Ogan shale, clay and coal, and Zaleski flint. Occurs below Winters cyclothem and stratigraphically above Brookville cyclothem. Occurs in Ohio column, but not present in area of this report, Perry County.

M. T. Sturgeon and others, 1958, Ohio Geol. Survey Bull. 57, p. 49 (table 7), 53–56. Cyclothem, although poorly exposed consists of (ascending) Ogan shale and (or) sandstone, Ogan coal and underclay, and Zaleski marine members. Occurs above Brookville cyclothem and below Winters(?) cyclothem. In this report, Allegheny series is described on cyclothemic basis; 13 cyclothems are named. [For complete sequence see Brookville cyclothem.]

Stout (1927) named Ogan coal and underclay from exposure on Ogan Farm in sec. 14, Elk Township, Vinton County.

Ogan shale and (or) sandstone member

Pennsylvanian (Allegheny Series) : Eastern Ohio.

M. T. Sturgeon and others, 1958, Ohio Geol. Survey Bull. 57, p. 49 (table 7), 53–55. Member of Ogan cyclothem in report on Athens County. Where best exposed, consists of about 29 feet of gray silty to sandy micaceous fairly evenly bedded shale that occupies full interval between Putnam Hill member of Brookville cyclothem and Zaleski marine member of Ogan cyclothem.

Stout (1927) named Ogan coal and underclay from exposure on Ogan Farm, sec. 14, Elk Township, Vinton County.

Ogden Flint[1]

Permian: Central Kansas.

Original reference: C. S. Prosser, 1894, Geol. Soc. America Bull., v. 6, p. 48.

Occurs near Ogden, Riley County.

†Ogden Quartzite[1]

Lower and Middle Cambrian: Northeastern Utah.

Original reference: C. King, 1876, Am. Jour. Sci., 3d, v. 11, p. 477–479.

J. D. Forrester, 1937, Geol. Soc. America Bull., v. 48, no. 5, p. 638. Conformably overlying Ophir shale in Uinta Mountains is so-called Ogden (Ordovician) quartzite of Weeks (1907, Geol. Soc. America Bull., v. 18, p. 437). This unit, believed to be of Cambrian age, is here termed Pine Valley quartzite.

Named for development in Ogden Canyon.

Ogdensburg Formation[1]

Ogdenburg Member (of Tribes Hill Formation)

Lower Ordovician: Northern New York.

Original reference: G. H. Chadwick, 1915, Geol. Soc. America Bull., v. 26, p. 289, 291.

R. R. Wheeler, 1941, (abs.) Geol. Soc. America Bull., v. 52, no. 12, pt. 2, p. 1938–1939. Rank reduced to member.

R. R. Wheeler, 1946, Harvard Univ. Summaries of Theses 1942, p. 144. Uppermost member of formation in St. Lawrence Valley. Has more faunal similarity to Tribes Hill than to upper Beekmantown beds with which it has been correlated. Overlies Bucks Bridge member.

F. M. Swartz, 1948, Am. Assoc. Petroleum Geologists Bull., v. 32, no. 8, p. 1552. Limestone is about 120 feet thick in Thousand Islands region where it is of late Beekmantown age.

W. H. Twenhofel and others, 1954, Geol. Soc. America Bull., v. 65, no. 3, chart 2, column 19. Shown on chart as a dolomite unit overlying Tribes Hill dolomite.

Typical sections near Ogdensburg, St. Lawrence County.

Ogima Amygdaloid[1]

Precambrian (Keweenawan): Northern Michigan.

Original reference: B. S. Butler and W. S. Burbank, 1929, U.S. Geol. Survey Prof. Paper 144 (chart compiled by M. G. Wilmarth).

Named for occurrence in Ogima mine, Ontonagon County.

Ogima Flow[1]

Precambrian (Keweenawan): Northern Michigan.

Original reference: B. S. Butler and W. S. Burbank, 1929, U.S. Geol. Survey Prof. Paper 144 (chart compiled by M. G. Wilmarth).

Probably named for occurrence in Ogima mine, Ontonagon County.

Ogishke Conglomerate (in Knife Lake Group)

Ogishke Conglomerate Member (of Knife Lake Slate)[1]

Ogishke Granite Pebble Conglomerate (in Knife Lake Series)

Precambrian: Northeastern Minnesota.

Original reference: A. Winchell, 1887, Minnesota Geol. Nat. History Survey 15th Ann. Rept., p. 149, 179.

J. T. Stark and V. G. Sleight, 1939, Geol. Soc. America Bull., v. 50, no. 7, p. 1032 (table 2), 1034–1035. Ogishke conglomerate or group (in Kekequabic and Ogishkemuncie Lakes area) consists of three mappable facies. Each shows some lateral gradations into the other two, but there is also rude vertical range with Peebles or granite facies at base, overlain by West Gull or jasper facies, and Zeta Lake or granite porphyry facies at top. Thickness 4,800 feet. Group is unconformable above Dike Lake slate (new); underlies Knife Lake slate. Included in Knife Lake series.

J. W. Gruner, 1941, Geol. Soc. America Bull., v. 52, no. 10, p. 1583 (table 1), 1597–1601. Term Ogishke granite pebble conglomerate is herein used. Ogishke conglomerate should not be used in sense of basal conglomerate as was done in past. Clements (1903, U.S. Geol. Survey Mon. 45) included all conglomerates in Knife Lake series under term Ogishke. Stark and Sleight discuss belt only at type locality; there divisions are local and cannot be differentiated on map. In present report, Knife Lake series is divided into 20 members not necessarily all different chronologically; conglomerates appear at many horizons in series. Ogishke granite pebble conglomerate is listed as member 6 and rests on member 3—Disappointment Mountain and Moose Lake conglomerate.

Well exposed on southwest shore of Ogishkemuncie Lake, Vermilion district.

Oglesby Marble Member (of Nittany Formation)

Lower Ordovician (Canadian): Western Virginia.

B. N. Cooper, 1939, Jour. Geology, v. 47, no. 5, p. 511 (footnote). Name applied to lower member of formation; underlies Draper member (new). Thickness 155 feet.

B. N. Cooper, 1939, Virginia Geol. Survey Bull. 55, p. 17–18, pls. 1, 3, 6A. Formally proposed as Oglesby marble member. Composed of very fine grained vaughanitic limestone of various colors, pinkish- and bluish-gray being the predominant and persistent types. Thickness at type locality 90 to 115 feet; here too, there is approximately 80 feet of chert, dolomite, and limestone (also of Nittany age) below Oglesby member; on the geologic map these are included in the Oglesby. Type locality stated.

Type locality: In Draper Mountain area near Oglesby School, on lane leading south from Lee Highway at Pulaski-Wythe County line.

Oglesby Member (of Pecatonica Formation)

Middle Ordovician: Northern Illinois.

J. S. Templeton and H. B. Willman, 1952, Tri-State Geol. Soc. Guidebook 16th Ann. Field Conf., fig. 3. Shown on columnar section as underlying Brickeys member (new) of Mifflin formation and overlying Medusa member (new) of Pecatonica formation.

In copy of guidebook used by compiler, a handwritten note states that Brickeys member of Mifflin formation overlies Boarman formation. Thus, the sequence would be (descending) Boarman, Oglesby, Medusa.

Occurs in Dixon-Oregon area.

Oglethorpe Formation

Precambrian: North-central Georgia.

A. S. Furrcon and K. H. Teague, 1945, Georgia Geol. Survey Bull. 51, p. 35–36, pl. 3. Thick massive layers of biotite gneiss; medium- to thin-bedded fine-grained even-granular biotite gneiss, graywacke, and arkose. Overlies Amicalola gneiss (new) in northern part of area; terminated westward by coarse blue quartz conglomerate. As defined here, the Oglethorpe is that part of Ocoee series between Amicalola gneiss and blue quartz conglomerate.

Well exposed along road between Jasper and Connahaynee Lodge and Mount Oglethorpe [Pickens and Dawson Counties] where a large syncline in these rocks forms top and western sides of the mountain.

Ogontz Beds or Limestone

Ogontz Member (of Stonington Beds)[1]

Upper Ordovician: Northern Michigan.

Original reference: R. C. Hussey, 1926, Univ. Michigan Mus. Geol. Contr., v. 2, p. 113–150.

R. C. Hussey, 1952, Michigan Dept. Conserv. Geol. Survey Div. Pub. 46, Geol. Ser. 39, p. 52. States that Ogontz beds lie above the Stonington but also that "this member" was deposited under relatively clear water conditions.

W. H. Twenhofel, 1954, Geol. Soc. America Bull., v. 65, no. 3, chart 2 (column 46). Shown on correlation chart as Ogontz limestone; underlies Big Hill limestone; overlies Bay de Noc limestone.

Outcrops 6 miles northwest of Ogontz, Delta County, on farm of Andrew Barbeau, and at other places along east shore of Little Bay de Noc for 6½ miles north of Lighthouse Point.

Ohara Limestone

†Ohara Limestone Member[1] (of Ste. Genevieve Limestone)

Mississippian (Chesterian Series): Western Kentucky, southern Illinois, and central Tennessee.

Original reference: E. O. Ulrich and W. S. T. Smith, 1905, U.S. Geol. Survey Prof. Paper 36, p. 24, 41.

J. M. Weller and others, 1948, Geol. Soc. America Bull., v. 59, no. 2, p. 161–162, chart 5 (columns 85, 86). Ohara limestone shown on correlation chart as occurring in Kentucky and Tennessee. Overlies Ste. Genevieve Limestone. Type Ohara consists of Levias member of Ste. Genevieve and Renault formation; type Gasper appears to consist of both Renault and Paint Creek; thus the names overlap.

Named for Ohara, Caldwell County, Ky. The post office was for many years known as Cedar Hill or Cedar Bluff.

Ohia Basalt (in Hana Volcanic Series)

Pleistocene(?): Maui Island, Hawaii.

H. T. Stearns *in* H. T. Stearns and G. A. Macdonald, 1942, Hawaii Div. Hydrography Bull. 7, p. 95–96, pl. 20–B. Medium- to dark-gray olivine basalt with scattered phenocrysts of feldspar. Below altitude of 600 feet lava was confined to eastern side of Keanae Valley and filled small gulch in older alluvium along west edge of Pauwalu lava (new); near highway flowed through gap in spur between Keanae and Wailuanui Valleys and spread across fan of older alluvium to mouth of Wailuanui Stream. Exposed overlying alluvium in sea cliff along west side of Wailuanui Bay; one branch reaches sea between Pauwalu Point and Keanae village.

G. A. Macdonald and D. A. Davis *in* Jacques Avias and others, 1956, Lexique Strat. Internat., v. 6, Océanie, fasc. 2, p. 121. Pleistocene(?).

Named for Ohia Spring, which issues from it in Keanae Valley, east Maui.

Ohio Shale[1]

Upper Devonian: Ohio and north-central Kentucky.

Original reference: E. B. Andrews, 1870, Ohio Geol. Survey Rept. Prog. 1869, p. 62.

Guy Campbell, 1946, Geol. Soc. America Bull., v. 57, no. 9, p. 859–879. Black shale of Kentucky has been treated as part of New Albany, Chattanooga, or Ohio shale by different workers. Although it is continuous with all three, the shale above the Trousdale east of Cincinnati arch more nearly conforms to characters of Ohio shale. Formations of Ohio represented within limits of the New Albany are Olentangy, Huron, Olmsted, Cleveland, Bedford, Berea, and Sunbury. Lower Blackiston, upper Blackiston [Blackiston new in this report], and Sanderson (new) are equivalent to Huron, Olmsted, and Cleveland respectively. Olentangy is basal member of Huron.

J. F. Pepper, Wallace de Witt, Jr., and D. F. Demarest, 1954, U.S. Geol. Survey Prof. Paper 259, p. 14–16, pls. Ohio shale represents practically continuous deposition of black mud throughout much of Late Devonian time. It crops out in wide belt from Cuyahoga County, in northern Ohio, to Pulaski County, in southern Kentucky. In northern Ohio, this black shale is divided into two units, Cleveland and Huron members. Separation of Cleveland from Huron is difficult and contact is arbitrarily drawn. In western Lorain County, between Cuyahoga and Huron Counties, Cleveland and Huron members are separated by western edge of Chagrin shale. Thins southward; more than 500 feet in southern Huron County, Ohio; 250 feet near Vanceburg, Lewis County, Ky; 95 feet near Irvine in Estill County, Ky. In vicinity of Irvine, the Ohio merges with Sunbury shale of Mississippian age at southern limit of Bedford and Berea rocks. Contact of Ohio shale with overlying Bedford shale is generally well defined from Berea, Ohio, to Irvine, Ky.

K. V. Hoover, 1960, Ohio Geol. Survey Circ. 27, p. 5–6, 7 (fig. 2). Discussion of Devonian-Mississippian shale sequence in Ohio. In northern Ohio, Ohio shale is regarded as consisting of three members (ascending): Huron, Chagrin, and Cleveland. The Cleveland is considered by some writers to have a "member" called the Olmsted. Stratigraphically, Cleveland shale is considered by all investigators to be top member of Ohio shale. Stratigraphic position of other two members has been disputed, some researchers regarding the Huron as basal member and others the Chagrin. Some workers have considered Ohio shale as a facies deposit. For all practical purposes, black shales of central and southern Ohio should not be split lithologically into members.

Named for Ohio River hills.

Ohio Creek Formation

Ohio Creek Conglomerate[1]

Paleocene: Western Colorado.

Original reference: W. Cross, 1892, Am. Jour. Sci., 3d, v. 44, p. 21–23.

V. H. Johnson, 1948, Geology of the Paonia coal field, Delta and Gunnison Counties, Colorado (1:62,500): U.S. Geol. Survey Prelim. Map. Described in Delta and Gunnison Counties, where it rests on Mesaverde formation and is separated from it by irregular unconformity, and unconformably underlies Wasatch ("Ruby") formation. Consists of light-colored sandstone, locally containing abundant pebbles of chert, jasperoid quartz, and several kinds of igneous rocks. Erratic and locally absent, though in places as much as 200 feet thick. Tertiary age.

C. B. Hunt, 1956, U.S. Geol. Survey Prof. Paper 279, p. 19. Probably Paleocene.

J. R. Donnell, 1959, Rocky Mountain Assoc. Geologists [Guidebook] 13th Ann. Field Conf., Symposium, p. 76, 77. In Carbondale area, overlies Mesaverde formation. Probably Paleocene.

First described in Gunnison County.

Ohio River Formation[1]

Paleocene: Southern Indiana and northern Kentucky.

Original reference: G. H. Ashley, 1903, Indiana Dept. Geology and Nat. Resources 27th Ann. Rept., p. 68.

A. P. Pinsak, 1956, Indiana Geol. Survey Bull. 9, p. 7, 12–13, 52. Composed largely of unconsolidated but well-compacted sand that exhibits irregular, haphazard crossbedding; color ranges from red to white. Formation reaches its maximum thickness at Tip Top, Hardin County, Ky., where four units are represented: an upper red, upper medial white, lower medial tan, and lower white. Unconformably overlies Salem limestone in Clarke County and St. Louis limestone in Harrison County. If Highland Rim peneplane was developed during Pliocene time, Ohio River formation is Pliocene in age.

W. J. Wayne, 1960, Indiana Geol. Survey Bull. 21, p. 7–32, pl. 1. Formation is body of poorly consolidated medium- to fine-grained quartz sand in southern Indiana and northern Kentucky. It overlies limestones of middle Mississippian age in narrow belt from near Salem, Ind., to south of Fort Knox, Ky. Although regarded as a "ridge top" sand, formation does not cap the highest hills; formation was beveled along with surrounding rocks during late Tertiary cycle of erosion. Remnants of formation range from a few inches to more than 80 feet in thickness. Paleocene. Ashley did not designate type section but evidently considered exposures in Harrison County east and southeast of Elizabeth to be equivalent of a type area. Type section and reference sections herein designated.

Type section: Exposure 2 miles southeast of Elizabeth, in SW¼SE¼ sec. 3, T. 5 S., R. 5 E., Harrison County, Ind. Reference sections: SE¼NW¼ sec. 20, T. 1 S., R. 5 E., Clark County; SW¼SW¼ sec. 15, T. 5 S., R. 5 E., Harrison County.

Ohlson Ranch Formation

Pliocene, middle to upper (?) : Northern California.

C. G. Higgins, 1960, California Univ. Pubs. Geol. Sci., v. 36, no. 3, p. 199–232, map. Marine sandstone, siltstone, and conglomerate; includes fluviatile (?) conglomerates. Thickness 0 to 300 feet; uneven basal contact makes estimate of thickness uncertain. Patchy, poorly exposed, 500 to 1,700 feet above sea level on hilltops; unconformably overlies Franciscan formation. No identifiable traces of formation found west of San Andreas fault-zone trace. Invertebrate fauna.

J. H. Peck, Jr., 1960, California Univ. Pubs. Geol. Sci., v. 36, no. 4, p. 233–242, pl. 21. Paleontology discussed.

Type locality: Ernest Ohlson Ranch, 5½ miles east of Stewarts Point, N½ sec. 3, T. 9 N., R. 13 W., M. D., Annapolis quadrangle, Sonoma County.

Outcrop area is structural-topographic trough about 23 miles long, 4 miles wide, parallel to and 2 miles east of coastline.

Oil Creek Formation[1] (in Simpson Group)

Middle Ordovician: Central southern Oklahoma.

Original reference: C. E. Decker, 1930, Am. Assoc. Petroleum Geologists Bull., v. 14, no. 12, p. 1494, 1495, 1496. Name credited to E. O. Ulrich.

R. W. Harris, 1957, Oklahoma Geol. Survey Bull. 75, p. 61–68, charts 1, 2. Decker (1930) published correlation chart credited to Ulrich (and U.S. Geological Survey) as of 1928, in which Oil Creek was designated as lowermost of three Simpson formations: Oil Creek, Bromide, and West Spring Creek (with Criner member). Decker also presented chart which Ulrich reportedly presented from manuscript before Geological Society of America in meeting at New York City in 1928. In this second chart of Ulrich, basal Simpson was termed Joins Ranch (not Oil Creek), overlain by Nebo (not Bromide). Ulrich (1929 [1930], U.S. Natl. Mus. Proc., art. 21) published chart in which basal Simpson was designated Joins, with overlying Oil Creek in substitution for preempted term Nebo. Later stratigraphers have adopted last-mentioned nomenclature. In both surface and subsurface section, formation is divisible into two members: basal sandstone, and upper member of interbedded limestones and shales. Basal sandstone member predominates in eastern end of Arbuckles, whereas limestones predominate in central and western parts. Disconformably overlies Joins formation; in cases of overlap, rests unconformably on Arbuckle limestone or dolomite; disconformably underlies McLish formation. Thickness about 678 feet in West Spring Creek section; about 650 feet in U.S. Highway 77 section. Note on type locality. Chazyan.

Type locality: Along Oil Creek, which traverses formation in sec. 17, T. 3 S., R. 4 E., approximately 14 miles southeast of Sulphur, Murray County. Formation occurs throughout length of Arbuckle Mountains and crops out in Criner Hills.

Oil Creek Lake Group[1]

Upper Devonian and Mississippian: Northwestern Pennsylvania.

Original reference: J. P. Lesley, 1895, Pennsylvania 2d Geol. Survey Final Rept., v. 3, pt. 1, p. 1767.

Occurs at Oil Creek Lake, 14 miles northwest of Titusville, Crawford County.

Oil Lake Group[1] or Series

Mississippian: Northwestern Pennsylvania.

Original reference: I. C. White, 1881, Pennsylvania 2d Geol. Survey Rept. Q_4, p. 91–98.

K. E. Caster, 1938, Jour. Paleontology, v. 12, no. 1, p. 52 (fig. 9). Oil Lake series shown on generalized "facieological" diagram of Upper Devonian strata in northern Pennsylvania. Oil Lake series, which is Mississippian contains Knapp stage.

First described at Oil Creek Lake, Crawford County.

Oil Springs[1]

Upper Triassic: Western Wyoming.

Original reference: W. C. Knight, 1901, Eng. Mining Jour., v. 72, p. 359.

Wind River Mountains.

Ojo Alamo Sandstone[1]

Ojo Alamo Formation or Group

Upper Cretaceous: Northwestern New Mexico and southwestern Colorado.

Original reference: B. Brown, 1910, Am. Mus. Nat. History Bull. v. 28, p. 267–274.

H. E. Wood 2d and others, 1941, Geol. Soc. America Bull., v. 52, no. 1, p. 27, pl. 1. Formation or group. Upper Cretaceous. Underlies Puerco formation.

C. H. Dane, 1946, U.S. Geol. Survey Oil and Gas Inv. Prelim. Chart 24. Sandstone described in San Juan basin. Overlies Kirtland shale. Underlies Nacimiento formation.

C. D. Di Giambattista, 1952, Geological Symposium of the Four Corners region: Four Corners Geol. Soc., p. 6 (correlation chart), 8. Correlation chart shows Ojo Alamo sandstone as Paleocene. Overlies McDermott, angular unconformity; underlies Nacimiento formation. May be early Eocene. Southwestern Colorado and northwestern New Mexico.

R. Y. Anderson, 1960, New Mexico Bur. Mines and Mineral Resources Mem. 6, p. 2–4, 13. Discussion of Cretaceous-Tertiary palynology of eastern side of San Juan Basin, N. Mex. Ojo Alamo sandstone is of Montanan age from vertebrate evidence but Tertiary as determined from a few fragmentary plant fossils. Basal Ojo Alamo florule has only four forms in common with overlying or underlying florules and could be either Cretaceous or Paleocene. Middle florule has nine forms in common with overlying Nacimiento florules, suggesting Tertiary affinity.

Named for occurrence near Ojo Alamo, San Juan County, N. Mex.

Ojo Bonito Porphyry[1]

Cretaceous(?): Western Texas.

Original reference: C. L. Baker, 1929, Texas Univ. Bull. 2901, p. 73–74, 79–82.

Crops out in valley of Cibolo Creek, at eastern foot of main mass of Chinati Mountains.

Okaldakoochee Marl Member (of Fort Thompson Formation)

Pleistocene (Wisconsin): Southern Florida.

J. R. DuBar, 1957, Illinois Acad. Sci. Trans., v. 50, p. 192 (table 1). Table shows Fort Thompson formation divided into Okaldakoochee marl member below and Coffee Mill Hammock marl member above; occurs above Ayers Landing member (new) of Caloosahatchee marl.

J. R. DuBar, 1958, Gulf Coast Assoc. Geol. Soc. Trans., v. 8, p. 136 (fig. 4), 145. All Fort Thompson deposits that underlie Coffee Mill Hammock marl are grouped into Okaldakoochee marl; these include all fresh-water beds information at type locality and also lower marine unit here called "X, Chlamys bed".

Occurs in Caloosahatchee River area.

Okanogan glaciation

Okanogan[1] (till)

Pleistocene: Washington.

Original reference: C. R. Keyes, 1927, Pan-Am. Geologist, v. 47, p. 353.

C. R. Keyes, 1938, Pan-Am. Geologist, v. 69, no. 2, p. 129 (table). Referred to as glaciation. Preceded by Bowian and followed by Vashon.

Originated in Cordilleran center.

Okaw Formation[1]

Okaw Formation (in Homberg Group)

Upper Mississippian (Chester Series) : Southwestern Illinois.

Original reference: S. Weller, 1913, Illinois Acad. Sci. Trans., v. 6, p. 120, 127.

J. M. Weller *in* Stuart Weller and J. M. Weller, 1939, Illinois Geol. Survey Rept. Inv. 59, p. 12. As originally defined, Okaw included all beds between the Ruma below and Menard sandstone above. Main part of this interval consists principally of limestone, but at top there is considerable thickness of shaly and sandy strata. These two parts were termed Upper and Lower Okaw by Weller (1913) ; Ulrich (1917) applied name Plum Creek beds to upper division. Lower and Upper Okaw were for many years correlated with Golconda and Glen Dean formations, but it has been shown that both of these formations are actually included in Lower Okaw and that Upper Okaw is equivalent to Tar Springs, Vienna, and Waltersburg formations. Because Okaw, as originally defined, includes beds of both middle and upper Chester age and because its two divisions are separated by an unconformity and are separately mappable units, name Okaw is herein restricted to lower division and name Baldwin formation is proposed for Upper Okaw or Plum Creek beds. As thus redefined, Okaw crops out in several isolated areas entirely surrounded by Pennsylvanian beds in southwestern St. Clair County, southeast of Millstadt; its belt of continuous outcrop begins on Prairie du Long Creek 6 miles east of New Design and extends southeastward to Kaskaskia (Okaw) Valley, and then southward to the Mississippi; it occurs in Mississippi bluffs from a point 2 miles southeast of Modoc nearly to Marys River. Attains thickness of about 200 feet and consists principally of more or less heavy-bedded limestone separated by layers of shale.

J. M. Weller, 1939, Kansas Geol. Soc. Guidebook 13th Ann. Field Conf., p. 131, 136; J. M. Weller and A. J. Sutton, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 5, p. 766 (fig. 1), 833–834. Included in Homberg group (new).

Named for Okaw or Kaskaskia River, southwestern Illinois, whose valley is entirely excavated in these rocks.

Okay Limestone Lentil (of Pawhuska Formation)[1]

Pennsylvanian (Virgil Series) : Northeastern Oklahoma.

Original reference: K. C. Heald, 1918, U.S. Geol. Survey Bull. 686–E, p. 28–32.

R. C. Moore, 1937, Kansas Geol. Soc. Guidebook 11th Ann. Field Conf., p. 104. About 10 feet highest bed of Elgin sandstone. Probably equivalent to part of Lecompton limestone.

Named for exposures on and in neighborhood of O. K. Ranch, in sec. 31, Osage County.

†Okefenokee Formation (in Columbia Group)[1]

Pleistocene: Georgia Coastal Plain.

Original reference: J. O. Veatch and L. W. Stephenson, 1911, Georgia Geol. Survey Bull. 26, p. 60, 424–434.

Named for Okefenokee Swamp, a great swampy tract covering part of Charlton, Ware, and Clinch Counties.

Okesa Sandstone Member (of Barnsdall Formation)

Okesa Sandstone Member (of Ochelata Formation)[1]

Pennsylvanian (Missouri Series): Northeastern Oklahoma.

Original reference: O. B. Hopkins, 1918, U.S. Geol. Survey Bull. 686-H, p. 76–77, pl. 12.

M. C. Oakes, 1951, Tulsa Geol. Soc. Digest, v. 19, p. 120; W. F. Tanner, 1956, Oklahoma Geol. Survey Circ. 40, p. 30–32. Reallocated to member status in Barnsdall formation (new). Okesa thickens southward at expense of two unnamed shale members of formation and includes, as its basal bed, limy sandstone that is equivalent to Birch Creek limestone.

M. C. Oakes, 1959, Oklahoma Geol. Survey Bull. 81, p. 37, 39–40. In Creek County, Okesa overlies Wann formation. In T. 19 N., R. 9 E., contains two sandstone units and intervening sandy to silty shale unit with combined thickness of 90 feet in north part and 80 feet in south part. In T. 18 N., has total thickness of 120 to 170 feet. Tps. 14 and 15 N., Rs. 8 and 9 E. is single sandstone unit which thins southward from 160 feet to 85 feet. As mapped in this area, rests on Iola limestone as far south as south side of sec 20, T. 14 N., R. 9 E., and rests on Chanute formation farther south where Iola is absent.

Named for exposures east of Okesa, T. 26 N., R. 11 E., Osage County.

Oketa Shale Member (of Barneston Limestone)

Oketo Shale (in Chase Group)[1]

Permian: Central Kansas.

Original reference: R. C. Moore, 1936, Kansas Geol. Soc. 10th Ann. Field Conf. Guidebook p. 12 (fig. 4), 69 (fig. 45).

J. M. Jewett, 1941, Kansas Geol. Survey Bull. 39, p. 76–77. Member of Barneston. Blue and gray shale, calcareous, and locally contains one or more beds of limestone. Thickness as much as 17 feet. Underlies Fort Riley limestone member; overlies Florence limestone member. Wolfcamp series.

Name derived from Oketo, Marshall County.

Oklahoma Series[1]

Permian: Oklahoma.

Original reference: G. H. Ashley, 1923, Eng. and Min. Jour-Press, v. 115, p. 1106–1108.

C. C. Branson, 1957, Oklahoma Geology Notes, v. 17, no. 11, p. 102. Abandoned by Oklahoma Geological Survey. Name preoccupied by Oklahoman series (Keys, 1896).

Oklahoman series[1]

Permian: Oklahoma.

Original reference: C. R. Keyes, 1896, Am. Geologist, v. 18, p. 22–28.

Named for Oklahoma.

Oklan Series or Epoch

Middle Pennsylvanian; North America.

R. C. Moore and M. L. Thompson, 1949, Am. Assoc. Petroleum Geologists Bull., v. 33, no. 3, p. 284, 286, 288–289 (fig. 1), 292–297. Analysis of physical characters and paleontological features of Pennsylvanian rocks in North America leads to conclusion that stratigraphic cleavage at two positions within system has paramount significance. Three series recognized: Ardian-Lower Pennsylvanian; Oklan-Middle Pennsylvanian; Kawvian-Upper Pennsylvanian. Oklan series includes all Pennsylvanian deposits between Morrowan and Missourian rocks. Boundaries marked by disconformities which are clearly distinguished at many places but obscure in others. In some areas, Oklan formations rest disconformably or nonconformably on pre-Pennsylvanian rocks ranging in age from Mississippian to Precambrian. Divisible into two stages: Atokan (or Derryan) and Desmoinesian. Rocks of Oklan series are more widespread than those of either older or younger divisions of Pennsylvanian. Series contains several faunal zones which have world-wide distribution and which are readily identified. Time equivalent is Oklan epoch.

Name Oklan is based on abbreviation of State of Oklahoma and refers to the thick fossiliferous succession of Middle Pennsylvanian deposits in east-central and northwestern Oklahoma.

†Oklune Series[1]

Late Carboniferous(?), Mesozoic, and Tertiary: Southern Alaska.

Original reference: J. E. Spurr, 1900, U.S. Geol. Survey 20th Ann. Rept., pt. 7, p. 163–169, 181.

Exposed where Kanektok River emerges from Oklune Mountains and along the Kanetok on western side of mountains in Kuskokwim region.

Okmok Volcanics

Okmok Ash

Quaternary: Southwestern Alaska.

F. M. Byers, Jr., and others, 1947, U.S. Geol. Survey Alaska Volcano Inv. Rept. 2, pt. 3, p. 28, pl. 3. Rocks of Okmok ash chiefly of 1- to 10-foot beds of well-sorted ash, lapilli, and fragments of accessory materials. Consolidated bed of agglomerate, 5 to 20 feet thick and composed largely of bombs, occurs near base of Okmok beds exposed in wall of caldera and in gullies around outer slopes of volcano. Bombs 1 to 2 feet long abundant in this bed; bombs and accessory fragments as much as 3 feet long occur locally. Bed about 20 feet below top of ash on northern outer slope consists of flattened disc-shaped bombs; individual bombs 1 to 4 inches thick and 4 to 12 inches across. A few lava flows, 20 to 50 feet thick, and a few beds of tuff-breccia, poorly sorted are interlayered with ash beds. In caldera walls, thickness of ash ranges from a few feet to more than 300 feet and averages 170 feet. On outer slope, thickness decreases rapidly with increasing distance from caldera; less than 5 feet thick along Bering Sea coast. Overlies Tanak volcanics (new) and Tulik basalt (new).

F. M. Byers, Jr., 1959, U.S. Geol. Survey Bull. 1028–L, p. 314–323, pl. 41. Okmok volcanics includes Tanak volcanics and Okmok ash of Byers and others (1947). Maximum thickness about 400 feet at type locality; thins outward to as little as 20 feet. Younger than Crater Creek basalt. Recent.

Type locality: North Rim of Okmok Caldera, Umnak Island.

Okmulgee Group[1]

Pennsylvanian: Kansas and Oklahoma.

Original reference: R. C. Moore, 1931, Kansas Geol. Soc. 5th Ann. Field Conf. Guidebook, correlation chart.

C. C. Branson, 1957, Oklahoma Geology Notes, v. 17, no. 11, p. 102. Abandoned by Oklahoma Geological Survey.

Named for city and county in Oklahoma.

Okpikruak Formation

Lower Cretaceous: Northern Alaska.

George Gryc, W. W. Patton, Jr., and T. G. Payne, 1951, Washington Acad. Sci. Jour., v. 41, no. 5, p. 159–160, fig. 2. Predominantly fine-grained greenish-gray sandstone of graywacke type, dark clay, and silt shale with minor amounts of conglomerate near base. On Siksikpuk River, formation characterized by rhythmic alternation of fine-grained sandstone, silt shale, and clay shale. Alternation not well developed along Okpikruak River. Thickness about 2,400 feet at type locality, 1,850 feet on Siksikpuk River. Unconformably underlies Torok formation (new); rests on Jurassic or Triassic rocks with little or no angular discordance.

W. W. Patton, Jr., *in* George Gryc and others, 1956, Am. Assoc. Petroleum Geologists Bull., v. 40, no. 2, p. 215, 220, fig. 2. Overlies Tiglukpuk formation (new), in some places with angular discordance; locally underlies Fortress Mountain formation (new).

Type section: In middle of a major syncline and exposed on small tributary of Okpikruak River at about lat 68°34'30'' N. and long 153°38' W. Crops out in southern part of Arctic Foothills province from Itkillik River west to Kukpowruk River. Typically exposed along Okpikruak River.

†Oktibbeha Tongue (of Selma Chalk)[1]

Upper Cretaceous: Northeastern Mississippi.

Original reference: L. W. Stephenson, 1917, Washington Acad. Sci. Jour., v. 7, p. 243–250.

Named for Oktibbeha County.

Olaa Agglomerate

Pleistocene, upper(?) and Recent: Hawaii Island, Hawaii.

C. K. Wentworth, 1938, Hawaiian Volcano Observatory 3d Spec. Rept., p. 39–40. An accumulation of detrital material in mounds 5 to 25 feet high underlying Glenwood tuff.

D. A. Davis and G. A. Macdonald *in* Jacques Avias and others, 1956, Lexique Strat. Internat., v. 6, Océanie, fasc. 2, p. 121. Now known to be fragmental tops of irregular aa flows of Kau volcanic series.

Occurs on east slope of Mauna Loa, inland from Olaa and Camp Two, on Waiakea Plantation Railroad.

Olallie Lavas

Pleistocene: Northwestern Oregon.

T. P. Thayer, 1936, Jour. Geology, v. 44, no. 6, p. 706, 709 (fig. 2), 713; (fig. 3); 1937, Geol. Soc. America Bull., v. 48, no. 11, p. 1616 (fig. 2), 1617, 1618, 1631, 1632. High Cascade lavas are divided into four groups; in chronological order these are: Outerson basalts, Minto basalts, Santiam basalts, and Olallie lavas. Olallie lavas and Santiam basalts not in contact hence relative ages unknown. Extruded on dissected surface of Minto lavas.

Mapped in vicinity of Olallie Butte, Jefferson quadrangle. Olallie Butte is dissected cone typical of many built up on eroded Minto series.

Olathe Limestone Member[1] (of Stanton Limestone)

Pennsylvanian: Central eastern and northeastern Kansas.

Original references: R. C. Moore, M. K. Elias, and N. D. Newell, 1934, Stratigraphic sections of Pennsylvanian and "Permian" rocks of Kansas River valley: Kansas Geol. Survey, issued Dec.; R. C. Moore, 1935, Rock formations of Kansas *in* Kansas Geol. Soc.: Wichita, Kans., [Am. Assoc. Petroleum Geologists 20th Ann. Mtg., Mar. 21–23]; N. D. Newell, 1935, Kansas Geol. Survey Bull. 21, pt. 1, p. 76–79.

Type locality: At western edge of Olathe, secs. 34 and 35, T. 13 S., R. 23 E., Johnson County.

Olcese Sand[1]

Olcese Sand Member (of Temblor Formation)

Oligocene, upper, and Miocene, lower: Southern California (subsurface and surface).

Original reference: A. Diepenbrock, 1933, California Oil Fields, Div. Oil and Gas, v. 19, no. 2, p. 14, pl. 2.

A. M. Keen, 1943, San Diego Soc. Nat. History Trans., v. 10, no. 2, p. 26 (fig. 1), 28 (fig. 2), 29, 30. Mapped as Olcese sand in Kern River area around Round Mountain; considered member of Temblor. Underlies Round Mountain silt member; overlies Jewett silt member. Note on type locality.

Type locality: At west edge of Mount Poso oil field, northeast of Bakersfield, Kern County, in Ohio Oil Co. well No "Glide" 1, sec. 13, T. 27 S., R. 27 E.

Old Bridge Sand Member (of Raritan Formation)

Upper Cretaceous: East-central New Jersey.

H. C. Barksdale and others, 1943, The ground-water supplies of Middlesex County, New Jersey: New Jersey State Water Policy Comm. [Spec. Rept. 8], p. 67–101. Commonly a fine- to medium-grained sand, locally quite coarse; crossbedded, slightly micaceous; occasional small beds of clay. At outcrop, practically free of pyrite and lignite, but samples from boreholes show that downdip these substances are fairly common; dry sand is white or yellow. Thickness 80 to 110 feet (data based on surface exposures and from wells). Unit is No. 3 sand of previous reports. Occurs near top of formation below Amboy stoneware clay and above South Amboy fire clay, both of which are considered informal economic terms. Separated from Sayreville sand member (new) by South Amboy fire clay. Most of discussion of unit deals with its relationship to ground-water supply.

Named for outcrops in and near Old Bridge village, Middlesex County. Crops out or is exposed beneath Pleistocene deposits in irregular band that extends from Raritan Bay near South Amboy to and probably beyond Jamesburg.

Old Colony Amygdaloid[1] (in Central Mine Group)

Precambrian (Keweenawan): Northern Michigan.

Original reference: B. S. Butler and W. S. Burbank, 1929, U.S. Geol. Survey Prof. Paper 144 (chart compiled by M. G. Wilmarth).

Named for occurrence in Old Colony mine, Houghton County.

Old Colony Flow[1]

Precambrian (Keweenawan): Northern Michigan.

Original reference: B. S. Butler and W. S. Burbank, 1929, U.S. Geol. Survey Prof. Paper 144 (chart compiled by M. G. Wilmarth).

Probably named for occurrence in Old Colony mine, Houghton County.

Old Colony Sandstone[1] (in Portage Lake Lava Series)

Precambrian (Keweenawan): Northern Michigan.

Original reference: A. C. Lane, 1911, Michigan Geol. and Biol. Survey Pub. 6, Geol. Ser. 4, p. 304, 375, 421, 445, fig. 37.

W. S. White, H. R. Cornwall, and R. W. Swanson, 1953, U.S. Geol. Survey Geol. Quad. Map GQ-27. Included in Portage Lake lava series.

Named for occurrence in Old Colony mine, Houghton County.

Old Crow Gypsum[1]

Permian: Northwestern Oklahoma.

Original reference: F. W. Cragin, 1897, Am. Geologist, v. 19, p. 363.

Named for Old Crow crossing of Canadian River, Blaine or Dewey County.

Old Dominion Limestone[1] (in Stevens Series)

Lower Cambrian: Northeastern Washington.

Original reference: C. E. Weaver, 1920, Washington Geol. Survey Bull. 20, p. 66, map.

V. J. Okulitch, 1950, (abs.) Geol. Soc. America Bull., v. 61, no. 12, pt. 2, p. 1540. Faunal evidence indicates Lower Cambrian age of limestone. Overlies Addy quartzite.

Probably named for exposures near Old Dominion Mountain, Stevens County.

Old Gregory Formation

Miocene, upper: Western Nevada.

D. I. Axelrod, 1956, California Univ. Pubs. Geol. Sci., v. 33, p. 135, 137-138, figs. 6, 7, 8, 9. Made up chiefly of light greenish to white rhyolite tuffs and breccias regularly characterized by lapilli, which are partly devitrified. Some of the pyroclastic section appears to be subaerial in origin. Tuffs regularly show graded bedding and are often associated with cream to tan siliceous shales of lacustrine origin. Shale units range from 10 to as much as 70 feet think. Total thickness approximately 2,700 feet. Probably rests on undifferentiated metamorphic and granitic rocks. Underlies Chloropagus formation (new).

Named for exposures in area about Old Gregory Camp, which lies a mile southeast of Red Mountain.

Oldham Limestone[1]

Lower or Middle Silurian: East-central Kentucky.

Original reference: A. F. Foerste, 1905, Kentucky Geol. Survey Bull. 6, p. 145; 1906, Kentucky Geol. Survey Bull. 7, p. 10, 47.

C. K. Swartz and others, 1942, Geol. Soc. America Bull., v. 53, no. 4, chart 3. Correlation chart shows Oldham limestone below Lulbegrud conglomerate and above Plum Creek conglomerate. Silurian (Niagaran).

E. B. Branson and C. C. Branson, 1947, Jour. Paleontology, v. 21, no. 6, p. 550 (fig. 1). Table shows Oldham limestone overlying Plum Creek member of Brassfield formation. Lower Silurian (Medinan).

Named for Oldham Branch between Panola and Brassfield, Madison County.

Old Lassen Mud Flows

Age not stated: Northern California.

Howel Williams, 1932, California Univ. Pub., Bull. Dept. Geol. Sci., v. 21, no. 5, geol. map.; no. 8, geol. map. Shown on geologic map on east side of Mount Lassen.

Lassen Volcanic National Park.

Old Ocean Shale

Oligocene: Southern Texas (subsurface).

Alexander Deussen and K. D. Owen, 1939, Am. Assoc. Petroleum Geologists Bull., v. 23, no. 11, p. 1618, 1630 (fig. 5), 1631 (fig. 6), 1634. Name suggested for Oligocene marine shale wedge that occurs in subsurface above unit here named Van Vleck sands and below unit named Pierce Estate sands or Flour Bluff sand. Wedge is more than 3,400 feet thick, thins northward, and disappears in well No. 7 (Danciger, Raver No. 1) in southeast corner of Colorado County.

Typically displayed in well No. 24 (Harrison and Abercrombie, Bernard River Land Development Company No. 4), in Old Ocean field, Brazoria County.

Old Pewabic Amygdaloid[1] (in Ashbed Group)

Precambrian (Keweenawan): Northern Michigan.

Original reference: A. R. Marvine, 1873, Michigan Geol. Survey, v. 1 pt. 2, p. 86, chart.

Named for occurrence in an old mine on Pewabic property, in Keweenaw County.

Old Pewabic Flow[1]

Precambrian (Keweenawan): Northern Michigan.

Original reference: B. S. Butler and W. S. Burbank, 1929, U.S. Geol. Survey Prof. Paper 144 (chart compiled by M. G. Wilmarth).

Probably named for occurrence in an old mine on Pewabic property, in Keweenaw County.

Old Rag Granite[1]

Precambrian: Northern central Virginia.

Original reference: A. S. Furcron, 1934, Jour. Geology, v. 42, no. 4, p. 400–410.

Edward Steidtmann, 1945, Virginia Geol. Survey Bull. 64, p. 27. Mentioned in report on commercial granites in Virginia.

Named from exposures in Old Rag Mountain, east of Old Ray post office, Madison County.

Oldsmar Limestone

Eocene, lower: Northern and central Florida (subsurface).

P. L. Applin and E. R. Applin, 1944, Am. Assoc. Petroleum Geologists Bull., v. 28, no. 12, p. 1681, 1698–1701. 1751 (fig. 36). Name applied to limestone facies of lower Eocene in northern Florida and peninsula.

Defined to include interval that is marked at top by abundant specimens of *Helicostegina gyralis* Barker and Grimsdale and that rests on Cedar Keys limestone. Lithologically similar to overlying Lake City limestone (new). Thickness in type well 925 feet; 1,200 feet in Monroe County; 740 feet in Levy County.

Named from Oldsmar well, sec. 18, T. 28 S., R. 17 E., Hillsborough County. Samples from well are filed at Florida Geological Survey under No. W–8.

Old Woman Sandstone

Tertiary: Southern California.

R. L. Shreve *in* J. F. Richmond, 1960, California Div. Mines Spec. Rept. 65, p. 45–46, pl. 1. Massive reddish-buff conglomerate arkose devoid of marble casts. Sandstone becomes finer grained, more massive, and less conglomeratic stratigraphically upward and geographically northward. Thins rapidly northward; in Blackhawk Canyon, thickness decreases from estimated 600 feet near Voorhies fault to measured 200 feet near mouth of canyon 4,500 feet to north. Rests in depositional contact on deeply weathered gneiss; bedding in sandstone generally dips northward about 10° more steeply than contact with underlying gneiss. Overlain by terrace deposits.

Type locality: Lower Blackhawk Canyon, San Bernardino Mountains, north of Big Bear Lake, San Bernardino County. Forms typical badlands topography.

Olean Conglomerate Member (of Pottsville Formation)[1]

Olean Conglomerate

Lower Pennsylvanian: Western New York and northwestern Pennsylvania.

Original reference: J. P. Lesley, 1875, Pennsylvania 2d Geol. Survey Rept. I, p. 89, 96.

Henry Leighton, 1941, Pennsylvania Geol. Survey, 4th ser., Bull. M–23, p. 57, 103. Referred to as Olean conglomerate, Pottsville series. Thickness 55 feet in McKean and Elk Counties, Pa. Underlies Marshburg coal and clay which in turn underlies Kinzua Creek sandstone.

J. G. Woodruff, 1942, New York State Mus. Bull. 326, p. 17 (fig. 4), 67–68. Olean conglomerate does not crop out in area of this report [Wellsville quadrangle] but occurs just one-half mile to west elevation at 2,500 feet and has been useful in working out relationship of beds in Wellsville quadrangle. Data suggests unconformity with underlying Mississippian(?) Oswayo(?) formation.

R. C. Moore and others, 1944, Geol. Soc. America Bull., v. 55, no. 6. chart 6 (column 9). Correlation chart shows Olean conglomerate below Sharon shale in northwestern Pennsylvania and southwestern New York. Pottsville series.

Bradford Willard, 1946, Geol. Soc. America Bull., v. 57, no. 9, p. 781–796. Marine Mississippian of northwestern Pennsylvania meets and merges in north-central Pennsylvania with continental Mississippian spread from northeast. At their junction, the two facies are confined between overlying Olean or Pottsville spheroidal-pebble conglomerates of basal Pennsylvanian and underlying Devonian. Latter is represented by Mount Pleasant red shale of continental Catskill facies to east and youngest marine Devonian, Oswayo formation, to west.

Typical outcrop at Olean Rock City, 6 miles south of Olean, Cattaraugus County, N.Y.

Olean Drift

Olean Substage

Pleistocene (Wisconsin) : New York and Pennsylvania.

Paul MacClintock and E. T. Apfel, 1944, Geol. Soc. America Bull., v. 55, no. 10, p. 1145 (fig. 1), 1153–1155, pl. 1. Based primarily on lithologic differences, three Wisconsin drift sheets are recognized (ascending) : Olean, Binghamton, and Valley Heads. Olean drift is composed dominantly of sandstones, siltstones, and shales from bedrock constituting the plateau; contains only 2 to 3 percent limestone and very little igneous material. This contrasts with Binghamton drift which normally contains 12 to 20 percent limestone and 5 to 7 percent igneous material.

L. C. Peltier, 1949, Pennsylvania Geol. Survey, 4th ser., Bull. G–23, p. 4 (table 1), 16 (fig. 5), 20–26, table 5. Referred to as Olean substage in discussion of glacial geology of Susquehanna River terraces. Also discussion of Olean till, silt, sand, and gravel. Underlies Binghamton drift.

Well exposed in vicinity of Olean, Cattaraugus County, N.Y.

†Olean Shale[1]

Pennsylvanian: Western New York.

Original reference: J. M. Clarke, 1902, New York State Mus. Bull. 52, p. 525.

Olean quadrangle.

Olentangy Shale[1]

Olentangy Shale Member (of Blackiston Formation)

Upper Devonian: Central Ohio.

Original reference: N. H. Winchell, 1874, Ohio Geol. Survey, v. 2, p. 243, 287.

Guy Campbell, 1946, Geol. Soc. America Bull., v. 46, no. 9, p. 859, 861, 865–866, 868–870, 876, pl. 1. New Albany shale in Indiana consists of Devonian Blocher and Blackiston formations (both new), 90 feet thick, and Mississippian Sanderson, Underwood, and Henryville formations (all new), 11 feet thick. These divisions continue through Kentucky, Ohio, and Tennessee. Olentangy shale is basal Blackiston and Upper Devonian in age. In Kentucky, Olentangy overlaps Silurian beds from Ohio River to Olympian Springs, the Portwood (new) to Indian Fields, and the Trousdale to Crab Orchard. Thickness 17½ feet at Fox Springs; 8½ feet at Rice Station; pinches out at Crab Orchard.

K. V. Hoover, 1960, Ohio Geol. Survey Inf. Circ. 27, p. 8–16. Stratigraphic position and correlation of Olentangy shale discussed in detail. Difference of opinion arises from fact that a shale unit and a limestone unit lie between Huron shale and Delaware limestone of northern Ohio (or Dundee limestone of northwestern Ohio) and so hold generally the position occupied by Olentangy in central Ohio. Limestone in northern part of state is the Prout. It is described as immediately underlying Huron (Ohio) shale. Subjacent to this limestone is Plum Brook shale. Names "Silica formation" and "Ten Mile Creek dolomite" are assigned to disputed shale unit and carbonate unit, respectively, in northwestern Ohio. Problem of correlation revolves around relationship of Olentangy in central Ohio to Prout limestone-Plum Brook shale of northern Ohio and Silica shale-Ten Mile Creek dolomite of northwestern Ohio. At various times and by different authors, Plum Brook shale has been correlated with Olentangy, and so-called Prout limestone has been regarded as member of Olentangy shale. Dating these rocks in the three geographic regions under consideration remains controversial matter. It is here suggested that Olentangy, Plum Brook shale, Prout limestone, Silica shale, and Ten Mile Creek are stratigraphically correlatable with reservation that Olentangy is probably Upper Devonian. Top limit of Olentangy in central and southern Ohio is uppermost gray shale bed in contact with a black shale layer. In area of Prout limestone and Ten Mile Creek dolomite outcrop, contact between them and overlying black shale presents no problem. Disconformable relationship exists between underlying older formations and base of Olentangy. In northern Delaware County, Olentangy disappears beneath glacial drift. Devonian rocks next crop out in Huron County to north or Lucas County to northwest. Undisputed Olentangy is not present in these areas; rather Olentangy stratigraphic interval is represented by Prout limestone and Plum Brook shale (northern Ohio) or Silica shale and Ten Mile Creek dolomite (northwestern Ohio). Undisputed Olentangy is variable in thickness. In type area averages 28 feet. In southern Ohio ranges from 0 to 58 feet.

Named for exposures on Olentangy River, Delaware County.

Olequa Formation[1]

Eocene: Southwestern Washington.

Original reference: R. Arnold and H. Hannibal, 1913, Am. Philos. Soc. Proc., v. 52, p. 566, 568.

Type locality not stated.

Olequa Creek Member (of Cowlitz Formation)

Eocene, upper: Southwestern Washington.

D. A. Henriksen, 1954, Dissert. Abs., v. 14, no. 12, p. 2316. Named as member of Cowlitz. Underlies Goble volcanics member; overlies Pe Ell volcanics member (new).

D. A. Henriksen, 1956, Washington Div. Mines and Geology Bull. 43, p. 37, 48–49, pl. 1. Comprises two lithologic facies: (1) brackish water, shallow marine, and nonmarine consisting of massive to crossbedded fine-grained arkoses, feldspathic sandstones, and thin-bedded sandy siltstones, with intercalated beds of coal, bone, and carbonaceous siltstone and claystone; (2) near-shore marine consisting of massive to well-bedded mudstone, siltstone, and silty sandstones, in part carbonaceous, micaceous, glauconitic, and limy. Minimum thickness 800 feet. Thickness at type locality 2,500 feet; thickens toward southeast; along Cowlitz River may be as much as 5,000 feet or more. Conformably overlies Stillwater Creek member; contact gradational. Unconformably overlain by Oligocene sediments along contact line which trends northeastward from Cowlitz River to Chehalis River north of Pe Ell; in southeastern part of area member is overlain with marked angular unconformity by basalt flows and interbedded sediments of Astoria formation.

Type section: Along Olequa Creek from its confluence with Cowlitz River northward to Oligocene contact south of Winlock, and along Stillwater Creek from Brim Creek to Olequa Creek, Lewis County.

Oley Valley Slates[1]

Precambrian: Southeastern Pennsylvnaia.

Original reference: E. V. d'Invilliers, 1883, Pennsylvania 2d Geol. Survey Rept. D_3, v. 2, p. 47, 158, 180.

Berks County.

Olinger Gray Shale Member (of Chattanooga Shale)[1]

Mississippian (Kinderhook): Southwestern Virginia and southern Tennessee.

Original reference: J. H. Swartz, 1927, Am. Jour. Sci., 5th, v. 14, p. 485–499.

J. M. Weller and others, 1948, Geol. Soc. America Bull., v. 59, no. 2, p. 193, chart 5 (columns 93, 94, 97). Age shown on chart as Mississippian (Kinderhookian series).

W. H. Hass, 1956, U.S. Geol. Survey Prof. Paper 286, p. 26. Thin gray mudstone bed at type locality of Chattanooga shale, which Swartz identified as his Olinger member of Chattanooga, is placed in Maury formation as herein defined. Assignment made because its lithologic character more closely resembles that of Maury formation than that of underlying grayish-black Chattanooga shale.

Well exposed at Olinger, Lee County, Va.

Olive Hill facies (of Muldraugh Formation)

Lower Mississippian: Central Kentucky.

P. B. Stockdale, 1939, Geol. Soc. America Spec. Paper 22, p. 76, 217–222, pl. 16. Easternmost facies of formation. Essential feature is Rothwell shale member (new) at base, which, at some places, is sole representative of formation. Above Rothwell shale are beds of argillaceous limestone with shaly partings, essentially like those of Hummel facies to southeast. Thickness about 50 feet. Unconformably underlies Upper Mississippian rocks—in some areas St. Louis limestone and in other areas Ste. Genevieve limestone. Overlies Floyds Knob formation.

Type section: Along U.S. Highway 60, at steep hill 2¾ miles west-southwest of Olive Hill, Carter County. Name derived from town of Olive Hill, western Carter County.

Olive Hill Fire Clay (in Pottsville Formation)[1]

Pennsylvanian: Northeastern Kentucky.

Original reference: A. F. Crider, 1913, Kentucky Geol. Survey, 4th ser., v. 1, pt. 2, between p. 594 and 616.

H. R. Wanless, 1939, Geol. Soc. America Spec. Paper 17, p. 97. Of Pottsville age; commonly at very base of Pennsylvanian.

Named for Olive Hill, Carter County.

Olive Hill Formation[1] (in Linden Group)

Lower Devonian: Western and central Tennessee.

Original reference: C. O. Dunbar, 1918, Am. Jour. Sci. 4th, v. 46, p. 738.

C. W. Wilson, Jr., 1949, Tennessee Div. Geology Bull. 56, p. 280–281, fig. 2. In this report [pre-Chattanooga stratigraphy of central Tennessee], Dunbar's 1919 (Tennessee Div. Geology Bull. 21) classification of Lower

Devonian is modified. Units formerly included in Olive Hill are reclassified, and term Olive Hill is considered unnecessary.

Named for exposure in bluff on Indian Creek at Olive Hill, Hardin County.

Oliverian Plutonic Series

Oliverian Magma Series[1]

Middle or Upper Devonian(?) : New Hampshire and southeastern Vermont.

Original reference: M. P. Billings, 1934, Science, new ser. v. 79, p. 55–56.

Katharine Fowler-Lunn and Louise Kingsley, 1937, Geol. Soc. America Bull., v. 48, no. 10, p. 1374, pl. 3. Represented by Smarts Mountain granite in Cardigan quadrangle, New Hampshire. Devonian.

C. A. Chapman and others, 1938, Geologic map and structure sections of the Mascoma quadrangle, New Hampshire (1:62,500) : New Hampshire Highway Dept. Includes Mascoma group, Smarts Mountain group, Croydon group, and Lebanon group. Upper Devonian(?).

J. B. Hadley and others, 1938, Geologic map and structure sections of the New Hampshire portion of the Mt. Cube quadrangle (1:62,500) : New Hampshire Highway Dept. Includes Baker Pond gneiss.

C. A. Chapman, 1942, Geol. Soc. America Bull., v. 53, no. 6, p. 897. Represented by Unity and Croydon groups in Claremont-Newport area, New Hampshire.

R. W. Chapman, 1948, Geol. Soc. America Bull., v. 59, no. 11, p. 1075–1079. Extended to include quartz diorite formerly termed Berlin gneiss of New Hampshire magma series in Percy quadrangle, New Hampshire.

G. E. Moore, Jr., 1949, Geol. Soc. America Bull., v. 60, no. 10, p. 1635–1639, pl. 1. Geographically extended to southeastern Vermont.

M. P. Billings, 1955, Geologic map of New Hampshire (1:250,000) : U.S. Geol. Survey. Plutonic series includes Whitefield gneiss and Lebanon granite. Middle or Upper Devonian(?).

M. P. Billings, 1956, Geology of New Hampshire, pt. 2, Bedrock geology: Concord, New Hampshire State Plan. Devel. Comm., p. 48–53, 106–107, 122–125, 147–148, 186–187. Summary discussion. Characteristics include pink color of many rocks, common foliation and (or) lineation, granoblastic texture, and evidence of deformation.

Named for Oliverian Brook in southwestern corner of Moosilauke quadrangle, New Hampshire.

†Oljeto Sandstone Member[1] (of Moenkopi Formation)

Upper Permian, Lower Triassic, and Upper(?) Triassic: Southeastern Utah.

Original reference: E. G. Woodruff, 1912, U.S. Geol. Survey Bull. 471, p. 80, 87.

Forms cliffs in Moonlight Valley, at Oljato (now Oljeto), San Juan County.

Olmos Formation (in Navarro Group)[1]

Upper Cretaceous (Gulf Series) : Southwestern Texas.

Original reference: L. W. Stephenson, 1927, Am. Assoc. Petroleum Geologists Bull., v. 11, p. 10, 14.

L. W. Stephenson and others, 1942, Geol. Soc. America Bull. v. 53, no 3, chart 9. Shown on correlation chart below Escondido formation and above San Miguel formation. Basal member of Navarro group

Named for flag station of Olmos, Maverick County, which is located on outcrop of formations, and also for Olmos Creek (now generally called Elm Creek), which follows strike of formation near center of belt of outcrop from point, 7 or 8 miles north of Eagle Pass to junction of creek with Rio Grande.

Olmos Sand[1] (in Whitsett Formation)

Eocene (Jackson): Southeastern Texas.

Original reference: A. C. Ellisor, 1933, Am. Assoc. Petroleum Geologists Bull., v. 17, no. 11, p. 1302, 1316.

D. H. Eargle, 1959, Am. Assoc. Petroleum Geologists Bull., v. 43, no. 11, p. 2634. Overlies Fashing clay member of Whitsett but not included in Whitsett in this report. Apparently overlapped by Catahoula in southeastern Atascosa, western Karnes and northern Live Oak Counties. Name is preempted but substitute name is not recommended in this report.

Named for Olmos Creek near Whitsett, Live Oak County.

†Olmsted Shale Member (of Cleveland Shale)[1]

Upper Devonian or Mississippian: Northeastern Ohio.

Original reference: H. P. Cushing, 1912, Am. Jour. Sci., 4th, v. 33, p. 583.

U.S. Geological Survey currently classifies the Cleveland Shale as a member of the Ohio Shale; hence, the name Olmsted Shale Member has been abandoned.

Named for exposures at Olmsted Falls, Cuyahoga County.

Olney Member (of Manlius Limestone)

Olney Limestone[1] (in Manlius Group)

Lower Devonian: Central New York.

Original reference: Burnett Smith, 1929, New York State Mus. Bull. 281, p. 26, 27.

L. V. Rickard, 1955, New York State Geol. Assoc. Guidebook 27th Ann. Mtg., p. 7. Manlius formation subdivided into (ascending) Thacher (new), Olney, Elmwood, Clark Reservation, and Jamesville. The higher limestone members all named by Smith (1929) pass laterally into Coeymans limestone of eastern New York and hence are undoubtedly Devonian in age.

L. V. Rickard, 1956, Dissert. Abs., v. 16, no. 1, p. 102. When traced westward from the Helderbergs, Coeymans formation thickens to nearly 100 feet at Cherry Valley. Further west this thickened Coeymans splits into three parts. Lower part, for which name Dayville is proposed, grades laterally into Olney limestone of Syracuse area.

Type section: One and three-fourths miles east of Olney Station, on Auburn and Syracuse Electric Railroad, at old quarry at Split Rock, Onondaga County.

Olokele Formation (in Waimea Canyon Volcanic Series)

Pliocene(?): Kauai Island, Hawaii.

G. A. Macdonald, D. A. Davis, and D. C. Cox, 1954, Volcano Letter 526, p. 2; D. A. Davis and G. A. Macdonald *in* Jacques Avias and others, 1956, Lexique Strat. Internat., v. 6, Océanie, fasc. 2, p. 121–122. Massive lava flows and associated pyroclastics that accumulated within boundaries of principal caldera of Kauai shield volcano. Lavas predominantly olivine basalt. Maximum thickness 2,600 feet; base not exposed. Younger than most or all of Napali formations (new); probably coeval with Haupu formation (new).

G. A. Macdonald, D. A. Davis, and D. C. Cox, 1960, Hawaii Div. Hydrography Bull. 13, p. 32–42, table facing p. 20, pl. 1. Lava flows and associated pyroclastic rocks that accumulated within boundaries of major caldera of Kauai shield volcano. Total thickness not known; base not exposed; exposed thickness 2,000 to 2,600 feet. Separated from Napali formation by buried fault scarps marking edge of ancient caldera, and locally by masses of talus breccia that accumulated along fault scarp before it was buried. Separated from Makaweli formation in part by fault scarp at head of Makaweli graben. Upper part coeval with Makaweli formation. Believed to have been formed during Pliocene.

Type section: Walls of upper Olokele Canyon, and of Poomau, Koaie, and Waialae Streams, tributaries of Waimea River.

Olomoana Volcanics

Pliocene(?): Samoa Islands (Tutuila).

H. T. Stearns, 1944, Geol. Soc. America Bull., v. 55, no. 11, p. 1286 (table), 1288–1289. Chiefly olivine basalts capped with andesitic basalts and perforated by plug of trachyte. Thickness about 1,074 feet. Pliocene and lower Pleistocene(?).

G. A. Macdonald *in* Jacques Avias and others, 1956, Lexique Strat. Internat., v. 6, Océanie, fasc. 2, p. 187. Appear to be overlapped by Alofau volcanics. Pliocene(?); no fossils; age assignment made on basis of weathering and erosion.

Cover about 1½ square miles at eastern end of island surrounding Olomoana Peak.

Olpe Shale[1]

Pennsylvanian: Eastern Kansas.

Original reference: G. I. Adams, 1903, U.S. Geol. Survey Bull. 211, p. 51–52.

Named for exposures at Olpe, Lyon County.

†Omadi Sandstone (in Dakota Group)

Cretaceous: Eastern Nebraska.

G. E. Condra and E. C. Reed, 1943, Nebraska Geol. Survey Bull. 14, p. 15 (fig. 7), 18–19. Since the time Dakota group was named it has been separated into three formations, upper one of which is yet called Dakota sandstone, a usage conflicting with the name of the group. Omadi sandstone is herein proposed for so-called Dakota formation to include section between Fuson and Graneros shales. Includes (ascending) Fall River, Skull Creek, and Newcastle members. Thickness about 147 feet.

Type section: In Missouri River bluffs extending through Omadi Township, Dakota County. Term Omadi relates to an abandoned town, Omaha Creek, and the Omaha Indians.

Omega cyclothem (in McLeansboro Group)

Pennsylvanian: Southeastern Illinois.

J. M. Weller, 1942, Illinois Acad. Sci. Trans., v. 35, no. 2, p. 145. In list of cyclothems in the McLeansboro the Omega occurs above upper Newton cyclothem and below Gila cyclothem.

C. L. Cooper, 1946, Illinois Geol. Survey Bull. 70, p. 13. Studies by Ekblaw in south-central Illinois led to tentative recognition of six cyclothems in which Omega is fourth in sequence (ascending)). Occurs below Shelby (new) and above Effingham (new). Subsequent attempts to set up single standard section based on assumption that Omega and Greenup limestones are equivalent resulted in series of 13 cyclothems, of which the Omega or Greenup are tenth in sequence (ascending), occurring below the Gila and above the Newton. If the Greenup and Omega are not equivalent, the section includes 14 cyclothems with Omega ninth in sequence, below Shelby and above Effingham. If this sequence is correct, or nearly so, it is probably incomplete, and other cyclothems may occur both above and below the Omega.

H. R. Wanless and Raymond Siever, 1956, Illinois Geol. Survey Circ. 217, p. 12. Type locality stated.

Type locality: List Fork and Bee Branch, secs. 18, 19, and 30, T. 3 N., R. 4 E., Marion County.

Omega Limestone Member (of Mattoon Formation)

Omega Limestone (in McLeansboro Formation[1] or Group)

Pennsylvanian: Southeastern Illinois.

Original reference: J. E. Lamar and H. B. Willman, 1934, Illinois Geol. Survey Bull. 61, p. 135.

H. R. Wanless and Raymond Siever, 1956, Illinois Geol. Survey Circ. 217, p. 12, pl. 1 (column 6). Shown on correlation chart as limestone in McLeansboro group. Occurs below Shumway limestone; separated from Millersville limestone by Trowbridge and Shelbyville coals. Type locality stated.

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 40, 51 (table 1), 81–82, pl. 1. Rank reduced to member status in Mattoon formation (new). Occurs above Bonpas limestone member (new) and below Shumway limestone member. Thickness about 10½ feet at type exposure. Presentation of new rock-stratigraphic classification of Pennsylvanian in Illinois.

Type locality: NW¼NW¼NE¼ sec. 30, T. 3 N., R. 4 W., Salem quadrangle, Marion County.

Omen Glauconitic Sandstone Member (of Queen City Formation)

Omen Member (of Mount Selman Formation)[1]

Eocene, middle: Northwestern Louisiana and eastern Texas.

Original reference: E. A. Wendlandt and G. M. Knebel, 1929, Am. Assoc. Petroleum Geologists Bull., v. 13, no. 10, p. 1355–1356.

H. B. Stenzel, 1953, Texas Univ. Bur. Econ. Geology Pub. 5305, p. 10 (fig. 3), 95–99, 110, 113, pl. 1. Described in Henrys Chapel quadrangle as glauconitic sandstone member of Queen City formation. Thickness 22 feet. Underlies an unnamed sand member; overlies Arp member.

C. R. Smith, 1958, Am. Assoc. Petroleum Geologists Bull., v. 42, no. 10, p. 2520. Geographically extended into Caddo Parish, La., where it is about 22 feet thick. Overlies Arp member; underlies Mytis sand member (new).

Well exposed near Omen and Arp in eastern Smith County, Tex.

Onaga Limestone[1]

Pennsylvanian: Northeastern Kansas.

Original reference: F. F. Crevecoeur, 1903, Kansas Acad. Sci. Trans., v. 18, p. 124, 125.

Occurs in vicinity of Onaga, Pottawatomie County.

Onaga Shale (in Admire Group)

Permian: Northeastern Kansas.

R. C. Moore and M. R. Mudge, 1956, Am. Assoc. Petroleum Geologists Bull., v. 40, no. 9, p. 2273, 2274 (fig. 1). Defined to include strata between Falls City limestone above and Wood Siding formation below. Thickness ranges from about 12 to 140 feet. Comprises (ascending) Towle shale, Aspinwall limestone, and Hawxby shale members.

Type section: In east-west roadcut and ditch in SW¼SW¼ sec. 2, T. 8 S., R. 10 E., Pottawatomie County. Name derived from town of Onaga in northern part of county.

Onalaska Clay[1]

Onalaska Member (of Catahoula Formation)

Miocene: Eastern Texas.

Original reference: E. T. Dumble, 1915, Geol, Soc. America Bull., v. 26, p. 466.

F. B. Plummer, 1933, Texas Univ. Bull. 3232, p. 530 (chart), 715, 717 (fig. 48). Catahoula in east Texas divided into Onalaska above and Chita member (new) below. Dumble gave name Onalaska to strata above his basal sandstone member (now called Chita) and below base of Fleming (now called Lagarto and Oakville). Beds consist of tuffaceous shales, sandy clays, and crossbedded lenticular sandstones in places cemented opal. Type locality stated. Chart, p. 30, shows Onalaska member; figure 48 shows Onalaska tuff.

Type locality: Exposures in Rocky Creek, east of Onalaska, Polk County.

O'Nan Coal Member (of Spoon Formation)

Pennsylvanian: Northern Kentucky and southeastern Illinois.

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 32, 45 (table 1), pl. 1. Proposed to replace Curlew coal in order to retain name Curlew for underlying limestone; stratigraphically above New Burnside coal member (new) and below Granger sandstone member (new). Presentation of new rock-stratigraphic classification of Pennsylvanian of Illinois. Cyclical classification is retained but is entirely independent of rock-stratigraphic classification.

Type locality: At Indian Hill, near Curlew, Union County, Ky. Name derived from Dennis O'Nan Ditch, which flows across north tip of Indian Hill, DeKoven quadrangle.

Onate Formation

Middle Devonian: Central southern New Mexico.

F. V. Stevenson, 1945, Jour. Geology, v. 53, no. 4, p. 222–227. Variable and intergradational series of shale, siltstone, fine sandstone, and limestone. Lateral transitional changes, such as gradations from shale to siltstone to arenaceous limestone in a distance of a few hundred feet. Gray brown. Flagstone bedding accompanied by fucoids(?), and worm trails are prevalent characteristics of unit. Greatest thickness of 86 feet 4 inches at type locality; thins to north and absent north of Rhodes Pass (Canyon). Averages 35 feet in Sacramento Mountains. Has relatively less shale and more massive beds than overlying Sly Gap formation. Disconformably overlies Fusselman limestone in Sacramento Mountains and Fusselman and Montoya in San Andres Mountains.

V. C. Kelley and Caswell Silver, 1952, New Mexico Univ. Pubs. in Geology 4, p. 77–78. Units such as Onate and Sly Gap not distinguishable lithologically, and hence are not mappable in New Mexico. These are no more than faunal zones at best, and prior and well established term Percha formation should be retained and applied widely to this lithologically and topographically distinct unit in New Mexico.

F. E. Kottlowski and others, 1956, New Mexico Bur. Mines Mineral Resources Mem. 1, p. 28–29. Upper 45 feet of type section appear more closely related to, and should be placed in Sly Gap formation.

Type section: On north slope of San Andres Canyon, near an abandoned lead mine, in sec. 18, T. 18 S., R. 4 E., San Andres Mountains, Dona Ana County. Named from Onate Mountain, a ridge north of San Andres Peak. Limited in outcrop to Sacramento Mountains and southern and central parts of San Andres Mountains.

Onawa Granite

Age not stated: Maine.

R. S. Houston, 1956, Maine Geol. Survey Bull. [7], p. 12, 105. Composes Onawa pluton. Similar to felsic intrusion near town of Ludlow which is described as grading from coarsely granular biotite microcline granite near center of intrusion to finer grained more mafic phases along border.

Occurs in southern Piscataquis County.

Oneco Amygdaloid[1] (in Central Mine Group)

Precambrian (Keweenawan): Northern Michigan.

Original reference: W. H. Weed, 1925, The Mines Handb., p. 1061.

Named for occurrence in Oneco mine, Houghton County.

Oneco Flow[1]

Precambrian (Keweenawan): Northern Michigan.

Original reference: B. S. Butler and W. S. Burbank, 1929, U.S. Geol. Survey Prof. Paper 144 (chart compiled by M. G. Wilmarth).

Probably named for occurrence in Oneco mine, Houghton County.

Onego Limestone Member (of Salona Limestone)

Middle Ordovician (Trentonian): Western Virginia and eastern West Virginia.

Marshall Kay, 1956, Geol. Soc. America Bull., v. 67, no. 1, p. 68, 69, 70, 71, 73, 88 (fig. 6), 89, 103. Occurs in lower part of formation. Includes argillaceous calcilutite and argillaceous calcisiltite, shaly calcitite, metabentonite. Thickness 32 to 70 feet. Overlies Nealmont formation. Believed to correspond approximately to lowermost Salona of Pennsylvania, though it probably extends a little lower, to Oranda of Shenandoah Valley, and to all but lowest part of Eggleston in New River region. Has been called Oranda by Kay (1948, Am. Assoc. Petroleum Geologists Bull., v. 32, no. 8).

Type section: In hillside north of Blue Grass, Highland County, Va. Named from Onego, Pendleton County, W. Va., a few miles northwest of type section.

One Horse Gypsum[1]

Permian: Northwestern Oklahoma.

Original reference: F. W. Cragin, 1897, Am. Geologist, v. 19, p. 363.

Exposed in brow of bluffs on south side of Canadian River in D County. Named for One Horse Ford of Canadian River, Blaine or Dewey County.

†Oneida Conglomerate[1]

Precambrian (Keweenawan): Northern Michigan.

Original reference: S. H. Broughton, 1863, Remarks on the mining interest and details of the geology of Ontonagon County, pamph. of 24 pages, map: Philadelphia, 1863, p. 21, map.

Ontonagon County.

Oneida Conglomerate[1]

Oneida Conglomerate (in Clinton Group)

Silurian: New York.

Original reference: L. Vanuxem, 1840, New York Geol. Survey 4th Rept., p. 374.

C. K. Swartz and others, 1942, Geol. Soc. America Bull., v. 53, no. 4 chart 3. Shown on correlation chart as basal formation in Clinton group. Occurs above Grimsby sandstone and below Sauquoit beds. Albion and Niagaran series.

Named for exposures in Oneida County.

O'Neill Formation

Upper Triassic: North-central Nevada.

R. R. Compton 1960, Geol. Soc. America Bull., v. 71, no. 9, p. 1387, pl. 1. About 2,000 feet of interbedded dark quartzites and phyllites. Characteristic rock is black or dark-gray brown-weathering micaceous quartzite that forms bed 1 to 6 feet thick: this quartzite is less abundant than the phyllites and thin quartzites, but it crops out much more prominently. Overlies Winnemucca formation, contact drawn at top of highest calcareous slate or phyllite in dominantly calcareous and thin-bedded sequence that characterizes Winnemucca. Underlies Singas formation (new).

Type area: Ridge between Wash O'Neill Creek and Provo Canyon, Santa Rosa Range, Winnemucca region.

Oneonta Sandstone[1]

Upper Devonian: Eastern and central New York.

Original reference: L. Vanuxem, 1840, New York Geol. Survey 4th Rept., p. 381.

Winifred Goldring, 1943, New York State Mus. Bull. 332, p. 273. Continental red beds of Catskill front and northern Helderberg area were long regarded as Oneonta beds of Ithaca age. It is now known that in Catskill front the Ithaca is to be looked for in "Catskill" beds. This report [Coxsackie quadrangle] uses term Kiskatom beds.

Named for exposures on upper part of hill at Oneonta, Otsego County.

Oneota Dolomite (in Prairie du Chien Group)[1]

Oneota Dolomite Member (of Prairie du Chien Formation)

Lower Ordovician: Northwestern Iowa, northwestern Illinois, southern Minnesota, and southwestern Wisconsin.

Original reference: W. J. McGee, 1891, U.S. Geol. Survey 11th Ann. Rept., pt. 1, p. 331, 332.

C. R. Stauffer and G. A. Thiel, 1941, Minnesota Geol. Survey Bull. 29, p. 55–59. In southeastern Minnesota, Oneota dolomite underlies Root Valley sandstone (new) and overlies Jordan sandstone. In some areas, separated from underlying Jordan by Kasota sandstone which in turn is overlain by thin unit referred to as Blue Earth siltstone. Thicknesses: about 45 feet at Mankato, 70 feet at Minneapolis, 150 feet at Dresbach, 197 feet at Lewiston. Beekmantownian.

H. B. Willman and J. S. Templeton, 1951, Illinois Acad. Sci. Trans., v. 44, p. 110 (fig. 1), 111 (fig. 2), 117–119. Most of formation in northern Illinois consists of light- to blue-gray uniformly coarsely crystalline dense cherty dolomite in massive beds as much as 15 feet thick. Total thickness 116 to 180 feet. Overlies Gunter formation; underlies New Richmond formation; contacts appear conformable. Lower Ordovician.

G. O. Raasch, 1951, Illinois Acad. Sci. Trans., v. 44, p. 150. In central and southern Wisconsin overlies Sunset Point formation (new) which name is proposed to replace term Madison.

G. O. Raasch, 1952, Illinois Acad. Sci. Trans., v. 45, p. 85–95. Formation, in Stoddard quadrangle, Wisconsin, subdivided into (ascending) Hickory Ridge, Mound Ridge, Genoa, and Stoddard members (all new). Thickness about 180 feet. Unconformably overlies Cambrian Sunset Point formation; underlies Lower Ordovician Shakopee (or Willow River) dolomite, from which it is separated by limited thickness of sandstone strata (New Richmond sandstone). In Prairie du Chien group.

R. L. Heller, 1956, Geol. Soc. America Guidebook for Field Trips Minneapolis Mtg., Field Trip 2, p. 29–36. Rank reduced to member status in the Prairie du Chien which is herein redefined as formation. Lowermost member of formation; underlies New Richmond sandstone member; overlies Jordan sandstone. Consists predominantly of fine- to medium-grained light-brownish-gray to buff compact to vuggy thin- to thick-bedded dolomite. Lower part of member (0 to 15 feet) commonly arenaceous, with lower few feet grading downward into dolomitic sandstone. Thickness probably less than 70 feet in northern part of outcrop area; basinward, as in southern Minnesota and northern Iowa, thickness is 170 feet. In Stillwater, Minn., area, temporary nondeposition near beginning of Ordovician time could account for relatively thin Oneota section and sharp lithologic break observed at Cambrian-Ordovician boundary. Preliminary studies in Minnesota River valley suggest that Kasota sandstone and Blue Earth siltstone should not be considered as formations but rather as a sandstone and siltstone facies of the Oneota.

Named for exposures on Oneota River, Allamakee County, Iowa. Oneota is former name for Upper Iowa River.

Onesquethaw Stage or Group

Lower or Middle Devonian (Ulsterian): North America.

G. A. Cooper and others, 1942, Geol. Soc. America Bull., v. 53, no. 12, pt. 1, p. 1733, chart 4. Devonian is subdivided into 10 stages of which Onesquethaw is third in sequence (ascending). Succeeds the Deerpark and is followed by the Cazenovia. [For complete sequence see Helderberg stage.] Includes sediments of the Esopus, Schoharie, and Onondaga and their correlates elsewhere on the continent.

Charles Schuchert, [1943], Stratigraphy of the eastern and central United States: New York, John Wiley and Sons, Inc., p. 85. Should be abandoned. Covers identical formations of Ulsterian stage.

G. M. Ehlers *in* K. K. Landes, G. M. Ehlers, and G. M. Stanley, 1945, Michigan Dept. Conserv., Geol. Survey Div. Pub. 44, Geol. Ser. 37, p. 35 (table 1). Used as group in Mackinac Straits region, Michigan, where it includes Bois Blanc formation (new). Overlies Deerpark group; underlies Detroit River group. Ulsterian.

J. M. Dennison, 1960, Dissert. Abs., v. 21, no. 3, p. 593. Discussion of stratigraphy of Devonian Onesquethaw stage in West Virginia and Maryland. Top of stage in type region in New York not precisely defined. Top of Tioga bentonite proposed as upper boundary. This permits direct physical correlation of New York and central Appalachian sections. Tioga bentonite is present in subsurface between the two regions and crops out in New York in addition to 45 known localities in West Virginia, Virginia, and Maryland. Remainder and majority of stage consists of three formations or facies: Needmore shale, Huntersville chert, and Onondaga limestone.

Type section (stage): In Helderberg Mountains west of Clarksville and facing valley of Onesquethaw Creek in Albany County, N.Y.

Onion Creek Marl[1]

Pleistocene: Central Texas.

Original reference: R. T. Hill and T. W. Vaughan, 1898, U.S. Geol. Survey 18th Ann. Rept., pt. 2, p. 252–254, 277.

Named for Onion Creek, Hays County.

Ono Formation

Lower Cretaceous: Northern California.

M. A. Murphy, 1956, (abs.) Jour. Sed. Petrology, v. 26, no. 2, p. 209; 1956, Am. Assoc. Petroleum Geologists Bull., v. 40, no. 9, p. 2101 (fig. 2), 2105–2112. Approximately 4,200 feet of mudstone, siltstone, conglomerate, graywacke, and limestone. Gradationally overlies Rector formation (new); underlies unnamed conglomerate units. Includes Huling and Roaring River tongues (both new). Horsetown stage.

M. A. Murphy and P. U. Rodda, 1960, Jour. Paleontology, v. 34, no. 5, p. 835. Conformably underlies Bald Hills formation (new).

Type section: Along North Fork of Cottonwood Creek from Ono to confluence of North Fork with Huling Creek. Named for village of Ono. Shasta County.

Onondaga Limestone[1]

Onondaga Formation (in Hamilton Group)

Onondaga Group

Middle Devonian: New York, western Maryland, Pennsylvania, Virginia, and West Virginia, and Ontario, Canada.

Original references: J. Hall, 1839, New York Geol. Survey 3d Rept., p. 293–309; L. Vanuxem, 1840, New York Geol. Survey 4th Rept., p. 378.

Bradford Willard, 1936, Jour. Geology, v. 44, no. 5, p. 578–603. Because of close faunal and stratigraphic affiliation with overlying beds, Onondaga formation in Pennsylvania is assigned to position of lowest formation of Hamilton group. In central Pennsylvania, comprises lower shale member (called Selinsgrove shale by White, 1883) and noncherty limestone (called Selinsgrove lower limestone by White, 1883). In eastern Pennsylvania, comprises lower member, Esopus shale (called Post-meridian by Rogers, 1858, Geology of Pennsylvania; and Caudi-galli by White). Middle Devonian.

Bradford Willard, 1939, Pennsylvania Geol. Survey, 4th ser., Bull. G–19, p. 141–160. Group as defined in Pennsylvania includes all stratigraphic units between top of preceding Oriskany group and succeeding Marcellus formation of Hamilton group. In central Pennsylvania, comprises (ascending) Needmore shale (new) and Selinsgrove limestone; in eastern Pennsylvania, comprises (ascending) Esopus shale and Buttermilk Falls limestone.

B. N. Cooper, 1939, Virginia Geol. Survey Bull. 55, p. 41–42, pl. 3. In Draper Mountain area, Onondaga formation (chert) is 10 to 70 feet thick, overlies Becraft(?) sandstone and underlies Millboro shale (new).

Charles Butts, 1940, Virginia Geol. Survey Bull. 52, pt. 1, p. 294–303. At different localities in Virginia, the Onondaga is underlain by one or another of following formations: Oriskany sandstone, Becraft limestone, Cayuga beds of Wills Creek age, Keefer sandstone, undivided Clinton, Clinch sandstone, Juniata formation, and, as along low ridge between Walker Mountain and Marion, Smyth County, by *Orthorhynchula* zone of Martinsburg shale. Average thickness 50 to 100 feet. Underlies Romney shale.

G. A. Cooper and others, 1942, Geol. Soc. America Bull., v. 53, no. 12, pt. 1, p. 1733, 1744–1745, chart 4. Onondaga, Schoharie, and Esopus and their equivalents are included in Onesquethaw stage (new). In western New York, two faunas recognized in Onondaga. Lower one has many Schoharie and Camden elements and is characterized by *Amphigenia* and many corals and is best developed on southern peninsula of Ontario. Schoharie elements include *Centronella, Strophonella ampla, Cyrtinaella biplicata, Calymene platys*, and *Tetraspis*. Camden elements are *Eodevonaria* and *Anoplia*. Overlying *Amphigenia* fauna is one characterized by *Paraspirifer acuminatus* occurring at top of Onondaga in New York. In central New York, a third division of Onondaga, the Seneca limestone which underlies the Marcellus contains an abundance of *Chonetes lineatus, Dalmanites selenurus*, and large coiled cephalopods. Lower or Middle Devonian.

H. P. Woodward, 1943, West Virginia Geol. Survey, v. 15, p. 255–308. Onondaga group of this report includes all formations in West Virginia between top of Ridgeley sandstone and base of Marcellus shale. Has same constitution as Onondaga group of Pennsylvania as defined by Willard (1939) but has no relation to "Onondaga group" of New York or "Onondaga salt group" of early New York State geologists. Includes Huntersville chert and Needmore shale.

Winifred Goldring, 1943, New York State Mus. Bull. 332, p. 226–235, geol. map. Limestone shown on map legend (Coxsackie quadrangle) above Schoharie grit and limestone and below Bakoven shale. Contact with Bakoven not noted in field.

R. E. Stevenson, 1949, New York State Sci. Service Rept. Inv. 3, p. 3 (table 1), 6–7. Onondaga group, central New York, comprises (ascending) Esopus, Carlisle Center, Schoharie, and Onondaga formations. Onondaga formation includes (ascending) Springfield Center member (new), Babcock Hill member (new), and unnamed upper member.

W. A. Oliver, Jr., 1954, Geol. Soc. America Bull., v. 65, no. 7, p. 621–652. Onondaga limestone extends from Ontario, Canada, south to West Virginia, and its "equivalents" extend west to Mississippi. Some age variation over this large area is probable. In New York, formation is generally considered lower Middle Devonian (Onesquethaw) and is overlain by Marcellus black shale of Hamilton group. Conformably underlain by Schoharie grit, Esopus shale, and Oriskany sandstone in eastern New York; rests unconformably on Helderberg and Upper Silurian limestones in central and western New York. In central New York, subdivided into (ascending) Edgecliff, Nedrow, Moorehouse, and Seneca members (all new). All members are present in western New York section, but only Edgecliff member extends into eastern New York section. No complete exposures known from which exact thickness can be determined. Estimates of thickness range from 50 to 200 feet. Thickness about 70 feet near Syracuse. Hall did not designate type section. Chadwick (1944) stated that type locality was Split Rock but gave no reason for the designation; since only lowest member is fully exposed there, it is not adequate, and type locality should remain in "Onondaga County" where nearly whole formation is exposed at various places south of Syracuse.

W. A. Oliver, Jr., 1956, Geol. Soc. America Bull., v. 67, no. 11, p. 1441–1474. Discussion of Onondaga in eastern New York. Four members recognized by Oliver (1954) in central New York. In Onondaga County, type area, each member is divisible into two or more zones, which are more or less continuous as far east as Sangerfield quadrangle. Eastward zones gradually become indistinct, and horizontal facies changes are of greater interest. East of Cherry Valley, Seneca member grades laterally into Union Springs black shale which overlies Onondaga. Moorehouse and Edgecliff members recognizable, although greatly changed, as far southeast as Port Jervis. Lower Edgecliff grades into Schoharie formation in southeastern New York. Buttermilk Falls limestone of eastern Pennsylvania equated in time with Moorehouse member of southeastern New York and Nedrow and Moorehouse members of central New York.

F. M. Swain, 1958, Am. Assoc. Petroleum Geologists Bull., v. 42, no. 12, p. 2858–2891. Group, in Mount Union area, Pennsylvania, includes Newton Hamilton formation (new). Disconformably overlies Ridgeley sandstone of Oriskany group and underlies Marcellus black shale of Hamilton group.

H. H. Arndt and others, 1959, Geol. Soc. America Guidebook Pittsburgh Mtg., p. 4, 26. Formation comprises Needmore shale below and Selinsgrove limestone above members. At East Waterford section, Onondaga is about 70 feet thick. Overlies Ridgeley member of Oriskany and underlies Shamokin member of Marcellus formation.

Named for exposures in Onondaga County, N.Y.

†Onondaga Limestone Series[1]

Devonian: New York.

Original reference: T. A. Conrad, 1837, New York Geol. Survey 1st Rept., p. 178–181.

Quarried near Auburn and on Onondaga Hill, near Syracuse, Onondaga County.

†Onondaga Saliferous Group[1]

Silurian and Lower Devonian: New York.

Original reference: J. Hall, 1839, New York Geol. Survey 3d Rept., p. 290–293, 304.

†Onondaga Salt Group[1]

Silurian (Cayugan): New York.

Original reference: L. Vanuxem, 1840, New York Geol. Survey 4th Rept., p. 375–376, 378.

G. M. Ehlers *in* K. K. Landes, G. M. Ehlers, and G. M. Stanley, 1945, Michigan Geol. Survey Div. Pub. 44, Geol. Ser., 44, p. 24, 27. Hall (1851), Geological Reports *in* pt. V. of Foster and Whitney report on Geology of Lake Superior Land District, U.S. Senate, Spec. Ses. March, 1851, Ex. Doc. no. 4) assigned marls, gypsum and vesicular, and gashed limestones of Mackinac Island, the St. Martin Islands, and mainland north of St. Ignace to Onondaga salt group, which is typically exposed in New York. Most of strata of Onondaga salt group are now included in what is known as Salina group. The marls, chiefly green and red shales, and gypsum noted by Hall are included in Pointe aux Chenes formation (new). Rominger (1873, Geology of the Upper Peninsula: Michigan Geol. Survey, v. 1, pt. 3) used term Onondaga salt group for dolomite and green and red variegated shale with some gypsum overlying Middle Silurian "Niagara group" (Niagaran series). In this usage, he followed terminology of Hall. Strata of Rominger's Onondaga salt group are assigned to Pointe aux Chenes formation.

Ontarian Series[1]

Silurian: Ontario, Canada, and New York.

Original reference: J. D. Dana, 1890, Geol. Soc. America Bull., 1, p. 40–41.

D. W. Fisher, 1954, Am. Assoc. Petroleum Geologists Bull., v. 38, no. 9, p. 1979–1996. Standardization of Silurian stratigraphic terminology (exclusive of Cayugan) in southern Ontario and western New York, including type section in Niagara Gorge, discloses that strata are suited to tripartite division, both from faunal and physical standpoint. Silurian system is herein divided into Medina(n), Clinton(ian), and Niagara(n) groups, the three comprising the Ontarian series.

D. W. Fisher, 1959, New York State Mus. Sci. Service Geol. Survey Map and Chart Ser., No. 1. New York Silurian, the standard reference section for United States, is divided into two series, older Niagaran and younger Cayugan. Term "Ontario(an)" used as stage name for lower and middle parts of Clinton group.

Ontarian Stage

Middle Silurian (Niagaran): North America.

D. W. Fisher, 1959, New York State Mus. Sci. Service Geol. Survey Map and Chart Ser., no. 1. Niagaran series divided into four stages (ascending) Lewiston(ian), Ontario(an), Tonawanda(n), and Lockport(ian). Ontario stage includes lower and middle parts of Clinton group. Ontarian rocks thicken eastward from about 18 feet in Niagara Gorge, 60 feet in Genesee Gorge, 90 feet along Salmon Creek (Palmyra quadrangle) to over 135 feet near Oneida Lake.

Type section: In Genesee River Gorge at Rochester, N.Y.

†Ontario Group[1]

Silurian: New York.

Original reference: E. Emmons, 1842, Geology New York, pt. 2, div. 4, geology 2d dist., p. 100–101, 429.

Ontario Series[1]

Silurian: New York.

Original reference: G. H. Ashley, 1923, Eng. Mining Jour.-Press, v. 115, p. 1106–1108.

Ontelaunee Formation (in Beekmantown Group)

Lower Ordovician: Southeastern Pennsylvania.

J. P. Hobson, Jr., 1957, Am. Assoc. Petroleum Geologists Bull., v. 41, no. 12, p. 2716 (fig. 3), 2720–2721. Proposed for the dolomite and interbedded limestone and chert lying above Epler formation (new) and underlying either Annville limestone, Jacksonburg argillaceous limestone, or Martinsburg shale. Formation is 675 feet thick near type locality and is divided into three members: upper interbedded limestone and dolomite member, middle dolomite member, and lower interbedded chert and dolomite member. Thins to 150 to 250 feet near Reading. Contact with Epler is placed at top of first limestone beneath lowest chert bed of Ontelaunee; contact zone gradational; line demarcating contact in Berks County is placed 100 feet below lowest chert bed of Ontelaunee.

Carlyle Gray, A. R. Geyer, and D. B. McLaughlin, 1958, Geologic map of Richland quadrangle, Pennsylvania (1:24,000): Pennsylvania Geol. Survey, 4th ser., Atlas 167–D. Described in Lebanon County where it is uppermost formation of Beekmantown group and underlies Annville limestone (probably unconformable). Minimum thickness 500 feet.

Type section: Along east bank of Schuylkill River 1 mile southeast of Leesport, Berks County.

Onteora Formation

Onteora Red Beds[1]

Upper Devonian: Southeastern New York.

Original reference: G. H. Chadwick, 1933, Am. Jour. Sci., 5th, v. 26, p. 480 (chart), 483, 484.

G. H. Chadwick, 1940, New York Geol. Soc. Assoc. 16th Ann. Mtg. Field Guide Leaflets, p. 2. List of formations of Catskill region shows Onteora redbeds above Twilight Park conglomerate and below Stony Clove sandstones (new). Thickness 1,060 feet.

G. H. Chadwick, 1944, New York State Mus. Bull. 336, p. 125–129, 135, 136, geol. map [1946]. Redbeds described in Catskill and Kaaterskill quadrangles. Thickness about 1,150 feet. Underlies Stony Clove sandstone (also referred to as Stony Clove member of Katsberg); overlies Kaaterskill sandstones. Onteora redbeds differ little from Kiskatom redbeds except for incoming of substantial conglomerates especially at base (these conglomerates are Twilight Park conglomerate of Prosser, 1899).

Theodore Arnow, 1949, New York State Water Power and Control Comm. Bull. GW–20, p. 8 (table 1), 15. Formation present in Albany County where it overlies Kiskatom formation and underlies glacial deposits.

J. M. Berdan, 1950, New York State Water Power and Control Comm. Bull. GW-22, p. 10 (table 2), 20. Formation is youngest consolidated rock exposed in Schoharie County. Composed of red and green shales and gray sandstones. Probably over 2,000 feet thick in eastern part of county; probably not over 800 feet in western part of county. Interfingers with Gilboa formation; underlies glacial deposits.

Type section: Vicinity of Haines Falls, Greene County; up sides of Kaaterskill "High Peak" and "Round Top" Mountains. Up the opposite slope is Onteora Park.

Oologah Limestone[1] (in Marmaton Group)

Pennsylvanian (Des Moines Series): Northeastern Oklahoma.

Original reference: N. F. Drake, 1897, Am. Philos. Soc. Proc., v. 36, p. 377.

M. C. Oakes, 1952, Oklahoma Geol. Survey Bull. 69, p. 28–32, pl. 1. Term Oologah has heretofore been applied to thick limestone formation which extends from vicinity of Broken Arrow, Tulsa County, to locality about 4 miles northeast of Oologah where it bifurcates. Term is here extended to Kansas-Oklahoma line to include (ascending) Pawnee limestone, Bandera shale, and Altamont limestone members. South of Broken Arrow, Oologah equivalents were included in beds called Broken Arrow formation. Thickness about 40 feet north of Broken Arrow, thicker northward to maximum of about 100 feet in latitude of Catoosa, Rogers County, and progressively thinner farther north; about 60 feet thick in type locality near Oologah; at Kansas-Oklahoma line its three northern members have combined thickness of about 165 feet. Conformably overlies Labette formation; conformably underlies Nowata formation. Marmaton group.

R. D. Alexander, 1954, Oklahoma Geol. Survey Circ. 31, p. 14–15, 16 (fig. 2). Name Oologah here used for sequence of beds between base of cap rock of Lexington coal and top of Altamont limestone in Nowata County and for equivalent sequence of limestones not yet subdivided in vicinity of Tulsa. In Nowata County, the Oologah consists of Pawnee limestone at base, the Pawnee consisting in upward sequence of cap rock of Lexington coal, Anna shale, Myrick Station limestone, and Coal City limestone. Middle part of the Oologah is Bandera shale which thins southward from more than 100 feet at Kansas line to 2 feet near Tulsa. Upper Member of Oologah is Altamont limestone, which in turn has been subdivided into Amoret limestone below and Worland limestone above, with shale interval between. Overlies Labette shale; underlies Nowata shale.

Named for Oologah, Rogers County.

Ooltewah Formation

Middle Ordovician (Mohawkian): Southeastern Tennessee.

G. A. Cooper, 1956, Smithsonian Misc. Colln., v. 127, pt. 1, p. 80–81, chart 1 (facing p. 130). Ribbon-banded limestone with numerous intercalations of red Moccasin-type mudstone and fewer interbeds of buff shaly limestone. Lower half contains thin shaly layers. Thickness 250 to 600 feet. Underlies Bays formation; overlies Long Savannah formation (new). Name attributed to B. N. Cooper and G. A. Cooper.

Type section: Along Mahan Gap road, and extends for a quarter mile or more on either side of State Highway 60, Snow Hill (TVA 112-NE) quadrangle, Hamilton County.

†Oostanaula Shales[1] or Series[1]

Cambrian: Northwestern Georgia.

Original reference: J. W. Spencer, 1893, Georgia Geol. Survey, Paleozoic group, p. 34, 37, 77, 87, 99, 108, 112, 115, 119, 123, 130.

Named for exposures on Oostanaula River.

Opdyke Coal Member (of Mattoon Formation)

Pennsylvanian: Central and southeastern Illinois.

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 40, 51 (table 1), pl. 1. Assigned member status in Mattoon formation (new). Occurs above Shelbyville coal member and below Trowbridge coal member. Coal named by Cady and others (1952, Illinois Geol. Survey Bull. 78). Presentation of new rock-stratigraphic classification of Pennsylvanian strata in Illinois.

Type locality: Coal in vicinity of village of Belle Rive and Opdyke, T. 3 S., R. 4 E., Jefferson County.

Opeche Formation[1] or Shale

Opeche Shale Member (of Goose Egg Formation)

Opeche Shale (in Phosphoria Group)

Lower Permian: Western South Dakota, southeastern Montana, northwestern Nebraska, and Wyoming.

Original reference: N. H. Darton, 1901, U.S. Geol. Survey 21st Ann. Rept., pt. 4, p. 513.

G. E. Condra, E. C. Reed, and O. J. Scherer, 1940, Nebraska Geol. Survey Bull. 13, p. 2 (fig. 2), 6, 10, 12, 14. Opeche shale included in Phosphoria group. Basal formation in Phosphoria group, in Laramie Range. Thickness about 70 feet. Underlies Minnekahta limestone; overlies Owl Canyon formation of Cassa group (both new).

J. D. Love, N. M. Denson, and Theodore Botinelly, 1949, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 92. Opeche shale in Glendo area, Wyoming, consists of about 25 to 75 feet of bright-red silty shale with lesser amounts of shaly yellow to red sandstone near base; thin purple limestone partings present in upper part; at top is persistent purple limy shale about 10 feet thick; locally lens of white gypsum about 5 feet thick. Underlies Minnekahta limestone; overlies Hartville formation. No fossils.

Billings Geological Society, 1951, Billings Geol. Soc. Guidebook 2d Ann. Field Conf., p. 8 (chart). Correlation chart shows Opeche present in southeastern Montana.

Typically developed on Battle Creek, Custer County, S. Dak. Opeche is Indian name for Battle Creek.

Open Door Limestone (in Gallatin Group)

Upper Cambrian: Southwestern Wyoming.

A. B. Shaw and C. R. DeLand, 1955, Wyoming Geol. Assoc. Guidebook 10th Ann. Field Conf., p. 38, 39 (fig. 1), 40 (fig. 2), 41. Proposed for upper Gallatin limestone and flat-pebble conglomerates, without regard to their age. Name is used here in preference to any of many names proposed for Upper Cambrian of Wyoming because there is need for name for lithic unit that is upper Gallatin limestone. Names previously applied have been based on a knowledge of age of unit described (for example, Grove Creek and Snowy Range formations, Saga pebble conglomerates, and others). Reliable faunal evidence is not invariably available, and in its absence these names are not applicable. Therefore, name Open Door is meant to designate upper part of Gallatin group, regardless of its age, based solely on its recognition as lithic unit. Includes Dry Creek shale member at base. Overlies Du Noir limestone. Surface of erosion evident between Open Door and Lander sandstone member of Big Horn dolomite.

Type section: On east wall of Granite Canyon in Gros Ventre Mountains, just below topographic feature known as the Open Door, Teton County.

Opex Formation

Opex Dolomite[1]

Upper Cambrian: Central northern Utah.

Original reference: G. F. Loughlin, 1919, U.S. Geol. Survey Prof. Paper 107.

H. T. Morris, 1957, Utah Geol. Soc. Guidebook 12, p. 5 (fig. 2), 8–9. Formation described in East Tintic Mountains. Stratigraphically restricted to exclude lower dolomite member as originally defined by Loughlin; this lower unit now included in underlying Cole Canyon dolomite. Consists of alternating thin and thick beds of shaly oolitic limestone flat-pebble conglomerate, medium- and coarse-grained brown-weathering sandstone, and dusky blue-gray dolomite; one or more thick beds of red and green shale present locally at top of formation. Thickness 150 to 350 feet; about 250 feet near Eureka. Conformably underlies Ajax limestone. Upper Cambrian.

J. K. Rigby, 1958, Utah Geol. Soc. Guidebook 13, p. 7 (table 1), 23–24, 28 (fig. 4), geol. map. Described in Stansbury Mountains, Tooele County, where it is 450 to 500 feet thick; overlies Cole Canyon dolomite and underlies Dunderberg shale. Two members differentiated on geologic map; these correspond roughly to upper and lower Opex as mapped by Loughlin (1919) whose terminology is followed in this report.

C. B. Bentley, 1959, Brigham Young Univ. Research Studies, Geology Ser., v. 5, no. 6, p. 18–19. At Tintic, stratigraphically restricted to exclude uppermost shale and limestone of Lindgren and Loughlin (1919); this shale and limestone designated as Dunderberg.

R. E. Cohenour, 1959, Utah Geol. and Mineralog. Survey Bull. 63, p. 12 (table 1), 53–57, pls. 1, 7. Formation described in Sheeprock Mountains where it is principally limestone and about 938 feet thick. Overlies Cole Canyon dolomite; underlies Ajax formation; fault at top of Cole Canyon has cut out unknown thickness of basal Opex. Crops out in belt about 2,600 feet wide in southern end of East and West Lookout Hills.

J. K. Rigby, 1959, Utah Geol. Soc. Guidebook 14, p. 14 (table 1), 26–27, 29 (fig. 9), pl. 1. In southern Oquirrh Mountains, underlies Standsbury formation and overlies Cole Canyon dolomite. Thickness 175 to 185 feet. Gilluly (1932, U.S. Geol. Survey Prof. Paper 173) mapped these rocks as upper beds of Lynch dolomite.

H. J. Bissell, 1959, Utah Geol. Soc. Guidebook 14, p. 132–135. In Boulter Mountains, consists of interbedded mottled limestones, brown sandstones, and mottled dolomite. A mottled dark-blue-gray to maroon limestone containing large oolites is present within 25 feet of basal beds; cross-bedded dolomite and flat-pebble conglomerates near middle of formation;

upper dark shaly limestone present about 25 feet below top of formation. Overlies Cole Canyon dolomite; underlies Ajax limestone.

Named for Opex mine, one-half mile northwest of Mammoth, Tintic district.

Ophir Formation[1] or Shale

Ophir Group

Lower and Middle Cambrian: Central northern Utah.

Original reference: G. F. Loughlin, 1919, U.S. Geol. Survey Prof. Paper 107, p. 25–27.

J. D. Forrester, 1937, Geol. Soc. America Bull., v. 48, no. 5, p. 638, pls. 2, 3. In Uinta Mountains, conformably underlies Pine Valley quartzite (new).

A. E. Granger and others, 1952, Utah Geol. Soc. Guidebook 8, p. 7. In Wasatch Mountains, east of Salt Lake City, Ophir shale overlies Tintic quartzite and underlies Maxfield limestone. In a three-part unit about 400 feet thick. Cambrian.

N. C. Williams, 1953, Am. Assoc. Petroleum Geologists Bull., v. 37, no. 12, p. 2735–2739. In western Uinta Mountains, Ophir and Pine Valley formations, heretofore assigned to Cambrian and thought to be conformable, are separated by a 20° angle of discordance. Rocks earlier mapped as Ophir(?) formation of Cambrian age lie beneath the unconformity and are assigned to Precambrian and are here named Red Pine shale. Probable that true Ophir shale is represented in western Uinta Mountains by thin bed of shale at top of Tintic quartzite in South Fork basin; this shale is not sufficiently widespread or thick enough to serve as mappable unit.

H. T. Morris, 1957, Utah Geol. Soc. Guidebook 12, p. 4–6, pl. 1. In East Tintic Mountains, formation is 275 to more than 400 feet thick and consists of lower shale member, middle limestone member, and upper shale member. Conformably overlies Tintic quartzite; conformably underlies Teutonic limestone. Middle Cambrian.

G. B. Maxey, 1958, Geol. Soc. America Bull., v. 69, no. 6, p. 664, 669. In discussion of Lower and Middle Cambrian stratigraphy in northern Utah and southeastern Idaho, beds formerly assigned to upper part of Ophir formation and to Maxfield formation are here assigned to Langston formation.

J. K. Rigby, 1958, Utah Geol. Soc. Guidebook 13, p. 11–13. Rank raised to group. In Stansbury Mountains, includes Busby quartzite, Millard limestone, Dome, Burnt Canyon, and Burrows equivalents, and Condor formation. Underlies Teutonic limestone; overlies Pioche shale. Refers to Cohenour (unpub. thesis) for use of group.

R. E. Cohenour, 1959, Utah Geol. and Mineralog. Survey Bull. 63, p. 12 (table 1), 32–35, pl. 1. Proposed that Ophir shale and Ophir formation be restricted to areas in which they have been applied. Ophir group as used in this report [Sheeprock Mountains] comprises following formations or their equivalents: Pioche shale, Busby quartzite, Millard limestone, Burrows limestone, Burnt Canyon limestone, Dome limestone, and Condor formation.

J. K. Rigby, 1959, Utah Geol. Soc. Guidebook 14, p. 13–16. Group as used in this report [southern Oquirrh Mountains] overlies Pioche shale and underlies Teutonic limestone of Hartmann group. Unit not subdivided into formations in this area.

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T. S. Lovering and others, 1960, U.S. Geol. Survey Mineral Inv. Field Studies Map MF-230. Formation mapped in East Tintic district. Consists of lower shale member, 175 feet thick; middle limestone member, 145 to 160 feet thick; upper shale member 70 to 90 feet thick. Overlies Tintic quartzite; underlies Teutonic limestone. Lower and Middle Cambrian.

Named for exposures at Ophir, eastern Tooele County.

Opohonga Limestone[1]

Lower Ordovician: Central Utah.

Original reference: G. F. Loughlin, 1919, U.S. Geol. Survey Prof. Paper 107.

H. T. Morris, 1957, Utah Geol. Soc. Guidebook 12, p. 9–10, 11 (fig. 3), pl. 1. Repetitious sequence of medium- to fine-grained thin-bedded light-blue-gray argillaceous limestone and flat-pebble conglomerate that is streaked with thin layers and veinlets of siliceous clay which weather buff, yellow, and red. Base marked by bed of brown-weathering limy sandstone or sandy limestone; limestone beds immediately above sandstone bed enclose large nodules of white chert. Thickness 400 to more than 1,000 feet. Conformably overlies Ajax limestone; disconformably underlies Upper Ordovician Fish Haven dolomite. Term Fish Haven dolomite is currently applied in East Tintic Mountains to lower third of Bluebell dolomite of Loughlin (1919).

L. F. Hintze, 1959, Intermountain Assoc. Petroleum Geologists Guidebook 10th Ann. Field Conf., p. 46–53. Discussion of regional relationships in north-central Utah and adjacent areas. Believed that one set of names for Ibex basin and another set for northern Utah is sufficient for Lower Ordovician terminology in Utah. Recommended that terms Chokecherry dolomite and Oponhonga limestone in Gold Hill and Tintic mining districts be abandoned and standard nomenclature used; that is, Garden City formation (which may be subdivided) and Pogonip group which comprises six formations.

Named for Opohonga mine, about one-half mile southeast of Mammoth, Tintic district, Juab County.

Oppello Breccia[1]

Middle Cretaceous (?): Central northern Arkansas.

Original references: C. Croneis and M. Billings, 1929, Jour. Geology, v. 37, p. 543, 551; 1930, Arkansas Geol. Survey Bull. 3, p. 155–158.

Crops out on farm of W. J. Sadler, about 1 mile west of Oppello (Oppelo), Conway County.

Oquirrh Formation[1]

Oquirrh Group

Oquirrh Series

Lower Pennsylvanian to Lower Permian: Central northern Utah.

Original reference: J. Gilluly, 1932, U.S. Geol. Survey Prof. Paper 173.

H. J. Bissell, 1936, Iowa Acad. Sci. Proc., v. 43, p. 239–243. Suggested that term Oquirrh be elevated to rank of series to include all beds from lower to upper Pennsylvanian and that lower facies be named Kelly formation and upper facies Hobble formation.

A. A. Baker and J. S. Williams, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 4, p. 623 (fig. 4), 625–626. In Utah County, underlies Kirkman limestone (new).

A. A. Baker, 1947, U.S. Geol. Survey Oil and Gas Inv. Prelim. Chart 30. Described in Wasatch Mountains in vicinity of Provo where it has total thickness of about 26,000 feet. Preliminary study of some of fusulinids has shown presence of forms ranging in age from Morrow(?) in basal limestone, through Atoka, Des Moines, Missouri, and Virgil to middle or upper Wolfcamp and possibly Leonard. Formation may therefore include strata representative of nearly all the Pennsylvanian, and also may include at top some strata of Permian age.

H. J. Bissell, 1952, Am. Assoc. Petroleum Geologists Bull., v. 36, no. 4, p. 581–587. Described in Strawberry Valley quadrangle. Thickness 11,100 feet. Upper 9,800 feet considered Permian (Wolfcampian). Systemic boundary placed on basis of fusulinids. Overlies Weber sandstone; underlies Kirkman limestone.

H. T. Morris, 1957, Utah Geol. Soc. Guidebook 12, p. 23–25. Exposed in northern and southern parts of East Tintic Mountains; neither area includes complete or unfaulted section. Thickness about 15,000 feet. Overlies Manning Canyon shale; underlies Diamond Creek(?) sandstone. Pennsylvanian and Permian.

A. E. Disbrow, 1957, U.S. Geol. Survey Mineral Inv. Field Studies Map MF–131. Mapped in Fivemile Pass quadrangle where the lower 4,440 feet are exposed. Divided into five units, four limestone and one basal coquina limestone. Overlies Manning Canyon shale.

J. K. Rigby, 1958, Utah Geol. Soc. Guidebook 13, p. 49–51, 53 (fig. 7). In Stansbury Mountains, at least 15,000 feet thick. Overlies Manning Canyon formation; underlies North Horn(?) formation.

P. W. Nygreen, 1958, Utah Geol. and Mineralog. Survey Bull. 61, p. 1–67. Near Logan includes West Canyon member (new) in basal part.

H. J. Bissell, 1959, Utah Geol. Soc. Guidebook 14, p. 93–127, pl. 1. In southern part of Oquirrh Mountains and contiguous Fivemile Pass quadrangle, subdivided to include (ascending) Hall Canyon, Meadow Canyon, Cedar Fort, Lewiston Peak, and Pole Canyon members. These are referred to the Pennsylvanian. Thickness of the five members, 6,166 feet. Overlies Manning Canyon shale. Definitive Wolfcamp strata not mapped in area.

D. O. Peterson, 1960, Dissert. Abs., v. 20, no. 7, p. 2757. Suggested that Oquirrh formation be raised to group status and carried into Wells formation area, the Wells being dropped or retained as formation within group.

Named for occurrences in Oquirrh Range.

Oquirrh quartzite[1]

Carboniferous: Utah.

Original reference: C. R. Keyes, 1924, Pan-Am. Geologist, v. 41, p. 37.

Derivation of name not stated.

Orabai sandstone[1]

Upper Cretaceous: Northeastern Arizona.

Original reference: C. R. Keyes, 1922, Pan-Am. Geologist, v. 38, p. 250, 337.

Well exposed at Orabai Mesa, north of Winslow, Apache County.

Oracle Granite

Precambrian: Southeastern Arizona.

N. P. Peterson, 1938, Arizona Bur. Mines Bull. 144, Geol. Ser. 11, p. 8–9. Prevailingly a coarse-grained porphyritic biotite granite with large pink or salmon-colored feldspars 1¼ to 1½ inches across that give rock a pink or gray mottled appearance on fresh surfaces. Composition suggests that rock should be classed as quartz monzonite rather than granite. Surface exposures of light-buff color. Oldest rock exposed in Mammoth area. Unconformably underlies Apache series.

In Mammoth Mining camp area, 3 miles southwest of village of Mammoth. Mapped area almost entirely in W½ sec. 26 and E½ sec. 27, T. 8 S., R. 16 E., on east flank of Black Hills. Also in area of village of Oracle on northern slope of Santa Catalina Mountains, Pinal County.

Ora Loma Formation

See Oro Loma Formation.

Oran Sandstone Lentil (in Graford Formation)[1]

Pennsylvanian: Central northern Texas.

Original reference: F. B. Plummer and R. C. Moore, 1922, Texas Univ. Bull. 2132, p. 96, 97, 99, 100.

Probably named for Oran, Palo Pinto County.

Oranda Formation

Middle Ordovician: Western Virginia, south-central Pennsylvania, and southeastern West Virginia.

B. N. Cooper and G. A. Cooper, 1946, Geol. Soc. America Bull., v. 57, no. 1, p. 86–89. Proposed for the 30-foot zone, characterized by occurrence of *Reuschella "edsoni"* and its associates, which overlies the Edinburg and directly underlies *Sinuites* beds of the Martinsburg. Composed mainly of very argillaceous limestone with metabentonitic clays, shales, and ledge-making siltstones. Unit is important as zone of reference below which the facies changes in Edinburg (new) are observable between Lacey Spring and Winchester. Corresponds to *"Christiania"* [*Bimuria*] bed of Chambersburg limestone of southern Pennsylvania.

Marshall Kay, 1948, Am. Assoc. Petroleum Geologists Bull., v. 32, no. 8, p. 1402 (chart). Chart shows Oranda present in southeastern West Virginia, Cumberland Valley, Pa., and Shenandoah Valley, Va.

L. C. Craig, 1949, Geol. Soc. America Bull., v. 60, no. 4, p. 738–742. In south-central Pennsylvania, name Oranda is applied to beds formerly termed Greencastle; *Sinuites* zone is referred to base of Martinsburg. Throughout most of the area, formation consists of dark-gray to black fine-grained slabby to massive blue-gray to white-weathering limestone; in easternmost outcrops, consists of black argillaceous buff-weathering limestone with prominent shale partings. Thickness 17 feet south of Fannettsburg; over 158 feet northeast of Plainfield; 149 feet on Turnpike northeast of Newville. If present in Maryland, probably quite thin. Overlies Kauffman member (new) of Mercersburg or beds thought to be equivalent; underlies *Sinuites* zone of Martinsburg.

Carlyle Gray and others, 1960, Geologic map of Pennsylvania (1:250,000): Pennsylvania Geol. Survey, 4th ser. As mapped, Chambersburg formation includes dark-gray thin-bedded limestone (Oranda) at top; gray argillaceous limestone (Mercersburg) in middle; dark-gray cobbly and thin irregularly bedded limestone (Shippensburg) below.

Type section: Along State Highway 55 about 2.7 miles S. 40° W. of Oranda and somewhat less than one-half mile west of U.S. Route 11 in north environs of Strasburg, Shenandoah County, Va. Name derived from Oranda, a hamlet about 3½ miles northeast of Strasburg.

Orange Granite[1]

Devonian: Northeastern Vermont.

Original reference: E. J. Foyles and C. H. Richardson, 1929, Vermont State Geologist 16th Rept., table opposite p. 288.

Named for Orange Township, Orange County.

†Orange Phyllite[1]

Pre-Triassic: Southwestern Connecticut.

Original reference: H. E. Gregory, 1906, Connecticut Geol. Nat. History Bull. 6, p. 86, 101–102, map.

John Rodgers and others, 1956, Preliminary geological map of Connecticut (1:253,400): Connecticut Geol. Nat. History Survey; John Rodgers, R. M. Gates, and J. L. Rosenfeld, 1959, Connecticut Geol. Nat. History Bull. 84, p. 36–37. Includes dark-gray lustrous phyllite, commonly interbedded with finely laminated sericite-quartz phyllite or sericitic quartzite. Coarser toward the west where it is fine-grained mica-quartz-garnet schist. Beds of medium-crystalline micaceous limestone occur at several places. Few bodies of hornblende schist or amphibolite. Derivation of name stated.

M. H. Carr, 1960, Connecticut Geol. Nat. History Survey Quad. Rept. 9, p. 12–14, pl. 1. Mica quartzites just east of Prospect gneiss, previously included in Orange phyllite, are here included in Hartland formation. Thus, Orange phyllite is restricted to rocks between Milford chorite schist and Hartland formation.

Named for town of Orange, New Haven County.

†Orangeburg Formation[1]

Eocene, middle: Western and central South Carolina and southern Georgia.

Original references: W. H. Dall, 1898, U.S. Geol. Survey 18th Ann. Rept., pt. 2, p. 344, chart facing p. 334; published in 1897 as House Doc. 5, 55th Cong., 2d sess.

Typical locality in old Orangeburg district (Lang Syne plantation, near Fort Motte, now in Calhoun County), S.C.

Orange-Martin Limestone[1]

Mississippian: Indiana.

Original reference: D. D. Owen and R. Owen, 1862, Rept. of geol. reconn. of Indiana, p. 126–127.

Named for occurrence in Orange and Martin Counties.

Orangeville Shale (in Cuyahoga Group)[1]

Orangeville Shale Member (of Cuyahoga Formation)[1]

Mississippian: Northeastern Ohio and northwestern Pennsylvania.

Original reference: I. C. White, 1880, Pennsylvania 2d Geol. Survey Rept. Q_3, p. 63.

H. P. Cushing, Frank Leverett, and F. R. Van Horn, 1931, U.S. Geol. Survey Bull. 818, p. 48–50, 57. Cuyahoga formation raised to group rank in its typical area, and its subdivisions (ascending) Orangeville shale, Sharpsville sandstone, and Meadville shale are raised to formation rank. In Cleveland district, Ohio [this report], Orangeville is very homogeneous except that it carries fairly persistent sandstone member, the Aurora, from 6 to 10 feet thick, 10 feet or less above base. This bed is absent in some sections, as at Berea. The few feet of shale below this sandstone is on the horizon of Sunbury shale of central and southern Ohio. In Cleveland district, this shale zone is not easily separable from Cuyahoga beds. Thickness about 125 feet. In some areas, underlies Sharon conglomerate.

F. T. Holden, 1941, Illinois Acad. Sci. Trans., v. 34, no. 2, p. 172. Included in Tinkers Creek shale facies (new) of Cuyahoga formation.

Wallace de Witt, Jr., 1946, U.S. Geol. Survey Oil and Gas Inv. Prelim. Chart 21. Orangeville, at its type locality on Pennsylvania-Ohio State line, consists of about 75 feet of gray to brown hard semifissile clay shale containing a few thin flagstones. Traced eastward into vicinity of Titusville, the flags in the Orangeville increase in number, and the Orangeville merges into Sharpsville sandstone. In northeastern Ohio, the Orangeville has a basal carbonaceous shale member, the Sunbury, which can be traced throughout Ohio. In Cuyahoga and Geauga Counties, Ohio, Aurora sandstone and Chardon sandstone members are present.

Wallace de Witt, Jr., 1951, Geol. Soc. America Bull., v. 62, no. 11, p. 1362–1366; J. F. Pepper, Wallace de Witt, Jr., and D. F. Demarest, 1954, U.S. Geol. Survey Prof. Paper 259, p. 10, 13, 18, 41, 42–45, pl. 4. Following members recognized: Sunbury, Aurora siltstone, Chardon siltstone, Bartholomew siltstone (new), and Hungry Run sandstone (new). Overlies Shellhammer Hollow formation (new).

E. J. Szmuc, 1958, Dissert. Abs., v. 18, no. 6, p. 2109. Named for village of Orangeville, on Ohio-Pennsylvania line in Trumbull County, Ohio. Basal member of Cuyahoga. Underlies Sharpsville member. In this report, the Cuyahoga is subdivided into eight members.

Orca Group[1]

Upper Mesozoic(?): Central southern Alaska.

Original reference: F. C. Schrader, 1900, U.S. Geol. Survey 20th Ann. Rept., pt. 7, p. 404, 413.

F. H. Moffit, 1954, U.S. Geol. Survey Bull. 989–E, p. 236, 247–275. Workers who have studied sedimentary deposits of Prince William Sound region have accepted rocks around Port Valdez as typical of Valdez group and have agreed in assigning basaltic flows and intrusives, or greenstones as they are commonly called, and massive conglomerate beds of Ellamar district to Orca group. Aside from these points held in common, there is no generally accepted definition of what constitutes Valdez and Orca groups, what are their limits, and what are stratigraphic and structural relations of the beds included in them. Notwithstanding the similarities of the two groups, the Orca, when compared with the Valdez, shows greater diversity in kinds of rocks composing it. Consists dominantly of slate and graywacke. Type locality cited. Many or all of the sedimentary rocks exposed in islands and on mainland of southeastern part of Prince William Sound area, including type locality of Orca group, probably of Late Cretaceous age.

Type locality: Includes rocks of the mainland, adjacent to Orca Inlet and Orca Bay, and on Hawkins Island, southeastern Prince William Sound region.

Orcas Group[1]

Middle Devonian, Lower and Middle Pennsylvanian, Middle and Upper Permian and Upper Triassic: Northwestern Washington.

Original reference: R. D. McLellan, 1924, Am. Jour Sci., 5th, v. 8, p. 217–222.

G. A. Cooper and others, 1942, Geol. Soc. America Bull., v. 53, pt. 1, p. 1775. Part of this group is dated as Devonian by an identification of *Atrypa reticularis* reported by Schuchert. These seem to be Middle or Upper Devonian types rather than Silurian forms (McLellan, 1924).

W. R. Danner, 1960, Geol. Soc. America Bull., v. 71, no. 12, pt. 2, p. 2055–2056. Orcas group, originally designated as Devono-Mississippian, is now known to contain rocks of Middle Devonian, Early and Middle Pennsylvanian, Middle and Late Permian, and Late Triassic. No diagnostic Mississippian fossils found.

Named for exposures on Orcas Island.

Orchard Gneiss[1]

Precambrian: Northeastern New York.

Original reference: J. F. Kemp, 1898, Am. Inst. Mining Engrs. Trans., v. 27, p. 178, map, secs.

Occurs near Port Henry, Essex County. Probably named for Orchard Pit.

Orchard Creek Shale[1]

Orchard Creek Shale (in Maquoketa Group)

Lower Silurian: Southwestern Illinois and southeastern Missouri.

Original reference: T. E. Savage, 1909, Am. Jour. Sci., 4th, v. 28, p. 515.

J. M. Weller, 1939, Kansas Geol. Soc. Guidebook 13th Ann. Field Conf., p. 56. Savage draws Ordovician-Silurian boundary at base of Orchard Creek shale, although there is no doubt that this formation is southward continuation of some part of Maquoketa shale which is generally conceded to be Upper Ordovician.

A. M. Gutstadt, 1958, Am. Assoc. Petroleum Geologists Bull., v. 42, no. 3, pt. 1, p. 518 (table 2), 524. In area where Cape limestone (new) can be identified, Upper Ordovician rocks are referred to Maquoketa group which is composed of (ascending) Orchard Creek shale, Cape limestone, and Eden shale.

Named for Orchard Creek, 2 miles south of Thebes, Alexander County, Ill.

Orchard Point Conglomerate Member (of Blakeley Formation)

Oligocene, middle, or Miocene, lower: Northwestern Washington.

C. E. Weaver, 1937, Washington [State] Univ. Pubs. in Geology, v. 4, p. 114. Consists of approximately 1,800 feet of conglomerate at base of formation. Underlies 4,800-foot section of massive and stratified sandy shales and thick units of interstratified conglomerate. Middle Oligocene.

C. V. Fulmer, 1954, (abs.) Geol. Soc. America Bull., v. 65, no. 12, pt. 2, p. 1341. At type section, lowermost Blakeley consists of 845 feet of well-bedded hard marine gray sandstones and massive conglomerates, the Orchard Point member. Orchard Point underlies approximately 4,000 feet of marine, interbedded siltstone, sandstone, and shale herein named Restoration Point member. Based on foraminiferal assemblages contained, the Blakeley, as herein restricted, is best correlated with Zemorrian stage [lower Miocene] of California.

Named for occurrence at Orchard Point near entrance to Bremerton Inlet, Kitsap County.

Orcutt Formation[1] or Sand

Pleistocene, upper: Southern California.

Original reference: H. W. Hoots and S. C. Herold, 1935, *in* Geology of natural gas: Tulsa, Okla., Am. Assoc. Petroleum Geologists, p. 156.

W. P. Woodring, M. N. Bramlette, and K. E. Lohman, 1943, Am. Assoc. Petroleum Geologists Bull., v. 27, no. 10, p. 1336 (fig. 1), 1340 (table 1), 1359–1360. In Santa Maria district, reddish-brown sand and gravel resting discordantly on Paso Robles and older formations are designated Orcutt sand. Maximum outcrop thickness between 50 and 100 feet. Considered oldest and most extensive terrace deposit in district; tilted as much as 12 degrees in flanks of anticlines. In type region, has maximum thickness of 50 feet and overlaps formations down to and including the Sisquoc. Upper Pleistocene.

G. F. Worts, Jr., 1951, U.S. Geol. Survey Water-Supply Paper 1000, p. 33–36, pl. 3, table facing p. 23. Described as formation consisting of two conformable members: an upper fine-grained sand member which corresponds to that part of formation exposed at type locality, and lower coarse-grained member. Woodring's term seems to apply only to upper member. Thickness as much as 225 feet.

Type region: On north flank of Casmalia Hills immediately west of Orcutt, Santa Barbara County.

Ord Mountain Group

Triassic(?): Southern California.

D. L. Gardner, 1940, California Jour. Mines and Geology, v. 36, no. 3, p. 266–267. Consists of two major units, andesitic flows, tuffs, and breccia, and hypabyssal intrusive rocks with a porphyritic habit. Intruded by Jurassic(?) plutonics.

Occurs on Ord, East Ord, and Kane Mountains, and southern flank of Bessemer Mountains, San Bernardino County.

Ordnance Plant Member (of Moorefield Formation)

Mississippian (Chesterian): Northeastern Oklahoma.

G. G. Huffman and others, 1958, Oklahoma Geol. Survey Bull. 77, p. 57–61, pls. 1–5. Consists fundamentally of three parts (ascending): platy blue to yellow siltstone 9 feet thick; heavy-bedded blue fine-grained dense calcareous siltstone which weathers yellow, silty, and into concentric elements of concretionary nature 15 feet thick; and sequence of brown to black platy siltstone and shale 10 feet thick. Maximum thickness 35 feet. Northward from type locality, member loses upper and part of middle phase until only one or two of heavy ledges can be carried through; southward, the heavy-bedded siltstone development thins by convergence, and entire sequence passes into thin platy silty shale with occasional ledges and concretions of dense blue limestone. Believed to rest conformably upon Lindsey Bridge member (new) or in its absence upon Bayou Manard member (new); locally overlaps onto "knobs" of Boone chert; unconformably overlain by Hindsville limestone and northward from Pensacola is truncated by it.

Type locality: Along Pryor Creek within Oklahoma Ordnance Plant area and in west end of Low Water Dam, secs. 11 and 14, T. 20 N., R. 19 E., where all but uppermost beds are exposed in quarry, Mayes County. Uppermost beds well developed along west side of Grand River below its confluence with Pryor Creek in sec. 27, T. 20 N., R. 19 E.

Oread Limestone (in Shawnee Group)

Oread Limestone Member (of Vamoosa Formation)

Oread Limestone or Limestone Member (of Douglas Group or Formation)[1]

Pennsylvanian (Virgil Series) : Eastern Kansas, southwestern Iowa, northwestern Missouri, southeastern Nebraska, and northern Oklahoma.

Original reference: E. Haworth, 1894, Kansas Univ. Quart., v. 2, p. 123, 124.

R. C. Moore, 1948, Am. Assoc. Petroleum Geologists Bull., v. 32, no. 11, p. 2034–2036; 1949, F. C. Greene and W. V. Searight, 1949, Missouri Geol. Survey Rept. Inv. 11, p. vii (fig. 3), 16–17. Shawnee group was defined by Moore (1932, Kansas Geol. Soc. Guidebook 6th Ann. Field Conf.) as extending from base of Oread formation to top of Topeka formation. This classification of the Shawnee is now recognized by interstate agreement. Oread formation comprises (ascending) Toronto limestone, Snyderville shale, Leavenworth limestone, Heebner shale, Plattsmouth limestone, Heumader shale, and Kereford limestone members. Overlies Lawrence formation; underlies Kanwaka formation.

G. E. Condra, 1949, Nebraska Geol. Survey Bull. 16, p. 26. Nebraska Geological Survey uses term Weeping Water limestone in preference to Toronto for basal member of Oread.

W. F. Tanner, 1956, Oklahoma Geol. Survey Circ. 40, p. 12 (fig. 1), 52–54, pl. 1. Member of Vamoosa formation in Oklahoma. At type locality, Oread is composed of four limestones and three shales. Leavenworth member (No. 2 limestone, counting from bottom) is Middle Oread of this report [Osage County]; Upper Oread is Plattsmouth member (No. 3 limestone). Basal limestone does not crop out in Oklahoma. Middle Oread is a thin limestone, decreasing from about 4 feet near Kansas line to about 4 inches in sec. 15, T. 26 N., R. 9 E. South of this point, it is a calcareous zone, approximately 15 feet above top of Upper Wyona sandstone and perhaps 30 feet below overlying Elgin sandstone. Near Kansas line where member is well developed, it lies between 15 and 90 feet below Upper Oread limestone and approximately 100 feet above top of Jonesburg sandstone.

H. G. Hershey and others, 1960, Iowa Highway Research Board Bull. 15, p. 21, fig. 5. Basal formation in Shawnee group. Comprises (ascending) Toronto limestone, Heebner shale, Plattsmouth limestone, Heumader shale, and Kereford limestone members. Kereford missing in some localities. Where Toronto is missing, base of formation is indeterminate, and Snyderville shale cannot be separated from underlying Douglas group. Thickness 42 to 52 feet.

Named for fact it caps Mount Oread, at Lawrence, Douglas County, Kans.

Oreana shale[1]

Jurassic: Nevada.

Original reference: C. R. Keyes, 1923, Pan-Am. Geologist, v. 40, p. 52, 80.

Occupies west flank of Humboldt Range southward from Oreana Station, Pershing County.

Oreapolis Limestone[1]

Pennsylvanian: Southeastern Nebraska.

Original reference: G. E. Condra and N. A. Bengston, 1915, Nebraska Acad. Sci. Pub., v. 9, no. 2, p. 6, 10, 19, 34.

Named for Oreapolis, Cass County.

†Oregon Beds[1]

Oligocene(?) and Miocene: Central northern Oregon.

Original reference: E. D. Cope, 1879, Am. Nat., v. 13, p. 333.

Named for State of Oregon.

Oregon Limestone[1] (in High Bridge Group)

Oregon Member (of High Bridge Limestone)

Middle Ordovician: Central Kentucky.

Original reference: A. M. Miller, 1905, Kentucky Geol. Survey Bull. 2, p. 13.

A. C. McFarlan, 1943, Geology of Kentucky: Lexington, Ky., Kentucky Univ., p. 12; D. K. Hamilton, 1948, Econ. Geology, v. 43, no. 1, p. 40–41. Middle formation of High Bridge (Highbridge) group. Underlies Tyrone limestone; overlies Camp Nelson limestone.

J. L. Rich, 1951, Geol. Soc. America Bull., v. 62, no. 1, p. 18. Referred to as member of High Bridge limestone.

Named for Oregon, Mercer County.

Oregonia Member (of Arnheim Formation)

Oregonia division (in Arnheim Formation)[1]

Upper Ordovician (Richmond): Southwestern Ohio and north-central Kentucky.

Original reference: A. F. Foerste, 1910, Denison Univ. Sci. Lab. Bull. 16, p. 18.

Wilber Stout, Karl Ver Steeg, and G. F. Lamb, 1943, Ohio Geol. Survey, 4th ser., Bull. 44, chart facing p. 108. Shown on generalized section of Ohio as upper member of Arnheim; overlies Sunset member; underlies Fort Ancient member of Waynesville formation. Richmond series.

Named for Oregonia, Warren County, Ohio.

Ore Hill Limestone Member (of Gatesburg Formation)[1]

Upper Cambrian: Central Pennsylvania.

Original reference: Charles Butts, 1918, Am. Jour. Sci., 4th, v. 46, p. 527, 534, 537.

J. L. Wilson, 1952, Geol. Soc. America Bull., v. 63, no. 3, p. 282, 283–287, pls. 1, 3. Redefined to include nonarenaceous dark crystalline dolomite of the Gatesburg found at stratigraphic position of Butts' Ore Hill limestone from Williamsburg, Pa., northward through Tyrone and Bellefonte quadrangles. Thickness 130 to 213 feet; at Williamsburg and Birmingham, about 160 feet. Separated from overlying Mines dolomite member by interval, 650 to 700 feet thick, referred to as upper sandy Gatesburg member, and from underlying Stacy dolomite member by 400-foot interval referred to as lower sandy Gatesburg member. Type section designated.

Type section: Ore Hill quarry about 300 yards northeast of crossroads of Pennsylvania State Highway 686 and road leading east to Ore Hill Station, Bloomfield Township, Bedford County. Named for Ore Hill, Blair County.

Orejon Andesite[1]

Eocene: Southern New Mexico

Original reference: K. C. Dunham, 1935, New Mexico School Mines Bull. 11, p. 53, 54.

V. C. Kelley and Caswell Silver, 1952, New Mexico Univ. Pubs. in Geology 4, p. 114 (fig. 14). Age given as Eocene on chart showing nomenclature of Tertiary formations in Caballo Mountains and adjoining areas. Older than Cueva [rhyolite]; younger than Soledad [rhyolite].

Named for Orejon mine, Dona Ana County, in which it occurs as hanging wall of main fault.

Orella Member (of Brule Formation)

Oligocene, middle: Western Nebraska and southwestern Wyoming.

C. B. Schultz and T. M. Stout, 1938, (abs.) Geol. Soc. America Bull., v. 49, no. 12, pt. 2, p. 1921; 1941, Guide for a field conference on the Tertiary and Pleistocene of Nebraska: Nebraska Univ. State Mus. Spec. Rept., p. 4 (table 1), 37, fig. 8. Proposed for lower or *Oreodon* zone part of Brule formation. Thickness about 150 feet. Disconformably underlies Whitney member (new).

C. B. Schultz and T. M. Stout, 1955, Nebraska Univ. State Mus. Bull., v. 4, no. 2, p. 41–44, figs. 3, 10, table 1, 2. Four divisions distinguished. Chiefly silty clay, massive to laminated; commonly brownish-buff; locally greenish-gray. Thickness about 170 feet in Scottsbluff and Torrington areas, western Nebraska and eastern Wyoming; 184 feet in Crawford area, Nebraska. Overlies Chadron formation.

Type locality: About 2½ miles southwest of Orella Station in vicinity of Toadstool Park in sec. 8, T. 33 N., R. 53 W., Sioux County, Nebr.

Orellan Age

Oligocene: North America.

H. E. Wood 2d and others, 1941, Geol. Soc. America Bull., v. 52, no. 1, p. 11, pl. 1. Provincial time term, based on Orella member of Brule formation, type locality, Orella, Nebraska. Includes the old term "*Oreodon* beds" used in the most extended sense. Covers interval between Oligocene Chadronian (older) and Whitneyan ages. Report defines 18 provincial time terms, based on mammal-bearing units, for North American continental Tertiary. [For sequence see under Puercan.]

Type area: Northwestern Nebraska, southwestern South Dakota, and eastern Wyoming.

Ore Mountain Diorite

Pre-Upper Devonian: Central Maine.

S. S. Philbrick, 1936, Am. Jour. Sci., 5th ser., v. 31, no. 181, p. 9–10, 39. Incidental mention. Older than Onawa intrusive which is probably Upper Devonian in age.

Crops out between Katahdin Iron Works and Big Houston Pond in southern Piscataquis County.

Orestimba Group

Upper Cretaceous (Chico Series): Northern California.

F. M. Anderson, 1938, (abs.) Geol. Soc. America Bull., v. 49, no. 12, pt. 2, p. 1863. Chico series subdivided into Pioneer, Panoche, and Orestimba groups. Maximum thickness of Orestimba 5,000 feet.

F. M. Anderson, 1940, 6th Pacific Sci. Cong. Proc., v. 1, p. 395 [1939]. Orestimba group, Chico series, covers closing stages of Cretaceous. Crops out only in San Joaquin Valley. Overlies Panoche group along its eastern margin. Group begins with stratigraphic unit of unique character, as described by Anderson and Pack (1915), who termed it "Moreno formation." This shaly unit has thickness of 2,000 feet and in district of Orestimba Creek is overlain by 3,000 feet or more of sandy formation, termed the Garzas.

R. D. Reed, 1943, California Div. Mines Bull. 118, pt. 2, p. 109 (table 6) [preprint 1941]. Shown on table as overlying Panoche group and comprising Volta, Garzas, Quinto, and Moreno formations.

Occurs in outer foothills of Diablo Range. Named for fact it lies across Orestimba Creek, Stanislaus County.

Orfordville Formation

Middle Ordovician(?): Western New Hampshire and eastern Vermont.

J. B. Hadley and others, 1938, Geologic map and structure sections of the New Hampshire portion of the Mount Cube quadrangle (1:62,500); C. A. Chapman and others, 1938, Geologic map and structure sections of the Mascoma quadrangle, New Hampshire (1:62,500): New Hampshire Highway Dept. Consists of black to dark-gray mica schist, quartz-mica schist, feldspathic quartzite, staurolite schist, and staurolite-kyanite schist in middle grade metamorphic zone. Ottrelite schist or black schistose graphitic quartzite locally; also lenses of biotite gneiss in upper part. Dark-gray slate in lower grade zone. Includes Post Pond volcanic member (new) at base, Hardy Hill quartzite member (new) near middle, and Sunday Mountain volcanic member (new) at top. Underlies Albee formation.

J. B. Hadley, 1942, Geol. Soc. America Bull., v. 53, no. 1, p. 119–124. Thickness about 5,000 feet.

J. B. Lyons, 1955, Geol. Soc. America Bull., v. 66, no. 1, p. 108, 113–116, pl. 1. Stratigraphic revision. Includes (ascending) schists, Hardy Hill quartzite member, schists, and Post Pond volcanic member. Sunday Mountain volcanic member is considered equivalent of Post Pond member and is not mapped separately.

M. P. Billings, 1955, Geologic map of New Hampshire (1:250,000): U.S. Geol. Survey. Members are Hardy Hill quartzite, Post Pond volcanic member, and Sunday Mountain volcanics.

Crops out in belt trending southwestward from Orfordville in New Hampshire part of Mount Cube quadrangle. Extends into Vermont.

Organ Rock Tongue or **Member** (of Cutler Formation)[1]

Permian: Southeastern Utah and northeastern Arizona.

Original reference: A. A. Baker and J. B. Reeside, Jr., 1929, Am. Assoc. Petroleum Geologists Bull., v. 13, no. 11, p. 1420, 1422, 1423, 1441, 1443, 1446.

C. B. Hunt, Paul Averitt, and R. L. Miller, 1953, U.S. Geol. Survey Prof. Paper 228, p. 39 (table), 40 (fig. 7), 41, 42–44. Described in Henry Mountains region where it consists of red evenly bedded micaceous and shaly sandstone; grades northward into white crossbedded sandstone like White Rim or Cedar Mesa members. Thickness 265 to 400 feet. Conformably overlies Cedar Mesa sandstone member; conformably underlies White Rim sandstone member. In Monument Valley region, underlies De Chelly sandstone member.

G. K. Elias, 1957, *in* Four Corners Geol. Soc. Guidebook 2d Field Conf., p. 10. Correlation chart shows Organ Rock present in northeastern Arizona.

J. H. Stewart, 1959, Am. Assoc. Petroleum Geologists Bull., v. 43, no. 8, p. 1855 (fig. 2), 1857 (fig. 3), 1862. Underlies Hoskinnini (herein reallocated to member status in Moenkopi formation) in most of southeastern Utah.

Named for fact that the beds compose natural monument known as Organ Rock, south of San Juan River, between Moonlight and Copper Creeks, San Juan County, Utah.

Oriana Gypsum Member (of Peacock Formation)[1]

Permian: Central northern Texas.

Original reference: L. T. Patton, 1930, Texas Univ. Bull. 3027, p. 47.

Well exposed in valleys of Double Mountain Fork and Salt Fork Rivers, Stonewall County., and near station of Oriana, on Stamford & Northwestern Railroad.

Orient Formation

Paleozoic: North-central Utah.

B. F. Stringham, 1942, Geol. Soc. America Bull., v. 53, no. 2, p. 271, pl. 1. Brown well-crystallized quartzite, 15 feet thick, overlies 250-foot unit of dense greenish-brown shale. These will be referred to collectively as Orient formation and specifically as Orient quartzite and Orient shale.

R. E. Cohenour, 1959, Utah Geol. and Min. Survey Bull. 63, p. 75. Proposed that names Orient formation and its subdivisions, Orient shale and Orient quartzite, be supplanted by Kanosh shale and Swan Peak quartzite. Beds above Orient quartzite have been recognized to be units of Fish Haven dolomite.

Traced from Orient mine south and westward across Bates Gulch, West Tintic Mining District [Juab County].

Orient Gneiss[1]

Precambrian(?): Northeastern Washington.

Original reference: C. E. Weaver, 1920, Washington Geol. Survey Bull. 20, p. 85, map.

J. L. Barlow, 1958, U.S. Atomic Energy Comm. [Pub.] RME-2068, p. 7. Discussion of uranium occurrences in northern Ferry County. Oldest rocks in district are biotite-amphibole schists, gneisses, limestones, and quartzites, which Weaver (1920) designated Orient gneiss and tentatively assigned Precambrian age. Houghland (1933, unpub. thesis) subdivided this sequence and assigned name Rockcut formation to include two lower quartzite and limestone members of Lower Paleozoic(?) age. He also used term amphibole schist to include all basic medium- to fine-grained more or less metamorposed rocks in area. These schists are interbedded with the Rockcut.

Well exposed in railway cuts at town of Orient, Stevens County.

Orient Granite Porphyry

Tertiary: North-central Utah.

B. F. Stringham, 1942, Geol. Soc. America Bull., v. 53, no. 2, p. 275, pl. 1. Dense, buff colored, and massive. Phenocrysts of quartz, biotite, and feldspar; never predominate over groundmass.

Northeast of Orient mine, West Tintic Mining District, [Juab County].

Orienta Sandstone (in Bayfield Group)[1]

Precambrian: Northwestern Wisconsin.

Original reference: F. T. Thwaites, 1912, Wisconsin Geol. Nat. Hist. Survey Bull. 25, p. 41.

G. O. Raasch, 1950, Illinois Acad. Sci. Trans., v. 43, p. 145 (fig. 8), 147, 150. Critical examination of evidence on which Thwaites (1912) established his Chequamegon formation reveals that his Chequamegon brownstone formation is none other than Port Wing brownstone member of Orienta formation, repeated by faulting. [Thwaites' 1912 general section referred to Upper brownstone (of Port Wing); thickness 500 to 700 feet.] It is suggested that Bayfield sediments are of Middle and possibly also Early Cambrian age laid down in structural basins formed at or after close of Algonkian.

Named for exposures near Orienta, Bayfield County.

Orinda Formation[1]

Orinda Formation (in Contra Costa Group)

Pliocene: Western California.

Original reference: A. C. Lawson and C. Palache, 1902, California Univ. Pubs., Dept. Geol. Bull., v. 2, p. 371, map.

B. L. Clark, 1936, Geol. Soc. America Bull., v. 46, no. 7, p. 1035, pl. 88. Stratigraphic sequence on south side of Riggs Canyon fault zone, Mount Diablo area, shows Orinda formation, 3,060 feet below Moraga tuff and above Jacalitos(?).

C. E. Weaver, 1949, Geol. Soc. America Mem. 35, p. 16 (table 3), 91–92, pl. 11. Described in Mare Island quadrangle where it occupies less than 1½ square miles and is exposed just east of Pinole Point; beds lie in shallow syncline whose axis passes beneath San Pablo Bay. Near Rodeo, Orinda overlies Neroly sandstone.

D. E. Savage, B. A. Ogle, and R. S. Creely, 1951, (abs.) Geol. Soc. America Bull., v. 62, no. 12, pt. 2, p. 1511. Included in sequence of formations (in west-central Contra Costa County) for which new group name is proposed (name not given). Sequence (ascending) Orinda, Moraga, Siesta, Bald Peak, and unnamed formation. Unnamed formation formerly mapped as Orinda, but separate formational name is warranted so that structural and stratigraphic relationships of rocks of area may be demonstrated.

M. D. Crittenden, Jr., 1951, California Div. Mines Bull. 157, p. 22 (fig. 4), 41–42, pls. 1–3. Described in San Jose-Mount Hamilton area. Formation is exposed in center of Tularcitos syncline; beds are tightly folded, overturned in part, and rest unconformably on the Briones. Consists of loosely consolidated red, maroon, or greenish conglomerate, sandstone, and clay. Thickness 750 to 2,000 feet. Miocene-Pliocene. Older than Packwood gravels.

C. K. Ham, 1952, California Div. Mines Spec. Rept. 22, p. 6 (fig. 3), 14–16, pls. 1, 2. Described in Las Trampas Ridge area where it is basal formation in Contra Costa group (new). In some localities. overlain by Pinole tuff; in others by Mulholland formation (new) although the two cannot always be differentiated.

1955, Geol. Soc. America Cordilleran Sec. [Guidebook] Apr. 28–30, Trip 2, p. 2. Road log (between Oakland and Mount Diablo) mentions contact of Moraga volcanics with conglomerate of Orinda formation along crest of sharp asymmetrical anticline. Moraga volcanics stand almost vertical; Orinda sediments dip east at angles around 45°.

C. A. Hall, Jr., 1958, California Univ. Pub. Geol. Sci., v. 34, no. 1, p. 29–30, fig. 2, geol. map. Occurs mainly in northern part of Pleasanton area where it reaches thickness of 9,000 feet. In southern part of area in Tularcitos syncline, formation is 2,000 feet thick. Overlies Neroly sandstone; overlies Briones formation in Tularcitos syncline. Underlies Leona rhyolite in some areas and Livermore gravels in other areas. Age of Orinda has been in question for about 40 years, and no new evidence was discovered in this study to clarify situation. Pliocene.

Named for exposures at Orinda, Contra Costa County.

Oriskany Formation,[1] Sandstone,[1] or Group[1]

Lower Devonian: New York, western Maryland, Pennsylvania, Virginia, and eastern West Virginia.

Original reference: L. Vanuxem, 1839, New York Geol. Survey 3d Rept., p. 273.

Bradford Willard and A. B. Cleaves, 1938, Pennsylvania Geol. Survey, 4th ser., Bull. G–8. Oriskany treated as group in area of this report [south-central Pennsylvania]. Comprises Shriver chert below and Ridgeley sandstone above. Maximum thickness about 50 feet. Overlies Helderberg group; underlies Onondaga formation. Lower Ordovician.

Bradford Willard, 1938, Pennsylvania Geol. Survey, 4th ser., Bull. G–11, p. 6 (fig. 3), 14. In Delaware Water Gap area, the Oriskany group, undifferentiated, is about 135 feet thick; overlies Port Ewen-New Scotland shale of Helderberg group and underlies Esopus shale of Onondaga group.

A. B. Cleaves *in* Bradford Willard, F. M. Swartz, and A. B. Cleaves, 1939, Pennsylvania Geol. Survey, 4th ser., Bull. G–19, p. 92–130. Group in Pennsylvania includes all stratigraphic units between overlying Onondaga group (including Esopus shale in eastern Pennsylvania) and underlying Helderberg formations. Faunally distinct although possessing Helderbergian affinites. Includes Ridgeley formation above and Shriver formation below.

Winifred Goldring, 1943, New York State Mus. Bull. 332, p. 195–204, geol. map. In Coxsackie quadrangle, Oriskany loses its sandstone character, and becomes fossiliferous cherty limestone, sometimes interbedded with shaly phases. South of Saugerties, contains Glenerie limestone at top. In Rondout region, limestones are underlain by basal pebble conglomerate, 18 to 20 feet thick, Connelly conglomerate. Overlies Port Ewen limestone; underlies Esopus shale.

H. P. Woodward, 1943, West Virginia Geol. Survey, v. 15, p. 127–149. Although an "Oriskany group" is recognized, there is only one formation in West Virginia to which name Oriskany can be applied. This is Ridgeley sandstone. "Shriver chert" formerly assigned to Oriskany is now allocated to earlier position; Huntersville chert, previously described as Oriskany in age, is herein established as an Onondaga formation.

Charles Schuchert, 1943, Stratigraphy of the eastern and central United States: New York, John Wiley & Sons, Inc., p. 85. Littoral shore phase of typical or upper Oriskany might be distinguished as Oriskany Falls member, 0 to 20 feet thick.

J. M. Berdan, 1950, New York State Dept. Conserv., Water and Power Control Comm. Bull. GW-22, p. 10 (table 2), 17. Oriskany sandstone overlies Becraft limestone and underlies Esopus siltstone in Schoharie County. Thickness 6 to 12 feet.

Ernst Cloos, 1951, Maryland Dept. Geology, Mines and Water Resources [Rept. 14] Washington County, p. 85-87. Formation in Maryland consists of black cherty shale in lower part and calcareous sandstone or arenaceous limestone in upper part. Comprises Shriver chert and Ridgeley sandstone members. Overlies Helderberg formation; underlies Onondaga shale member of Romney shale.

H. H. Arndt and others, 1959, Geol. Soc. America Guidebook Pittsburgh, Mtg., p. 4, 13, 26. Formation comprises Shriver and Ridgeley members. Thickness as much as 200 feet. Overlies Helderberg formation; underlies Onondaga formation.

T. M. Kehn, 1960, (abs.) Geol. Soc. America Bull., v. 71, no. 12, pt. 2, p. 2018-2019. Recent mapping has revealed that, contrary to previously published reports and maps, there are two outcrop belts of Oriskany, Onondaga, and Marcellus formations between Schuylkill and Susquehanna Rivers. Area is bounded on north by Second Mountain and on south by Blue Mountain. In these belts, the Oriskany formation, 0 to 20 feet thick, is milky-white to brown medium- to coarse-grained locally conglomeratic quartzitic sandstone. Disconformably overlaps Bloomsburg red beds of Silurian age from east to west. Underlies Onondaga formation.

Named for occurrence at Oriskany Falls, Oneida County, N.Y.

Oriskany Falls Member (of Oriskany Sandstone)

Lower Devonian: New York.

Charles Schuchert, [1943], Stratigraphy of the eastern and central United States: New York, John Wiley and Sons, p. 85. Name applied to littoral shore phase of typical or upper Oriskany sandstone. Thickness 0 to 20 feet. From eastern New York, littoral clean sand phase overlaps westward, passing into younger beds.

Type locality and derivation of name not given.

Orlando Limestone (in Conemaugh Formation)[1]

Pennsylvanian: Northern West Virginia.

Original reference: D. B. Reger, 1916, West Virginia Geol. Survey Rept. Lewis and Gilmer Counties, p. 147.

Exposed at Orlando, Lewis County.

Orleans Phyllite[1]

Ordovician: Northeastern Vermont.

Original reference: E. C. Jacobs, 1923, Vermont State Geologist Rept. 1921-1922, p. 93-108.

Extends north and south across eastern part of Orleans County.

Orman Lake Limestone Member (of Greenhorn Formation)

Orman Lake Limestone Bed (in Belle Fourche Member of Graneros Formation)

Upper Cretaceous: Western South Dakota.

B. C. Petsch, 1949, South Dakota Geol. Survey Rept. Inv. 65, p. 9-10. Flaggy limestone near middle of Belle Fourche member. Replaces preoccupied name Middle Creek limestone (Wing, 1940). Upper part of Belle Fourche member above Orman Lake, has been included in Greenhorn formation on west side of Black Hills.

W. A. Cobban and J. B. Reeside, Jr., 1951, Wyoming Geol. Assoc. Guidebook 6th Ann. Field Conf., p. 61 (fig. 2). Shown on correlation chart as member of Greenhorn formation.

Named for exposures on south and west side of Orman Lake, Butte County, S. Dak.

Oro Blanco Conglomerate

Mesozoic: Southeastern Arizona.

G. M. Fowler, 1938, Arizona Bur. Mines Bull. 145, Geol. Ser. 12, p. 121, 122, pl. 32. Consists of angular coarse fragments. Difficult to classify rock as it combines characteristics of conglomerate and breccia. Fragments range between 1 inch and 12 inches in diameter. Small gravel present only in sufficient quantity to fill interstices. Reddish and grayish color with some dark-hued greenish fragments giving mass variegated appearance in some places. Rests on weathered quartz monzonite surface under Montana mine workings.

B. P. Webb and K. C. Coryell, 1954, U.S. Atomic Energy Comm. [Pub.] RME–2009, p. 8. In Ruby quadrangle overlies Pajarito lavas (new).

Covers large area in western part of Santa Cruz County, and is exposed in and around Montana mine, which is in Oro Blanco mining district, Santa Cruz County, 5 miles north of Mexican boundary and about 30 miles west of Nogales. Named for the mining district.

Orocopia Schist

Precambrian: Southern California.

W. J. Miller, 1944, California Jour. Mines and Geology, v. 40, no. 1, p. 21, pl. 2. Consists of well-bedded metasediments, largely mica-schist. In Orocopia Mountains, in fault contact with Chuckwalla complex, considered older.

T. W. Dibblee, Jr., 1954, California Div. Mines Bull. 170, Chap. 2, p. 25. In eastern Mecca Hills, overlapped by Canebrake conglomerate (new).

Named for exposures in northwestern part of Orocopia Mountains, 5 or 6 square miles of which consist of the schist within Palm Springs-Blythe area, Riverside County.

Orocovis Limestone

Upper Cretaceous: Puerto Rico.

R. C. Mitchell, 1954, Puerto Rico Univ. Agr. Expt. Sta. Tech. Paper 13, p. 47, 48 (table 4). Limestone occurring in San Juan district and tentatively correlated with Guayama limestone in Coamo-Guayama district.

Orofino Series[1]

Precambrian (Belt Series): Northern Idaho.

Original reference: A. L. Anderson, 1930, Idaho Bur. Mines and Geology Pamph. 34.

C. P. Ross and J. D. Forrester, 1958, Idaho Bur. Mines and Geology Bull. 15, p. 5. Orofino series cannot be correlated with any part of Belt series farther north and must either be older than that series or belong to part of Prichard formation not exposed to north. Orofino series includes banded micaceous and hornblendic quartzite, schist, and gneiss with intercalated beds of marble.

Well exposed in Clearwater Canyon, near Orofino, the lower 11 miles of Orofino Creek in lower Canyon walls, and along lower course of North Fork between Elk Creek and Ahsahka.

Oro Grande Series[1]

Carboniferous: Southern California.

Original reference: O. H. Hersey, 1902, Am. Geologist, v. 29, p. 273–290.

W. J. Miller, 1946, Geol. Soc. America Bull., v. 57, no. 5, p. 503, table 4. Late Paleozoic strata (Mississippian?) are represented in Victorville area by Oro Grande metasediments comprising thousands of feet of crystalline limestones and quartzites. Some poorly preserved fossils in the limestones. Locally interbedded with Sidewinder Valley metavolcanics.

O. E. Bowen, Jr., 1954, California Div. Mines Bull. 165, p. 16 (fig. 2), 23–34, pls. 1, 2, 3, 4, 6, 7, 8. Hersey's type section measured and described in detail. At type section, an unknown thickness has been eroded out or faulted off so that total thickness of 2,450 feet is not representative of true thickness; maximum thickness of 9,670 feet is in Shadow Mountain section; aggregate thickness 1,200 feet in Sidewinder Mountain where series consists of three members separated by probable unconformities. Unconformably underlies Permian Fairview Valley formation; intruded by Waterman gneiss (new). Miller believed the Oro Grande to be interbedded with Sidewinder Valley metavolcanics, but present study does not support this view. Carboniferous.

Type section: East slope Quartzite Mountains, 1 mile east of Oro Grande, San Bernardino County.

Oro Loma Formation

Pliocene, lower or middle: Southern California.

F. F. Davis and D. W. Carlson, 1952, California Jour. Mines and Geology, v. 48, no. 3, p. 212. Ora Loma formation consists of deep reddish-colored poorly consolidated silts, sands, and gravels. Stratigraphically between San Pablo and Tulare formation. Name credited to L. I. Briggs, Jr. (unpub. paper).

L. I. Briggs, Jr., 1953, California Div. Mines Bull. 167, p. 12 (fig. 2), 46–48, pls. 1, 2, 3. Described in Ortigalita Peak quadrangle. Anderson and Pack (1915, U.S. Geol. Survey Bull. 603) included in their Tulare(?) formation beds overlying San Pablo formation along front of Laguna Seca Hills which [beds] dip beneath valley alluvium at angles up to 40°, and flattish beds bordering Little Panoche Creek. Name Oro [Ora] Loma is given to the strata of Laguna Seca Hills. Oro Loma beds are folded with bedrock series, and Tulare strata extensively overlap all these units. Maximum thickness of about 300 feet occurs in vicinity of Oro Loma Creek. Type section designated; derivation of name given.

Type section: Along Oro Loma Creek, Ortigalita Peak quadrangle, which is mostly in Merced County. Continuously exposed for about 6 miles south of Rattlesnake Canyon.

Oronoco Formation

Precambrian or Cambrian: Central Virginia.

R. O. Bloomer and R. R. Bloomer, 1947, Jour. Geology, v. 55, no. 2, p. 94, 95. Variable thickness of both metamorphosed and unmetamorphosed conglomerate sandstone, tuff, and andesite. Underlies Catoctin formation; unconformably overlies Precambrian crystalline basement complex.

G. W. Stose and A. J. Stose, 1949, Geol. Soc. America Bull., v. 60, no. 2, p. 311. In central Virginia, a series of flows, tuffs, and arkoses has been described as Oronoco formation. At its type locality, this formation overlies the injection complex, is overlain by Catoctin basalt, and is equivalent to Swift Run tuff which had previously been named and mapped as far south as this part of Virginia. New name for formation is not warranted.

R. O. Bloomer, 1950, Am. Jour. Sci., 248, no. 11, p. 768–771. Name should be abandoned in favor of Swift Run which is its equivalent and has priority.

Occurs in northeastern part of Buena quadrangle. Named from Oronoco post office, Amherst County.

Oronto Group[1]

Precambrian: Northwestern Wisconsin.

Original reference: F. T. Thwaites, 1912, Wisconsin Geol. Nat. History Survey Bull. 25, p. 48.

S. A. Tyler and others, 1940, Geol. Soc. America Bull., v. 51, no. 10, p. 1474–1479. Group revised to include (ascending) Outer conglomerate, Nonesuch shale, and Freda sandstone. Underlies Bayfield group. Thickness as revised 13,550 feet. Thwaites (1912) included Eileen sandstone and Amnicon formation in Oronto group. Revision made on basis of lithological and heavy mineral evidence which suggests that Eileen sandstone belongs above Amnicon and includes beds on Middle River and Fish Creek sections which Thwaites classed as lower Orienta (in Bayfield group). Eileen sandstone, which resembles Bayfield group of sandstones, is probably basal Orienta, and Amnicon arkose is upper Freda. Thickness of Amnicon given by Thwaites—5,000 feet—is included in his estimate of thickness of Freda, and the 2,000 feet assigned to the Eileen is included in Orienta. Hence, 7,000 feet is eliminated from Thwaites' estimate of the section.

Named for exposures on Oronto Bay, Iron County.

Oro Plata Granite Porphyry

Tertiary: North-central Utah.

B. F. Stringham, 1942, Geol. Soc. America Bull., v. 53, no. 2, p. 275, pl. 1. Dense, buff, and massive. Phenocrysts of quartz, biotite, and feldspar never predominate over groundmass.

Near Oro mine, West Tintic Mining District [Juab County].

Oroville Beds[1]

Upper(?) Jurassic: Northern California.

Original reference: W. M. Fontaine, 1900, U.S. Geol. Survey 10th Ann. Rept., pt. 2, p. 342.

Occur near Oroville, Butte County.

Orr Formation[1]

Upper Cambrian: Western Utah.

Original reference: C. D. Walcott, 1908, Smithsonian Misc. Colln., v. 53, no. 1804, p. 9, 10.

C. B. Bentley, 1958, Brigham Young Univ. Research Studies, Geology Ser., v. 5, no. 6, p. 14–17, 40–42, 44–45, 48–50. In Wah Wah, Fish Springs, and House Ranges, divided into two formations, lower composed predominantly of limestone and in some places dolomite, and upper of shale and alternating shale and limestone. Name Orr retained for lower formation; name Dunderberg (extended from Nevada) applied to upper formation. Thickness 711 to 1,299 feet. Overlies Weeks formation and in some areas not distinguished from it.

Type locality: Orr Ridge, spur extending from main mass of Notch Peak, on south side of Weeks Canyon, House Range.

Ortega Formation

Tertiary: North-central New Mexico.

H. T. U. Smith, 1937, (abs.) Geol. Soc. America Proc. 1936, p. 103. Grades from talus breccia to conglomerate and sandstone; well-indurated: brick-red. Maximum thickness about 200 feet. Younger than Chicoma volcanic formation (new); older than Abiquiu tuff (new).

Occurs in Abiquiu quadrangle, Rio Arriba County.

Ortega Quartzite

Precambrian (Proterozoic): Central northern New Mexico.

Evan Just. 1937, New Mexico School Mines Bull. 13, p. 11, 13 (table 1), 21–22, 43, pls. 2, 3. Divisible into quartzitic and quartz-muscovite schistose phases. Essentially quartzite which is typically white to bluish gray. Includes Petaca schist phase, local conglomeratic phases, and several of Vallecitos rhyolites (new) in Petaca area, and Rinconada schist phase (new), and some of Picuris basalts particularly near base in Picuris area. Ranges from 2 to 5 miles in thickness. Lies above Hopewell series. Succeeded by Hondo slate in Picuris area.

Arthur Montgomery, 1953, New Mexico Bur. Mines Mineral Resources Bull. 30, p. 6–21, pl. 1. Formation consists of three members: quartzite member which has no exposed base, Rinconada schist member, and Pilar phyllite member (new). Estimated thickness in Picuris Range 6,600 feet.

Fred Barker, 1958, New Mexico Bur. Mines Mineral Resources Bull. 45, p. 10 (table 2), 11–14, pl. 1. Redefined to include only quartzite that is stratigraphically equivalent to quartzite in Ortega Mountains (cited as Just's type area) and to overlying quartzite that extends up to, but does not include Big Rock conglomerate (new). Petaca schist mapped separately.

Widely exposed in Petaca area, including Ortega Mountain type area, and in Picuris area, Rio Arriba and Taos Counties.

Ortigalita Sandstone Member (of Ciervo Shale)

Upper Cretaceous: Central California.

M. B. Payne, 1960, Soc. Econ. Paleontologists and Mineralogists, Pacific Sec., Guidebook Spring Field Trip, p. 5 (fig. 3), 6 (fig. 4), 7 (fig. 5), 13 (fig. 6). Brownish-green sandstone 570 feet thick. Occurs 600 feet below top of Ciervo formation (new). Name credited to D. W. Sutton (unpub. thesis).

Type locality: Papanatas Canyon, Fresno County. Name derived from Ortigalita Peak, in south-central sec. 18, T. 13 S., R. 10 E.

Ortigalita Creek Conglomerate

Upper Cretaceous: Western California.

L. I. Briggs, Jr., 1953, California Div. Mines Bull. 167, p. 31. Mentioned in discussion of Panoche formation in Ortigalita Peak quadrangle.

Orting Glaciation, Drift

Orting Gravel[1]

Pleistocene: Western Washington.

Original reference: B. Willis, 1898, Geol. Soc. America Bull., v. 9, p. 111.

J. E. Sceva, 1957, U.S. Geol. Survey Water-Supply Paper 1413, p. 15, pl. 1. Described in Kitsap County. Subdivided into two members, lower (unnamed) and Kitsap clay. Thickness about 500 feet. Unconformably overlies Admiralty drift; underlies Puyallup sand.

D. R. Crandell, D. R. Mullineaux, and H. H. Waldron, 1958, Am. Jour. Sci., v. 256, no. 6, p. 384–397. Restudy of Pleistocene deposits in Puget Sound lowland resulted in refinement and expansion of sequence described by Willis (1898). Willis' sequence of two glaciations (Admiralty and Vashon) and single interglacial interval (Puyallup) is replaced by four glaciations separated by nonglacial intervals. Stratigraphic section consists of Orting drift (oldest), Alderton formation (nonglacial), Stuck drift, Puyallup formation (nonglacial), Salmon Springs drift, and Vashon drift. Section of Orting drift designated as typical by Willis restudied and redescribed. Thickness measured section A is more than 165 feet; measured section B is more than 138 feet. Orting drift overlies deeply weathered sedimentary and volcanic rocks.

Typical section: SE¼SE¼ sec. 29, T. 19 N., R. 5 E., on east bank of Carbon River, at Orting, Pierce County.

Orton Gravels

Pleistocene: Central South Dakota.

B. C. Petsch and E. J. Bolin, 1950, Areal geology of the Fort Bennett quadrangle (1:62,500): South Dakota Geol. Survey; E. H. Stevens and J. M. Wilson, 1952, Areal geology of the No Heart quadrangle (1:62,500): South Dakota Geol. Survey. Sands and gravels of western origin containing considerable white chert and broken agate.

Mapped in Stanley County.

Ortonville Granite (in Minnesota Valley Granite Series)

Precambrian: Southwestern Minnesota.

E. H. Lund, 1956, Geol. Soc. America Bull., v. 67, no. 11, p. 1482, 1485. Variable in texture, color, and structure. Commonly red but locally pinkish gray. Texture ranges from medium granitoid to coarse porphyritic with aligned phenocrysts; pink pegmatites present in many areas. Crops out northwest of Montevideo granite (new).

Term Ortonville granite was used as trade name for dark-red granite quarried near town of Ortonville, Minn. (*See* E. F. Burchard, 1910, U.S. Geol. Survey Bull. 430; O. Bowles, 1918, U.S. Geol. Survey Bull. 663).

Principal outcrops lie between Odessa and Ortonville, Big Stone County. Same rock type crops out over large area southeast of Milbank, S. Dak.

Orwell Limestone

Middle Ordovician (Black River-Trenton): West-central Vermont.

W. M. Cady, 1945, Geol. Soc. America Bull., v. 56, no. 5, p. 524, 556–557. Massive heavy-ledged rather fine-textured black limestone, weathering light dove gray, cut through by innumerable white calcite veins. Discontinuous black chert beds occur in the limestone. Maximum thickness over 50 feet. Underlies Glens Falls limestone; overlies Middlebury limestone (new).

Named for extensive outcrops in southeastern part of Orwell Township, Addison County.

Osage Lens (in Newcastle Formation)

Upper Cretaceous: Northeastern Wyoming.

R. M. Grace, 1952, Wyoming Geol. Survey Bull. 44, p. 14, 15. Predominantly shale and siltstone. Maximum thickness 70 feet near Osage. A point in sec. 31, T. 46 N., R. 62 W., near Pedro is arbitrarily taken as division between Newcastle lens (new) and Osage.

Named for exposures near Osage, Weston County.

†Osage Limestone[1]

Lower Ordovician (Beekmantown): Central Missouri.

Original reference: A. Winslow, 1894, Missouri Geol. Survey, v. 6, p. 331, 366, 375.

Named for Osage Bluff, Cole County.

†Osage Limestone (in Shawnee Formation)[1]

Pennsylvanian: Eastern Kansas.

Original reference: J. G. Hall, 1898, Kansas Univ. Geol. Survey, v. 3, p. 71.

Named for exposures at Osage City, Osage County.

Osage Series

Osage Group[1]

Lower Mississippian: Mississippi Valley region.

Original reference: H. S. Williams, 1891, U.S. Geol. Survey Bull. 80, p. 169.

R. C. Moore, 1933, Historical Geology: New York, McGraw-Hill Book Company, p. 262–264. Valmeyer series (new) includes Osage group below and Meramec group above.

K. E. Born, 1936, Tennessee Div. Geology, Resources of Tennessee, 2d ser., p. 33. Osage series in Tennessee includes (ascending) New Providence formation, Grainger shale, and Fort Payne chert.

J. M. Weller, 1939, Kansas Geol. Soc. Guidebook 13th Ann. Field Conf., p. 131, 132–133. Osage group, Valmeyer series, includes (ascending) Fern Glen limestone, Keokuk limestone, and Burlington limestone. Underlies Meramec group; overlies Kinderhook series.

J. M. Weller and A. H. Sutton, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 5, p. 766 (fig. 1), 771, 777–778. Iowa series includes (ascending) Kinderhook, Osage, and Meramec groups. Osage group comprises (ascending) Fern Glen, Burlington, Keokuk, and Warsaw. This classification follows Illinois Geological Survey usage. Authors favor raising Kinderhook to rank of series and including Osage and Meramec groups in Valmeyer series.

L. R. Laudon, 1948, Jour. Geology, v. 56, no. 4, p. 288–302. Discussion of Osage-Meramec contact. Problems concerning contact cannot be solved at type sections of either Osage or Meramec series because both type sections are incomplete. At type section of Osage, the Upper Burlington, Keokuk, Salem, and St. Louis formations are all missing. Upper Burlington and Keokuk beds are exposed at other places in west-central Missouri, the Warsaw and Salem formations are not represented at all, and the St. Louis is known only from one small area. At type section of Meramec series, beds of Osage age are not exposed. In the vicinity, beds of Keokuk, Burlington, Reeds Spring, and Fern Glen age are exposed, but the Warsaw is not represented. If distribution of Osage rocks is compared with distribution of Meramec rocks, an important break between the two series is suggested. Analysis of ranges of fossils within Mississippian rocks reveals one of most remarkable faunal breaks in whole Paleozoic sequence at end of Osage series.

J. M. Weller and others, 1948, Geol. Soc. America Bull., v. 59, no. 2, p. 98 (fig. 1), 99–100, chart 5. In this report, the Mississippian is subdivided into (ascending) Kinderhookian, Osagean, Meramecian, and Chesterian series. In standard section, Osagean comprises (ascending) Fern Glen, Burlington, and Keokuk. Occurs above Easley group (new) of Kinderhookian series. Disagreement exists regarding boundary between Meramecian and Osagean, and current usage is not consistent. Indiana, Iowa, and Illinois Geological Survey classify the Warsaw with the Osagean, while U.S. Geological Survey and Missouri Geological Survey include it in the Meramecian. Uncertainty also exists regarding Osagean-Kinderhookian boundary. This question involves consideration of three formations: Fern Glen, Sedalia, and Gilmore City.

C. P. Kaiser, 1950, Am. Assoc. Petroleum Geologists Bull., v. 34, no. 11, p. 2157–2171. At time Williams introduced term Osage, no geographic location was given for derivation of name. Keyes (1893, Iowa Geol. Survey, v. 1) stated that Williams suggested title "Osage" from name of river in southwestern Missouri which cuts through some of lower Carboniferous series in St. Clair County. Keyes also stated that most typical section of Osagian rocks is exposed at Osceola, in St. Clair County. Osceola is in deepest part of an east-west structural basin, and maximum Osage section along Osage River is present. Lower two-thirds of Burlington limestone is only part of Osagian represented in Osceola area. Most complete section is at Hunt-Bullard quarry about 1 mile west of town in NE¼NW¼SE¼ sec. 18, T. 38 N.. R. 25 W. Lowest beds are exposed in railroad cut in town of Osceola 2 blocks east of dam across Osage River. No rocks of Keokuk age are present in Osceola area. Hence type section was not well chosen. Nevertheless, term Osagian has gained wide acceptance and should continue to be used. Area south of Osage River in southwestern Missouri, northwestern Arkansas, and northeastern Oklahoma contains nearly complete sequence of Osagian rocks. St. Joe and Reeds Spring limestones occur below Burlington limestone, and are now referred to Osagian series. Keokuk and Warsaw formations above the Burlington are included in Osagian series. No single locality in this area exhibits complete sequence of all five formations.

L. E. Workman and Tracey [Tracy] Gillette, 1956, Illinois Geol. Survey Rept. Inv. 189, p. 8 (fig. 1). In some areas Osage group, Valmeyer series, occurs above North Hill group of Kinderhook series.

H. R. Wanless, 1957, Illinois Geol. Survey Bull. 82, p. 28 (fig. 9), 44–47. In Beardstown, Glasford, Havana, and Vermont quadrangles, Osage group, Valmeyer series, comprises Burlington, Keokuk, and Warsaw formations. Overlies Hannibal group of Kinderhook series; underlies Meramec group.

Named for Osage River, Mo., along which Burlington limestones are exposed in vicinity of Osceola, St. Clair County.

†Osage City Limestone[1]

Pennsylvanian: Eastern Kansas.

Original reference: J. G. Hall, 1896, Kansas Univ. Geol. Survey, v. 1, p. 104.

Crops out 6 miles southeast of Burlingame, Osage County.

†Osage City Shale (in Shawnee Formation)[1]

Pennsylvanian: Eastern Kansas.

Original references: E. Haworth, 1895, Kansas Univ. Quart., v. 3, p. 278, pl. 20; 1895, Am. Jour. Sci., 3d, v. 50, p. 461–462.

Named for exposures at Osage City, Osage County.

Osagian (Osagean) Series, Stage

See **Osage Series.**

†Osborne Limestone[1]

Upper Cretaceous: Central northern Kansas.

Original reference: F. W. Cragin, 1896, Colorado Coll. Studies, v. 6, p. 51.

Named for exposures at Osborne and in Osborne County.

Oscar Sandstone[1]

Pennsylvanian: Central southern Oklahoma.

Original reference: J. R. Bunn, 1930, Oklahoma Geol. Survey Bull. 40PP, p. 11.

Exposed at and near town of Oscar, Jefferson County.

Osceola Amygdaloid[1] (in Portage Lake Lava Series)

Precambrian (Keweenawan): Northern Michigan.

Original reference: L. L. Hubbard, 1894, Lake Superior Min. Inst. Proc. 2d Ann. Mtg., p. 79–96.

H. R. Cornwall, 1954, U.S. Geol. Survey Geol. Quad. Map GQ–34. Included in Portage Lake lava series.

Named for occurrence in Osceola mine, Houghton County.

Osceola Clay[1]

Pleistocene (Wisconsin): Western Washington.

Original reference: B. Willis, 1898, Geol. Soc. America Bull., v. 9, p. 111.

Occurs in bluffs which form northern bank of Carbon River, 2 or 3 miles below Carbonado, Pierce County.

Osceola Flow[1] (in Portage Lake Lava Series)

Precambrian (Keweenawan): Northern Michigan.

Original reference: B. S. Butler and W. S. Burbank, 1929, U.S. Geol. Survey Prof. Paper 144 (chart compiled by M. G. Wilmarth).

W. S. White, H. R. Cornwall, and R. W. Swanson, 1953, U.S. Geol. Survey Geol. Quad. Map GQ–27. Included in Portage Lake lava series.

Occurs in Osceola mine, Houghton County.

†Osceola Glacial Drift[1]

Pleistocene (Wisconsin): Western Washington.

Original reference: Bailey Willis, 1898, Geol. Soc. America Bull., v. 9, p. 111.

D. R. Crandell and H. H. Waldron, 1954, (abs.) Soc. America Bull., v. 65, no. 12, pt. 2, p. 1337. Unit termed Osceola till by Willis (1898) is now believed to be Recent mudflow.

Named for occurrence in vicinity of Osceola, near Mt. Rainier.

Osceola Mudflow

Recent: Western Washington.

D. R. Crandell and H. H. Waldron, 1956, Am. Jour. Sci., v. 254, no. 6, p. 349–362. Osceola till of Willis (1898) is herein redefined as Osceola mudflow. Flow is of Recent age and is restricted in geographic distribution to Mount Rainier and adjoining part of Puget Sound lowland in vicinity of White River. Thickness 75 feet at typical section. Maximum thickness 350 feet. Overlies stratified drift of Vashon age.

Typical section: In gully in northeast valley wall of White River about 3½ miles west of Enumclaw. Gully is in NE¼SE¼ sec. 29, T. 20 N., R. 6 E., and is about 0.2 mile west of intersection of Wilson Road and Barker Road.

Oscuro limestone[1]

Pennsylvanian: New Mexico.

Original reference: C. R. Keyes, 1909, Iowa Acad. Sci. Proc., v. 16, p. 159–163.

In Rio Grande region. Derivation of name not stated.

Osgood Formation[1] or Shale[1]

Osgood Formation (in Clinton or Wayne Group)

Osgood Limestone Member (of Bainbridge Formation)

Osgood Member (of Alger Formation)

Middle Silurian: Southern Indiana, west-central Kentucky, southeastern Missouri, and central Tennessee.

Original reference: A. F. Foerste, 1896, Cincinnati Soc. Nat. History Jour., v. 18, p. 191–192.

Wilber Stout, 1941, Ohio Geol. Survey, 4th ser., Bull. 42, p. 35, table facing p. 46. In Ohio, considered member of Alger formation. Underlies Laurel member; overlies Dayton formation. Thickness 10 to 80 feet; average 45. Blue-gray calcareous shale with layers of dolomite.

J. R. Ball, 1942, Am. Assoc. Petroleum Geologists Bull., v. 26, no. 1, p. 7–9. Osgood limestone geographically extended into southeastern Missouri where it is considered member of Bainbridge formation; underlies Laurel member. Argillaceous limestone in thin to medium beds.

C. W. Wilson, Jr., 1949, Tennessee Div. Geology Bull. 56, p. 244–248. Osgood formation included in Wayne group. Unconformably overlies Brassfield limestone and conformably grades into overlying Laurel limestone. Composed largely of gray sometimes bluish and sometimes greenish calcareous shale; locally may contain one or more beds of almost silt-free limestone; in western valley, basal few feet are red, and locally entire formation is red. Thickness 10 to 20 feet.

J. B. Patton, T. G. Perry, and W. J. Wayne, 1953, Indiana Geol. Survey Field Conf. Guidebook 6, pl. 1. In Indiana Osgood formation underlies Laurel formation and overlies Brassfield formation. Consists of tan dense argillaceous limestone, and light-gray calcareous shale. Thickness 13 to 23 feet. In Clinton group.

R. J. Bernhagen, chm., 1960, Ohio Acad. Sci. Geology Sec. Guidebook 35th Ann. Field Conf., p. 17. Silurian section in Yellow Springs region shows Osgood shale, 25 feet thick, above Dayton limestone and below Laurel dolomite.

Named for Osgood, Ripley County, Ind.

Osgood Mountain Quartzite

Lower Cambrian(?): North-central Nevada.

H. G. Ferguson, S. W. Muller, and R. J. Roberts, 1951, Geology of the Winnemucca quadrangle, Nevada: U.S. Geol. Survey Geol. Quad. Map [GQ–11]; 1952, Geology of the Golconda quadrangle, Nevada: U.S. Geol. Survey Geol. Quad. Map [GQ–15]. White quartzite, somewhat micaceous, in upper part interbedded with quartz mica schist. Thickness at type locality 5,000 feet. Base not exposed. Underlies Preble formation (new). In thrust contact with other Paleozoic formations.

Type locality: Osgood Mountains, Golconda quadrangle.

Oshawanan series[1]

Lower Mississippian: Southern Illinois.

Original reference: C. R. Keyes, 1931, Pan-Am. Geologist, v. 55, p. 45, 50, 222.

Named for "the old name Oshawano Mountains, which was once applied to the easternmost folds of the Ozark uplift, on the flanks of which the complete section reclines."

Osier Mountain Welded Tuff Member (of Treasure Mountain Rhyolite)

Miocene, upper: Northwestern New Mexico.

W. R. Muehlberger and others, 1960, New Mexico Geol. Soc. Guidebook 11th Field Conf., p. 100, 101. Rhyolite near quartz latite in composition. Light gray to medium light gray at top; grades to pale red at base. Thickness 54 feet. Overlies Lagunitas clastic member (new). Name credited to E. L. Trice (unpub. thesis).

Crops out in Chama area, northern Rio Arriba County.

Osila Sand

Cretaceous or Eocene(?): Southern California.

F. C. Hodges and E. R. Murray-Aaron, 1943, California Oil Fields, v. 29, no. 1, p. 14, pl. 6. Shown as both surface and subsurface on structure section of Aliso Canyon oil field. Surface section occurs above Santa Susana fault. Wells have found approximately 400 to 1,900 feet of Osila depending on structural position.

C. E. Leach, 1948, *in* Structure of typical American oil fields: Tulsa, Okla., Am. Assoc. Petroleum Geologists, v. 3, p. 34. There is definite evidence for age of Osila above fault block, but its lithologic character and its position in stratigraphic section are similar to undifferentiated Eocene and Cretaceous section below fault.

Aliso Canyon field is in eastern part of Santa Susana Mountains, approximately 30 miles northwest from center of Los Angeles.

Oskaloosa Shale Member (of Deer Creek Limestone)[1]

Pennsylvanian (Virgil Series): Eastern Kansas, southwestern Iowa, and northwestern Missouri.

Original references: R. C. Moore, M. K. Elias, and N. D. Newell, 1934. Stratigraphic sections of Pennsylvanian and "Permian" rocks of Kansas River valley: Kansas Geol. Survey, issued Dec.; R. C. Moore, 1935, Rock formations of Kansas *in* Kansas Geol. Soc. Wichita, Kans. [Am. Assoc. Petroleum Geologists 20th Ann. Mtg., Mar. 21–23]; G. E. Condra, 1935, Nebraska Geol. Survey Paper 8, p. 12.

F. G. Greene and W. V. Searight, 1949, Missouri Geol. Survey and Water Resources Rept. Inv., p. vii, 17. Columnar section shows Oskaloosa shale member above Ozawkie limestone member and below Rock Bluff limestone member. [Text does not discuss unit in Missouri.]

R. C. Moore and others, 1951, Kansas Geol. Survey Bull. 89, p. 65. Consists of bluish- or yellowish-gray shale in northern Kansas and sandy micaceous shale containing red zone and some nodular limestone in southern part of state. Thickness ranges from minimum of 3 feet to maximum of about 50 feet locally in Osage County. Overlies Ozawkie limestone member; underlies Rock Bluff limestone member.

H. G. Hershey and others, 1960, Iowa Highway Research Board Bull. 15, p. 18, fig. 5. Greenish-gray blocky 6-foot interval in quarry south of Pacific Junction, E½NW¼NW¼ sec. 15, T. 71 N., R. 43 W., Mills County, has been identified as Oskaloosa shale. Not recognized over greater part of area if this report [southwestern Iowa]. Underlies Rock Bluff limestone member; overlies Ozawkie limestone member.

Type locality: Vicinity of Oskaloosa, Jefferson County, Kans.

Oso beds (in Chuaran series)

Precambrian: Northern Arizona.

Charles Keyes, 1938, Pan-Am. Geologist, v. 70, no. 2, p. 107 (chart), 112. Sandstones and shaly sandstones. Thickness 500 feet. Underlie Venus formation (new); overlie Jupiter shales (new).

Crop out prominently in Oso Gorge, a side-canyon reaching from Marble Canyon into Kwagunt Valley; Grand Canyon region.

Oso Member (of Capistrano Formation)

Miocene, upper, and Pliocene, lower: Southern California.

J. G. Vedder, R. F. Yerkes, and J. E. Schoellhamer, 1957, U.S. Geol. Survey Oil and Gas Inv. Map OM–193. Consists mainly of white friable coarse-grained feldspathic sandstone and grit, which are massive and poorly bedded. Member represents coarse sandy facies of Capistrano formation and grades laterally into typical sandy siltstone of Capistrano south of Arroyo Trabuco. Attains thickness of about 1,500 feet along Serrano Creek. Between Agua Chinon Wash and Borrego Canyon, the Oso rests conformably on Soquel member of Puente formation and is unconformably overlain by Niguel formation (new). Between Oso Creek and Arroyo Trabuco, the Oso rests unconformably on Monterey shale and is overlain by and interfingers with typical lithology of Capistrano.

Type area: Between Agua Chinon Wash and Oso Creek, approximately 2½ miles east of village of El Toro. Named for creek that lies between Aliso Creek and Arroyo Trabuco.

Osobb Formation

Upper Triassic: North-central Nevada.

S. W. Muller, H. G. Ferguson, and R. J. Roberts, 1951, Geology of the Mount Tobin quadrangle, Nevada: U.S. Geol. Survey Geol. Quad. Map [GQ–7]. Quartzitic sandstone, shale, and some lenses of limestone and dolomite. Sandstone markedly crossbedded; some limestone and dolomite of bioclastic origin. Exposed thickness about 2,000 feet. Conformably overlies Cane Spring formation (new).

Type locality: Southwest slope of Augusta Mountain in north end of Dixie Valley (Osobb Valley of Fortieth Parallel survey).

Osos Basalt[1]

Jurassic(?): Western California.

Original reference: H. W. Fairbanks, 1904, U.S. Geol. Survey. Atlas, Folio 101.

Named for outcrops in Los Osos Valley, San Luis Obispo County.

Osoyoos Granodiorite[1]

Mesozoic: North-central Washington, and southern British Columbia, Canada.

Original reference: R. A. Daly, 1906, Geol. Soc. America Bull., v. 17, p. 329–376.

A. C. Waters and Konrad Krauskopf, 1941, Geol. Soc. America Bull., v. 52, no. 10, pl. 1. Mapped in north-central Washington. Roughly contemporaneous with Colville batholith. Mesozoic.

Occurs in vicinity of Osoyoos Lake. Extends across international boundary.

Ost Limestone Member (of Tecumseh Shale)[1]

Pennsylvanian (Virgil Series): Southeastern Nebraska and southwestern Iowa.

Original reference: G. E. Condra, 1930, Nebraska Geol. Survey Bull. 3, 2d ser., p. 47, 52.

G. E. Condra, 1949, Nebraska Geol. Survey Bull. 16, p. 23. Thickness 2 to 4 feet. Underlies Rakes shale member; overlies Kenosha shale member. Does not persist very far into Kansas.

H. G. Hershey and others, 1960, Iowa Highway Research Board Bull. 15, p. 19, fig. 5. Recognized near Thurman, Fremont County, where it consists of two limestone beds separated by greenish-gray argillaceous shale that is about 1½ feet thick. Upper limestone is light gray, with fossil fragments of *Osagia*, and is little more than 1 foot thick; lowermost bed is brownish gray and massive and about 2.5 feet thick. Underlies Rakes Creek shale member; overlies Kenosha shale member.

Type locality: On Ost Farm on South Branch, Weeping Water Creek, 3½ miles east of Avoca, Cass County, Nebr.

Ostrander Member (of Dakota Formation)

Lower Cretaceous: Southeastern Minnesota.

C. R. Stauffer and G. A. Thiel, 1941, Minnesota Geol. Survey Bull. 29, p. 103–104, 148. Consists of gravel, sand, clay and iron conglomerate; gravels commonly yellow-stained and poorly sorted; sands vary from coarse to fine; crossbedding common. Thickness at type locality about 21½ feet. Overlies post-Devonian erosion surface; underlies glacial drift. In Minnesota, replaces name Windrow formation, type locality of which is in Wisconsin.

G. W. Andrews, 1958, Jour. Geology, v. 66, no. 6, p. 599. Unit termed Ostrander member of Dakota formation by Stauffer and Thiel (1941) is here defined as East Bluff member of Windrow formation.

Type locality: Carthog gravel pit in SE¼ sec. 29, T. 102 N., R. 13 W., at south end of village of Ostrander, Fillmore County; supplementary locality: On the Frank Farnhill Farm, SE¼ sec. 20, Bloomfield Township, Fillmore County.

Oswaldo Formation (in Magdalena Group)[1]

Pennsylvanian: Southwestern New Mexico.

Original reference: A. C. Spencer and S. Paige, 1935, U.S. Geol. Survey Bull. 895.

M. L. Thompson, 1942, New Mexico Bur. Mines Mineral Resources Bull. 17, p. 23. Studies in Silver City-Santa Rita area show that Oswaldo and Syrena formations each include parts of at least two series of Pennsylvanian and not useful as stratigraphic units.

P. F. Kerr and others, 1950, Geol. Soc. America Bull., v. 61, no. 4, p. 281 (fig. 3), 283 (fig. 5), 284. Discussed in report on hydrothermal alteration at Santa Rita. Divided into (ascending) Parting shale, Middle Blue limestone, and Upper Blue limestone members. Overlies Hanover limestone here included in upper part of Lake Valley limestone. Underlies Mountain Home shale, lower member of Syrena limestone.

Named for Oswaldo patented mining claim, about 1 mile south of Hanover post office, Santa Rita district.

Oswayo Formation[1]

Oswayo Formation (in Conewango Group)

Oswayo Formation (in Susquehanna Group)

Devonian: Southwestern New York and northern Pennsylvania.

Original reference: L. C. Glenn, 1903, New York State Mus. Bull. 69, p. 978–989, map.

J. G. Woodruff, 1942, New York State Mus. Bull. 326, p. 63–67. Formation (or monothem) described in Wellsville quadrangle. Thickness about 150 feet. Base is about 200 feet above Salamanca conglomerate member of Cattaraugus.

I. H. Tesmer, 1954, Hobbies, v. 35, no. 2, p. 30, 33. Described in Chautauqua County, N.Y., where it is middle formation of Conewango group. Overlies Cattaraugus formation; underlies Knapp formation. Thickness about 100 feet. Upper Devonian.

Carlyle Gray and others, 1960, Geologic map of Pennsylvania (1:250,000): Pennsylvania Geol. Survey, 4th ser. Unit mapped as Oswayo in western part of State consists of greenish-gray to gray shales, siltstones, and sandstones becoming increasingly shaly westward; considered equivalent to type Oswayo. Overlies Cattaraugus formation. In central and eastern part of State, consists of brownish- and greenish-gray, fine- and medium-grained sandstones with shales and scattered calcareous lenses; includes red shales which become more numerous eastward. Relation to type Oswayo not proved. Overlies Catskill formation. Included in Susquehanna group. Upper Devonian.

Named for exposures in vicinity of Oswayo Creek, Cattaraugus County, N.Y.

†Oswegatchie Series[1]

Precambrian: Northern New York.

Original reference: C. H. Smyth, Jr., 1894, New York State Mus. 47th Ann. Rept., p. 687–692.

Oswegatchie River flows through these rocks for many miles in St. Lawrence and Jefferson Counties.

†Oswego Limestone[1]

Pennsylvanian: Eastern Kansas.

Original reference: E. Haworth and M. Z. Kirk, 1894, Kansas Univ. Quart., v. 2, p. 105–107, 116.

Named for Oswego, Labette County.

Oswego Sandstone[1]

Upper Ordovician: New York, Pennsylvania, and Virginia, and Ontario, Canada.

Original reference: C. S. Prosser, 1888, Am. Inst. Mining Engineers Trans., v. 16, p. 946. Emmons and Vanuxem referred to unit as "Gray sandstone of Oswego" (see Wilmarth Lexicon); hence Prosser's term is first formal usage.

Charles Butts and E. S. Moore, 1936, U.S. Geol. Survey Bull. 855, p. 45–47, pls. 1, 3. In Bellefonte quadrangle, Pennsylvania, Oswego sandstone is nonfossiliferous formation of thick-bedded greenish-gray iron-speckled somewhat arkosic sandstone. Thickness 800 feet. Overlies *Orthorhynchula* zone at top of Reedsville shale; underlies Juniata formation.

Bradford Willard and A. B. Cleaves, 1939, Geol. Soc. America Bull., v. 50, no. 7, p. 1174. Term Oswego has been misapplied in Pennsylvania. There is probably little or no true Oswego in the state. For beds commonly referred to as Oswego, the term Bald Eagle is revived and treated as basal Juniata.

H. B. Woodward, 1951, West Virginia Geol. Survey, v. 21, p. 376–387. Crops out in West Virginia in two belts: (1) eastern outcrop in Berkeley, Morgan, Hampshire, and Hardy Counties, and (2) western belt in Grant and Pendleton Counties. Fails to reach surface of Mineral County and is absent in all geologic sections elsewhere in State. As described herein, the Oswego is considered to be of late Ordovician (Maysville or Richmond) age. Oswego of this report has been called "Gray Medina sandstone" by West Virginia Geological Survey. Thickness as much as 350 feet. Not certain that term Bald Eagle sandstone, revived for use in Pennsylvania by Willard and Cleaves, is appropriate for use in West Virginia.

W. B. Brent, 1960, Virginia Div. Mineral Resources Bull. 76, p. 11 (table 1), 41–42. Described in Rockingham County, where it is 300 to 600 feet thick; underlies Juniata formation and overlies Martinsburg shale. In some areas, in fault contact with Martinsburg. Upper Ordovician.

Named for Oswego County, N.Y.

Otero Formation[1]

Tertiary(?): Southeastern New Mexico.

Original reference: C. L. Herrick, 1904, Am. Geologist, v. 34, p. 179, 186.

Derivation of name not stated, but report in which it is described is on Lake Otero, ancient salt-lake basin in southeastern New Mexico between Sacramento and San Andres Mountains.

Otero limestone[1]

Permian: Western Texas.

Original reference: C. R. Keyes, 1936, Pan-Am. Geologist, v. 65, no. 1, p. 39, 42, 46.

In Guadalupe Mountains. Derivation of name not stated.

Otero Mesa Member (of Yeso Formation)

Lower Permian (Leonard Series): Central southern New Mexico.

G. O. Bachman and P. T. Hayes, 1958, Geol. Soc. America Bull., v. 69, no. 6, p. 696 (fig. 4), 698. At type section, consists of 168 feet of red to maroon shale and resistant ledges of reddish-brown to tan cross-laminated sandstone. Lies conformably on poorly exposed sequence of gypsum, gray shale, and thin-bedded dolomite about 50 feet thick, which is designated as basal part of formation. Overlain by poorly exposed sequence of gypsum, pink shale, and fine-grained sandstone. Unit has been considered part of Abo sandstone by various workers.

Type section: In westward-facing cuesta in S½ sec. 17, T. 21 S., R. 11 E., about 5 miles south of Culp Canyon, Otero County. Named for exposures at base of Otero Mesa.

†Otis Limestone[1]

Precambrian: Massachusetts.

Original reference: B. K. Emerson, 1899, U.S. Geol. Survey Bull. 159, p. 54, 57.

Exposed at Otis and vicinity, in eastern Berkshire County.

Otis Limestone[1] Member (of Wapsipinicon Formation)

Middle Devonian: Central eastern Iowa.

Original reference: W. H. Norton, 1894, Iowa Acad, Sci. Proc., v. 1, pt. 4, p. 22–24.

E. H. Scobey, 1940, Jour. Sed. Petrology, v. 10, no. 1, p. 38 (fig. 1), 41–42. Term Otis is applied to some thin- to medium-bedded limestones and dolomites that occur between Coggon belowand Kenwood members. Not exposed north of Linn County; in Fayette County, has been cut off by overlap and Spring Grove member rests directly on Silurian. Age shown on chart as Middle Devonian(?).

Named for railway junction of Otis, east of Cedar Rapids, Linn County.

Otisco Member[1] (of Ludlowville Formation)

Middle Devonian: Central New York.

W. A. Oliver, Jr., 1951, Am. Jour. Sci., v. 249, no. 10, p. 708, 709–713, fig. 6 (facing p. 724). Includes two named coral beds: Staghorn Point submember in lower part and Joshua submember (new) in upper part. Coral beds interfinger laterally with surrounding shale; upper and lower contacts sharply defined except in fringing areas where complete gradation into normal shales may occur. Overlies Centerfield member.

Type section: In Millers Place ravine on west side of Otisco Lake, 1 mile northwest of the causeway, Skaneateles quadrangle.

Otisville Shale Member (of Shawangunk Formation)[1]

Silurian: Southeastern New York.

Original reference: C. K. Swartz and F. M. Swartz, 1931, Geol. Soc. America Bull., v. 42, p. 651, 652, 656, 660.

At Otisville, Orange County.

Otoe Member (of Wellington Formation)

Permian: North-central Oklahoma.

G. O. Raasch, 1941, (abs.) Geol. Soc. America Bull., v. 52, no. 12, pt. 2, p. 1928. Thickness 115 feet. Underlies Midco (lacustrine) member (new); overlies 190-foot anhydrite sequence.

Type locality and derivation of name not stated.

Otoe Shale Member (of Friedrich Formation)

Pennsylvanian (Virgil Series): Northeastern Kansas and southeastern Nebraska.

G. E. Condra and E. C. Reed, 1938, Nebraska Geol. Survey Paper 12, p. 9. Defined as uppermost member of formation. Overlies Palmyra limestone member (new).

G. E. Condra, 1949, Nebraska Geol. Survey Bull. 16, p. 14. Consists of shale, grayish above and reddish below. Thickness about 7½ feet.

Type locality: In ravine tributary to South Table Creek, 2½ miles southwest of Nebraska City, NW¼SW¼ sec. 20, T. 8 N., R. 14 E., Otoe County, Nebr.

Otsego Member (of Marcellus Shale)[1]

Middle Devonian: Eastern New York.

Original reference: G. A. Cooper, 1933, Am. Jour. Sci., 5th, v. 26, p. 544, 548.

G. A. Cooper and others, 1942, Geol. Soc. America Bull., v. 53, no. 12, pt. 1, chart 4. Otsego shale and sandstone shown on correlation chart above Mount Marion shale and sandstone and below Ashokan sandstone.

Type section: In "Dugway" on east side of Otsego Lake, Berne quadrangle.

Otselic Shale and Sandstone[1]

Upper Devonian: Central New York.

Original references: J. M. Clarke (Otselic flags), 1899, New York State Geologist Ann. Rept. 1896, p. 35; 1903, New York State Mus. Handb. 19, p. 24, chart.

W. L. Grossman, 1944, Geol. Soc. America Bull., v. 55, no. 1, p. 72. Ithaca is divided into Otselic member below and Cincinnatus member by Clarke (1903) from vicinity of De Ruyter eastward to Chanango [Chenango] Valley. The projected Genesee group includes the beds to top, or nearly so, of Otselic division in this area.

Well exposed along Otselic River in Chenango and Cortland Counties.

Otsquago Sandstone[1]

Silurian: East-central New York.

Original reference: G. H. Chadwick, 1918, Geol. Soc. America Bull., v. 29, p. 327–368.

D. W. Fisher and L. V. Rickard, 1953, New York State Mus. Circ. 36, p. 8, 10, 13, fig. 1. Overlies Oneida formation; occurs 25 to 30 feet below Bryman shale.

Typically exposed in and near Otsquago Creek below Vanhornsville, Herkimer County.

Ottauquechee Formation[1]

Ottauquechee Group

Middle Cambrian: East-central and west-central Vermont.

Original reference: E. L. Perry, 1927, Vermont State Geologist 15th Rept., p. 161.

H. E. Hawkes, Jr., 1941, Geol. Soc. America Bull., v. 52, no. 5, p. 655 (fig. 2), 656. Referred to as group. Occurs above Pinney Hollow schist and below Bethel schist and Missisquoi group.

P. H. Osberg, 1952, Vermont Geol. Survey Bull. 5, p. 61–65, geol. map. Formation described in eastern sequence in Green Mountain anticlinorium near Rochester and East Middlebury. Overlies Pinney Hollow formation; underlies Stowe formation (new). Approximate thickness ranges from 1,800 to 2,500 feet.

W. F. Brace, 1953, Vermont Geol. Survey Bull. 6, p. 42 (table 2), 50–51. Formation, in Rutland area, overlies Pinney Hollow formation and underlies "Bethel" formation [schist] (Richardson, 1924). Thickness about 3,500 feet.

W. M. Cady, 1956, U.S. Geol. Survey Geol. Quad. Map GQ–79. In Montpelier quadrangle, overlies and intergrades with Camels Hump group (new); underlies Stowe formation.

A. L. Albee, 1957, U.S. Geol. Survey Geol. Quad. Map GQ–102. In Hyde Park quadrangle, overlies Belvidere Mountain amphibolite of Camels Hump group.

Type exposures: On Ottauquechee River in Bridgewater, Windsor County.

Ottawa Limestone[1]

Pennsylvanian: Eastern Kansas.

Original reference: E. Haworth, 1894, Kansas Univ. Court., v. 2, p. 121–122, 124.

Quarried at Ottawa, Franklin County.

Otter Formation (in Big Snowy Group)

Otter Shale Member (of Quadrant Formation)[1]

Upper Mississippian: Central and eastern Montana.

Original reference: W. H. Weed, 1892, Geol. Soc. America Bull., v. 3, p. 307.

H. W. Scott, 1935, Geol. Soc. America Proc. 1934, p. 367; 1935, Jour. Geology, v. 43, no. 8, pt. 2, p. 1027–1028. Included in Big Snowy group (new).

E. S. Perry, 1937, Montana Bur. Mines and Geology Mem. 3, p. 16. In type locality, Big Snowy group comprises (ascending) Kibbey, Otter, and Heath formations. The Otter, about 600 feet thick, consists of gray to vivid green shale with some anhydrite and gypsum, and thin beds of limestone and sandstone.

L. R. Laudon, 1955, Billings Geol. Soc. Guidebook 6th Ann. Field Conf., p. 210. Kibbey, Heath, Otter, and Amsden are believed to represent shore facies of various parts of early Pennsylvanian seas.

L. S. Gardner, 1959, Am. Assoc. Petroleum Geologists Bull., v. 43, no. 2, p. 333 (fig. 2), 334 (fig. 3), 340–341, 346–347. Thickness 374 feet in composite standard section for revised Big Snowy group. Otter is used in this report as defined and delimited by Scott (1935).

Named for exposures along Otter Creek in Little Belt Mountains.

Otter Creek Granite[1]

Precambrian: South-central Wisconsin.

Original reference: J. T. Stark, 1932, Jour. Geology, v. 40, no. 2, p. 120, 121, 133.

Crops out on both sides of Otter Creek, Sumpter Township, SE¼ sec. 32 and SW¼ sec. 33, T. 10 N., R. 6 E., a short distance north of old Myers mill, Baraboo district.

Otter Creek Sandstone Member (of Cloverly Formation)

[Cretaceous]: Wyoming.

Arthur Mirsky, 1960, Dissert. Abs., v. 21, no. 4, p. 850, 851. White sandstone that forms lower part of Cloverly. Underlies unit referred to as mudstone member of Cloverly. Contact between Otter Creek member of Cloverly and Morrison formation appears to represent hiatus, but does not necessarily represent Jurassic-Cretaceous boundary.

Area of report is southern Big Horn Mountains.

Otterdale Sandstone (in Newark Group)[1]

Upper Triassic: Eastern Virginia.

Original reference: N. S. Shaler and J. B. Woodworth, 1899, U.S. Geol. Survey 19th Ann. Rept., pt. 2, p. 435–436.

W. T. Parrott and R. S. Young, 1960, Virginia Acad. Sci. Geol. Field Trip, May 14, geol. map. Shown on map legend above Vinita sandstones and shales and below diabase dikes.

Well exposed north, south, and west of Otterdale, Chesterfield County.

Otterville Member (of Golf Course Formation)

Otterville Limestone Member (of Dornick Hills Formation)[1]

Pennsylvanian (Morrow Series): Central southern Oklahoma.

Original reference: W. L. Goldston, Jr., 1922, Am. Assoc. Petroleum Geologists Bull., v. 6, p. 8.

B. H. Harlton, 1956, *in* Ardmore Geol. Soc., Petroleum geology of southern Oklahoma—a symposium, v. 1: Tulsa, Okla., Am. Assoc. Petroleum Geologists, p. 137 (fig. 2), 138, 139. Reallocated to member status in Golf Course formation (new). Best developed at West Velma, in Harrisburg trough, where it is about 870 feet thick and consists of dark gray generally calcareous and carbonaceous shale, or silty very fine sandy carbonaceous marly shale to marl, and argillaceous fine-grained calcareous sandstone to fine sandy fossiliferous limestone. Member may contain oolitic limestone with typical Morrow ostracods, brachiopods, and Bryozoa. Overlies Limestone Gap shale member; underlies Bostwick member of Lake Murray formation (new).

C. W. Tomlinson and William McBee, 1959, *in* Ardmore Geol. Soc., Petroleum geology of southern Oklahoma—a symposium v. 2: Tulsa, Okla., Am. Assoc. Petroleum Geologists, p. 6 (fig. 2), 20–21. Member of Golf Course formation. Includes 25 feet or more of limestone. Along southwest limb of Caddo anticline, northwest of Lake Ardmore, it is single resistant unit. Elsewhere it comprises two to four separate ledges with intervening tan shales occupying 100 to 400 feet of stratigraphic section. South of Ardmore, about 800 feet of black shale with sideritic layers intervene between underlying Jolliff conglomerates and Otterville limestone. Above Otterville are 100 to 500 feet of light-colored shale with a few ledges of thin calcareous sandstone and sandy limestone, which become conglomeratic southward. Otterville member was named by Goldston (1922) from village of that name not now in existence but shown on early maps in NW¼SW¼ sec. 3, T. 3 S., R. 1 W. Roth (1937, personal commun.) discovered fusulinids in limestone which Goldston had mapped as Otterville at that locality. These fusulinds proved limestone to be younger (possibly as young as Lester) than those mapped as Otterville elsewhere through Ardmore basin, including both localities from which Girty and Roundy (1923, Am. Assoc. Petroleum Geologists Bull., v. 7, no. 4) made their collections of prolific Otterville fauna. Name Otterville is here retained for those limestone from which these collections came and not for one vanished village of Otterville. New type locality suggested for redefined Otterville.

Type locality: Girty and Roundy's (1923, p. 343) Station 4062, 250 feet southwest of NE cor. sec. 6, T. 6 S., R. 2 E., Love County, together with adjacent exposure 650 feet south of that corner in draw at east side of road in sec. 5. Named from village of Otterville.

Ottosee Shale or Limestone

Ottosee Shale or Limestone (in Blount Group)[1]

Middle Ordovician: Eastern Tennessee, northwestern Georgia, and southwestern Virginia.

Original reference: E. O. Ulrich, 1911, Geol. Soc. America Bull., v. 22, p. 453, 538, 539, 551, 555, 556, 557, pl. 27.

Charles Butts, 1940, Virginia Geol. Survey Bull. 52, pt. 1, p. 170–178. Ottosee included in Blount group. Normally, Ottosee is limited below by Tellico sandstone and above by Lowville-Moccasin (Bays) limestone, but in Virginia Ottosee is bounded below by Athens shale in Rich Valley and generally southeast of Clinch Mountain, by Holston limestone in the two belts next northwest of Clinch Mountain, and by Lenoir limestone still farther northwest, as in Rye Cove, Scott County, and at south base of Big A Mountain in Russell County. Thickness 100 to 595 feet. Underlies Lowville-Moccasin limestone of Black River group.

B. N. Cooper and C. E. Prouty, 1943, Geol. Soc. America Bull., v. 54, no. 6, p. 819–886. Lower Middle Ordovician succession of Tazewell County, southwestern Virginia, is subdivided into 29 distinctive zones grouped into eight formations. Study has revealed inconsistencies in use of names Stones River, Murfreesboro, Mosheim, Lenoir, Blount, Holston, Ottosee, Lowville, and Moccasin. In proposed revised nomenclature, Cliffield formation (new) includes beds which Butts (1940) has called Murfreesboro, Mosheim, Lenoir, Holston, and Ottosee.

C. E. Prouty, 1946, Am. Assoc. Petroleum Geologists Bull., v. 30, no. 7, p. 1182–1183. Discussion of lower Middle Ordovician of southwest Virginia and northeast Tennessee. Measured sections compared with revised classification of Tazewell County, Va. Term Ottosee should be discontinued as definite formational name.

Charles Butts and Benjamin Gildersleeve, 1948, Georgia Geol. Survey Bull. 54, p. 27, 29. Geographically extended into northwestern Georgia where it is included in Blount group. Referred to as Ottosee (Sevier) shale. Overlies Holston marble.

John Rodgers, 1952, Geology of the Athens quadrangle, Tennessee (1:24,000): U.S. Geol. Survey Geol. Quad. Map [GQ–19]. Ottosee shale in Athens quadrangle was formerly called Sevier shale, but typical Sevier appears to be of different age. Lower part of formation contains "marble" lenses. Upper part of member contains layers of red, semicrystalline and crystalline limestone, some of them quartzose, interbedded with layers of shale. Thickness about 1,000 feet. Overlies Holston limestone. Middle Ordovician.

John Rodgers, 1953, Tennessee Div. Geology Bull. 58, pt. 2, p. 68–76, pls. Rocks in belt between Saltville fault and Knoxville and Rocky Valley faults divided into (ascending) Lenoir and Holston formations, Ottosee shale, and Bays formation. This sequence is here considered as standard of reference, and the belt is referred to as standard belt. In this belt, the Ottosee consists of blue yellow-weathering limy shale and slabby siltstone, with lenses of crystalline limestone ("marble") some of which are mappable. Near base of formation are beds of shaly and sandy limestone packed with bryozoans; these beds grade down into red quartz-bearing lime-sandstone, all interbedded with calcareous shale. Thickness about 1,000 feet in standard belt.

B. N. Cooper, 1953, Geol. Soc. America Mem. 55, p. 4. Discussion of trilobites of Appalachian Valley. Ottosee formation as previously recognized in southwestern Virginia and eastern Tennessee, is facies of limestone which ranges as low as Lincolnshire limestone and as high as middle Black River.

J. M. Cattermole, 1955, U.S. Geol. Survey Geol. Quad. Map GQ–76. Keith (1895, U.S. Geol. Survey Geol. Atlas, Folio 16) mapped as Sevier shale rocks in Shooks Gap quadrangle herein called Ottosee. Thickness about 1,850 feet. Overlies Chapman Ridge sandstone (new). Underlies Bays formation. Name Chapman Ridge applied to strata formerly called Tellico.

R. B. Neuman, 1955, U.S. Geol. Survey Prof. Paper 274–F, p. 145. Believed that Rodgers' introduction of terms Ottosee shale and Holston formation and continued use of Athens shale give these terms time-stratigraphic rather than rock-unit status. Sevier formation is used in present report in preference to Ottosee shale as used by Rodgers.

Josiah Bridge, 1956, U.S. Geol. Survey Prof. Paper 277, p. 57. Term Blount group discarded.

J. M. Cattermole, 1960, U.S. Geol. Survey Geol. Quad. Map GQ–126. Strata identified as Ottosee in this report [Bearden quadrangle, Tennessee] were mapped by Keith (1896, U.S. Geol. Survey Geol. Atlas, Folio 25) as Sevier shale in Middle Ordovician belts south of Saltville fault, as Chickamauga limestone and Sevier shale in belt around Dead Horse Lake, and as Chickamauga limestone north of Beaver Valley fault. Thickness about 1,100 feet. Underlies Moccasin formation; main body of Ottosee overlies and interfingers with Chapman Ridge sandstone; lower tongue of Ottosee underlies the Chapman Ridge.

Named for exposures at Ottosee Lake, in park at Knoxville, Tenn.

Ottumwan Epoch[1] or Series[1]

Pleistocene (Kansan and Yarmouthian) : Iowa and Illinois.

Original reference: G. F. Kay, 1931, Geol. Soc. America Bull., v. 42, no. 1, p. 449–452.

J. C. Frye and A. B. Leonard, 1952, Kansas Geol. Survey Bull. 99, p. 38. In Iowa and Illinois, Pleistocene is classed as a Period (System) and four Epochs (Series) are used to include glacial-interglacial pair each. These are Grandian (Nebraskan and Aftonian), Ottumwan (Kansan and Yarmouthian), Centralian (Illinoian and Sangamonian), and Eldoran (Wisconsinan and Recent). Of these units, each of the first three essentially coincides with a glacial cycle; present data indicate that the youngest (Eldoran) includes two distinct cycles, each of which is complex within itself. These terms have not been adopted for official use in Kansas partly because of this inconsistency and partly because retention of Quaternary as System-Period with Pleistocene as its contained Series-Epoch would necessitate erection of new category of names to include these terms and thus produce further complication of classification system.

Named for Ottumwa, Iowa, where both Kansan and Yarmouth stages are well developed.

†Ouachita Shale[1]

Lower and Middle Ordovician: Southwestern Arkansas.

Original reference: A. H. Purdue, 1909, Slates of Arkansas: Arkansas Geol. Survey, p. 30, 33.

Named for Ouachita Mountains.

Oumalik Formation

Lower Cretaceous: Northern Alaska (subsurface).

F. M. Robinson, F. P. Rucker, and H. R. Bergquist *in* George Gryc and others, 1956, Am. Assoc. Petroleum Geologists Bull., v. 40, no. 2, p. 223, 225–229, figs. 2, 6. Divided into two units in type section: upper shale unit, 4,410 feet thick; and lower sandy shale, 1,610 feet thick. Upper unit is monotonous section of clay shale, medium dark gray to dark gray, slightly micaceous, carbonaceous, and pyritic. Lower unit made up of 40 percent siltstone and sandstone, in addition to clay shale of type found in unit above. Contact between upper and lower units is gradational but is placed at top of first sandstone of appreciable thickness. Sandstone and siltstone are medium light gray, hard, massive, silty, and very fine to fine grained. Formation approximately 6,000 feet thick, thins rapidly northward. Gradational into overlying Topagoruk formation in vicinity of type locality, angular unconformity between two formations in other areas. Overlies Lower Cretaceous(?) and Upper Jurassic(?) rocks undifferentiated.

Type locality: From 4,860 to 10,880 feet in Oumalik test well No. 1, on Oumalik anticline about 100 miles south of Barrow, Alaska, lat 69°50′18″ N., long 155°59′24″ W.

Ouray Limestone[1]

Upper Devonian: Southwestern Colorado, eastern Arizona, and southeastern Utah.

Original reference: W. Cross and A. C. Spencer, 1899, U.S. Geol. Survey Geol. Atlas, Folio 60, p. 8.

A. A. Stoyanow, 1936, Geol. Soc. America Bull., v. 47, no. 4, p. 489. On Pinal Creek, north of Globe, Ariz., lower Ouray limestone, 54 feet thick, overlies Martin limestone and underlies Escabrosa limestone. Devonian.

W. S. Burbank, 1941, U.S. Geol. Survey Bull. 906–E, p. 194, 196 (chart). In Uncompahgre district, term Ouray limestone is restricted to dolomitic limestone beds of Devonian age. Thickness 65 to 70 feet. Underlies Leadville limestone, name introduced in this area for beds containing Mississippian fossils; overlies Elbert formation.

J. C. Cooper, 1955, Four Corners Geol. Soc. Guidebook [1st] Field Conf., p. 63. Thickness 0 to 238 feet in Four Corners area. Consists of massive dense argillaceous limestone, ranging from buff, tan, cream to gray in color, with some thin streaks of waxy gray-green clayey shales. In Utah, limestone is locally slightly sandy and in places basal part carries sandstone. Brachiopod and crinoid fragments occur in some wells. Unconformably underlies Mississippian Madison formation; overlies Elbert formation, probable unconformity.

R. L. Knight and D. L. Baars, 1957, Am. Assoc. Petroleum Geologists Bull., v. 41, no. 10, p. 2275–2283. Ouray limestone extends from surface in San Juan Mountains of Colorado into subsurface of much of Colorado Plateau province. Since typical Ouray limestone fauna has both Mississippian and Devonian aspects and formation contacts are gradational, it is suggested that unit is transitional between Upper Devonian, Elbert formation, and Lower Mississippian, Leadville limestone.

J. A. Momper, 1957, Four Corners Geol. Soc. Guidebook 2d Field Conf., p. 87. Ouray formation of current usage is restricted to extreme northwestern part of area. For purposes of this paper [southern and western San Juan basin], it has been included in Leadville formation.

Named for prominent occurrence in vicinity of Ouray, Ouray County, Colo., at junction of Canon Creek with Uncompaghre River.

Oursan Sandstone (in Monterey Group)[1]

Miocene, middle: Western California.

Original reference: A. C. Lawson, 1914, U.S. Geol. Survey Geol. Atlas, Folio 193.

C. E. Weaver, 1949, Geol. Soc. America Mem. 39, p. 17 (table 3), 69 (table 14), 70, pl. 12. Described in Coast Ranges immediately north of San Francisco Bay area. Fine-grained light-gray tuffaceous sandstone; marine. Thickness about 400 feet. Lies conformably upon Claremont shale and beneath Tice shale; dips northward at low angles. Where exposed in axis of Rodeo anticline is overridden by shales of Chico formation along thrust fault. South of San Pablo Bay passes unconformably beneath Pleistocene terrace deposits.

C. A. Hall, Jr., 1958, California Univ. Pubs., Geol. Sci., v. 34, no. 1, p. 18–19, fig. 2, geol. map. Oursan sandstone, in Pleasanton area, Alameda and Contra Costa Counties, is 250 to 500 feet thick. Overlies Claremont shale; underlies Tice shale. Term Monterey group not considered appropriate in this area.

Named for exposures on Oursan Ridge, Concord quadrangle, Contra Costa County.

Outer Conglomerate (in Copper Harbor Group)[1]

Outer Conglomerate (in Oronto Group)

Precambrian: Northern Michigan and Wisconsin.

Original reference: R. D. Irving, 1883, U.S. Geol. Survey Mon. 5, p. 186, pls. 17, 18.

S. A. Tyler and others, 1940, Geol. Soc. America Bull., v. 51, no. 10, p. 1472, 1474. Basal unit of Oronto group. Underlies Nonesuch shale. Thickness about 1,200 feet.

Named for fact that at Keweenaw Point, Mich., it is the outer conglomerate, the supposedly thicker Greater conglomerate, being the inner conglomerate.

Outer Brass Limestone (in Virgin Island Group)

Upper Cretaceous: Virgin Islands.

T. W. Donnelley, 1960, Dissert. Abs., v. 20, no. 7, p. 2756; 1960, Caribbean 2d Geol. Conf. Trans., Mayagüez, Puerto Rico, p. 153. Thin-bedded graphitic silicified radiolarian limestone, with small amount of tuffaceous material. Thickness 200 to 600 feet. Overlies Louisenhoj formation and underlies Tutu formation (both new). Virgin Island group considered of Cenomanian age.

Report discusses geology of St. Thomas and St. John Islands.

Outerson Basalts or Series

Pliocene: Northwestern Oregon.

T. P. Thayer, 1936, Jour. Geology, v. 44, no. 6, p. 705, 706, 709 (fig. 2), 713 (fig. 3); 1937, Geol. Soc. America Bull., v. 48, no. 11, p. 1616 (fig 2), 1617–1618, 1627, 1633. High Cascade volcanic rocks consist of at least four structurally distinct series separated by pronounced erosional unconformities In chronological order: Outerson series, Minto lavas, and two probably nearly equivalent series, Olallie lavas, and Santiam basalts. Outerson series consists chiefly of basaltic lavas with minor tuffs and lapilli beds with steeply dipping bedded agglomerates in lower parts. Thickness as much as 3,000 feet. Where Outerson accumulations were high, Minto lavas flowed around them; where Outerson deposits were thinner, Minto lavas overrode them. Rest with marked unconformity on Breitenbush series (new).

Named for occurrence in vicinity of Outerson Mountain, Marion County.

Outlaw Formation

Lower Cretaceous: Southeastern Arizona.

H. E. Enlows, 1955, Geol. Soc. America Bull., v. 66, no. 10, p. 1217. Discussion of sequence of rocks in Chiricahua National Monument. Chiricahua limestone is succeeded by thick section of Lower Cretaceous Bisbee group with recognizable Glance conglomerate at base, and in turn, by section of what appears to be Morita formation. This sequence of Lower Cretaceous rocks is apparently similar to Outlaw formation (Raydon, unpub. thesis) described from area east of Paradise. Above Bisbee group is a 300-foot sequence of red beds and associated tuff named Bonita Park formation (Waller, unpub. thesis).

Described from area east of Paradise, Cochise County.

Outlet Tunnel Quartz Latite[1] (in Alboroto Group)

Miocene: Southwestern Colorado.

Original reference: W. H. Emmons and E. S. Larsen, 1923, U.S. Geol. Survey Bull. 718

E. S. Larsen, Jr., and Whitman Cross, 1956, U.S. Geol. Survey Prof. Paper 258, p. 93 (table 18). Alboroto rhyolite described in San Juan district. Lower part consists of tridymite rhyolite which includes Campbell Mountain and Willow Creek rhyolites and probably Outlet Tunnel quartz latite [all included in Alboroto group] of Creede district.

Named for development at Outlet tunnel, Creede district.

Oveja formation (in Kwaguntan series)

Precambrian: Northern Arizona.

Charles Keyes, 1938, Pan-Am. Geologist, v. 70, no. 2, p. 107 (chart), 113. Consists of sandstone, massively bedded in middle, but more or less shaly towards bottom and top of section. Thickness 175 feet. Underlies Solitude limestone (new); unconformably overlies Final shales (new).

Named from longitudinal ridge that separates Colorado River Canyon from Chuar Valley, must below mouth of Little Colorado River, Grand Canyon region.

Overall Limestone Member (of Admiral Formation)

Permian (Wolfcamp Series) : North-central Texas.

R. C. Moore, 1947, *in* A. K. Miller and Walter Youngquist, Kansas Paleont. Contr. 2, Mollusca, art. 1, p. 1 (footnote). Incidental mention.

R. C. Moore, 1949, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 80, sheet 2. Limestone was called "Bed No. 5" by Drake (1893, Texas Geol. Survey 4th Ann. Rept., pt. 1) and included at top of Fisk formation by Cheney (1940). Comprises normally two or more subdivisions of gray limestone weathering yellowish brown, each a few feet thick, separated by thin shale. Thickness 20 to 40 feet; average near Colorado River about 30 feet. Overlies Wildcat Creek shale member; underlies Jim Ned shale member of Belle Plains formation.

P. T. Stafford, 1960, U.S. Geol. Survey Bull. 1081–G, p. 272. Moore (1949) divided Admiral into four members in Colorado River drainage area. In Brazos River drainage area, the Admiral cannot easily be distinguished from underlying Putnam and overlying Belle Plains formations.

Named for exposures near Overall switch on Gulf Coast and Santa Fe Railway, about 4 miles east of Valera, Coleman County.

†Overbrook Granite Gneiss[1]

Precambrian : Southeastern Pennsylvania and Maryland.

Original reference: F. Bascom, 1904, Am. Jour. Sci., 4th, v. 17, p. 143.

Occurs at and around Overbrook, Philadelphia region, Pa.

Overbrook Sandstone (in Springer Group)

Overbrook Sandstone Member (of Springer Formation)[1]

Lower Pennsylvanian: Central southern Oklahoma (subsurface and surface).

Original reference (subsurface) : R. Roth, 1928, Econ. Geology, v. 23, p. 45, 53.

C. W. Tomlinson, 1928, Oklahoma Geol. Survey Bull. 46, p. 17. Surface outcrop noted. Derivation of name given.

R. C. Moore and others, 1944, Geol. Soc. America Bull. v. 55, no. 6, chart 6 (column 37). Shown on correlation chart as Overbrook sandstone; here Springer is considered a group. Lower Pennsylvanian.

C. W. Tomlinson and William McBee, 1959, *in* Ardmore Geol. Soc., Petroleum geology of southern Oklahoma—a symposium, v. 2: Tulsa, Okla., Am. Assoc. Petroleum Geologists, p. 6 (fig. 2), 11. Overbrook sandstone is 800 to 1,000 feet above Rod Club sandstone. Thickness 45 to 105 feet. Typically medium fine grained, white and massive, varying to slabby or thin bedded, some outcrops devoid of shale partings. From 500 to 700 feet below Lake Ardmore formation (redefined). Springer group.

Named for outcrop across middle of N½ sec. 6, T. 6 S., R. 2 E., half a mile east of Overbrook, at north edge of Love County.

Overland Mountain Granite (in Pikes Peak Group)

Precambrian : North-central Colorado.

J. M. Bray, 1942, Geol. Soc. America Bull., v. 53, no. 5, p. 768 (fig. 1), 770. Overland Mountain granite, classed by Lovering and Goddard (1939, Geologic map of the Front Range mineral belt, Colorado: U.S. Geol. Survey) is here given local name, following Goddard's original idea (U.S. Geol. Survey, unpub. rept.). Younger member of Pikes Peak group. Gneissic border closely resembles Boulder Creek granite. The rock, very coarse grained, feldspathic, and containing microline phenocrysts in coarse groundmass of andesine, quartz, and biotite, is like a fine-grained pegmatite.

In Jamestown district, central Boulder County, 35 miles northwest of Denver.

Overton Fanglomerate[1]

Cretaceous(?) or Tertiary(?): Southeastern Nevada.

Original references: C. R. Longwell, 1921, Am. Jour. Sci., 5th, v. 1, p. 52; 1928, U.S. Geol. Survey Bull. 798.

C. R. Longwell, 1949, Geol. Soc. America Bull., v. 60, no. 5, p. 931, 933–935, table 1. Stratigraphically restricted to exclude about 3,800 feet of coarse conglomerate, clays, and sandstones at base of unit in northern Muddy Mountains, Nev., now dated as Cretaceous and put in Willow Tank formation (new) and Baseline sandstone (new). Consists of extremely coarse fan debris with some interbedded lenses of silt. Deposition of coarse Overton debris followed violent disturbance of the stratigraphic section by an overriding thrust plate. Thickness ranges from 20 to 3,000 feet. Overlies Baseline sandstone with angular unconformity; underlies Horse Spring formation. Age shown on table as Late Cretaceous or Early Cenozoic.

Exposures indicate deposit once covered practically every part of Muddy Mountains area, Clark County.

Ovid Formation or Limestone

Upper Cambrian: Southeastern Idaho and central northern Utah.

C. D. Walcott, 1925, Smithsonian Misc. Colln., v. 74, no. 3, p. 96, 104, 105. Ovid formation mentioned in description of fossil locality in Oneida County, Idaho.

E. O. Ulrich and G. A. Cooper, 1938, Geol. Soc. America Spec. Paper 13, p. 25. Limestone is the Mons limestone equivalent which has been removed from St. Charles formation, Wasatch Range, Utah.

On north side of Two Mile Canyon, 2 miles southeast of Malad, Oneida County, Idaho.

Owasco Member[1] (of Ludlowville Formation)

Middle Devonian: Central New York.

Original reference: Burnett Smith, 1935, New York State Mus. Bull. 300, p. 11, 50.

G. A. Cooper and others, 1942, Geol. Soc. America Bull., v. 53, no. 12, pt. 1, chart 4. Uppermost member of Ludlowville; overlies Spafford member; underlies Portland Point limestone.

Probably named for outcrops on west side of Owasco Lake valley in Edgewater Ravine at a level about 200 feet above Owasco Lake and just below new cement road, Skaneateles quadrangle.

Owego shale member (of Cayuta monothem)

Upper Devonian: Pennsylvania.

K. E. Caster, 1938, Jour. Paleontology, v. 12, no. 1, p. 45 (fig. 7), 47. Member of Cayuta monothem. Thickness about 112 feet. Below Starruca [Starrucca] shale member and above Cascade Creek sandstone member.

Type locality and derivation of name not given.

Owen Limestone Member (of Lime Creek Formation)

Owen Substage or Beds[1]

Upper Devonian: Central northern Iowa.

Original reference: W. H. Norton, 1897, Iowa Geol. Survey, v. 6, p. 148.

M. A. Stainbrook, 1944, Illinois Geol. Survey Bull. 68, p. 182 (fig. 1), 187. Uppermost member of Lime Creek formation. Overlies Cerro Gordo member. Consists of dolomitic fossiliferous limestone about 40 feet thick.

Named for exposures on Owen Creek, Cerro Gordo County.

Owens Valley Formation

Permian: Eastern California.

C. W. Merriam and W. E. Hall, 1957, U.S. Geol. Survey Bull. 1061–A, p. 4 (table 1), 6 (table 2), 7–12. Name proposed for highly diverse marine strata of Permian age which occupy large area on western slope of Inyo Mountains near Owens Valley border. Comprises interbedded silty and sandy limestone, fairly pure biogenic limestone, argillaceous shale, siltstone, sandstone, and conglomerate. In areas of plutonic intrusion, formation has been altered to argillite, minor quartzite, and calc-hornfels. Rocks previously classified as Diamond Peak quartzite (Kirk, 1918) are in considerable part considered altered middle and lower Owens Valley. Diamond Peak formation, and Upper Mississippian unit in central Nevada (Nolan and others, 1956) has not been traced into Inyo Mountains. Includes Reward conglomerate member (near top) and Owenyo limestone member. Thickness at type locality about 1,800 feet; in Darwin quadrangle, thickness may increase to about 3,000 feet. Formation folded and faulted. Rests with angular unconformity upon Keeler Canyon formation (new); underlies beds of early Triassic age.

W. E. Hall and E. M. MacKevett, 1958, California Div. Mines Spec. Rept. 51, p. 7 (table 1), 10–11, pl. 2. Described in Darwin quadrangle where it is about 3,200 feet thick and consists of three unnamed members: lower limestone, middle shale, and upper limestone-conglomerate member. Overlies Keeler Canyon formation; underlies Cretaceous quartz monzonite.

Type locality: In foothills between Union Wash and Reward mine, about 9 miles southeast of Independence, between Owenyo and Kearsarge, southern Inyo Mountains.

Owenyo Limestone Member (of Owens Valley Formation)

Owenyo Limestone[1]

Permian: Eastern California.

Original reference: E. Kirk, 1918, U.S. Geol. Survey Prof. Paper 110.

C. W. Merriam and W. E. Hall, 1957, U.S. Geol. Survey Bull. 1061–A, p. 8, 10. Reduced to member status in Owens Valley formation (new).

Named for exposures about 3½ miles north of Owenyo Station on Southern Pacific, between Union Wash and Reward mine, Inyo Mountains.

Owl Canyon Formation (in Cassa Group)

Permian: Northeastern Colorado, southwestern South Dakota, and eastern Wyoming.

G. E. Condra, E. C. Reed, and O. J. Scherer, 1940, Nebraska Geol. Survey Bull. 13, p. 2 (fig. 2), 5, 6–7, 19, 45. To the south, formation consists of red shales and sands which grade northward into red sands and some shale. Thickness 90 to 275 feet. Comprises that part of Cassa group (new) below Lyons sandstone.

Type locality: Lower part of Owl Canyon, NW¼ sec. 1, T. 9 N., R. 70 W., Larimer County, Colo.

Owl Creek Formation[1] (in Selma Group)

Owl Creek Sandy Clay Member or Tongue (of Ripley Formation)

Upper Cretaceous: Northeastern Mississippi, southeastern Missouri, and southwestern Tennessee.

Original reference: E. W. Hilgard, 1860, Mississippi Geol. and Agric. Rept., p. 79, 84–91, 102.

Willard Farrar and Lyle McManamy, 1937, Missouri Geol. Survey and Water Resources 59th Bienn. Rept., App. 6, p. 17, 21. Geographically extended into Stoddard County, southeastern Missouri, where it is referred to as Owl Creek sandy clay member or tongue of Ripley formation.

W. E. Belt and others, 1945, Geologic map of Mississippi (1:500,000): Mississippi Geol. Survey. Assigned to Selma group.

L. W. Stephenson, 1955, U.S. Geol. Survey Prof. Paper 274–E, p. 97–137. Formation, in Crowleys Ridge area, Missouri, consists of 11 feet of clay and sand. Unconformably overlies McNairy sand; unconformably underlies Clayton formation. Fossils described.

C. W. Wilson, Jr., 1958, Tennessee Div. Geology Rept. Inv. 5, p. 4 (fig. 3). Chart of Cretaceous, Tertiary, and Quaternary strata of west Tennessee refers to Owl Creek tongue of Ripley formation.

N. F. Sohl, 1960, U.S. Geol. Survey Prof. Paper 331–A, p. 4, 5, 22–25. Formation described in Tennessee and Mississippi where it consists characteristically of dark silty sand and subordinate amounts of clay, which are glauconitic, micaceous, and highly fossiliferous. Thickness commonly 30 to 40 feet; thickest in southern area of outcrop where it merges into Prairie Bluff chalk. In Hardeman County, Tenn., formation is overlapped by Midway group; southward along outcrop belt, it can be traced until it interfingers with Prairie Bluff chalk in Pontotoc County, Miss. Owl Creek lies within bounds of *Exogyra costata* zone; it is unconformably overlain by Clayton formation and lies with unconformity on Ripley formation. In some areas, overlies NcNairy sand member of Ripley and in other areas Keownville limestone member (new) of Ripley.

Named for exposures on Owl Creek, 3 miles northeast of Ripley, Tippah County, Miss.

Owl Mountain Glacial Substage

Owl Mountain Till

Pleistocene (pre-Wisconsin): North-central Colorado.

D. F. Eschman, 1952, (abs.) Geol. Soc. America Bull., v. 63, no. 12, pt. 2, p. 1380. Time of earliest of four glacial advances in area. Represented by deeply weathered till of patchy distribution, for most part found in front of mountains or high on valley walls. Preceded Gould glacial advance.

D. F. Eschman, 1955, Jour. Geology, v. 63, no. 3, p. 201–203, fig. 2. Deposits of substage mapped as Owl Mountain till. Till weathered and stained with limonite from top to bottom. In many places on surface of deposits, there is a scattering of weathered erratics which range to 8 feet in diameter.

Deposits found on northeast flank of Owl Mountain, and in several other areas of Michigan River basin, North Park.

Owl Rock Member (of Chinle Formation)

Upper Triassic: Northeastern Arizona, west-central New Mexico, and southeastern Utah.

G. A. Kiersch, 1955, Mineral resources, Navajo-Hopi Reservations, Arizona-Utah, v. 2: Tucson, Univ. Arizona Press, p. 4 (fig. 1), 5. Comprises alternating beds of siliceous limestones and siltstones. Overlies Petrified Forest member.

J. H. Stewart, 1957, Am. Assoc. Petroleum Geologists Bull., v. 41, no. 3, p. 458. Pale-red and pale-reddish-brown structureless siltstone interstratified with thin to thick beds of limestone. Thickness as much as 450 feet; commonly 150 to 250 feet. Conformably overlies Petrified Forest member, or Moss Back member where Petrified Forest is absent. Conformably underlies Church Rock member or disconformably underlies Wingate sandstone in places where Church Rock member is absent. Intertongues with overlying Church Rock member and absence of member in San Rafael Swell and Moab areas is probably due to lateral replacement of Owl Rock member by Church Rock member. Corresponds to Division B of Chinle formation described by Gregory (1917, U.S. Geol. Survey Prof. Paper 93) Name credited to I. J. Witkind and Rex. E. Thaden.

J. P. Akers, M. E. Cooley, and C. A. Repenning, 1958, New Mexico Geol. Soc. Guidebook 9th Field Conf., p. 93–94. At type section, consists of 131 feet of interbedded limestone and calcareous siltstone. Limestone is mottled pale blue and grayish pink and contains chert nodules and mud pellets; locally silty; bedding within siltstone is irregular and lenticular. Extends over entire Navajo country. About 300 feet thick along southwest-trending line between Round Rock and Castle Butte; thins northwestward and southeastward from this line.

Type section: Owl Rock in Monument Valley, Navajo County, Ariz.

Owls Head Granite[1]

Middle or Upper Devonian (?): West-central New Hampshire.

Original reference: M. P. Billings, 1935, Geology of Littleton and Moosilauke quadrangles, New Hampshire, p. 26, 34, Moosilauke map.

L. R. Page, 1940, Geologic map and structure sections of the Rumney quadrangle, New Hampshire (1:62,500): New Hampshire Highway Dept. Upper Devonian(?).

M. P. Billings, 1956, Geology of New Hampshire, pt. 2, Bedrock geology: Concord, New Hampshire State Plan. Devel. Comm., p. 48. Included in Oliverian plutonic series of Middle or Upper Devonian(?) age.

Occurs on and around Owls Head Cliff in southwestern corner of Moosilauke quadrangle.

Owyhee Basalt[1]

Miocene: Southeastern Oregon.

Original references: K. Bryan, 1929, U.S. Geol. Survey Water-Supply Paper 597–A; B. C. Renick, 1930, Jour. Geology, v. 38, p. 494.

E. M. Baldwin, 1959, Geology of Oregon: Ann Arbor, Mich., Edwards Bros., Inc., p. 108. Maximum thickness about 1,500 feet. Unconformably overlies Payette tuffs and rhyolites; unconformably underlies Pinnacle Point beds (new), tentatively considered to be late Miocene.

Named for occurrence in bluffs along lower part of Owyhee River, in Malheur County.

Owyhee Rhyolite[1]

Tertiary-Quaternary: Southwestern Idaho.

Original reference: V. R. D. Kirkham, 1931, Jour. Geology, v. 39, no. 6, p. 579.

C. N. Savage, 1958, Idaho Bur. Mines and Geology County Rept. 3, p. 21 (table 1), 24–25, 35, 49 (table 2). Unconformably overlies Payette formation.

Well exposed in Owyhee County.

Oxbow Dolomite (in Bertie Group)

Upper Silurian (Murderian) : Central New York.

D. W. Fisher, 1959, New York State Mus. Sci. Service Geol. Survey Map and Chart Ser. 1. Overlies Forge Hollow shale; underlies unnamed dolomite. Name credited to L. V. Rickard, Fieldwork has not demonstrated lateral continuity of Williamsville and Oxbow as shown on present chart. Thick glacial deposits conceal these units in area where they may merge. For present, distinct names are used in western and central New York.

Type locality and derivation of name not given.

Oxbow Creek Basalt

Miocene and (or) Pliocene : Northwestern Wyoming.

A. D. Howard, 1937, Geol. Soc. America Special Paper 6, p. 77–79. Olivine basalt. Thickness from 15 to 20 feet where Tower Falls road passes through cut on west side of Oxbow Creek valley, about 0.7 miles west of stream crossing. Terminates everywhere in scarp, from 15 to 20 feet high.

An exposure of basalt 4 miles long and one-half mile wide, which forms gentle, northwestward-sloping surface west of Oxbow Creek, Yellowstone National Park.

Oxbow Mountain Rhyolite

Precambrian : East-central Arizona.

Gordon Gastil, 1958, Geol. Soc. America Bull., v. 69, no. 12, pt. 1, p. 1498 (table 1), 1506. Grayish-white welded rhyolite tuff. Consists of coarse phenoclasts and welded glass shards. Over 1,250 feet thick. Overlies Haigler formation (new). Name given on table to Oxbow Mountain rhyolite but unit described in text as rhyolite of Oxbow Mountain.

Best exposures on southwest corner of Oxbow Mountain, in northeastern corner of Diamond Butte quadrangle.

†Oxford Gneiss[1] or type[1]

Precambrian : Northern New Jersey.

Original reference: F. L. Nason, 1889, New Jersey Geol. Survey Ann. Rept. 1889, p. 30.

Occurs in Van Nest Gap Tunnel of Delaware, Lackawanna & Western Railroad at Oxford Furnace, Warren County.

Oxford Gravel[1]

Pleistocene : Southwestern Colorado.

Original reference: W. W. Atwood and K. F. Mather, 1932, U.S. Geol. Survey Prof. Paper 166.

Covers lowlands surrounding village of Oxford, La Plata County.

Oxford Member (of Whitewater Formation)

Ordovician (Richmond) : Southwestern Ohio.

Wilber Stout, Karl Ver Steeg, and G. F. Lamb, 1943, Ohio Geol. Survey, 4th ser., Bull. 44, p. 110, 114, chart facing p. 108. Listed on page 110 as member of Whitewater; sequence (ascending) Weisburg, Saluda, Oxford. Stratigraphic chart and page 114 shows Whitewater sequence (ascending) Lower Whitewater, Saluda, Upper Whitewater.

Type locality and derivation of name not given.

Oxford Schist[1]

Carboniferous : Eastern Massachusetts.

Original reference: B. K. Emerson, 1917, U.S. Geol. Survey Bull. 597, p. 60–68, map.

Named for town of Oxford, Worcester County.

†Oxmoor Sandstone and Shales[1]

Mississippian: Northern Alabama.

Original reference: E. A. Smith, 1880, Alabama Geol. Survey Rept. on Cahaba coal field, p. 155–157, p. 162, map, section.

Named for Oxmoor, Jefferson County.

Ox Valley Tuff

Tertiary: Southwestern Utah.

E. F. Cook, 1960, Utah Geol. and Mineralog. Survey Bull. 70, p. 18 (fig. 1), 45, maps 1 and 2. Lightly to moderately or highly welded rhyolitic vitric-crystal tuff about 400 feet thick in thickest measured section. Light grayish blue to pink or purple. Lies above Cove Mountain formation (new). Underlies unit referred to as "Muddy Creek" formation. Name credited to H. R. Blank (unpub. thesis).

Ox Valley is in Bull Valley district, Washington County.

Oxyoke Canyon Sandstone Member (of Nevada Formation)

Lower and Middle Devonian: Central Nevada.

T. B. Nolan, C. W. Merriam, and J. S. Williams, 1956, U.S. Geol. Survey Prof. Paper 276, p. 41, 43, pl. 2. Consists mainly of light-olive-gray thick-bedded sandstone or quartzite that commonly weathers to shades of brown. Beds are commonly several feet thick and many of them exhibit crossbedding. There are a few beds of Beacon Peak member type dolomite in lower part of member and more abundant thicker beds of a coarsely granular dolomite in upper part. Ranges in thickness from 430 to 450 feet. Gradational contacts with underlying Beacon Peak dolomite member (new) and overlying Sentinel Mountain dolomite member (new).

Type section: In canyon along southwest slope of Beacon Peak where old wood road along bottom of canyon provides excellent exposures. Name taken from Oxyoke Canyon where member is exposed in several fault blocks, vicinity of Eureka.

Oyster Ridge Sandstone Member (of Frontier Formation)[1]

Upper Cretaceous: Southwestern Wyoming and northeastern Utah.

Original reference: A. C. Veatch, 1906, U.S. Geol. Survey Bull. 285, pl. 12.

J. D. Love, J. L. Weitz, and R. K. Hose, 1955, Geologic map of Wyoming (1:500,000): U.S. Geol. Survey. Mapped in upper part of Frontier formation.

L. A. Hale, 1960, Wyoming Geol. Assoc. Guidebook 15th Ann. Field Conf., p. 136 (chart 1), 140, 141. Overlies Allan Hollow shale member (new); unconformably underlies Dry Hollow member (new). Basal Oyster Ridge is 45 to 80 feet thick with 150 to 200 feet of interbedded green to brown shale and sandstone comprising upper part of member.

Forms Oyster Ridge, Uinta County, Wyo.

Ozan Formation[1]

Upper Cretaceous (Gulf Series): Southwestern Arkansas and southeastern Oklahoma.

Original reference: C. H. Dane, 1926, U.S. Geol. Survey Press Bull. 8823, Sept. 10, 1926.

H. D. Miser and others, 1954, Geologic map of Oklahoma (1:500,000): U.S. Geol. Survey. Mapped in southeastern Oklahoma.

Named for exposures along middle fork of Ozan Creek and for town of Ozan, Hempstead County, Ark.

†Ozark Group[1]

Mississippian: Mississippi Valley region.

Original reference: H. S. Williams, 1922, Pan-Am. Geologist, v. 37, no. 1, p. 36–40.

Named for prominent development of formations constituting group on southern and western margins of Ozark uplift.

†Ozark Marble[1]

Upper Cambrian: Southeastern Missouri.

Original reference: G. C. Broadhead, 1889, Am. Geologist, v. 3, p. 7–8.

Named for Ozark uplift.

†Ozark Sands[1]

Pleistocene: Southern Alabama.

Original reference: E. A. Smith, 1892, Sketch of geology of Alabama: Birmingham, Ala., Roberts and Son, pamph. of 36 pp.

Cover 2,000 square miles in Henry, Dale, Geneva, Covington, Escambia, Mobile, and Baldwin Counties. Derivation of name not stated but probably suggested by presence of sands at Ozark, Dale County.

Ozark Sandstone[1]

Pennsylvanian: Western Arkansas.

Original reference: A. Winslow, 1896, New York Acad. Sci. Trans., v. 15, p. 51.

Probably named for Ozark, Franklin County.

†Ozark Series[1]

Upper Cambrian and Lower Ordovician: Southeastern Missouri.

Original reference: G. C. Broadhead, 1891, Am. Geologist, v. 8, p. 33.

Named for development of the rocks in Ozark Mountains.

†Ozarkian[1]

Pliocene and Quaternary: North America.

Original reference: O. H. Hershey, 1896, Science, new ser., v. 3, p. 620–622.

Ozarkian System[1] or Series

Cambrovician: Southern Appalachians and Mississippi regions.

Original reference: E. O. Ulrich, 1911, Geol. Soc. America Bull., v. 22, p. 627–647, pl. 27.

A. W. Grabau, 1937, Paleozoic formations in the light of the pulsation theory, v. 3, Cambrovician pulsation, pt. 2, Appalachian, Paleocordilleran, Pre-Andean, Himalayan, and Cathaysian geosynclines: Peiping, China, Univ. Press, Nat. Univ. Peking, p. 10–11, 12–14. Ulrich's definition of term Ozarkian, that is limited below by disconformity which separates it from Nolichucky or older formations, and above by base of Stonehenge limestone, is exact equivalent of Upper Cambrian as used in this report. Term Ozarkian is herein extended to cover entire transgressive series, that is, Upper Cambrian as well as Tremadoc equivalent or Stonehengian (new). Ozarkian series and overlying Shenandoan series (redefined) comprise Cambrovician in southern Appalachian region.

Earl McCracken, 1952, Missouri Geol. Survey and Water Resources Rept. Inv. 13, p. 60–61. Two classifications of formations below the St. Peter have been used in Missouri. The one which disregards Ulrich's Ozarkian and Canadian systems, places base of Ordovician at base of Gunter sandstone. The other classification, that of Ulrich, places those formations above the Gasconade and below the St. Peter-Everton in Canadian system and those formations below the Roubidoux and above the Derby-Doerun in the Ozarkian system. Whether the Lower Ordovician and Cambrian should be broken up to make the Ozarkian and Canadian as separate systems has been subject of controversy for many years. An area so small as Missouri should not be determining factor in this controversy. Ultimate correlation should be used on regional evidence. In Missouri, greatest break is at base of Roubidoux formation. Beneath the Roubidoux, the Upper Gasconade is entirely removed, and the Roubidoux rests on Lower Gasconade in parts of western Missouri. Recent work in Missouri, however, does not substantiate the regional break at the base of the Ozarkian.

Typical exposures occur in Ozark region of Missouri.

Ozaukee Formation[1]

Middle Devonian: Southwestern Wisconsin.

Original reference: E. R. Pohl, 1929, Pub. Mus. City Milwaukee Bull., v. 11, p. 7–8.

Ozaukee and Milwaukee Counties.

Ozaukee Member[1] (of Lake Church Formation)

Devonian: Southeastern Wisconsin.

Original reference: G. O. Raasch, 1935, Kansas Geol. Soc. Rept. 9th Ann. Field Conf., p. 260, 262, 263.

Named for Ozaukee County.

Ozawkie Limestone Member (of Deer Creek Limestone)[1]

Pennsylvanian (Virgil Series): Eastern Kansas, southwestern Iowa, and northwestern Missouri.

Original references: R. C. Moore, M. K. Elias, and N. D. Newell, 1934, Stratigraphic sections of Pennsylvanian and "Permian" rocks of Kansas River valley: Kansas Geol. Survey, issued Dec.; R. C. Moore, 1935, Rock formations of Kansas *in* Kansas Geol. Soc.: Wichita, Kans. [Am. Asoc. Petroleum Geologists 20th Ann. Mtg., Mar. 21–23]; G. E. Condra, 1935, Nebraska Geol. Survey Paper 8, p. 12.

F. C. Greene and W. V. Searight, 1949, Missouri Geol. Survey and Water Resources Rept. Inv. 11, p. vii, 17. Columnar section shows Ozawkie limestone member at base of Deer Creek limestone. [Text does not discuss unit in Missouri.]

R. C. Moore and others, 1951, Kansas Geol. Survey Bull. 89, p. 66. Consists of brownish-gray brown-weathering massive limestone. Fusulines and other marine fossils locally abundant. Commonly thickness is about 5 feet but ranges from about 1 to 20 feet. Underlies Oskaloosa shale member; overlies Tecumseh formation.

H. G. Hershey and others, 1960, Iowa Highway Research Board Bull. 15, p. 18, fig. 5. Identified only in quarry south of Pacific Junction, E½NW¼NW¼ sec. 15, T. 71 N., R. 43 W., Mills County. Here it is 0.4 foot of light-gray fine-grained limestone overlying 1½ feet of dark-gray arenaceous shale which in turn overlies buff sandy limestone bed about 1 foot thick. Where not recognized, the Ozwakie and overlying Oskaloosa shale member may be included in upper part of Tecumseh shale.

Type locality: In roadcut in NE¼ sec. 31, T. 9 S., R. 18 E., near Ozawkie, Jefferson County, Kans.