# Lexicon of Geologic Names Of the United States For 1936–1960

## Part 3, P–Z

GEOLOGICAL SURVEY BULLETIN 1200

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*By* GRACE C. KEROHER *and others*

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## LEXICON—PART 3, P-Z

**Paakea 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), 251–252, pl. 1. Single aa flow; locally interflow clinker may indicate two flow units. Platy jointing rare; columnar jointing well developed. Sparsely vesicular with scattered phenocrysts of olivine in microcrystalline groundmass. Exposed thickness at mouth of Paakea Gulch approximately 150 feet; 1½ to 5 feet where tongues cross highway at Kapaula Gulch; 41 feet in test hole 12. Fills shallow valley cut in Kapaula lava (new). Each 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. 102. Pleistocene(?).

Named for occurrence along Paakea Gulch. Flow entered area from southwest and divided into two branches which advanced to coast along valleys of Kapaula and Paakea, east Maui.

**Pablo Formation**

Permian(?) : South-central Nevada.

H. G. Ferguson and S. H. Cathcart, 1954, U.S. Geol. Survey Geol. Quad. Map GQ–40. Consists largely of greenstone and chert but contains small proportion of sedimentary rocks, chiefly slate and conglomerate. Contains also flows of felsitic lavas similar to intrusive Darrough felsite (new). Thickness probably exceeds 5,000 feet. Overlies Diablo formation; intrusive contact with Darrough felsite.

N. J. Silbering, 1959, U.S. Geol. Survey Prof. Paper 322, p. 6–10, pls. 10–11. Pablo formation is base of sequence in Union district, Shoshone Mountains, Nev. Three local members recognized. Lowest is coarse- and fine-grained sedimentary rocks interstratified with andesitic volcanic rocks; relatively thin limestone member; thick greenstone member composed of altered andesitic flows and volcanic breccia. Thickness about 2,450 to 3,450 feet. Base not exposed. Underlies Grantsville formation, little if any angular discordance.

Type locality: Pablo Creek, Toyabe [Toiyabe] Range.

Pabst Member (of Tyler Slate)[1]

Precambrian : Northwestern Michigan and northwestern Wisconsin.

Original reference: W. O. Hotchkiss, 1919, Eng. and Min. Jour., v. 108, p. 501–506.

N. K. Huber, 1959, Econ. Geology, v. 54, no. 1, p. 104 (table 10), 106 (table 11), 107 (fig. 6). Described from drill holes at Pence, Wis., as conglomerate and chert-carbonate rock. Thicknesses 16 feet and 30 feet.

Named for Pabst mine, east of Ironwood, Gogebic County, Mich.

Pacheco Group

Upper Cretaceous: West-central California.

N. L. Taliaferro, 1943, California Div. Mines Bull. 118, pt. 2, p. 130–132, pl. 2 [preprint 1941]. Upper Cretaceous of central Coast Ranges divided into Pacheco group, below, and Asuncion, above. The groups are separated by Santa Lucian orogeny. In Pacheco Pass quadrangle, group consists of 7,000 to 8,000 feet of gray sandy shales, sandstones, and conglomerates which are either vertical or dip eastward at high angles; beds extend both north and south of quadrangle as continuous belt and also occur west of belt on El Puerto Creek in western Stanislaus County. Less widely distributed in central Coast Ranges than Asuncion group, but reverse may be case in northern Coast Ranges. Overlies Shasta group; in southern part of Diablo Range, Pacheco beds rest on Franciscan; to the north, they rest on Paskenta; to the east of Priest Valley and Waltham Creek, Pacheco conglomerates, grading upward into sandstones and shales, rest unconformably on Paskenta, Knoxville, and Franciscan in turn.

N. L. Taliaferro, 1944, Am. Assoc. Petroleum Geologists Bull., v. 28, no. 4, p. 475–484. Name Jack Creek formation proposed as formational name for representative of Pacheco group in Santa Lucia Range.

F. M. Anderson, 1958, Geol. Soc. America Mem. 71, p. 15–30. Discussion of subdivisions of Pacific Coast Upper Cretaceous. Taliaferro's terms Pacheco and Asuncion groups used. Age of Pacheco ranges from latest Albian to close of Turonian time.

Named for development of beds in Pacheco Pass quadrangle especially on Quinto and Garzas Creeks.

Pacheta Member (of Lowell Formation)

Lower Cretaceous: Southeastern Arizona.

A. A. Stoyanow, 1949, Geol. Soc. America Mem. 38, p. 12, 14–15, pl. 27. Consists of following units (ascending): Lancha limestone (new), yellow dolomite, streaked and crossbedded sandstone with fragments of silicified trees, Tusonimo limestone (new), Cienda limestone (new), Black Knob dolomite (new), and Black Knob quartzite (new). Thickness 97 feet. Underlies Joserita member (new); 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.

**Pachuta Marl 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. 1830 (fig. 6), 1839 (footnote). Pachuta (marl) member of Yazoo clay (or formation) proposed for 6 to 25 feet of buff, gray, or white, partly indurated generally glauconitic fossiliferous marl, overlain by Shubuta (clay) member (new) and underlain by Cocoa sand member or North Creek clay member (new).

L. D. Toulmin, P. E. LaMoreaux, and C. R. Lanphere, 1951, Alabama Geol. Survey Spec. Rept. 21, p. 122, 126, pl. 3. In Choctaw County, Ala., consists of yellow sandy hard limestone with prints of fossils and light-gray almost white chalky marlstone irregularly indurated and containing white lime nodules; thins gradually from about 10 feet at Mississippi-Alabama line to about 5 feet in south-central part of county.

Type locality: Exposures on south side of Pachuta Creek, 1¼ miles south and southeast of Pachuta in SW¼ sec. 8, T. 2 N., R. 14 E., Clarke County, Miss.

Pacific muck

Pleistocene and Recent: Panamá.

[T. F. Thompson], 1943, Panama Canal, Spec. Eng. Div., 3d Locks Proj., pt. 2, chap. 3, p. 23–24. Series of low wave-cut benches and raised-beach or shallow-water bay deposits occurs at certain localities on Pacific side of Isthmus, above elevations attained by present tides. Locally similar to Atlantic Pleistocene deposits. Near city of Panamá, soft silt and clay-muck blanket covers underlying older agglomerates and tuffs. This layer deposited in late Pleistocene embayment and contains well-preserved fossils.

W. P. Woodring *in* R. Hoffstetter and others, 1960, Lexique Strat. Internat., v. 5, Amérique Latine, fasc. 2a, p. 341. Pleistocene. Informal name.

**Pacific Quartz Latite**[1]

Tertiary: New Mexico.

Original reference: H. G. Ferguson, 1927, U.S. Geol. Survey Bull. 787.

Named for outcrops near Pacific mine, in western part of Mogollon district.

†Pacific Sandstone[1]

Lower Ordovician: Central eastern Missouri.

Original reference: S. H. Ball and A. F. Smith, 1903, Missouri Bur. Geology and Mines, v. 1, 2d ser., p. 79.

Named for Pacific, Franklin County.

**Packard Quartz Latite**

Packard Rhyolite[1] or Rhyolite Series

Eocene, middle: Central northern Utah.

Original reference: G. W. Tower, Jr., and G. O. Smith, 1899, U.S. Geol. Survey 19th Ann. Rept., pt. 3, map.

P. D. Proctor and others, 1956, U.S. Geol. Survey Mineral Inv. Field Studies Map MF–45. Referred to as Packard quartz latite. Flows, tuffs, and breccias as much as 400 feet thick.

H. T. Morris, 1957, Utah Geol. Soc. Guidebook 12, p. 30–32, pl. 1. Packard quartz latite subdivided into four units: basal tuff, a few inches to as much as 100 feet thick, locally absent; lower vitrophyre, a few feet to more than 700 feet thick, locally absent; massive quartz latite a few feet to more than 2,300 feet thick; and upper vitrophyre. Packard and Fernow quartz latites are apparently parts of same volcanic series which have been separated geographically by overlying latite volcanic rocks.

D. R. Cook, 1957, Utah Geol. Soc. Guidebook 12, p. 65 (fig. 6). As shown on chart, Packard rhyolite series underlies Laguna latite series (new) and overlies Humbug formation.

J. M. Foster, 1959, Brigham Young Univ. Research Studies, Geology Ser., v. 6, no. 4, p. 35–36, pl. 4. Packard rhyolite series was followed by Laguna latite sequence.

Named for exposures on Packard Peak, Tintic district.

Packard Ranch Member (of Supai Formation)

Pennsylvanian: East-central Arizona.

R. L. Jackson, 1951, Plateau, v. 24, no. 2, p. 88, 89, figs. 2, 3. Arenaceous at type locality, becomes more calcareous eastward. Packard Ranch member of Oak Creek and Fossil Creek appears to intertongue with Naco formation to southeast. Underlies Oak Creek member (new) and overlies Naco formation.

Has optimum expression and development at Sycamore Canyon, and is recognizable both at Oak Creek Canyon and at Fossil Creek.

Pack Creek Substage

Pleistocene (Wisconsin) : Central Colorado.

G. M. Richmond, 1953, Friends of the Pleistocene Rocky Mountain Section [Guidebook] 2d Ann. Field Trip, correlation chart. Substage of Pinedale stage. Occupies Cary-Mankato interval between Cary sub-age and Mankato sub-age.

Twin Lakes area.

†Packer Clay[1]

Pleistocene (late Illinoian) : Southeastern Pennsylvania.

Original reference: E. H. Williams, Jr., 1894, Geol. Soc. America Bull., v. 5, p. 281–288.

Occurs between Easton and Topton divide and below level of 500 feet with exception of part of Saucon Valley west and south of Hellertown, Northampton County. Name derived from glacial lake named Packer.

**Packsaddle Schist[1]**

Precambrian (Llano Series) : Central Texas.

Original reference: T. B. Comstock and E. T. Dumble, 1890, Texas Geol. Survey 1st Ann. Rept., p. lvii, lviii, 276–281, pl. 3.

V. E. Barnes, 1946, Texas Univ. Bur. Econ. Geology Pub. 4301, p. [1945] Intruded by Big Branch gneiss.

Virgil Barnes, Frederick Romberg, and W. A. Anderson, 1954, Internat. Geol. Cong., 19th, Algiers 1952, Comptes rendus, sec. 9, pt. 9, p. 152–153. Oldest Precambrian rocks in Llano uplift are most light colored, highly feldspathic metasediments, named Valley Spring gneiss, followed by dark-colored metasediments; including amphibolite, mica schist, graphite schist, and some marble, all of which are included in Packsaddle schist. These rocks are highly folded, and during folding it is believed the igneous rocks were intruded which were metamorphosed into Red Mountain gneiss and dioritic Big Branch gneiss. Date of intrusion of perioditic rocks, now serpentized into Coal Creek serpentine, in relation to Big Branch gneiss not satisfactorily determined. Town Mountain granite invaded the already deformed metasediments and was followed by Oatman Creek granite, Sixmile granite, and Llanite, the latter being the youngest.

Named for Packsaddle Mountain, Llano County.

**Packsaddle Mountain Granodiorite[1]**

Probably Jurassic or Cretaceous: Northern Idaho.

Original reference: J. L. Gillson, 1927, Jour. Geology, v. 35, no. 1.

Named for fact it composes Packsaddle Mountain, Bonner County.

Packwood Gravels

Pliocene to Pleistocene: Central California.

M. D. Crittenden, Jr., 1951, California Div. Mines Bull. 157, p. 22 (fig. 4), 42–43, pl. 1. Consists of poorly consolidated gravel, pebbly sandstone, silt, and clay. Estimated minimum thickness 500 feet. Reconnaissance indicates homoclinal dip to east of 10° to 30°, yielding a thickness of at least 3,000 feet with neither base nor top exposed. Underlies Santa Clara formation; overlies Orinda formation. Name credited to C. F. Tolman (unpub. rept.).

Sediments crop out in lower part of Packwood Creek, Morgan Hill quadrangle, where they occur in a block which has been dropped down between the Silver Creek and Calaveras fault zones. Area of study is in central Coast Ranges, about 50 miles southeast of San Francisco.

Pacoima Formation

Pleistocene, middle: Southern California.

G. B. Oakeshott, 1952, Petroleum World, v. 49, no. 1, p. 21 (map), 22. About 1,000 feet of poorly sorted gravels and fanglomerate. Unconformably overlies Saugus formation; unconformably underlies oldest terrace deposits. Fanglomerate [formation] has been distinctly folded along Little Tujunga syncline, and crystalline rocks have been thrust over it along Hospital fault.

G. B. Oakeshott, 1958, California Div. Mines Bull. 172, p. 22 (fig. 2), 23 (fig. 3), 85–87, pl. 1. Formal proposal of name. Thickness 500 to 1,000 feet, south of San Gabriel fault; 200 feet, north of fault. In both areas, overlies Saugus formation and underlies terrace deposits; both contacts angular unconformities. Overlaps Elsmere member of Repetto near Olive View. Probably deposited in middle to early upper Pleistocene.

Type locality: At mouth of Pacoima Canyon one-half mile below Pacoima Dam, near eastern end of Sylmar 6-minute quadrangle, San Fernando quadrangle, Los Angeles County.

**Paddock Shale Member** (of Nolans Limestone)

Paddock 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. 61.

R. C. Moore and others, 1951, Kansas Geol. Survey Bull. 89, p. 41. Member of Nolans limestone. Underlies Herington limestone member; overlies Krider limestone member. Thickness 7 to 10 feet in northern part of Kansas and about 30 feet in southern part. Leonard series.

Type locality: Roadcut one-fourth mile south of Krider, Gage County, Nebr. Named for Paddock Township, southern Gage County.

Paducah Formation[1]

Pleistocene: Western Kentucky.

Original reference: F. J. Fohs, 1907, Kentucky Geol. Survey Bull. 9, p. 67.

Probably named for Paducah, McCracken County.

Pagan Limestone

Pleistocene(?) or Recent: Mariana Islands (Pagan).

Risaburo Tayama, 1952, Coral reefs in the South Seas; Japan Hydrog. Office Bull., v. 11, table 4 [English translation in library of U.S. Geol.

Survey, p. 56]. Composed chiefly of reef-building corals; situated 1 to 2 meters above the reef flat and roughly 0.5 meter above the high-water mark. Covered with agglomerate. Recent.

S. Hanzawa *in* Jacques Avias and others, 1956, Lexique Strat. Internat., v. 6, Océanie, fasc. 2, p. 51–52. Pleistocene(?).

Forms outer caldera wall of island.

Page Ranch Formation

Tertiary: Southwestern Utah.

E. F. Cook, 1957, Utah Geol. Mineralog. Survey Bull. 58, p. 18, 20, 21, 61–63. Consists of two units: a lower gray to gray-brown poorly bedded rough-textured tuff-breccia which contains occasional subangular boulders to 6 feet in diameter in a matrix of smaller lithic fragments and broken mineral crystals; and an upper crystal biotite dacite ignimbrite, moderately welded, gray brown to purplish brown, containing sparse lithic fragments. Only in mountain northwest of Page ranch are two units together, where they appear to be conformable; elsewhere either one or the other missing. Maximum thickness at least 600 feet. Overlies Rencher formation (new).

J. H. Mackin, 1960, Am. Jour. Sci., v. 258, no. 2, p. 90 (table 1), 92 (fig 2), 97–98. Subdivided into (ascending) Irontown and Kane Point tuff members. Kane Point has zircon age of 19 million years. This suggests that Rencher-Page Ranch period of extrusive-intrusive igneous activity is late Oligocene or early Miocene.

Mapped in northern half of Pine Valley Mountains, Washington and Iron Counties. Named for exposures capping mountain northwest of Page Ranch.

Pageton 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. 243.

Quarried at Pageton, McDowell County.

**Pago Volcanic Series**

Pliocene and Pleistocene(?) : Samoa Islands (Tutuila).

H. T. Stearns, 1944, Geol. Soc. America Bull., v. 55, no. 11, p. 1285 (table 1), 1290–1299, pl. 1; G. A Macdonald *in* Jacques Avias and others, 1956, Lexique Strat. Internat., v. 6, Océanie, fasc. 2, p. 187–188. Includes extra-caldera lavas, dikes, plugs, cinder cones, vitric tuffs, lithic tuffs, and breccias; and intra-caldera lavas, dikes, plugs, cones, tuffs, and breccias. Intra-caldera volcanics, about 2,141 feet, include massive aphanitic and porphyritic basaltic and andesitic lava flows, and cinder cones, associated with three trachyte plugs; and interbedded lithic-vitric tuff member is 50 to 500 feet thick. Extra-caldera unit, about 1,609 feet thick, consists of lower member of thin-bedded primitive olivine basalts, associated thin dikes, and thin beds of vitric and lithic tuff having aggregate thickness of more than 1,000 feet; upper member consists of basalts, basaltic andesites, andesitic basalts, and andesites, associated with five plugs. Flows are massive and have maximum thickness of 500 feet.

Forms entire central part of island. Type locality of intra-caldera tuff and breccia member is head of Pago Pago Valley on north side of trail to Fagasa.

**Pagoda Limestone**

Pagoda Oolite[1]

Middle Cambrian: Northwestern Montana.

Original reference: C. F. Deiss, 1933, Montana Bur. Mines and Geology Mem. 6, p. 37.

Charles Deiss, 1938, Geol. Soc. America Bull., v. 49, no. 7, p. 1075, 1085, 1090 (fig. 2). Termed Pagoda limestone. Underlies Pentagon shale; overlies Dearborn limestone. Thickness type section 364 feet. Middle Cambrian.

Charles Deiss, 1939, Geol. Soc. America Spec. Paper 18, p. 40–41, measured sections. Underlies Steamboat limestone in central and southern sections. Detailed measured sections.

Type locality: On east side of peak lying N. 20° E. of top of Pagoda Mountain in SW¼ sec. 3, T. 22 N., R. 13 W. Named for Pagoda Peak, but not present on peak that forms very top of mountain.

**Pahala Ash** (in Kahuku Volcanic Series)

Pahala Basalt[1]

Pleistocene: Hawaii Island, Hawaii.

Original reference: W. O. Clark, L. F. Noble, and H. S. Washington, 1923, Am. Jour. Sci., 5th, v. 6, p. 119.

H. T. Stearns and G. A. Macdonald, 1946, Hawaii Div. Hydrography Bull. 9, p. 62 (table), 64 (table), 67 (table), 68, 69, 71–76. Pahala basalt replaced by Kahuku volcanic series (new). Name Pahala here restricted to top ash member; as thus restricted it is the persistent ash formation, derived from several sources, which caps Hilina volcanic series on Kilauea, Kahuku volcanic series on Mauna Loa, and Hamakua volcanic series on Mauna Kea. Also overlies Hilina, Hawi, and part of Hualalai volcanic series; underlies Kau, Puna, and Laupahoehoe volcanic series. Includes Waiau tuff described by Wentworth. Thickness as much as 50 feet.

D. A. Davis and G. A. Macdonald *in* Jacques Avias and others, 1956, Lexique Strat. Internat., v. 6, Océanie, fasc. 2, p. 122–123. Pahala ash, as used by Stone (1926, Bernice P. Bishop Mus. Bull. 33), included ash deposits on Mauna Loa and Kileau, but did not definitely include those on Mauna Kea. Wentworth (1938, Hawaiian Volcano Observatory, 3d Spec. Rept.) used term Pahala tuff in same general sense. Stearns and Clark (1930, U.S. Geol. Survey Water-Supply Paper 616) included the ash as upper member of Pahala basalt. Present usage follows that of Stearns and Macdonald (1946).

Named for town of Pahala on south slope of Mauna Loa. Crops out about 450 square miles, chiefly on Mauna Kea and Mauna Loa.

**Pahasapa Limestone[1]**

Lower Mississippian: Western South Dakota and northeastern Wyoming.

Original reference: N. H. Darton, 1901, U.S. Geol. Survey 21st Ann. Rept., pt. 4, p. 509.

E. P. Rothrock, 1955, North Dakota Geol. Soc. Guidebook Black Hills Field Conf., p. 76. Mississippian system represented in South Dakota by formations of Madison group, called Englewood and Pahasapa, where they outcrop, and Bakken, Lodgepole, Mission Canyon, and Charles where encountered in wells.

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.

Name is Dakota [Sioux] Indian name for Black Hills

Pahranagat limestone[1]

Ordovician: Nevada.

Original reference: C. R. Keyes, 1923, Pan-Am. Geologist, v. 40, p. 53, 80.

Named for Pahranagat Mountains, north of Las Vegas, Clark County.

**Pahrump Series**

Pahrump Group

Precambrian: Southern California.

D. F. Hewett, 1940, Washington Acad. Sci. Jour., v. 30, no. 6, p. 239–240; 1956, U.S. Geol. Survey Prof. Paper 275, p. 25–28, pl. 1. Comprises about 6,500 feet of sandstone, conglomerate, quartzite, shale, and dolomite. Unconformably overlies Precambrian granite gneiss; unconformably underlies sedimentary rocks that probably represent basal formation of Paleozoic rocks. Lower Cambrian in age. Divided into (descending) Kingston Peak formation, Beck Spring dolomite, and Crystal Spring formation.

D. F. Hewett, 1948, California Div. Mines Bull. 129, p. 197. In Kingston Range, San Bernardino County, underlies Noonday dolomite.

L. A. Wright, 1952, California Div. Mines Spec. Rept. 20, p. 7, 8 (fig. 4). In Superior Talc area, Death Valley region, all three formations of Pahrump series exposed in a relatively undeformed section; this is only known locality west of Kingston Range where all units occur in virtually complete thicknesses. Series more than 5,500 feet thick, composes a north-trending structural block forming Saratoga Hills; block is about 2 miles long and dips eastward at moderate to steep angles.

D. H. Kupfer, 1954, California Div. Mines Bull. 170, map sheet 19. Referred to as Pahrump group.

D. H. Kupfer, 1960, Geol. Soc. America Bull., v. 71, no. 2, p. 188–194, pls. 1, 2. Name changed to group. In Silurian Hills [this report], exposed part is more than 11,000 feet thick and can be subdivided into 35 mappable members. Because of rapid facies changes in group, these members may not be recognized in other areas, and hence, are not given formal names but numbered (ascending) 1 to 35. Correlation of these members with Hewett's formations are uncertain. The 35 members may all be part of Crystal Spring formation, or they may represent all of Hewett's formations and a younger, previously unrecognized formation. Coarse clastic sediments dominate group; sandstone, generally orthoquartzite, is most common rock type; beds of carbonate rock, mainly dolomite, occur throughout section. Nonconformable on older metamorphic rocks; in measured section, top not exposed. Intruded by granitic rocks of two or more ages. Thrust faulting and chaos structure of area discussed.

Occurs in Kingston Range, Ivanpah quadrangle. Name derived from valley that borders Kingston Range on the north. Silurian Hills in San Bernardino County are 15 miles southeast of Death Valley.

Paicines Formation[1]

Pliocene: Southern California.

Original reference: P. F. Kerr and H. G. Schenck, 1925, Geol. Soc. America Bull., v. 36, p. 470, 476, map.

Probably named for extensive development west of Paicines, San Benito County.

**Paine Shale Member** (of Lodgepole Limestone)

Paine Shale Member (of Madison Limestone)[1]

Lower Mississippian: Central northern, central southern, and southwestern Montana.

Original reference: W. H. Weed, 1899, U.S. Geol. Survey Geol. Atlas, Folio 55.

L. L. Sloss and R. H. Hamblin, 1942, Am. Assoc. Petroleum Geologists Bull., v. 26, no. 3, p. 315, 317–318, 319, 320, 321, 322, 323, 324. Reallocated to member status in Lodgepole limestone. At type locality and throughout southwestern part of state, characterized by thin-bedded dense limestones in units averaging 5 inches thick separated by almost equal amounts of calcareous shale and shaly limestone; chert lenticules common. In Big Snowy Mountains, member is highly massive. Eastward from Bridger and Gallatin Ranges, thins progressively and is missing in Pryor and Big Horn Mountains. Thickness 56 to 331 feet. Underlies Woodhurst member; overlies Three Forks limestone.

L. R. Laudon and J. L. Severson, 1953, Jour. Paleontology, v. 27, no. 4, p. 509 (fig. 2a). Columnar section Fairy Lake area, Bridger Mountains, shows Paine member overlying Sappington formation.

First mapped at and around Paine Gulch, southwestern corner Fort Benton quadrangle, Little Belt Mountains.

Paint Slate[1]

Precambrian: Northwestern Michigan.

Original reference: R. C. Allen, 1910, Michigan Geol. and Biol. Survey Pub. 3, geol. ser. 2, p. 100–101.

R. H. Nanz, Jr., 1953, Jour. Geology, v. 61, no. 1, p. 53, 55. Incidental mention in discussion of chemical composition of Precambrian slates.

Named for Paint River, Iron County.

**Paint Creek Formation**[1] **or Shale**

Paint Creek Formation (in New Design Group)

Upper Mississippian (Chester Series): Southern Illinois, southern Indiana, western Kentucky, and southeastern Missouri.

Original reference: S. Weller, 1913, Illinois Acad. Sci. Trans., v. 6, p. 120, 125.

R. E. Stouder, 1938, Am. Assoc. Petroleum Geologists Bull., v. 22, no. 3, p. 268 (fig. 1), 269, 270 (fig. 2), 275–277. Paint Creek used here to include group of formations above Sample sandstone and below Cypress sandstone between Ohio River and southern end of Hardin and Breckinridge Counties, Ky. Includes three distinct formations: basal limestone 30 feet thick, central sandstone and shale 20 to 40 feet thick, and upper limestone member about 8 feet thick. Aggregate average thickness 62 feet near Lodiburg. These formations have been lumped together as upper Gasper; this name inadequate because it was originally used to describe a local phase in a restricted territory. The three formations of Paint Creek are correlatives of the Indiana formations (ascending), Reelsville limestone, Elwren sandstone and shale, and Beech Creek limestone. Names Reelsville and Elwren here proposed for the two lower members of the Kentucky formation; descriptive term *Productus inflatus* zone, first used by C. Butts, is here used in same manner.

J. M. Weller and A. H. Sutton, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 5, p. 766 (fig. 1), 827–828. Assigned to New Design group (new). In standard Mississippian section, overlies Bethel sandstone and underlies Cypress sandstone. In Monroe and Randolph Counties, Ill., and northern Perry County, Mo., uniformly consists of calcareous shale and interbedded limestone with a conspicuous dark-red nonlaminated clay 12 to 15 feet thick about 10 feet above base; in lower part, shale predominates and limestone beds are argillaceous and separated by numerous bluish shaly partings; in upper part, limestone layers are more massive, purer, and crystalline, and at top is limestone bed about 10 feet thick. In areas where Bethel sandstone is absent, Renault and Paint Creek formations cannot be separated. In Meade, Breckinridge, Ohio, and parts of Hardin and Grayson Counties, Ky., Paint Creek consists of five variable members; three of these, the lowermost, middle, and uppermost, are largely shale, and the two intermediate are somewhat massive limestone. From Todd County to Grayson County, Ky., where Bethel sandstone is absent, Renault and Paint Creek formations together form limestone unit that cannot be easily subdivided; these beds are now known as Girkin limestone. In Indiana, formation comprises three members (ascending): Reelsville limestone, Elwren sandstone and shale, and Beech Creek limestone.

O. E. Wagner, Jr., *in* L. W. Currier, 1944, U.S. Geol. Survey Bull. 942, p. 17–18. Referred to as Paint Creek shale in Fluorspar area of Hardin County, Ill.

Elwood Atherton and D. H. Swann, 1948, (abs.) Am. Assoc. Petroleum Geologists Bull., v. 32, no. 2, p. 300. Lower Chester formations are correlated in western Illinois, subsurface of southeastern Illinois basin, Hardin County, Ill., and Indiana. Paint Creek of southern and western Illinois is divided into three members: upper limestone and shale zone, named Ridenhower member and correlated with "Paint Creek" of southeastern Illinois; middle sandstone and shale zone, correlated with Bethel sandstone of southeastern Illinois; and a lower "pink crinoidal limestone" correlated with upper part of "Renault" formation and called Downeys Bluff member in southeastern Illinois. Correlations credited to F. E. Tippie (unpub. ms.).

A. H. Sutton and W. A. Oesterling, 1952, Am. Assoc. Petroleum Geologists Bull., v. 36, no. 9, p. 1786. Paint Creek was named by Weller (1913) from exposures in southwestern Illinois. Name Ridenhower was applied by Butts (1917) to same part of Chester section, the shale between the Bethel and Cypress sandstones in the Fluorspar district.

C. A. Malott, 1952, Stratigraphy of the Ste. Genevieve and Chester formations of southern Indiana: Ann Arbor, Mich., The Edwards Letter Shop, p. 7. Paint Creek formation of standard Chester column has triple expression in southern Indiana (ascending): Reelsville limestone, Elwren sandstone, and Beech Creek limestone. Each of these is a distinct stratigraphic unit in parity with other formations of the Chester and deserves name in its own right.

Named for Paint Creek, Monroe County, Ill. Typically developed in tributary of Paint Creek about 5½ miles northeast of Prairie du Rocher.

†Painted Desert Formation[1]

Jurassic and older(?): Northern Arizona, northwestern New Mexico, and southwestern Utah.

Original reference: L. F. Ward, 1901, Am. Jour. Sci., 4th, v. 12, p. 401–413.

Named for Painted Desert, Coconino County, Ariz.

Painted Hill Formation

Pliocene, lower or middle: Southern California.

C. R. Allen, 1954, California Div. Mines Bull. 170, map sheet 20. Typically unconsolidated gray conglomerate, locally contains white sandstone, fresh-water limestone, and interlayered flows of olivine basalt. Thickness about 3,400 feet. Underlies Quaternary gravels; overlies Imperial formation with essential conformity although Imperial beds pinch out to north.

C. R. Allen, 1957, Geol. Soc. America Bull., v. 68, no. 3, p. 324 (fig. 2), 325 (table 1), 328–329, pls. 2, 3. Name Painted Hill formation herein applied to continental beds that conformably overlie Imperial formation east of Painted Hills. Bramkamp (1934, Ph.D. thesis, Univ. California, Berkeley, p. 15) termed the unit Indio because its stratigraphic position is similar to that of Indio formation in the Indio Hills. North of point where Imperial formation pinches out, Painted Hill lies directly on Coachella fanglomerate with marked angular unconformity. Probably early or middle Pliocene.

Named for Painted Hill, San Gorgonio Pass area, Riverside County.

Painted Rock Formation

Painted Rock Sandstone Member (of Vaqueros Formation)

Miocene, lower: Southern California.

T. W. Dibblee, Jr., 1952, *in* Am. Assoc. Petroleum Geologists, Soc. Econ. Paleontologists and Mineralogists, and Soc. Econ. Geologists guidebook, Joint Ann. Mtg., Los Angeles, p. 82, 86. Marine sandstone and siltstone, 5,500 feet thick. Underlies Monterey marine shale and associated lava flows and sills; overlies Soda Lake formation (new). Outcrops noted on road log.

I. T. Schwade, 1954, California Div. Mines Bull. 170, map sheet 1. Noted as occurring in hanging-wall block of Morales fault, Cuyama Valley. Here consists of about 50 percent sandstone.

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), 2978 (fig. 3), 2986–2987, 2988 (fig. 7). Rank reduced to member status in Vaqueros formation. At designated type locality, consists of a sequence of sandstones and siltstones with minor amounts of shale; thickness about 5,430 feet; in vicinity of Painted Rock, about 6,000 feet. Overlies Soda Lake shale member; underlies Monterey clay shale; both contacts gradational. Eaton and others (1941, Am. Assoc. Petroleum Geologists Bull., v. 25, no. 2) included upper 900 feet of section as part of their Temblor and called the rest, from which they report occurrence of *Turritella inezana*, "Vaqueros"; this separation was based on faunal content and not on lithology; because this predominantly sandstone section is lithologically inseparable throughout its areal extent, term Painted Rock sandstone member is applied. Top of sandstone at Caliente Mountain is stratigraphically about 800 feet lower than it is in northwestern Caliente Range. In southeastern Caliente Range, Painted Rock thins, and upper part grades laterally eastward into basal beds of nonmarine Caliente formation.

Type locality: Caliente Mountain and Midway Peak Southwest quadrangles. Name derived from Painted Rock, a sandstone knob on which Indian pictographs are preserved, sec. 17, T. 32 S., R. 20 E., Caliente Range. Range is an anticlinal uplift developed in thick series of Tertiary sediments and is partially overturned and thrustfaulted southwestward toward Cuyama Valley.

†Painterhood Limestone[1]

Pennsylvanian: Southeastern Kansas.

Original reference: F. C. Schrader and E. Haworth, 1905, U.S. Geol. Survey Bull. 260, p. 447.

Named for Painterhood Creek, Elk County.

Paint Lick Limestone (in Eden Group)[1]

Upper Ordovician: East-central Kentucky and southwestern Ohio.

Original reference: A. F. Foerste, 1906, Kentucky Geol. Survey Bull. 7, p. 10, 19, 212, 215.

A. C. McFarlan, 1943, Geology of Kentucky: Lexington, Ky., Kentucky Univ., p. 24. In central Kentucky, divisions of Eden include Fulton, Million, and Paint Lick. Paint Lick constitutes lower and massive part of Garrard sandstone of Campbell (1898).

Probably named for Paint Lick Creek, Madison and Garrard Counties, Ky.

Paint Pot Crater Flow

Recent: Northern California.

C. A. Anderson, 1941, California Univ. Dept. Geol. Sci. Bull., v. 25, no. 7, p. 371. Name applied to a basalt flow from Paint Pot Crater. Considered older than Burnt Lava flow.

Occurs on western flank of Medicine Lake Highland near Little Glass Mountain, Modoc Lava Bed quadrangle.

Paint River Greenstones (in Quinnesec Schist)

Precambrian (Huronian): Northern Michigan.

H. M. Martin, 1936, The centennial geological map of the northern peninsula of Michigan (1:500,000): Michigan Dept. Conserv., Geol. Survey Div. Pub. 39, Geol. Ser. 33. Shown on map legend. Occurs in Crystal Falls and Iron River districts.

**Paint River Group**

Precambrian (Animikie Series): Northern Michigan.

H. L. James, 1958, U.S. Geol. Survey Prof. Paper 314–C, p. 30 (table 1), 37. Uppermost of four groups in the series; younger than Baraga group. Comprises (ascending) newly defined Dunn Creek slate, Riverton iron-formation, Hiawatha graywacke, Stambaugh formation, and Fortune Lakes slate. In previous reports, these strata were considered part of the Michigamme slate. Iron River-Crystal Falls district is a deep tightly folded major synclinal structure incompletely bounded by Badwater greenstone; east of Crystal Falls, greenstone is absent and strata of the district proper rest directly on Michigamme slate. Recognition of stratigraphic position of Badwater greenstone formed basis for definition of Paint River group.

Named for Paint River which drains northern and eastern part of district, Iron and Dickinson Counties.

Paint Rock Bed (in Wichita Group)[1]

Paint Rock Limestone (in Lueders Group)

Permian: Central Texas.

Original reference: N. F. Drake, 1893, Texas Geol. Survey 4th Ann. Rept., pt. 1, p. 421, 428.

M. G. Cheney, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 1, p. 66 (fig. 1). Rank raised to formation in the Lueders here given group status. Underlies Maybelle limestone; overlies Talpa formation.

R. C. Moore, 1949, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 80, sheet 2. Type "Paint Rock" in Concho County has been traced into type exposure of Talpa limestone; "Paint Rock" is a synonym for Talpa limestone and preference in nomenclature is given latter term.

Named for Paint Rock, Concho County.

Pajarito Lavas

Mesozoic(?): Southern Arizona.

B. P. Webb and K. C. Coryell, 1954, U.S. Atomic Energy Comm. RME–2009, p. 8, pl. 1. Consists principally of massive coarse-grained rhyolite, with abundant pink feldspar phenocrysts. Underlies Oro Blanco conglomerate.

Well developed in Pajarito Mountains in southeast section of Ruby quadrangle, Santa Cruz County.

**Pajarito Shale**

Pajarito Shale 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. Member consists of soft brown sandstone alternating with gray shale that contains *Ostrea quadriplicata;* on basis of this fossil, believed to be Washita in age. Overlies Mesa Rica sandstone member (new) or, where Mesa Rica is absent, Tucumcari shale member.

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 60 feet.

Type locality and derivation of name not stated. First described in northwestern Quay County.

Pakoon Limestone

Permian (Wolfcampian): Northwestern Arizona.

A. H. McNair, 1951, Am. Assoc. Petroleum Geologists Bull., v. 35, no. 3, p. 515 (fig. 2), 524–525. Dolomitic limestones. Thickness 688 feet at type section; 305 feet in Grand Wash Cliffs. Overlies Callville limestone; underlies Queantoweap sandstone (new). Wedges out some distance west of termination of upper Callville member.

Grant Steele, 1960, Dissert. Abs., v. 20, no. 12, p. 4635. Overlies Ferguson Springs formation (new).

Type section: On west face and crest of Pakoon Ridge, northwest of Pakoon Spring, Mohave County, approximately T. 35 N., R. 16 W.

**Pala Conglomerate**[1]

Pleistocene: Southern California.

Original reference: A. J. Ellis, 1919, U.S. Geol. Survey Water-Supply Paper 446.

Occurs in valley of San Luis Rey, in vicinity of Pala, San Diego County.

Palafox Sandstone Member (of Mount Selman Formation)[1]

Eocene, middle: Southern Texas, and Tamaulipas, Mexico.

Original reference: W. G. Kane and G. B. Gierhart, 1935, Am. Assoc. Petroleum Geologists Bull., v. 19, no. 9, p. 1370, 1371, 1377, 1381, 1385.

Forms a high cliff down the east bank of Rio Grande from mouth of Espada Creek to bluffs east of Palafox, Webb County, Tex. Can be traced from Rio Grande to Rio San Juan, Tamaulipas, Mex.

Palao Limestone

*See* Palau Limestone.

Palatine Bridge Limestone Member (of Tribes Hill Formation)

Lower Ordovician (lower Canadian): East-central New York.

D. W. Fisher, 1954, Geol. Soc. America Bull., v. 65, no. 1, p. 76 (fig. 2), 85–87. Name proposed for thin-bedded fucoidal arenaceous dolomilutite with many intercalations of shaly calcilutite. Described as fine- to medium-grained light-blue-gray rock with "glassy" appearance on fresh fracture. Pebble calcarenite layers common near top; pyrite abundant in uppermost few feet. Maximum thickness 56 feet; much variation. Conformably underlies Wolf Hollow member (new); overlies Fort Johnson member (new) with gradational contact in exposures west of Cranesville and unconformably in those to the east. Represents part of original "Calciferous" which was termed "Fucoidal Layers."

Type locality: Quarry 0.5 mile west of Palatine Bridge, Montgomery County.

Palau Limestone

Miocene to Pleistocene: Caroline Islands (Babelthuap)

Risaburo Tayama, 1935, Tohoku Univ. Inst. Geology and Paleontology Contr. in Japanese Language, no. 18, p. 13, 14–15, 37–39 [English translation in library of U.S. Geol. Survey, p. 16–17, 43–44, 45–46]. Consists of basal tuffaceous sand and gravel which contains andesite blocks and coral masses; an *Acropora* bed, about 10 meters thick; massive coral limestone which carries Nullipore and Foraminifera. Overlies Babelthuap agglomerate. Resembles Mariana limestone and may be contemporaneous with it.

U.S. Army Corps of Engineers, 1956, Military geology of Palau Islands, Caroline Islands:

U.S. Army Corps of Engineers, Far East, p. 39 (table 5), 55–59, pls. 4, 8, 9, 10, 11. Maximum thickness probably 750 feet or more. Age ranges from Miocene to Pleistocene; Miocene age indicated only at two localities.

Chart and plates show Palau older than Peleliu limestone and younger than Ngeremlengui formation.

S. Hanzawa *in* Jacques Avias and others, 1956, Lexique Strat. Internat., v. 6, Océanie, fasc. 2, p. 52. Pleistocene.

Well developed along southern shore of Babelthuap; widely distributed in islands south of Babelthuap.

**Palestine Sandstone**[1]

Palestine Sandstone (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 Clore limestone and overlies Menard limestone. Generally thin bedded and flaggy and contains much sandy shale. More massive beds occur locally as in Pope County, Ill., and northern Christian County, Ky. Within short distance beyond latter locality, formation becomes shaly and loses its identity in Leitchfield shale. In southwestern Indiana, probably represented by thin Bristow sandstone.

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 Palestine sandstone extended into southern Indiana where it replaces term Bristow sandstone. Local Indiana names of upper Chester dropped, and formations given names of standard Chester column.

T. G. Perry and N. M. Smith, 1958, Indiana Geol. Survey Bull. 12, pl. 1. Palestine sandstone shown on stratigraphic column of upper Chester in Indiana as gray to brown flaggy sandstone and green-gray shale. Thickness 5 to 40 feet. Term Elvira group not used in Indiana.

Named for Palestine Township, Randolph County, Ill., where formation is well developed along some tributaries of Tindall Creek.

**Pali 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. 123–124. Lithic tuff, cinder, agglomerate, vent breccia, and a lava flow and dike of nepheline basanite containing dunite inclusions. Maximum thickness of cinders about 40 feet; lava flow more than 20 feet. Uncomformably overlie Koolau volcanic series; also overlie Kaneohe, Nuuanu, and Aliamanu volcanics; underlie Salt Lake tuff. Pali cinders interbedded with alluvium in terraces-probably graded to the plus 95-foot (Kaena) stand of sea.

Crops out along road down the Nuuanu Pali, for which it is named. Exposed over about 0.2 square mile on face of Nuuani Pali (cliff) on northeast side of Koolau Range about 10 miles northwest of Makapuu Head.

**Palikea Formation** (in Koloa Volcanic Series)

Pleistocene: Kauai Island, Hawaii.

G. A. Macdonald, D. A. Davis, and D. C. Cox, 1954, Volcano Letter 526, p. 3; D. A. Davis and G. A. Macdonald *in* Jacques Avias and others, 1956, Lexique Strat. Internat., v. 6, Océanie, fasc. 2, p. 124; G. A. Macdonald, D. A. Davis, and D. C. Cox, 1960, Hawaii Div. Hydrography Bull. 13, p. 20, 75–84, pl. 1. Sedimentary breccias and conglomerates intercalated with volcanic rocks of Koloa series and lying between Koloa lavas and eroded rocks of Waimea Canyon series. Thickness at type locality 700 feet; elsewhere not over 200 feet.

Type locality: Palikea Ridge, 3.2 miles southeast of Kawaikini Peak, on eastern side of central mountain massif of Kauai. Crops out as narrow bands along edge of central massif of Kauai and intercalated with Koloa lavas over eastern two-third of island.

†Palisade Andesite (in Potosi Volcanic Series)[1]

Miocene: Southwestern Colorado.

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

**Palisade Diabase**[1]

Upper Triassic: Northern New Jersey and eastern New York.

Original reference: N. H. Darton, 1889, Am. Jour. Sci., 3d, v. 38, p. 134–139.

N. M. Perlmutter and Theodore Arnow, 1953, New York State Water Power and Control Comm. Bull. GW–32, p. 9 (table 2). Predominantly a medium- to coarse-grained dark-gray rock of intrusive origin consisting chiefly of plagioclase, augite, and hypersthene. Occurs as intrusive bodies in Newark group.

Forms the Palisades of the Hudson.

†Palisade Porphyry[1]

Precambrian (Keweenawan): Northeastern Minnesota.

Original reference: R. D. Irving, 1883, U.S. Geol. Survey Mon. 5, p. 262–268.

Forms the Great Palisades of Minnesota coast of Lake Superior.

Palisade Canyon Rhyolite

Miocene, upper, or Pliocene, lower: Northeastern Nevada.

Jerome Regnier, 1960, Geol. Soc. America Bull., v. 71, no. 8, p. 1191, 1198. Consists of several flows, some of which are more than 200 feet thick. Rock is brownish red and weathers dark brown. Maximum thickness 500 feet. Flows thin out and disappear toward the east. Unconformably overlies Raine Ranch formation (new); underlies Carlin formation (new).

Forms cliff 500 feet high in Palisade Canyon, vicinity of Carlin. Separates Carlin basin from Pine Valley. Folded into open syncline in which Humboldt River flows and into an anticline that determines a ridge 1,000 feet high west of the river.

Palisades Conglomerate[1]

Pleistocene(?): Southwestern Alaska.

Original reference: J. E. Spurr, 1898, U.S. Geol. Survey 18th Ann. Rept., pt. 3.

A. J. Eardley, 1938, Geol. Soc. America Bull., v. 49, no. 2, p. 323, 338. Pleistocene(?).

On left bank of Yukon, about 35 miles below mouth of Tanana, at base of cliffs, 150 feet high, that have been named the Palisades, Yukon gold district.

Palisades Flow, Andesite

Pleistocene to Recent: Southwestern Oregon.

Howel Williams, 1942, Carnegie Inst. Washington Pub. 540, p. 32, 62, 134. Thick andesitic flow forming Palisade Point. Rests on glacial moraines. Top is irregular, having monolithic crags and deep steep-sided fissures. Lies to west of Roundtop flow (new). In sections northwest of the Wineglass, white lump pumice and tuffaceous dacite [Wineglass welded tuff] cover Palisades flow. Was part of main andesitic cone of former Mount Mazama.

The Palisades are on northeast rim of Crater Lake.

†Palm Beach Limestone[1]

Pleistocene: Southern Florida.

Original reference: S. Sanford, 1909, Florida Geol. Survey 2d Ann. Rept., p. 209–211, table opposite p. 50.

Typically exposed in T. 45, R. 41, 12 miles west of Lantana, Palm Beach County.

Palm Canyon Complex

Paleozoic and (or) Mesozoic: Southern California.

W. J. Miller, 1944, California Jour. Mines and Geology, v. 40, no. 1, p. 12, 21–25, 36, 37, 38, pl. 1. A metasedimentary-igneous complex consisting largely of crystalline limestone, quartzites, and mica schists of phyllites, cut and locally injected by dioritic, granitic, pegmatitic, and silexitic material; highly deformed. Intruded by Bradley granodiorite (new), usually in form of sills.

W. J. Miller, 1946, Geol. Soc. America Bull., v. 57, no. 5, p. 530. Paleozoic and (or) Mesozoic; wholly or partly correlative with Diamond Valley complex (new).

Named for typical exposures on the east side of lower Palm Canyon [south of Palm Springs], Riverside County. Exposed for 12 or 14 miles southeast of Palm Springs.

Palmer Gneiss[1]

Precambrian: Northwestern Michigan.

Original reference: C. R. Van Hise and W. S. Bayley, 1895, U.S. Geol. Survey 15th Ann. Rept., p. 514.

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 Marguette area (ascending) Mesnard, Kona, Wewe. Palmer gneiss not listed on this table.

Typical exposures west of Palmer Lake, Marquette district.

Palmer Volcanics[1]

Tertiary(?): Northeastern Washington.

Original reference: C. E. Weaver, 1920, Washington Geol. Survey Bull. 20, p. 103, map.

Occurs west of Palmer, Stevens County.

Palmerton Sandstone (in Onondaga Group)

Palmerton Sandstone Member (of Onondaga Formation)

Middle Devonian: Southeastern Pennsylvania.

F. M. Swartz, 1939, *in* Bradford Willard, F. M. Swartz, and A. B. Cleaves, Pennsylvania Geol. Survey, 4th ser., Bull. G–19, p. 16, 52 (fig. 17), 108, 153. In area east of Schuylkill River to Carbon County, Oriskany sandstone is overlain by Bowmanstown chert and Palmerton sandstone; latter has for many years been mistaken for the Oriskany. Thickness 120 to 145 feet. Overlies Bowmanstown chert; underlies Esopus. Onondaga group. In eastern Monroe County and northwestern New Jersey, Esopus is believed to be contemporaneous with Bowmanstown chert and Palmerton sandstone.

C. K. Swartz and F. M. Swartz, 1941, Geol. Soc. America Bull., v. 52, no. 8, p. 1148, 1150, 1153, 1156, 1177. Description of a number of measured sections. Derivation of name given. Middle Devonian.

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

Carlyle Gray and others, 1960, Geologic map of Pennsylvania (1:250,000): Pennsylvania Geol. Survey, 4th ser. Onondaga formation, as mapped, includes Palmerton sandstone in Lehigh Gap area.

Named from exposures on ridges and in quarries north of Palmerton, Carbon County.

**Palmetto Formation**[1]

Lower and Middle(?) Ordovician: Southwestern Nevada.

Original reference: H. W. Turner, 1902, Am. Geologist, v. 29, p. 261–272.

H. G. Ferguson and S. H. Cathcart, 1954, U.S. Geol. Survey Geol. Quad. Map GQ–40. Mapped in Round Mountain quadrangle. Includes beds equivalent to Mayflower schist, Zanzibar limestone, and Toquima formation of Manhattan district. Slates carry graptolites of Chazy and Normanskill age, the former only from one locality in Toyabe Range. Estimated thickness 5,000 feet in Toquima Range and 2,500 feet or more in Toyabe Range. Map bracket shows Ordovician.

H. G. Ferguson, S. W. Muller, and S. H. Cathcart, 1954, U.S. Geol. Survey Geol. Quad. Map GQ–45. Thickness in Mina quadrangle about 4,000 feet, base concealed. Tertiary volcanic rocks cover contact between Cambrian Miller Mountain formation (new) and Palmetto. Underlies Diablo formation.

B. M. Page, 1959, Nevada Bur. Mines Bull. 56, p. 15–18, 19 (fig. 7), pl. 7. Oldest rocks exposed in Candelaria mining district. Isoclinally folded and cut by numerous faults. Thickness 87 to 167 feet, although total thickness unknown; neither top nor base exposed. Upper part eroded prior to deposition of Diablo formation; in some areas, in fault contact with Candelaria formation.

Type locality: Palmetto Mountains, Silver Peak quadrangle, Esmeralda County.

Palmetto (type) granite

Paleozoic (epi-Paleozoic): Northeastern Georgia.

G. W. Crickmay, 1952, Georgia Geol. Survey Bull. 58, p. 40, 44. Porphyritic biotite granite that closely resembles Stone Mountain type except that it includes many phenocrysts of feldspar, generally microcline. In Greene and Elbert Counties, gradational into Stone Mountain type, and one appears to be but a phase of the other. In Greene County porphyritic type predominates, and in Elbert County equi-granular type is most common.

Named for exposures south of Palmetto, Fulton County.

Palm Park Formation

Oligocene: Southwestern New Mexico.

V. C. Kelley and Caswell Silver, 1952, New Mexico Univ. Pubs. in Geology 4, p. 114 (fig. 14), 120–121. In southern part of Caballo Mountains, a sequence of clastic rocks which is probably older than McRae formation (new) and which underlies Santa Fe beds of Miocene-Pliocene age. Sequence has generally high content of volcanic debris as well as a few flows, all of which range from rhyolitic to basaltic in composition. Sequence divisible into lower dark-colored unit termed Palm Park formation and upper light-colored unit termed Thurmond formation. Generally has reddish-brown hue in outcrop. In some places, consists in large part of coarse bouldery conglomerate. At Palm Park where upper part is exposed, formation contains much reddish, grayish, and purplish-brown latitic to andesitic breccia and tuff. Reddish-brown tuffaceous clay and silt commonly intercalated with the tuff and breccia. Thickness probably at least 1,000 feet. Complete section nowhere exposed. At type locality, lower part of formation dropped below surface along Palm fault. Elsewhere, lower or upper boundaries may be covered by younger pediment-capping sediments. Base exposed along Apache Canyon where it stands steeply but in near conformity with underlying Magdalena beds. In this locality, upper beds are faulted beneath Thurmond formation.

Named for valley widely known as Palm Park located along southeastern edge of Caballo area, Sierra County.

Palms Granite

Precambrian: Southern California.

W. J. Miller, 1938, Geol. Soc. America Bull., v. 49, no. 3, p. 419 (fig. 1), 421–423. Typically a true granite, varying locally to a quartz monzonite, mostly medium grained, light gray, medium gray, and pinkish gray. Structure ranges from massive to highly foliated. Considered younger than Gold Park gabbro-diorite (new). Cut by White Tank monzonite (new).

Named from its typical and extensive development in Forty-nine Palms Mountain, Riverside County.

**Palms Quartzite**[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.

N. K. Huber, 1959, Econ. Geology, v. 54, no. 1, p. 85 (table 1). Included in Animikie series. Underlies Ironwood iron-formation; unconformably overlies Bad River dolomite.

Named for exposures just south of Palms mine, on Palms property, near Bessemer, Mich.

**Palm Spring Formation**[1]

Miocene, middle or upper: Southern California.

Original reference: W. P. Woodring, 1931, Carnegie Inst. Washington Pub. 418, p. 10.

L. A. Tarbet and W. H. Holman, 1944, (abs.) Am. Assoc. Petroleum Geologists Bull., v. 28, no. 12, p. 1782. Noted as overlying Imperial formation and underlying Borrego formation (new).

T. W. Dibblee, Jr., 1954, California Div. Mines Bull. 170, chap. 2, p. 22, 23, 25, pl. 2. Described in Imperial Valley as a series of land-laid arkosic sandstones and red clays of Pliocene age. Thickness at type locality 4,800 feet; attains maximum thickness of 7,100 feet in Borrego Badlands; thins eastward to 6,800 feet on north flank of San Felipe Hills anticlinorium and to 3,600 feet or less on east-plunging nose and south flank of structural feature. In southwestern Imperial Valley, grades downward into marine Imperial formation and westward into Canebrake conglomerate (new); in Borrego Valley, grades upward into Borrego lacustrine beds; on Mecca anticline, unconformably overlies Mecca formation (new).

Named for spring on lower part of Vallecito Creek, a southwestward-flowing tributary entering Carrizo Creek about 1 mile above old stage station. Dibblee (1954) refers to type locality as south side of Carrizo Valley [Imperial and San Diego Counties].

Palmyra Limestone 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 middle member of formation. Underlies Otoe shale member (new); overlies Minersville shale member (new).

G. E. Condra, 1949, Nebraska Geol. Survey Bull. 16, p. 14. Consists of one or two light-gray limestones containing *Triticites*. Thickness 1 to 3 feet.

Type locality: In cut-bank of Little Nemaha River, southeast of railroad station at Palmyra, Otoe County, Nebr.

†Palo Dur Beds[1]

Pliocene: Western Texas.

Original reference: W. B. Scott, 1894, Geol. Soc. America Bull., v. 5, p. 594–595.

Named for Palo Duro Canyon, western part of Panhandle of Texas.

Palolo Valley Mud Flow

*See* Kaau Mud Flow.

**Palomas Gravel**[1]

Pleistocene: 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.

V. C. Kelley and Caswell Silver, 1952, New Mexico Univ. Pubs. in Geology 4, p. 114 (fig. 14), 123. Shown on correlation chart of formations in Caballo Mountains and adjoining areas. Occurs above Santa Fe formation, and appears to be both Pliocene and Pleistocene.

Named for exposures on Palomas River, Sierra County.

Palomasan 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. 2, 10.

**Palo Pinto Limestone** (in Canyon Group)[1]

Palo Pinto Limestone (in Whitt Group)

Pennsylvanian: 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), 88. Reallocated to Whitt group (new). Expanded above to top of Wiles limestone and below to base of subjacent sandstone above Keechi Creek formation (redefined). Canyon series.

D. H. Eargle, 1960, U.S. Geol. Survey Prof. Paper 315–D, p. 63. Recommended that name Palo Pinto be abandoned in Colorado River valley, and that beds called Palo Pinto with question by Nickell (1938, Texas Univ. Bur. Econ. Geology Pub. 3801) and shale unit between the beds and Capps limestone member be included in Brownwood shale member of Graford formation, in accordance with general current usage in Texas.

Named for Palo Pinto, Palo Pinto County.

**Palos Verdes Sand**[1]

Pleistocene, upper: Southern California.

Original reference: A. J. Tieje, 1926, Am. Assoc. Petroleum Geologists Bull., v. 10, no. 5, p. 502–512.

W. P. Woodring, M. N. Bramlette, and W. S. W. Kew, 1946, U.S. Geol. Survey Prof. Paper 207, p. 53 (fig. 1), 56–59, pl. 1 Restricted to the marine deposits in Arnold's upper San Pedro series, that is, to deposits on the lowest (youngest) of 12 terraces. Consists of a thin veneer on terrace platform which bevels formations ranging in age from lower Pleistocene to Miocene. Composed of coarse-grained sand and gravel with silty sand and silt; limestone cobbles common in gravel. Thickness ranges from a few inches to 15 feet; average less than 10 feet. Type region designated as original type locality no longer exists.

Type region: Water front and adjoining region in San Pedro, Los Angeles County.

**Palouse Formation**[1]

Palouse soil

Pleistocene: Southeastern Washington, Idaho, and Oregon.

Original reference: R. C. Treasher, 1925, Science, new ser., v. 61, p. 469.

V. E. Scheid, 1940, Northwest Sci., v. 14, no. 3, p. 56–57. Discovery of fossil horse tooth from formation at Moscow, Idaho, raises question of age of formation.

W. D. Lowry and E. M. Baldwin, 1952, Geol. Soc. America Bull., v. 63, no. 1, p. 12. Formation appears to be correlative with Ringold formation and, if so, is of late Pliocene or Pleistocene age.

H. H. Waldron and L. M. Gard, Jr., 1954, U.S. Geol. Survey Geol. Quad. Map GQ–48; 1955, U.S. Geol. Survey Geol. Quad. Map GQ–56. Formation described in Hay and Penawawa quadrangles, Washington, where it mantles most of plateau upland surface and is a few inches to more than 200 feet thick.

Named for occurrence in Palouse Hills, southeastern Washington.

**Paluxy Sand**[1] or **Formation** (in Trinity Group)

Lower Cretaceous (Comanche Series): Eastern Texas, southwestern Arkansas, and southeastern Oklahoma.

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

R. W. Imlay, 1940, Arkansas Geol. Survey Inf. Circ. 12, p. 2, 42 (table 6), 43 (table 7). Overlies Mooringsport formation (new). Crops out in Little River and Hempstead Counties, Ark.

F. E. Lozo, 1949, Shreveport Geol. Soc. Guidebook 17th Ann. Field Trip, p. 85–92. Paluxy sand, heretofore generally considered as uppermost formation of Trinity group is indicated to be lateral equivalent of Walnut formation, in part, of central Texas. Paluxy sand, from type locality southward into central Texas, is more properly placed in Fredericksburg group on basis of sedimentary history.

F. B. Plummer, 1950, Texas Univ. Bur. Econ. Geology Pub. 4329, p. 102, 109. Described in Llano region where it is uppermost formation in Trinity group. Extends in narrow band around east and northeast border of region and across central Burnet and north-central Lampasas Counties; occurs at base of Cretaceous outliers north of region. Commonly less than 10 feet thick. Overlies Glen Rose limestone; underlies Walnut clay of Fredericksburg group.

J. M. Forgotson, Jr., 1957, Am. Assoc. Petroleum Geologists Bull., v. 41, no. 10, p. 2334, 2335. Paluxy not included in Trinity group as defined in this report. Term Paluxy formation is restricted to those sandstones and shales which are time-stratigraphic equivalent of, and are laterally continuous with, part of the Walnut which is lowest formation of Fredericksburg group. Rusk formation occupies stratigraphic interval formerly termed Upper Glen Rose formation and Paluxy formation. Sandstones and red shales of upper part of Trinity group are time-stratigraphic equivalents of upper part of Glen Rose formation and are referred to in this report as "Paluxy-like" lithology.

L. V. Davis, 1960, Oklahoma Geol. Survey Bull. 86, p. 26–31. Paluxy sand described in McCurtain County where it is exposed as an east-trending belt about 8 to 10 miles wide which covers most of T. 6 S., Rs. 21 to 27 E. Thickness 0 to 880 feet. Conformably overlies De Queen limestone; unconformably underlies Goodland limestone.

Named for town and creek in Somervell County, Tex.

Palzo Sandstone Member (of Spoon Formation)

Palzo Sandstone (in Carbondale Group)

Pennsylvanian: Southern Illinois.

J. M. Weller, L. G. Henbest, and C. O. Dunbar, 1942, Illinois Geol. Survey Bull. 67, p. 10, 15 (fig. 2) [1943]. Sandstone at base of Carbondale group; overlies DeKoven coal.

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 32, 46 (table 1), 63, pl. 1. Rank reduced to member status in Spoon formation (new). Occurs at top of formation above DeKoven coal member. Maximum thickness 40 feet. Presentation of new rock-stratigraphic classification of Pennsylvanian strata in Illinois.

Type locality: SE¼ sec. 16, T. 10 S., R. 4 E., Williamson County. Named for exposures at Palzo, 10 miles north of Marion.

**Pamelia Limestone**[1] (in Black River Group)

Middle Ordovician : Northern New York.

Original reference: H. P. Cushing, 1908, Geol. Soc. America Bull., v. 19, p. 155.

F. P. Young, Jr., 1943, Am. Jour. Sci., v. 241, no. 3, p. 144–155. Basal formation of Black River group. Underlies Lowville. Consists essentially of dolomitic and shaly limestones with maximum thickness of 150 feet in Watertown region. Southeastward along Black River valley, it thins and disappears; westward, in Ontario, it retains its characteristic lithology but thins to 30 feet at Marmora, Hastings County.

G. A. Cooper, 1956, Smithsonian Misc. Colln., v. 127, pt. 1, p. 22–23. Greatest thickness, 150 feet, is in Jefferson County. Consists of lower division of about 70 feet composed of basal conglomerate and arkosic sandstones, dark-gray fossiliferous rock, and sublithographic limestone interbedded with gray dolomitic limestone. Upper division, about 80 feet thick, is light-gray or whitish earthy limestone interbedded with gray magnesian and sublithographic limestone. In both divisions, the dolomitic and earthy limestones weather to buff or yellowish-brown hue and are easily distinguished from overlying Lowville. Formation thins to east and west of its area of greatest thickness. Thins to disappearance in Oneida County to the east. Age and affinities of the Pamelia have been subject of debate, but it is generally conceded now that it has strongest ties with the Lowville rather than Chazy group.

J. H. Johnsen and G. D. Toung, 1960, (abs.) Geol. Soc. America Bull., v. 71, no. 12, pt. 2, p. 1898. Exposure of formation reported east of Frontenac axis in New York. Thickness 3⅔ feet in quarry southeast of village of Chazy, Clinton County. Overlies Valcour formation; underlies Lowville limestone. Black River group (Lower Mohawkian).

Named for exposures at Pamelia, Jefferson County.

Pamelian (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 lowest division of Black Riveran series. Older than newly named Lowvillian [stage].

Name probably derived from Pamelia, Jefferson County, for which Pamelia limestone is named.

**Pamlico Formation**[1] or **Sand** (in Columbia Group)

Pleistocene : Atlantic Coastal Plain from Delaware to Mississippi.

Original reference: W. B. Clark, 1910, Geol. Soc. America Bull., v. 20, p. 651.

G. G. Parker and C. W. Cooke, 1944, Florida Geol. Survey Bull. 27, p. 74–75. Geographically extended into Florida where it includes all marine Pleistocene deposits younger than Anastasia formation. Consists chiefly of sand. Thickness ranges from featheredge to about 50 feet. Generally lies at altitudes of less than 25 feet above sea level on east, south, and west coasts.

G. F. Brown and others, 1944, Mississippi Geol. Survey Bull. 60, p. 60–61. Pamlico sand underlies Pamlico plain along north shore of Mississippi Sound. Much of outer edge of sand is capped by Recent beach and dune deposits from which it cannot readily be separated. Thickness on southeast bank of Wolf River 15 feet.

C. W. Cooke, 1952, Maryland Dept. Geology, Mines and Water Resources Bull. 10, p. 50–51. In Prince Georges County, Md., and in District of Columbia, is entirely fluvial and estuarine. Thickness does not exceed 30 feet. Lies on valley floors cut in crystalline rocks and in sedimentary deposits ranging in age from Cretaceous Potomac group to Miocene Chesapeake group; may locally lie unconformably on Pleistocene Wicomico formation. Where it does not form the surface, overlain unconformably by Recent sediments. Formation accumulated during third cycle of downcutting and subsequent drowning of Potomac River; presumably this epoch is in later Pleistocene; it began during third glacial stage (Illinoian) and continued and was completed during third interglacial stage (Sangamon).

J. R. Dubar, 1958, Gulf Coast Assoc. Geol. Soc. Trans., v. 8, p. 133 (table 1), 135, 136 (fig. 4), 146, 147, 149 (fig. 13), 150, 154. In southwestern Florida, forms an almost continuous blanket of sand at elevations less than 25 feet above sea level. Generally rests with apparent unconformity on a member of the Fort Thompson, Caloosahatchee, or Tamiami formations. Between La Belle and Ortona Locks, commonly overlies Coffee Mill Hammock marl and may be overlain by Lake Flirt marl or lie exposed at surface; downstream from La Belle as far as Fort Denaud, rests, in many places, directly on Caloosahatchee formation, sometimes on upper shale bed and sometimes unconformably on Bee Branch member (new).

Named for Pamlico Sound, eastern North Carolina.

Pampa Schist

Jurassic or older: Southern California.

T. W. Dibblee, Jr., and C. W. Chesterman, 1953, California Div. Mines Bull. 168, p. 12 (fig. 2), 18–22, pls. 1, 2, 3. Dark-gray mica schists; chiastolite-mica schists; chlorite greenstone schists. About 8,000 feet thick. Crops out within granitic rocks as linear inclusions with vertical or near-vertical attitudes. May be a phase of Kernville series, but its relationship to Kernville is obscured by granitic invasions.

Prominently exposed in Cottonwood Canyon drainage area west of Pampa Peak, Breckenridge Mountain quadrangle, Kern County.

**Pamunkey Group**[1]

Eocene, lower and middle: Eastern Virginia and eastern Maryland.

Original reference: N. H. Darton, 1891, Geol. Soc. America Bull., v. 2, p. 431–450, map.

N. H. Darton, 1951, Geol. Soc. America Bull., v. 62, no. 7, p. 752–759. Group includes Aquia and Nanjemoy formations.

R. R. Bennett and G. G. Collins, 1952, Washington Acad. Sci. Jour., v. 42, no. 4, p. 114–116. In Prince Georges County, Md., Aquia greensand, lower unit of group, overlies Paleocene Brightseat formation (new).

D. J. Cederstrom, 1957, U.S. Geol. Survey Water-Supply Paper 1361. Aquia formation is early Eocene; Nanjemoy formation is early and middle Eocene.

Named for exposures on Pamunkey River, Va.

**Panaca Formation**[1]

Pliocene: Eastern Nevada.

Original references: C. Stock, 1921, Geol. Soc. America Bull., v. 32, p. 146–147; 1921, Am. Jour. Sci., 5th, v. 2, p. 252–257.

D. A. Phoenix, 1948, Nevada State Engineer Resources Bull. 7, p. 34–38, 45–46, pl. 2. Described in Meadow Valley Wash drainage area; where best exposed, composed of terra-cotta to light-brown silts and fine sands and locally some diatomite and volcanic ash. Beds dip gently from both sides of Meadow Valley and are cut by faults of small displacement. Full thickness not known; where best exposed and most deeply dissected, estimated thickness at least 1,400 feet. Covered by Quaternary alluvium. Overlies Miocene(?) volcanic rocks. Pliocene.

Named for exposures near village of Panaca, Lincoln County.

**Panama Conglomerate Lentil** (in Cattaraugus Formation)

Panama Conglomerate[1]

Panama Conglomerate Member (of Venango Formation)

Panama Member (of Cattaraugus Formation)

Devonian: Southwestern New York and northwestern Pennsylvania.

Original reference: J. F. Carll, 1880, Pennsylvania 2d Geol. Survey Rept. $I_3$, p. 58, 60, 70, 124.

I. H. Tesmer, 1954, Dissert. Abs., v. 14, no. 12, p. 2317, 2318. Reallocated to member status in Venango formation. Underlies Cherry Creek member (new). Upper Devonian. Area of report, Cherry Creek quadrangle, New York.

I. H. Tesmer, 1954, Hobbies, v. 35, no. 2, p. 30, 33. Basal member of Cattaraugus formation. Underlies Amity member; overlies Chadakoin formation of Arkwright group (new). Thickness 30 feet in Chautauqua County.

I. H. Tesmer, 1955, New York State Mus. Sci. Service Circ. 42, p. 19. Panama and Wolf Creek conglomerates and sandstones are contiguous. Panama has priority; name Wolf Creek abandoned.

Named for exposures at Panama, Chautauqua County, N.Y.

**Panamá Formation**[1]

Panamá Tuff

Miocene, lower: Panamá.

Original reference: R. T. Hill, 1898, Harvard Coll. Mus. Comp. Zoology Bull. 28, no. 5, p. 200–202.

A. A. Olsson, 1942, 8th Am. Sci. Cong. Proc., v. 4, p. 234 (chart); W. P. Woodring and T. F. Thompson, 1949, Am. Assoc. Petroleum Geologists Bull., v. 33, no. 2, p. 242, 246 (fig. 2); W. S. Cole, 1952, U.S. Geol. Survey Prof. Paper 244, p. 2 (fig. 1). Referred to as Panamá tuff.

W. P. Woodring, 1957, U.S. Geol. Survey Prof. Paper 306–A, p. 12, 39–42, 51 (fig. 4), pl. 1. Formation proper includes tuff, tuffaceous sandstone, tuffaceous siltstone and agglomerate. They evidently represent nonmarine, essentially fine grained tuff and tuffaceous strata that interfinger with and overlie La Boca marine member and Pedro Miguel agglomerate member. Estimated thickness at least 300 meters. Geologic map suggests that formation proper overlaps part of Caimito formation, but that relation needs confirmation. La Boca marine member apparently overlaps

Cucaracha and Culebra formations. La Boca member and presumably entire Panamá formation is not much younger than the Culebra formation and like the Culebra is considered early Miocene. Entire succession above Los Cascadas agglomerate (Culebra, Cucaracha, and Panamá formations) is believed to represent early half of early Miocene time; that is, the disputed Oligocene or Miocene.

Type area: Exposures along water front in city of Panamá, Panamá Province.

Panamint Metamorphic Complex[1]

Precambrian: Southeastern California.

Original reference: F. M. Murphy, 1933, California Div. Mines Rept. 28 of State Mineralogist, July-Oct. 1932, p. 329–356.

R. H. Hopper, 1947, Geol. Soc. America Bull., v. 58, no. 5, p. 403. This investigation has supported suggestion made by earlier workers that Murphy's Panamint metamorphic complex is Archean.

Occurs in southern part of Panamint Range, Inyo County.

Panamintan series[1]

Lower Cambrian: Eastern California, western Nevada, and Utah.

Original reference; C. R. Keyes, 1923, Pan-Am. Geologist, v. 40, p. 51, 53, 80.

Named for Panamint Mountains, eastern California.

Pancho Rico facies (of San Ardo Group)

Pliocene: Western California.

T. A. Baldwin, 1950, Am. Assoc. Petroleum Geologists Bull., v. 34, no. 10, p. 1986 (fig. 6), 1988. Diatomaceous and silty mudstones which bear a fauna similar to Reed Ridge, Sisquoc, and Purisima formations. Pancho Rico is lowermost of three overlapping facies in group. Underlies and interfingers with sands of Etchegoin facies. Overlies Santa Margarita sand.

Exposed on slopes of Pancho Rico Canyon and the nearby gulches which drain westward to the Salinas River near San Ardo, Monterey County.

Pandermitan series[1]

Lower Cambrian: Nevada and Utah.

Original reference: C. R. Keyes, 1927, Pan-Am. Geologist, v. 48, p. 68.

Derivation of name not stated.

**Pando Porphyry**

Tertiary, lower: Central Colorado.

Ogden Tweto, 1951, Geol. Soc. America Bull., v. 62, no. 5, p. 510. Quartz latite porphyry composed of scattered quartz and plagioclase phenocrysts and grains of altered biotite in light-gray or buff dense groundmass. Weak linear orientation detected in most chilled Pando porphyry, but planar orientation is indiscernible. Forms persistent sill or zone of sills in Pennsylvanian shale just above Leadville limestone; also in small sills in pre-Pennsylvanian quartzites and dolomites and in few dikes. Cut by Elk Mountain and by Eagle River porphyries.

Main sill persistent for several miles along upper Eagle River, from East Fork northward beyond Gilman, and crops out boldly on slope just east of Pando. In southern part of Gore Range, Eagle and Summit Counties.

†Panhandle Beds[1]

Panhandle Formation

Pliocene: Northwestern Texas.

Original reference: J. W. Gidley, 1903, Am. Mus. Nat. History Bull., v. 19, p. 634–635.

H. E. Wood 2d and others, 1941, Geol. Soc. America Bull., v. 52, no. 1, p. 27. Formation, proposed by Gidley, for pre-Clarendon beds of Texas Panhandle but usually treated as Texas equivalent of Ogallala, not in regular current use in either sense. If unambiguous term in latter sense is desired, Llano Estacado formation is available.

G. L. Evans, 1948, Geol. Soc. America Bull., v. 59, no. 6, p. 617, Cummins (1890, Texas Geol. Survey 1st Ann Rept.) did not attempt to subdivide Cenozoic of Texas, and his Blanco beds are practically a synonym for what is now known as Panhandle formation, which includes all of plains Cenozoic in Texas except Recent surface sands.

G. L. Evans, 1949, West Texas Geol. Soc. Guidebook Field Trip 2, Nov. 6–9, p. 5–6. Names Couch and Bridwell formations proposed for Pliocene units exposed along eastern side of plains in Lubbock, Crosby, and Floyd Counties. Terms Ogallala and Panhandle have been applied to most of High Plains Cenozoic beds.

May be named for the Panhandle of Texas or for town in Carson County where beds are exposed.

**Paniau Volcanic Series**

Pliocene(?): Niihau Island, Hawaii.

H. T. Stearns, 1946, Hawaii Div. Hydrography Bull. 8, p. 90–91; H. T. Stearns and G. A. Macdonald, 1947, Hawaii Div. Hydrography Bull. 12, p. 17 (table), 18–19, 42–45; D. A. Davis and G. A. Macdonald *in* Jacques Avias and others, 1956, Lexique Strat. Internat., v. 6, Océanie, fasc. 2, p. 125. Thin-bedded vesicular olivine basalts, both aa and pahoehoe, and correlative dikes and plugs. Total exposed thickness 1,281 feet. Separated from overlying Kiekie volcanic series (new) by erosional unconformity.

Type locality: East side Paniau Hill. Comprises central highland part of island.

**Panoche Formation**[1]

Panoche Group

Upper Cretaceous: Southern California.

Original reference: R. Anderson and R. W. Pack, 1915, U.S. Geol. Survey Bull. 603.

F. M. Anderson, 1937, (abs.) Am. Assoc. Petroleum Geologists Bull., v. 21, no. 12, p. 1612. Upper Cretaceous Chico series subdivided into Gaines group (new), western Shasta County; Panoche group, Diablo Range; and Moreno group, Diablo Range. Panoche group, including Chico Creek and Los Gatos beds, has characteristic faunas in its upper one-third, but lower and major part is barren.

F. M. Anderson, 1938, (abs.) Geol. Soc. America Bull., v. 49, no. 12, pt. 2, p. 1863. Chico series subdivided into three major groups: Pioneer (new), Panoche, and Orestimba (new). Panoche group is best exposed on west border of San Joaquin Valley, where it has average thickness of 14,200 feet on flanks of Diablo Range.

M. B. Payne, 1941, (abs.) Geol. Soc. America Bull., v. 52, no. 12, pt. 2, p. 1954–1955; 1951, California Div. Mines Spec. Rept. 9, p. 6 (fig. 2), 7, 8 (fig. 4), 12 (fig. 6). Formation underlies Dosados sand and shale member (new) of Moreno formation in type area of Moreno.

N. L. Taliaferro, 1943, California Div. Mines Bull. 118, pt. 2, p. 130–134 [preprint 1941]; 1944, Am. Assoc. Petroleum Geologists Bull., v. 28, no. 4, p. 472. In 1915 term Panoche was introduced for Cretaceous along west side of San Joaquin Valley north of Coalinga. Later work has shown that Panoche, as mapped at that time, includes Knoxville, Paskenta, and Horsetown and extends across several disconformities. Recently term Chico series has been used to include all Upper Cretaceous and Panoche as upper group of series. This usage is unfortunate because it makes the Chico include beds separated by a disconformity which locally becomes pronounced unconformity. Two group names proposed: Pacheco below and Asuncion above, the two separated by Santa Lucian orogeny. As originally defined and mapped, Panoche formation includes not only a part of present Asuncion group and all of Pacheco group but also Shasta and Knoxville. Use of Panoche as group name would cause confusion. Panoche formation should be used for sediments, chiefly sandstones above the Pacheco and below the Moreno.

F. M. Anderson, 1943, California Div. Mines Bull. 118, p. 185–186 [preprint 1941]. Panoche group, Chico series, subdivided into (ascending) Yolo, Butte, Joaquin, and Los Gatos faunal stages.

I. F. Wilson, 1943, California Jour. Geology and Mines, v. 39, no. 2, p. 199–204, 226 (fig. 5). Group, in San Benito quadrangle, exposed on both limbs of Butts Ranch syncline for distance of about 9 miles. The two belts continue to southeast beyond limits of quadrangle and are overlapped to northwest by San Benito gravels. To the southwest, belt is 7,000 to 9,000 feet thick; northeast, belt is 5,000 to 6,000 feet. A separate mass of Panoche beds, with exposed thickness of more than 4,000 feet, occurs in northwest part of quadrangle, in Browns Valley region, where it is in fault contact with the Franciscan to north and Eocene Los Muertos Creek formation (new) to south. On northeast side of Butts Ranch syncline, divided into (ascending) Paynes shale and sandstone, Call sandstone, and Butts Ranch shale members (all new); on southwest limb, divided into (ascending) Paynes shale and sandstone, Call sandstone, and Big Oak Flat shale and sandstone (new) members. On northeast flank of Butts Ranch syncline, group is in contact with Franciscan; this contact is a fault as far east as Chemise Ridge, but east of that point appears to be depositional; on southwest side of syncline, group rests on Knoxville and Paskenta formations. Underlies Moreno shale.

P. P. Goudkoff, 1945, Am. Assoc. Petroleum Geologists Bull., v. 29, no. 7, p. 962 (fig. 2). Correlation chart shows that Panoche group, Coalinga-Ortigalito area, comprises (ascending) Curry Mountain shale, Long Canyon sandstone, lower Waltham shale, Juniper Ridge sandstone, upper Waltham shale, Los Gatos sandstone, Alcade shale, Joaquin Ridge sandstone, Ragged Valley shale, and Brown Mountain sandstone.

Ralph Stewart, 1946, U.S. Geol. Survey Prof. Paper 205–C, p. 85–88, pl. 9. Formation. in Reef Ridge area, Coalinga district, is 7,000 feet thick; unconformably overlies Franciscan formation and unconformably underlies Avenal sandstone.

A. S. Huey, 1948, California Div. Mines Bull. 140, p. 16 (fig. 2), 24–31. Formation was first mapped across northern part of Tesla quadrangle by

Anderson and Pack. They recognized that formation, as they mapped it locally, included strata of Lower Cretaceous age (Horsetown of this report), which by more detailed mapping could be differentiated from Panoche proper. In recent years, there has been tendency to divide Panoche into different formations or establish new limits for it. Except for differentiation of Horsetown beds, the sense in which Panoche was orignally mapped in this area is retained in this report. Maximum thickness about 10,000 feet. Formation is in fault contact with Franciscan and Horsetown formations; overlain gradationally by Moreno Grande formation (new); overlain unconformably by Oursan(?), Cierbo, and Neroly formations and by Livermore gravels.

L. I. Briggs, Jr., 1953, California Div. Mines Bull. 167, p. 12 (fig. 2), 24–32, pls. 1, 2, 3. Formation described in Ortigalita Peak quadrangle where it is most widespread formation unit of map area and underlies about 100 square miles of area mapped. Maximum thickness measured 30,000 feet. East of Ortigalita Peak, overlies Wisenor formation (new) with angular discordance. Elsewhere, Upper Cretaceous sediments are in fault contact with Franciscan formation or contact is obscured by Quaternary deposits. Contact with overlying Moreno formation is gradational. Taliaferro and Anderson proposed divisions of Panoche group wherein Anderson's Pioneer group is approximately the equivalent of Taliaferro's Pacheco group and Anderson's Panoche and Moreno groups are inclusive of Taliaferro's Asuncion group. In present report, both the Pacheco and Asuncion groups of Taliaferro or Pioneer and Panoche groups of Anderson are represented though they have not been satisfactorily separated.

M. B. Payne, 1960, Soc. Econ. Paleontologists and Mineralogists, Pacific Sec., Guidebook Spring Field Trip, Apr. 15–16, p. 4, 5 (fig. 3), 6 (fig. 4), 6 (fig. 5), 13 (fig. 6). Panoche group, in type area, subdivided into (ascending) Redil shale, Benito sandstone, Ciervo shale, Marlife shale, Television sandstone, and Uhalde sandstone and shale members (all new). In fault contact with underlying Franciscan; underlies Moreno shale.

W. P. Popenoe, R. W. Imlay, and M. A. Murphy, 1960, Geol. Soc. America Bull., v. 71, no. 10, chart 10e (column 15). Includes Center Peak conglomerate member (new) at base.

Named for development in Panoche Hills, Fresno County.

## Panola Formation[1]

Silurian and Devonian: Central Kentucky.

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

Named for Panola, Madison County.

## Panola Granite

Age not given: Northwestern Georgia.

L. A. Herrmann, 1954, Georgia Geol. Survey Bull. 61, p. 85. Shows no visible structure but has pronounced porphyritic texture formed by small phenocrysts of microcline. Unlike Stone Mountain granite or Lithonia gneiss in structure, texture and composition.

Located near southeastern part corner of DeKalb County where it forms a small prominence known as Hog Mountain south of Panola. Of limited areal extent.

**Pansy Lee Conglomerate**

Upper Cretaceous or Tertiary, lower: Northwestern Nevada.

Ronald Willden, 1958, Am. Assoc. Petroleum Geologists Bull., v. 42, no. 10, p. 2381 (table 1), 2391–2394. Basal unit, poorly sorted pebble to boulder conglomerate with about one-half to two-thirds of clastics being exotic chert and quartzite, and remaining one-half to one-third locally derived. Conglomerate becomes better sorted upward and amount of locally derived material decreases. Coarse-grained sandstone interbedded with pebble conglomerate through most of section. Chert clasts light to dark gray, green, and a few red or reddish brown. Quartzite clasts dark gray to almost white, well sorted, fine to medium grained, and clean. Thickness 200 to 500 feet. Underlies assorted unnamed volcanic and sedimentary rocks; unconformably overlies King Lear formation (new).

Type locality: In sec. 1, T. 36 N., R. 36 E., and sec. 6, T. 36 N., R. 37 E., just north of Pansy Lee mine on north side of low hills between Blue Mountain and Winnemucca Mountain about 10 miles northwest of Winnemucca. Also exposed in Jackson Mountains on northeast flank of King Lear Peak and on east side of south end of Trout Creek Spur.

Pantano Formation

Miocene, lower: Central southern Arizona.

R. E. King, 1939, Geol. Soc. America Bull., v. 50, no. 11, p. 1692. Incidental mention as a conglomerate, the Pantano, near Tuscon. Age not stated. Name credited to C. F. Tolman (unpub. ms.).

D. J. Brennan, 1957, Dissert. Abs., v. 17, no. 7, p. 1533. Consists of 13,762 feet of conglomerate, sandstone, and mudstone, with three andesite flows intercalated with the sediments. Underlies younger sediments and thrust block of older rocks. Probably lower Miocene.

P. A. Wood, 1959, Arizona Geol. Soc. Guidebook 2, p. 59. Probably equivalent to Mineta beds which are in part lower Miocene.

At Cienega Gap, Pima County.

Pantera Trachyte (in Garren Group)

Tertiary: Western Texas.

Hugh Hay-Roe, 1957, Texas Univ. Bur. Econ. Geology Geol. Quad. Map 21. Hard brownish-gray nonvesiculary andesine trachyte porphyry. No complete section exposed. Thickness about 350 feet in vicinity of type section. Overlies Hogeye tuff; disconformably underlies Moon trachyte.

P. C. Twiss, 1959, Texas Univ. Bur. Econ. Geology Quad. Map 23. Traced from type section in Wylie Mountains through the Van Horns and into northern Sierra Vieja; crops out west of Green River along eastern flank of Indio Mountains. Pinches out in center of Colquitt syncline. About 40 feet of Pantera intercalated with Chambers tuff in northern Sierra Vieja. Underlies Hogeye tuff.

Type section: South face of Pantera Peak, Wylie Mountains area, Culberson County.

Panther Conglomerate or Sandstone (in Pottsville Group)[1]

Panther Sandstone (in New River 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. 185.

H. R. Wanless, 1939, Geol. Soc. America Spec. Paper 17, p. 97. Massive conglomeratic sandstone included in the New River group.

Exposed at Panther, McDowell County.

**Panther Tongue** (of Star Point Sandstone)[1]

Upper Cretaceous: Central eastern Utah.

Original reference: F. R. Clark, 1928, U.S. Geol. Survey Bull. 793.

R. G. Young, 1955, Geol. Soc. America Bull., v. 66, no. 2, p. 180 (fig. 2). Underlies Storrs tongue of Star Point sandstone and separated from it by tongue of Mancos shale; overlies Masuk tongue of Mancos shale. A conspicuous cliff former at Helper. Can be traced from front of Wasatch Plateau, where it is 125 feet thick, to short distance east of Soldier Canyon, where it disappears in Mancos shale.

Exposed in Panther Canyon, southeast of Castlegate, Carbon County.

**Panther Canyon Formation**

Middle Triassic: 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]; 1951, Geology of the Mount Moses quadrangle, Nevada: U.S. Geol. Survey Geol. Quad. Map [GQ–12]. Red shale, sandstone, conglomerate, and impure pink dolomite, weathering rusty brown. Total thickness about 700 feet in Mount Moses quadrangle. Thickness at type locality 300 feet; elsewhere, thins to 100 feet. Underlies Augusta Mountain formation; overlies China Mountain formation (new).

Type locality: Head of Panther Canyon, between Grass and Pumpernickel Valleys, Winnemucca quadrangle.

†Panther Creek Limestone Member (of Ochelata Formation)[1]

Pennsylvanian (Missouri Series): Northeastern Oklahoma.

Original reference: P. V. Roundy, K. C. Heald, and G. B. Richardson, 1922, U.S. Geol. Survey Bull. 686–Z, p. 397, pl. 55.

M. C. Oakes, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 4, p. 728; 1940, Oklahoma Acad. Sci. Proc., v. 20, p. 105. Abandoned; identical with Birch Creek limestone.

Named for Panther Creek in southwest part of T. 26 N., R. 12 E., Osage County, where it is well exposed along valley rim to east and west.

Panther Mountain Shale and Sandstone[1]

Middle Devonian: Eastern New York.

Original reference: G. A. Cooper, 1933, Am. Jour. Sci., 5th, v. 26, p. 544, 550.

G. A. Cooper and others, 1942, Geol. Soc. America Bull., v. 53, no. 12, pt. 1, chart 4. Panther Mountain sandstone shown on correlation chart below Portland Point limestone and extending downward to Solsville sandstone in some areas and to base of Otsego shale and sandstone in other areas. Middle Devonian.

Type section: In face of Panther Mountain, Hamilton County, along towpath about ½ mile south of Fultonham and up Panther Creek to its head, where the Portland Point is exposed on property of T. Wayman, 3½ miles east of Summit.

Panther Seep Formation

Pennsylvanian (Virgilian) : South-central New Mexico.

F. M. Kottlowski and others, 1956, New Mexico Bur. Mines Mineral Resources Mem. 1, p. 7 (table 2), 9 (fig. 3), 42–47, pl. 1. Silty brown shales, dark carbonaceous shales, dark argillaceous limestones, massive biostromal limestones, silty calcarenites, and silty calcareous sandstones; near Ash Canyon, two gypsum beds in upper part; near Rhodes and Hembrillo Canyon, numerous biohermal reefs. Thicknesses: 800 feet, Mocking Bird Gap; 1,458 feet, Rhodes Canyon; 1,825 feet, Hembrillo Canyon; and 2,390 feet, Ash Canyon. Underlies Bursum formation and locally Hueco formation; overlies unnamed sediments of Missourian age. Correlative to most of Holder formation of Sacramento Mountains, to upper part of Bar B formation of Caballo Mountains, and to Keller and Fresnal groups as measured by Thompson (1942) in Oscura, Mud Springs, and Robledo Mountains.

Type section: In or near Rhodes Canyon. Also well exposed in Bearden Canyon. Panther Seep is in Bearden Canyon, 4.1 miles from mouth of canyon where latter joins Rhodes Canyon, San Andres Mountains. Can be mapped from Mockingbird Gap to southern end of San Andres Mountains; upper part exposed in Franklin Mountains.

**Paola Limestone Member** (of Iola Limestone)

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

Original reference: R. C. Moore, 1932, Kansas Geol. Soc. 6th Ann. Field Conf., Guidebook, p. 92, 97.

M. C. Oakes, 1940, Oklahoma Geol. Survey Bull. 62, p. 68–69. Member, in Oklahoma, is 3 to 5 feet of massive calcareous sandstone and comprises three lenticular phases, which grade into each other, both laterally and vertically. Basal member of Iola; underlies Muncie Creek shale member; overlies Chanute formation.

F. C. Greene and W. V. Searight, 1949, Missouri Geol. Survey and Water Resources Rept. Inv. 11, p. 12, 13. Basal member of Iola formation as redefined for Missouri. Missouri Geological Survey had included Paola in Chanute formation.

H. G. Hershey and others, 1960, Iowa Highway Research Board Bull. 15, p. 26, fig. 5. Basal member of Iola. A light-gray sublithographic massive limestone with shale partings; fossiliferous. Thickness about 1 foot. Underlies Muncie Creek shale member; overlies Chanute shale.

Named for Paola, Miami County, Kans.

**Paoli Limestone**[1]

Paoli Limestone (in Blue River Group)

Paoli Member (of Renault Formation)

Upper Mississippian: Southern Indiana and central northern Kentucky.

Original reference: M. N. Elrod, 1899, Indiana Acad. Sci. Proc. 1898, p. 258–267.

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 the Ste. Genevieve and Chester formations of southern Indiana: Ann Arbor, Michigan, The Edwards Letter Shop, p. 7, 12. 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. Paoli limestone rests on Aux Vases sandstone or directly on Bryantsville breccia at top of Ste. Genevieve; underlies Mooretown shale or sandstone. Present from Ohio River to about 5 miles northwest of Greencastle, Putnam County, where it is cut off and overlapped by Pennsylvanian Mansfield sandstone.

T. G. Perry and N. M. Smith, 1958, Indiana Geol. Survey Bull. 12, p. 23, pl. 1. Thickness of Paoli limestone in Indiana 2¼ to 39 feet. Commonly light-gray, gray, tan, or light-brown dense finely granular semioolitic limestone with some crystalline beds; gray or greenish-gray calcareous shale occurs in middle of formation. Overlies Aux Vases formation; underlies Mooretown sandstone.

H. H. Gray, R. D. Jenkins, and R. M. Weidman, 1960, Indiana Geol. Survey Bull. 20, p. 36 (table 5), 49–50, pl. 1. Uppermost formation in Blue River group (new). Redefined to include unit formerly known as Aux Vases formation in Indiana, and term Aux Vases is rejected in Indiana. Thickness (as redefined) 29 to 38 feet. Overlies Ste. Genevieve limestone; underlies Bethel formation of West Baden group (redefined).

Named for Paoli, Orange County, Ind.

Paoli Limestone[1]

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

*See* **Paola Limestone Member** (of Iola Limestone) correct spelling.

**Paonia Shale Member** (of Mesaverde Formation)[1]

Upper Cretaceous: Central western Colorado.

Original reference: W. T. Lee, 1909, U.S. Geol. Survey Bull. 341, p. 320 (table), 323.

E. C. Dapples, 1939, Econ. Geology, v. 34, no. 4, p. 371. In Anthracite-Crested Butte quadrangle, sequence of Mesaverde formation is (ascending) Baldwin sandstone (new), Rollins shale, Paonia shale, and Upper Mesaverde members.

Named for Paonia, Delta County.

Papanatas Conglomerate Member (of Redil Formation)

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). Red boulder conglomerate 0 to 950 feet thick at base of Redil formation (new). In fault contact with Franciscan. Name credited to D. W. Sutton (unpub. thesis).

Type locality: Papanatas Canyon, secs. 23 and 24, T. 14 S., R. 10 E., Fresno County. Name derived from Papanatas Canyon.

Papatele Trachyte

Pleistocene(?): Samoa Islands (Tutuila).

R. A. Daly, 1924, Carnegie Inst. Washington Pub. 340, p. 106–108, 129–130. Small body of trachyte, probably volcanic neck, perhaps communicating with pipe through which Pioa trachyte welled up to fill main crater. Pioa rhyolite, Matafafao, Papatele, Afono, and Vatia trachytes were erupted contemporaneously or nearly so.

H. T. Stearns, 1944, Geol. Soc. America Bull., v. 55, no. 11, p. 1285–1286 (table 1), 1302. Papatele trachyte plug is associated with Pago volcanics (new). Pliocene and early Pleistocene(?).

G. A. Macdonald *in* Jacques Avias and others, 1956, Lexique Strat. Internat., v. 6, Océanie, fasc. 2, p. 189. Pleistocene(?).

Crops out in Papatele summit, about 0.05 mile southeast of Pioa Peak, east of Pago Pago Bay. Covers about 0.02 square mile at Papatele Peak.

Papel Blanco Shale (in Puente Formation)

Miocene, upper: Southern California.

M. L. Krueger, 1943, California Div. Mines Bull. 118, p. 363. Shown on structure section as underlying Blanco sandstone (new) and overlying middle Puente(?).

A. O. Woodford, T. G. Moran, and J. S. Shelton, 1946, Am. Assoc. Petroleum Geologists Bull., v. 30, no. 4, p. 521. Platy siliceous shale with some chert. Thickness about 330 feet. Upper part of Puente. Measured section noted.

Exposed in Slaughter Canyon, in southeastern Puente Hills between Chino and the Santa Ana River, San Bernardino County.

Paperville Formation

Middle Ordovician (Mohawkian): Northeastern Tennessee, northern Georgia, and western Virginia.

G. A. Cooper, 1956, Smithsonian Misc. Colln., v. 127, pt. 1, p. 82–83, chart 1 (facing p. 130). Thick succession of gray siltstones, black graptolitic shales and interbedded black limestones, and brown-weathering calcareous sandstones which were mapped as Athens in southeastern belts of Appalachian Valley in Tennessee. Beds form lower division of a buff-weathering shale-siltstone-sandstone succession totaling several thousand feet in thickness and overlying thin Fetzer formation [Fetzer tongue]. Underlies sandstones of "Tellico" formation. Name attributed to B. N. Cooper and G. A. Cooper.

Type section: Along Steele Creek, near Paperville, for which it is named, near Bristol, Bristol (T.V.A. 206–SW) quadrangle, Tennessee.

Papoose Volcanics

Tertiary: Northwestern Wyoming.

R. D. Krushensky, 1960, Dissert. Abs., v. 21, no. 4, p. 849. Consist chiefly of water-laid volcanic sandstones and conglomerates and some volcanic breccias. Oldest of five layered volcanic units in area. Underlie Squaw flows (new).

Hurricane Mesa area, Park County.

†Parachucla Marl[1] or Shale[1]

Miocene, lower: Southern Georgia and southwestern 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, 15–16, 18; 1908, South Carolina Geol. Survey, ser. 4, Bull. 2, p. 435, 464, 466.

Named for exposures along Savannah River in vicinity of Parachucla, a locality in southeastern Georgia.

**Parachute Creek 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 black-brown and gray marlstone including oil shale units; some beds of altered tuff, analcite, and chert; tongues of sandstone near base. Thickness 700 to 1,230 feet. Underlies Evacuation Creek member; overlies Garden Gulch member. Parachute Creek, Garden Gulch, and Douglas Creek members interfinger with a unit referred to as lower sandy member of Green River. Eocene.

M. D. Williams, 1950, Utah Geol. Soc. Guidebook 5, p. 102, 108. Member typical only of Piceance Creek basin of western Colorado and extreme eastern part of Uinta Basin. Age of Green River given as Middle Eocene.

J. R. Donnell, 1953, Rocky Mountain Assoc. Geologists Guidebook Field Conf. May 14, 15, and 16, chart (facing p. 16). Overlies Anvil Points member (new) and underlies Evacuation Creek member in area between Rifle and De Beque Canyon, Colo. Thickness about 1,125 feet.

C. H. Dane, 1954, Am. Assoc. Petroleum Geologists Bull., v. 38, no. 3, p. 407–413. Described in Duchesne, Uintah, and Wasatch Counties, Utah. Most widespread, distinctive, and continuous phase of Green River formation of Colorado and Utah. Phase extends uninterruptedly from vicinity of summit of Wasatch Range in central Utah eastward across the Green River to Evacuation Creek area near Utah-Colorado State line. As herein extended, characteristically contains thin extensive beds of oil shale and ranges in thickness from 435 to 500 feet. Underlies Evacuation Creek member.

W. B. Cashion and J. H. Brown, Jr., 1956, U.S. Geol. Survey Oil and Gas Inv. Map OM–153. In Bonanza-Dragon oil-shale area, Uintah County, Utah, and Rio Blanco County, Colo., the Parachute Creek member overlies Douglas Creek member in part of the area and Garden Gulch member elsewhere. Thickness 360 to 735 feet.

Named for exposures in vicinity of Parachute Creek, Garfield County, Colo.

Paradise Conglomerate[1]

Carboniferous: Southeastern Rhode Island.

Original reference: A. F. Foerste, 1899, U.S. Geol. Survey Mon. 33, p. 295–298.

Forms east side of Eastons Point terminating northward at Sachuest Beach near Newport, Newport County, and farther north forms Paradise Rocks.

Paradise Formation[1]

Upper Mississippian: Southeastern Arizona and southwestern New Mexico.

Original reference: A. A. Stoyanow, 1926, Am. Jour. Sci., 5th, v. 12, p. 316–320.

Elliot Gillerman, 1958, New Mexico Bur. Mines Mineral Resources Bull. 57, p. 29–30, pl. 1. Mapped in Peloncillo Mountains of southwestern New Mexico. In Big Hatchet Mountains and in Chiricahua Mountains, upper part of formation consists of continental deposits, but in Peloncillo Mountains no evidence of continental beds observed.

Originally described from occurrence on east face of Chiricahua Mountains, not far from Paradise, an abandoned mining camp 45 miles northeast of Bisbee, Ariz., and 10 miles west of New Mexico line.

†Paradise Limestone[1]

Silurian (Niagaran) : Northeastern Utah.

Original reference: E. Blackwelder, 1910, Geol. Soc. America Bull., v. 21, p. 517–542.

Northern Wasatch Mountains.

Paradise Spring Complex

Upper Paleozoic(?) : Southern California.

W. J. Miller, 1946, Geol. Soc. America Bull., v. 57, no. 5, p. 504, 531–532. Mentioned in discussion of age of Hinckley Valley complex. Paradise Spring contains crinoidal segments of presumably Late Paleozoic age.

Type locality and derivation of name not given. Area discussed is Barstow quadrangle.

**Paradox Formation**[1]

**Paradox Member** (of Hermosa Formation)

Paradox Formation (in Hermosa Group)

Middle Pennsylvanian: Western Colorado and southeastern Utah.

Original reference: A. A. Baker, 1933, U.S. Geol. Survey Bull. 841.

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. Rank reduced to member of Hermosa formation. Overlies and underlies unnamed parts of formation. On basis of fusulinids, believed to be Lampasas and Des Moines in age.

S. A. Wengerd and J. W. Strickland, 1954, Am. Assoc. Petroleum Geologists Bull., v. 38, no. 10, p. 2169–2173. In this report [stratigraphy of Paradox Salt basin], the Paradox is termed a formation. Comprises three unnamed members: lower member, 0 to 200 feet, is predominantly anhydrite, gypsum, black shale, and minor dolomite; middle member, chiefly Paradox salt; and upper member, 200 to 500 feet, black silty calcareous shale, grayish-brown finely crystalline argillaceous dolomite, white anhydrite, gray to white finely crystalline gypsum, and brown argillaceous fine-grained limestone. Maximum depositional thickness probably not over 5,000 feet; present thickness in anticlines ruptured by salt flowage may exceed 12,000 feet. Overlies Pinkerton Trail limestone (new) ; underlies Hermosa formation. Results of study prove Paradox to be entirely of Cherokee age.

George Herman and C. A. Barkell, 1957, Am. Assoc. Petroleum Geologists Bull., v. 41, no. 5, p. 867–872. Member, as used in this paper [stratigraphy and productive zones in Paradox Salt basin], includes not only the complex evaporitic sequences with minor carbonate and black shale interbeds but also overlying, underlying, and adjacent carbonates deposited in a restricted marine environment. Lies entirely within Hermosa formation and its equivalents, horizontally interfingering with and vertically grading into open marine sediments. Member is evaporite megacyclothem composed of discrete sedimentary sequences which are complete or partial cyclothems. Contact with lower (unnamed) Hermosa member gradational, the separation being made where open marine carbonates are overlain by either evaporites or carbonates deposited in a penesaline environment; underlies an upper Hermosa member.

S. A. Wengerd and M. L. Matheny, 1958, Am. Assoc. Petroleum Geologists Bull., v. 42, no. 9, p. 2055 (fig. 3), 2056, 2065–2075. Formation in Hermosa group. Divisible into three mappable members. Lower member is penesaline complex of buff arkosic granulite, greenish-gray sandy siltstone overlain by gypsum along edge of San Luis uplift; interbedded black shale, dark-gray siltstone, gypsum, and dolomite in central part and along southwest shelves of Paradox basin; and dark-gray shales, gray porous dolomite, and gray cherty limestone higher on southwest Paradox sedimentational shelf. Middle member, or "salt member," grades shelfward into penesaline gypsum, anhydrite, and dolomite, and biohermal-biostromal dolomitic limestones. Upper member, similar to lower member, grades from penesaline strata shelfward into biostromal-biohermal dolomitic limestone, gray shale, and silty dolomite. Depositional thickness more than 4,000 feet along axis of Paradox basin. Underlies Honaker Trail formation, name introduced to replace previously used phrase upper Hermosa. Results of this study establish existence of important datum (the "P" datum), which is top of Paradox formation and, over great part of Four Corners region, is a disconformity which marks end of Paradox penesaline deposition and is mappable surface critical in evaluation of sedimentational and structural history of Paradox geosyncline.

N. W. Bass, 1958, Rocky Mountain Assoc. Petroleum Geologists Symposium on Pennsylvanian rocks of Colorado and adjacent areas, p. 92, 93. In southern half of White River uplift, Colorado, name Paradox formation is applied to sequence 1,500 to 1,900(?) feet thick, that is dominated by thick beds of gypsum and interbedded black shale and underlies redbeds of Maroon formation. Overlies Belden formation.

E. M. Shoemaker and W. L. Newman, 1959, Am. Assoc. Petroleum Geologists Bull., v. 43, no. 8, p. 1843, 1845. Tenderfoot member (new) of Moenkopi overlies Cutler formation and, locally, Paradox member of Hermosa formation with angular unconformity. In Sinbad Valley and Fisher Valley, Ali Baba member (new) of Moenkopi overlies the Paradox.

Type locality: Paradox Valley, Montrose County, Colo.

Parashant 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, 98–99. Consists chiefly of fine- and uniform-grained dolomite which appears steely gray on fresh surfaces and weathers rusty brown. Usually contains much glauconitic and ferruginous material both as disseminated grains and in lenses. Strongly cross-laminated at Toroweap. Average thickness about 10 feet. Older than Boucher tongue (new); younger than Lava Falls tongue (new).

Thin but persistent and conspicuous unit in Cambrian sequence of Grand Canyon, extending from vicinity of Granite Park eastward at least as far as Toroweap.

Parguera Limestone (in Mayagüez Group)

Upper Cretaceous: Southwestern Puerto Rico.

P. H. Mattson, 1958, Dissert. Abs., v. 18, no. 1, p. 199; 1960, Geol. Soc. America Bull., v. 71, no. 3, p. 329–331, 333–335, pl. 1. Buff to gray medium-bedded calcilutite and medium-bedded to massive fragmental limestone (microcoquina) with less than 15 percent tuff and a slightly smaller amount of calcarenite. Słodowski (1956, unpub. thesis) described the Parguera as part of Ensenada formation. Mitchell (1922) described exposures at Ensenada as Ensenada shale, his term for medium-bedded calcareous material. Unit redefined because Ensenada formation of Slodowski includes limestones and volcanic rocks here placed in San Germán formation. In southern structures the Parguera lies probably conformably on Río Loco formation, or where that is absent, unconformably on Bermeja complex (new). Where top is exposed, probably disconformably overlain by Melones limestone (new).

Type area: Range of hills north of fishing village of La Parguera, Mayagüez area.

**Pariott Member** (of Moenkopi Formation)

Middle(?) Triassic: Southwestern Colorado and southwestern Utah.

E. M. Shoemaker and W. L. Newman, 1959, Am. Assoc. Petroleum Geologists Bull., v. 43, no. 8, p. 1838–1839, 1842, 1847–1848. Consists of red-brown to purplish-brown sandstone and chocolate-brown, orange, and red mudstone, siltstone, and shale. Thickness at type section 134 feet; 252 feet in Sinbad Valley, Colo.; thickens abruptly toward the west and is several hundred feet thick where it dips beneath the surface beyond northwest end of Castle Valley, Utah, where it is overlain by a lens of gray silty conglomeratic sandstone assigned by Baker (1933, U.S. Geol. Survey Bull. 841) to Shinarump conglomerate and by Dane (1935, U.S. Geol. Survey Bull. 863) to Chinle formation. Overlies Sewemup member (new); unconformably underlies Chinle formation and in some areas truncated by it.

Type section: South side of Pariott Mesa, sec. 5, T. 25 N., R. 23 E., Grand County, Utah.

Paris Formation[1]

Middle Ordovician: Central Kentucky.

Original reference: J. M. Nickles, 1905, Kentucky Geol. Survey Bull. 5, p. 15.

Named for Paris, Bourbon County.

†Paris Shale[1]

Pennsylvanian (Allegheny): Western Arkansas.

Original reference: A. J. Collier, 1907, U.S. Geol. Survey Bull. 326, p. 12, 20–21, map.

Named for Paris, Logan County.

Parita Formation[1]

Recent(?): Panamá.

Original reference: O. H. Hershey, 1901, California Univ. Dept. Geol. Bull., v. 2, p. 263.

W. P. Woodring *in* R. Hoffstetter and others, 1960, Lexique Strat. Internat. v. 5, Amérique Latine, fasc. 2a, p. 342. Poorly defined name for surficial deposits. Recent age implied. Note on derivation of name.

Present in Coclé Province. Hershey mentioned head of Bay of Parita. There is also town of Parita, 10 kilometers northwest of Chitré.

Park Granite[1]

Tertiary: Central northern Washington, and southern British Columbia, Canada.

Original reference: R. A. Daly, 1906, Geol. Soc. America Bull., v. 17, p. 329–376.

Occurs on northern spurs of Park Mountain, British Columbia or Washington.

Park sandstone[1]

Carboniferous: Utah.

Original reference: C. R. Keyes, 1924, Pan-Am. Geologist, v. 41, p. 37.

Derivation of name not stated.

**Park Shale[1] or Argillite**

Park Shale (in Gros Ventre Group)

Park Shale Member (of Gros Ventre Formation)

Middle Cambrian: Western Montana and northwestern Wyoming.

Original references: W. H. Weed, 1899, U.S. Geol. Survey Geol. Atlas, Folio 55; Folio 56; 1900, U.S. Geol. Survey 20th Ann. Rept., pt. 3, p. 286.

Charles Deiss, 1936, Geol. Soc. America Bull., v. 47, no. 8, p. 1281, 1332–1333. Park shale, as herein emended, lies between Meagher limestone below and Pilgrim limestone above (both emended). Thickness at emended type section, 212 feet, base not exposed; maximum thickness (estimated) 330 feet on Keegan Butte, Little Belt Mountains. Dominantly green-gray, extremely fissile, nearly unfossiliferous, slightly micaceous shale. Weed did not designate type section. [See Flathead Quartzite].

Erling Dorf and Christina Lochman, 1940, Geol. Soc. America Bull., v. 51, no. 4, p. 548. In southern Montana, underlies Maurice formation (new).

L. L. Sloss and C. A. Moritz, 1951, Am. Assoc. Petroleum Geologists Bull., v. 35, no. 10, p. 2143–2144. Shaly beds resting conformably and transitionally on Meagher limestone in southwestern Montana are assigned to Park shale named by Weed from Little Belt Mountains and emended by Deiss (1936). Thickness 125 feet on north flank of Arrowhead Mountain, Centennial Range. Underlies Hasmark formation.

A. B. Shaw and P. O. McGrew, 1954, Wyoming Geol. Assoc. Guidebook 9th Ann. Field Conf., chart 2. Considered uppermost formation in Gros Ventre group. Overlies Death Canyon limestone; underlies Du Noir limestone of Gallatin group.

H. R. Wanless, R. L. Belknap, and Helen Foster, 1955, Geol. Soc. America Mem. 63, p. 12 (table 1), 13. Park shale considered member of Gros Ventre formation. Overlies Death Canyon limestone member; underlies Boysen limestone. Thicknesses: 121 feet, Gros Ventre Range; 108 feet, Teton Range; 158½ feet, Snake River Range.

M. R. Klepper, R. A. Weeks, and E. T. Ruppel, 1957, U.S. Geol. Survey Prof. Paper 292, p. 10, pls. 1, 2, 3. Five lowest natural Cambrian map units in southern Elkhorn Mountains, Mont., are lithologically similar to Flathead sandstone, Wolsey shale, Meagher limestone, Park shale, and Pilgrim dolomite of nearby areas, as redefined by Deiss (1936). These formational names have been adopted. Thickness 215 feet, exclusive of andesite sills. Underlies Pilgrim dolomite; overlies Meagher limestone.

Type section (emended): On north side of Dry Wolf Creek, on eastern side of Little Belt Mountains. Emended section measured on spur east of eastern small unnamed creek which heads on Big Baldy Mountain and north of Dry Wolf Creek; locality lies in sec. 14, T. 14 N., R. 9 E. Name Big Park, referred to by Weed, is unknown to present inhabitants of Dry Creek valley, Montana.

**Park City Formation[1] or Group**

Permian: Northeastern Utah, northwestern Colorado, eastern Idaho, southwestern Montana, and central and eastern Wyoming.

Original reference: J. M. Boutwell, 1907, Jour. Geology, v. 15, p. 439–458.

A. A. Baker and J. S. Williams, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 4, p. 623 (fig. 4), 624–625. In Diamond Fork area, Utah, overlies Diamond Creek formation (new); underlies Woodside shale.

J. S. Williams, 1945, Am. Jour. Sci., v. 243, no. 9, p. 477. Unconformably underlies Red Wash formation (new).

V. E. McKelvey and others, 1956, Am. Assoc. Petroleum Geologists Bull., v. 40, no. 12, p. 2840–2844. At type locality, formation consists of upper member (Franson, new), and lower members, composed mainly of carbonate rock, separated by Meade Peak phosphatic shale tongue of Phosphoria. Tongues of formation extend into eastern Idaho, southwestern Montana, central and eastern Wyoming, and northwestern Colorado. Lower member defined as the interbedded carbonate rock, cherty carbonate rock, carbonatic sandstone, and carbonatic siltstone that overlie Weber quartzite in Utah, Wells formation (as restricted in this report) in Idaho, Tensleep sandstone in Wyoming, and Quadrant quartzite in Montana and that underlies Meade Peak tongue of Phosphoria. Beds that Thomas (1934) called Phosphoria in Wind River Mountains are herein designated as Park City, and Ervay tongue is considered member of Park City. Intertongues with Shedhorn sandstone (new).

T. M. Cheney and others *in* V. E. McKelvey and others, 1959, U.S. Geol. Survey Prof. Paper 313–A, p. 12–15. Unit referred to as "lower member" is here named Grandeur member; not well exposed in type section of Park City.

R. K. Hose and C. A. Repenning, 1959, Am. Assoc. Petroleum Geologists Bull., v. 43, no. 9, p. 2178. Rank raised to group in Confusion Range. Includes (ascending) Kaibab limestone, Plympton formation (new), and Gerster limestone. Overlies Arcturus formation; underlies Thaynes formation. Group considered correlative with Park City formation in other areas.

Named for Park City district, Utah.

Park City Volcanics

Oligocene, lower: North-central Utah.

A. J. Eardley, 1944, Geol. Soc. America Bull., v. 55, no. 7, p. 846; 1955, Utah Geol. Soc. Guidebook 10, p. 38, fig. 9. Chiefly andesitic. Norwood tuff (new) is fluviatile and lacustrine facies.

Present in Morgan Valley.

Park Creek Limestone Member (of Lykins Formation)

Permo-Triassic: Northern Colorado and eastern Wyoming.

T. L. Broin, 1958, Dissert. Abs., v. 19, no. 1, p. 114. Underlies Red Hill shale member (new) ; overlies Stonewall Creek shale member (new).

Extends northward beyond Horse Creek, Wyo., and as far south as Lykins Gulch, Colo.

Parker Formation[1]

Parker Limestone (in McLeansboro Group)

Parker Limestone (in Wabash Formation)

Pennsylvanian : Southeastern Illinois and southwestern Indiana.

Original reference: M. M. Fidlar, 1933, Indiana Acad. Sci. Proc., v. 42, p. 137, 139.

R. C. Moore and others, 1944, Geol. Soc. America Bull., v. 55, no. 6, chart 6 (column 25). Shown on correlation chart as limestone near base of Wabash formation.

C. L. Cooper, 1946, Illinois Geol. Survey Bull. 70, p. 16 (fig. 2). Shown on correlation chart as limestone in McLeansboro group.

May or may not be same unit referred to as Parkers Formation by Malott 1947.

First described in Knox County, Ind.

Parker Quartz Diorite[1]

Upper Jurassic(?) : Southern California.

Original reference: W. J. Miller, 1934, Univ. California at Los Angeles, Pub. in Math. and Phys. Sci., v. 1, no. 1, p 37–65, 83, map.

W. J. Miller, 1946, Geol. Soc. America Bull., v. 57, no. 5, p 517, table 4 Listed under late Mesozoic intrusives.

Typical occurrence in Parker Mountain, west of Acton, San Gabriel Mountains.

**Parker Slate**[1]

Parker Shale

Lower Cambrian : Northwestern Vermont.

Original reference: Arthur Keith, 1932, Washington Acad. Sci. Jour., v. 22, p. 360, 371.

C. E. Resser and B. F. Howell, 1938, Geol. Soc. America Bull., v. 49, no. 2, p. 202–203. Unit termed a shale.

A. B. Shaw, 1954, Geol. Soc. America Bull., v. 65, no. 11, p. 1038–1044, 1045. Lower and Middle Cambrian.

V. H. Booth, 1950, Geol. Soc. America Bull., v. 61, no. 10, p. 1136, 1151. In Oak Hill sequence, northwestern Vermont, the Parker slate, 25 to 100 feet thick, overlies Dunham dolomite and underlies Rugg Brook formation. Lower Cambrian. Unit herein designated Parker slate is the Oak Hill slate of Clark (1934, Geol. Soc. America Bull., v. 45, no. 1).

A. B. Shaw, 1958, Geol. Soc. America Bull., v. 69, no. 5, p. 528–531, pl. 1. Parker slate described in St. Albans area. Thickness about 250 feet in southwestern part of area where it is poorly exposed; thickens to maximum of 1,000 to 1,200 feet north of Fonda quarry. Overlies Dunham dolomite with erosional unconformity; underlies Rugg Brook dolomite. Lower and Middle Cambrian. Unit might properly be called Georgia slates, for Walcott's (1886, U.S. Geol. Survey Bull. 30) original Georgia shales began at Parker's ledge, the type locality of Parker slate, but older name has not been retained because of its confused history.

Named for exposures on old Parker farm and around sides of Parker Cobble, 2 miles northwest of Georgia Center, Milton quadrangle, Franklin County.

Parker Hill Sandstone Member (of Stanley Shale)

Pennsylvanian: Southwestern Arkansas.

N. H. Stearn *in* J. M. Hansell and J. C. Reed, 1935, Am. Inst. Mining and Metall. Engineers Trans., v. 115, p. 245. Name applied to a sandy zone about 175 feet thick, that occurs about 700 feet stratigraphically below the Gap Ridge member (new).

N. H. Stearn, 1936, Econ. Geology, v. 31, no. 1, p. 4 (fig. 2), 15–16. Thickness about 200 feet. Beds vertical. Pennsylvanian.

Named from Parker Hill mine, an important mining development in that horizon. Mine is in SE¼SW¼ sec. 1, T. 7 S., R. 26 W., Pike County.

Parker Hill Schist[1]

Pre-Devonian(?): Northwestern New Hampshire.

Original reference: F. H. Lahee, 1916, Jour. Geology, v. 24, p. 366–381.

Probably named for the Parker Hill in northwest corner of Moosilauke quadrangle.

Parkers Formation

Upper Pennsylvanian: Southwestern Indiana.

C. A. Malott, 1947, Indiana Acad. Sci. Proc., v. 57, p. 131–132, 133 (fig. 2), 138. Consists chiefly of shales with thin sandy beds near base, two thin coals with one near the top capped by a black sheety shale; this upper coal is the Parkers coal. Contains Rabens Branch bed (new) about 20 feet below Parkers coal and black sheety shale. Thickness 25 to 30 feet. Overlies Dicksburg Hills sandstone; underlies St. Wendells sandstone. Name is a variation of the name Parker, used for the coal, black sheety shale, and limestone of upper part of the formation by Fuller and Clapp (1904) in Patoka folio of the U.S. Geological Survey.

Name derived from Parkers Settlement in eastern Posey County, about 8 miles northwest of Evansville on State Road 66.

**Parkhead Sandstone Member** (of Jennings Formation)[1]

Parkhead Sandstone (in Portage Group)

Upper Devonian: Western Maryland, central Pennsylvania, and northeastern West Virginia.

Original reference: G. W. Stose and C. K. Swartz, 1912, U.S. Geol. Survey Geol. Atlas, Folio 179.

Bradford Willard and A. B. Cleaves, 1938, Pennsylvania Geol. Survey, 4th ser., Bull. G–8, p. 16. Geographically extended into south-central Pennsylvania where it is referred to as Parkhead sandstone at top of Portage group. Occurs above Trimmers Rock sandstone.

Ernst Cloos, 1951, Maryland Dept. Geology, Mines and Water Resources Washington County [Rept. 14], p. 91. In Washington County, Md., consists of shale interbedded with massive conglomeratic sandstone; commonly three conglomerate horizons in east—at base, in middle, and near top; lower sandstone is highly fossiliferous, and upper one very massive near Parkhead; toward the west, sandstones grade laterally into shales that can scarcely be distinguished from overlying Woodmont shale; underlies Chemung sandstone.

Named from exposures at Parkhead Station, Washington County, Md.

**Parkman Sandstone** (in Montana Group)

**Parkman Sandstone Member** (of Claggett Formation)

**Parkman Sandstone Member** (of Judith River Formation)

**Parkman Sandstone Member**[1] (of Mesaverde Formation)

Upper Cretaceous: Northern Wyoming and southern Montana.

Original reference: N. H. Darton, 1906, U.S. Geol. Survey Prof. Paper 51, p. 13, 58.

C. H. Wegemann, 1918, U.S. Geol. Survey Bull. 670, p. 21–22. Lowermost member of Mesaverde formation. Consists of basal sandstone, 170 feet thick, a capping sandstone, 110 feet thick, and an intervening series of shale, carbonaceous shale, and coal beds, 190 feet thick. Separated from overlying Teapot sandstone member by unnamed shale interval 325 feet thick. Overlies Steele shale.

W. T. Thom, Jr., and others, 1935, U.S. Geol. Survey Bull. 856, p. 53–58, 128. At type locality, Parkman consists of conspicuous cliff-forming basal sandstone 70 feet thick, overlain in order named, by 120 feet of shale, 10 feet of white fine-grained sandstone, 75 feet of shale, and 5 feet of white sandstone. Aggregate thickness 280 feet. North of Parkman, top of sandstone is overlain by coal bed. Formation thickens northward and westward to maximum of 350 feet in northwestern part of Big Horn County, Mont. [this report], where it contains thick beds of shale. South of Crow Indian Reservation, sandstones of Parkman can be traced definitely, though not in continuous outcrop, from Parkman to Salt Creek and other localities in central Wyoming. Overlies Claggett shale; underlies Bearpaw shale. Montana group.

G. R. Downs, 1947, Wyoming Geol. Assoc. Guidebook 2d Ann. Field Conf., p. 139. Referred to as sandstone member of Claggett formation.

P. W. Richards, 1955, U.S. Geol. Survey Bull. 1026, p. 63. Described in Hardin area, Montana-Wyoming, where it consists of about 250 feet of sandy shale and sandstone. Overlies Claggett shale member of Cody shale; underlies Bearpaw shale. Montana group.

R. K. Hose, 1955, U.S. Geol. Survey Bull. 1027–B, p. 64, pl. 6. Parkman sandstone described in Johnson County, Wyo., where it is dominantly yellowish-gray sandstone, lower half of which contains large moderate-brown ellipsoidal concretions. Thickness as much as 720 feet. Overlies Cody shale; underlies Bearpaw shale. Parkman sandstone of mapped area referred to as Mesaverde formation 15 miles south of mapped area. There Mesaverde is divided into three units: Parkman sandstone member at base, unnamed member just above the middle, and Teapot sandstone member at top. The white to very light gray 8-foot sandstone at top of the Parkman in area of present report is probably equivalent to the Teapot sandstone member of Mesaverde, but lower members of Mesaverde cannot be recognized as distinct units in mapped area.

M. M. Knechtel and S. H. Patterson, 1956, U.S. Geol. Survey Bull. 1023, p. 12 (fig. 3), 14, pl. 1. Mapped in Hardin district, Montana and Wyoming, as lower member of Judith River formation. Underlies unnamed member; overlies Claggett shale member of Cody shale. Thickness about 350 feet.

J. M. Parker, 1958, Wyoming Geol. Assoc. Guidebook 13th Ann. Field Conf., p. 90–102. Type Parkman was originally described as a 300- to 500-foot sandstone containing harder, darker concretions. Later work in Crow Indian Reservation (Thom and others, 1935) defined Parkman formation to include sandy unit between Bearpaw shale and Claggett shale. Type Teapot sand was also named in the basin [Powder River]. Present subsurface and outcrop control makes it possible to show that type Teapot is part of original Parkman, as first described near town of Parkman and as later defined on Crow Indian Reservation. Thus, to conform to usage in the north and west-central parts of basin and to remain with original definition, the Parkman should be treated as formation with Teapot sandstone as uppermost member and the so-called Parkman of southwest Powder River basin should be designated as lower Parkman member. Hose (1955), in surface mapping in Johnson County, Wyo., considered Teapot sandstone to be upper member of his "Parkman" formation. By using formation names Bearpaw, Parkman, Claggett, Eagle, Telegraph Creek, and Niobrara, it is possible to do away with terms Lewis, Cody, Steele, and Mesaverde in this area.

E. I. Rich, 1958, Am. Assoc. Petroleum Geologists Bull., v. 42, no. 10, p. 2427–2428. Parkman sandstone member of Mesaverde formation, as used in this report, includes basal near-shore marine sandstone of the Mesaverde overlying Cody shale and underlying unnamed middle member of Mesaverde. A massive sandstone containing discontinuous shale lenses near base and top. Thickness 500 feet in southwestern part of Powder River basin; about 50 feet in southeastern part of Wind River basin.

W. J. Mapel, 1959, U.S. Geol. Survey Bull. 1078, p. 57–59, pls. Parkman sandstone described in Buffalo-Lake DeSmet area, Johnson and Sheridan Counties, Wyo., where it is about 720 feet thick. Grades into underlying Cody shale through transition zone as much as 150 feet thick. Underlies Bearpaw shale. Passes northward into nonmarine Judith River formation of central Montana.

Named for exposures near Parkman, Sheridan County, Wyo.

Parks Formation (in Kickapoo Creek Group)

Parks Formation (in Smithwick Group)

Parks Group

Pennsylvanian (Lampasas): North-central Texas (subsurface).

M. G. Cheney, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 1, p. 66 (fig. 1), 84 (fig. 3), 86–87. Named as uppermost formation of Smithwick group. Includes limestones and sandstones that lie at depths of 3,626 to 3,820 feet in type well. Overlies Caddo Pool formation (new); underlies unnamed subsurface formations of Millsap Lake group.

M. G. Cheney and others, 1945, Am. Assoc. Petroleum Geologists Bull., v. 29, no. 2, p. 163. Rank raised to group. Typically consists of a variable sequence of dark shales, limestones, and sandstones between the black shales, gray, black and siliceous limestones of Smithwick group and an unconformity at the base of the conglomerates, sandstones, blue shales, and limestones of the Strawn series; in Brazos River outcrop section, this unconformity is placed at base of chert conglomerate overlying Dennis Bridge limestone at Dennis, Parker County. Near here, drilling indicates a thickness of about 1,600 feet for Parks group.

M. G. Cheney, 1947, Jour. Geology, v. 55, no. 3, p. 209. Kickapoo Creek group used in preference to Parks group. Parks retained as formation in Kickapoo Creek group.

Type well: Anza Oil Corp. Graham No. 1, central Young County. Named for town of Parks on Parks lease, central Stephens County.

Parks Creek Limestone (in Pottsville Formation)[1]

Pennsylvanian: Central western Illinois.

Original reference: T. E. Savage, 1927, Am. Jour. Sci., 5th, v. 14, p. 307–316.

H. R. Wanless, 1957, Illinois Geol. Survey Bull. 82, p. 72–73. Seville limestone was originally designated Parks Creek limestone by Savage (1927), apparently a typographical error for Barker Creek near Seville.

Derivation of name not stated but probably a creek in Fulton County.

**Parks Mountain Sandstone Member** (of Thrifty Formation)[1]

Parks Mountain Sandstone Member (of Chaffin Formation)

Upper Pennsylvanian: Central Texas.

Original reference: N. F. Drake, 1893, Texas Geol. Survey 4th Ann. Rept., pt. 1, p. 387, 410.

Wallace Lee and others, 1938, Texas Univ. Bur. Econ. Geology Pub. 3801, p. 126–127. The member called "Parks Mountain bed" by Drake is an unconformable deposit whose base on east side of Parks Mountain south of Whon cuts out Thrifty beds to a horizon within 10 feet of *Bellerophon* limestone (Drake, 1893) and whose top on account of poor outcrops is not exactly determinable, though it is at or near top of Lohn shale as defined by Drake. Interval from top of Lohn shale to lowest observed beds of Parks Mountain deposits is 99 feet, but there is reason to believe that top of Parks Mountain member lies a short distance below top of Lohn as defined by Drake. Parks Mountain may prove to lie within limits set by Drake for Lohn shale and may be represented in Brazos River area by one of the sandstone lentils below the Blach Ranch limestone. Speck Mountain limestone is cut out by Parks Mountain sandstone at south end of Parks Mountain, and 2½ miles south of Whon almost entire Thrifty formation is missing. Underlies Chaffin limestone member.

M. G. Cheney, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 1, p. 66 (fig. 1). Reallocated to member status in Chaffin formation. Thrifty group. Cisco series.

D. H. Eargle, 1960, U.S. Geol. Survey Prof. Paper 315–D, p. 74, pl. 27. Member of Thrifty formation. Underlies Chaffin limestone member; overlies Breckenridge limestone member. Parks Mountain was termed Avis sandstone by Bullard and Cuyler (1935) because that name had been applied to the first conglomeratic sandstone bed above the Wayland shale of Plummer and Moore (1921 [1922]) in Brazos River valley and because this conglomerate holds same relation to the Wayland along the Colorado River. The Avis of Plummer and Moore has been shown by Wallace Lee and others (1938) to have originated before the Ivan limestone member [of Graham formation] was deposited, and therefore name Avis of Bullard and Cuyler cannot be correctly applied to the stratigraphically higher Parks Mountain sandstone.

Named for Parks Mountain, Waldrip quadrangle, Coleman County.

†Parkville Limestone (in Kansas City Formation)[1]

Pennsylvanian: Northwestern Missouri.

Original reference: J. A. Gallaher, 1898, Missouri Bur. Geology and Mines Bienn. Rept., p. 51.

Named for exposures at Parkville, Platte County.

†Parkville shale[1]

Pennsylvanian: Northwestern Missouri and southwestern Iowa.

Original reference: C. R. Keyes, 1898, Am. Geologist, v. 21, p. 349.

Named for exposures at Parkville, Platte County, Mo.

**Parkwood Formation**[1]

Upper Mississippian: Northern Alabama.

Original references: C. Butts, 1910, U.S. Geol. Survey Bull. 400, p. 15, 20; 1910, U.S. Geol. Survey Geol. Atlas, Folio 175, p. 8.

J. M. Weller and others, 1948, Geol. Soc. America Bull., v. 59, no. 2, p. 166, chart 5 (column 90). Formation, recognized only in small area in east-central Alabama, at various places overlies Pennington shale, Bangor limestone, or Floyd shale. Relations of these formations not clear; Pennington shale may grade laterally into either or both the Floyd and Parkwood; Floyd and Parkwood may also be gradational.

H. E. Rothrock, 1949, Alabama Geol. Survey Bull. 61, pt. 1, p. 18–19, fig. 2. Traced from outcrop in vicinity of Birmingham to southeast side of Shoal Creek valley. In this area, conformably overlies Floyd shale and underlies Shades sandstone member of Pottsville formation. Gray or olive-brown claystone and siltstone with fine-grained sandstone at base and tough black claystone at top. Thickness 460 feet. Mississippian.

R. B. Morton, 1949, Mississippi Geol. Soc. Guidebook 7th Field Trip, p. 37, 38, 40. Includes Little Shades sandstone (new) in basal part.

W. H. Robinson, J. B. Ivey, and G. A. Billingsley, 1953, U.S. Geol. Survey Circ. 254, p. 51. In Birmingham area, consists of about 2,000 feet of sandstone and shale, shale generally predominating.

Named for exposures at Parkwood, Jefferson County.

**Parma Sandstone**[1]

Pennsylvanian: Southern Michigan.

Original reference: A. Winchell, 1861, Michigan Geol. Survey 1st Bienn. Rept. Prog., p. 112, 138.

G. V. Cohee, Carol Macha, and Margery Holk, 1951, U.S. Geol. Survey Oil and Gas Inv. Chart OC–41, sheet 5. Basal formation of Pennsylvanian of Michigan. Thickness commonly less than 100 feet; attains maximum thickness of 150 feet in northeastern Clare County. Underlies Saginaw formation; overlies Bayport limestone.

Named for exposures at Parma, Jackson County.

Parmachenee Formation

Silurian (?): Central western Maine.

A. R. Cariani, 1959, Dissert. Abs., v. 19, no. 10, p. 2577. Thinly bedded gray phyllites, impure biotite quartzites, and black limestone. Contains notable amounts of pyrite and pyrrhotite. Older than Madrin formation (new); younger than Perry Mountain formation (new).

R. J. Willard, 1959, Dissert. Abs., v. 19, no. 11, p. 2918. Carbonaceous argillaceous quartz silts in Kennabago Lake quadrangle. Thickness about 2,000 feet. Silurian (?).

In Anson and Kennebago quadrangles.

**Parrish Limestone Bed** (in Cashaqua Shale Member of Sonyea Formation)

Parrish Limestone Lentil (in Cashaqua Shale[1] Member of Sonyea Formation)

Upper Devonian: West-central New York.

Original reference: J. M. Clarke and D. D. Luther, 1904, New York State Mus. Bull. 63, p. 31–32.

W. H. Bradley and J. F. Pepper, 1938, U.S. Geol. Survey Bull. 899–A, p. 12, 13. Lentil overlies Rock Stream flagstone member (new) of Cashaqua shale. Underlies Rhinestreet shale.

R. G. Sutton, 1960, New York State Mus. Bull. 380, p. 17–18, 53, 55, figs. 2, 5. Rye Point member (new) of Cashaqua formation includes red and green nodular limestone bed known as Parrish limestone lentil (Clarke and Luther, 1904).

U.S. Geological Survey currently classifies the Parrish as a bed in Cashaqua Shale Member of Sonyea Formation.

Well exposed in Parrish Gully at Parrish, Ontario County.

†Parsons Formation (in Pleasanton group)[1]

Pennsylvanian: Southeastern Kansas.

Original reference: G. I. Adams, 1903, U.S. Geol. Survey Bull. 211, p. 33.

U.S. Geological Survey has abandoned the term Parsons Formation because the following members are now treated as separate formations: Lenapah, Nowata, and Altamont.

Named for Parsons, Labette County.

**Parsonsburg Sand**

Pleistocene (late Wisconsin): Southeastern Maryland (subsurface and surface).

W. C. Rasmussen and T. H. Slaughter, 1955, Maryland Dept. Geology, Mines and Water Resources Bull. 16, p. 114 (table 17), 118–119. Composed predominantly of medium-grained sand but is poorly sorted. Materials range from size of small boulders (rare), through cobbles, gravel, very coarse to very fine sand, silt, and clay. In color, it is buff, tan, orange, or brown. Thickness in reference locality 25 feet; elsewhere ranges from a fraction of a foot to as much as 33 feet. In different places, rests unconformably on each of the earlier Pleistocene deposits. In reference locality, overlies the Walston silt (new). Overlain only by soils, alluvium, and peat of Recent series.

Reference locality is test hole Wi–Bg 11 at Melson, at north end of Parsonsburg Ridge. Named for Parsonsburg, a village 6 miles east of Salisbury.

**Parting Member** (of Chaffee Formation)

**Parting Quartzite Member** (of Chaffee Formation)[1]

Upper Devonian: 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.

Ogden Tweto, 1949, Colorado Sci. Soc. Proc., v. 15, no. 4, p. 152 (table 1), 170–174. Described in Pando area where it is 45 to 57 feet thick, underlies Dyer dolomite member, and unconformably overlies Harding quartzite.

I. H. Mackay, 1953, Colorado School Mines Quart., v. 48, no. 4, p. 22, 27, 28. Described in Eagle and Pitkin Counties where it is 104 to 114 feet thick, underlies Dyer dolomite member, and disconformably overlies Manitou dolomite.

N. W. Bass and S. A. Northrop, 1953, Am. Assoc. Petroleum Geologists Bull., v. 37, no. 5, p. 907. In White River Plateau region, Parting member of Chaffee formation overlies Tie Gulch dolomite member (new) of Manitou formation (redefined). Top section in this area.

Named for exposures on Parting Spur, the spur that extends northwest from Dyer Mountain toward West Dyer Mountain, Lake County, east of Leadville.

Parting Shale

Parting Shale Member (of Oswaldo Formation)

Lower Pennsylvanian: Southwestern New Mexico.

Harrison Schmitt, 1939, Geol. Soc. America Bull., v. 50, no. 5, p. 780 (table), 781. Rests disconformably on Hanover limestone, the contact marked locally by thin conglomerate which is in places mainly white chert derived from underlying Hanover limestone. Where unmetamorphosed, the shale contains abundant plant remains. Some layers should be classified as fine-grained sandstone which, near main intrusive in area, is metamorphosed to quartzite. Thickness 18 feet. In lower Magdalena; underlies middle blue limestone.

P. F. Kerr and others, 1950, Geol. Soc. America Bull., v. 61, no. 4, p. 283 (fig. 5), 284. Basal member of Oswaldo formation. Thickness 18 to 20 feet.

Central Mining district, in vicinity of Hanover, Grant County.

**Partridge Formation**

Partridge Slate[1]

Upper Ordovician (?): Central and southern New Hampshire.

Original reference: M. P. Billings, 1934, Science, v. 79, no. 2038, p. 55–56

M. P. Billings, 1955, Geologic map of New Hampshire (1:250,000): U.S. Geol. Survey. Formation described. Chiefly dark-gray slate in chlorite metamorphic zone; includes thin-bedded light-gray quartzite and buff soda-rhyolite tuff at base. Is a gray mica schist in staurolite and sillimanite metamorphic zones. Age shown as Upper Ordovician (?).

M. P. Billings, 1956, Geology of New Hampshire, pt. 2, Bedrock geology: Concord, New Hampshire State Plan. Devel. Comm., p. 19–21, 98. Maximum thickness 2,000 feet. Discussion of age; may be Middle Ordovician.

Named for Partridge Lake, Littleton Township, Grafton County.

†Partridge Point Formation[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. 593. Name Partridge Point should be abandoned in favor of Thunder Bay limestone.

Type locality: East shore of Partridge Point, 3 miles south of Alpena, Alpena County.

**Parunuweap Formation**

Pliocene(?): Southwestern Utah.

H. E. Gregory, 1945, Jour. Geology, v. 53, no. 2, p. 110–115. Includes conglomerates and alluvial or lacustrine silts. In Virgin and Parunuweap Valleys, conglomeratic phase consists chiefly of angular slabs of gray sandstone 1 to 4 feet in length, partly worn pebbles of limestone, elongated iron concretions 1 to 12 inches in diameter, and rounded pebbles of quartz, quartzite, and chert. In Kanab Valley, conglomerate includes angular blocks of basalt and many mud balls. In Coal Valley, chief components are slabs of pink and red limestone, gray sandstone, and rhyolite 1 to 3 feet in diameter, angular and rounded pebbles of quartzite, and chips of chalcedony. Along branches of Paria River, coarse gravels have consolidated into caliche mass that forms caps of mesas 50 to 70 feet above stream bed. Thickness 30 to 80 feet. Overlies Triassic, Jurassic, and Cretaceous formations; unconformably underlies sheets of basalt, talus, stratified sand, and gravel of very recent age.

Named for typical exposures in Parunuweap Valley—Kane, Washington, and Iron Counties.

Par Value Member (of Montoya Dolomite)

Upper Ordovician: Southwestern New Mexico.

L. P. Entwistle, 1944, New Mexico Bur. Mines Mineral Resources Bull. 19, p. 17. Composed of alternating bands of red chert and gray dolomite. Proportions are about one-third chert and two-thirds dolomite. Thickness at type locality 65 feet. Underlies Raven member (new); overlies Second Value member (new).

Typically developed on Par Value claim, Boston Hill mining district, Grant County.

Pasadena Formation[1]

Miocene: Southern California.

Original reference: R. Arnold and A. M. Strong, 1905, Geol. Soc. America Bull., v. 16, p. 188.

Flanks San Rafael Hills on south and underlies southern part of city of Pasadena, Los Angeles County.

Pasamonte Flow

Late Cenozoic: Northeastern New Mexico.

Brewster Baldwin and W. R. Muehlberger, 1959, New Mexico Bur. Mines Mineral Resources Bull. 63, p. 138 (table 5), 139, 145. Oldest flow on east side of Don Carlos Hills.

Don Carlos Hills are in southwestern Union County.

Pasayten Andesite[1]

Lower Cretaceous: Central northern Washington, and southern British Columbia, Canada.

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

Pasayten River, British Columbia and Washington, crosses this mass.

**Pasayten Formation**[1]

Pasayten Group

Lower Cretaceous: Central northern Washington, and southern British Columbia, Canada.

Original reference: G. O. Smith and F. C. Calkins, 1904, U.S. Geol. Survey Bull. 235.

W. P. Popenoe, R. W. Imlay, and M. A. Murphy, 1960, Geol. Soc. America Bull., v. 71, no. 10, p. 1533–1534, chart 10e (column 60). Shown as Lower and Upper Cretaceous on correlation chart. Includes red beds at top. Stratigraphically above Dewdney Creek formation. Age limits uncertain.

Term Pasayten group is used in Canadian publications.

Named for occurrences in Pasayten River valley.

Pasayten Volcanic Formation[1]

Lower Cretaceous: Central northern Washington.

Original reference: R. A. Daly, 1912, Canada Geol. Survey Dept. Mines Mem. 38, map 14.

Occurs in only one part of boundary belt, on densely thicketed slopes of Pasayten River valley.

**Pascagoula Clay**[1] or **Formation**

Miocene, upper: Mississippi, southwestern Alabama, and Louisiana.

Original reference: W. J. McGee, 1891, U.S. Geol. Survey 12th Ann. Rept., pt. 1, p. 409.

G. F. Brown and W. F. Guyton, 1943, Mississippi Geol. Survey Bull. 56, p. 30–50. In area of Camp Van Dorn, formation includes Homochitto member below and Fort Adams member above (both new). Overlies Hattiesburg formation; underlies Citronelle formation and younger terrace deposits. Report deals mostly with ground-water supply.

Named for exposures along Pascagoula River, in Jackson County, Miss.

**Paskenta Formation**[1]

Paskenta Group

Paskenta Stage

Lower Cretaceous (Shasta Series): Northern California and southern Oregon.

Original reference: F. M. Anderson, 1902, California Acad. Sci. Proc., 3d ser., Geology, v. 2, no. 1, p. 43–47.

F. M. Anderson, 1938, Geol. Soc. America Spec. Paper 16, p. 38 (table 1), 41–61. Name Paskenta was suggested by writer (Anderson, 1902) for lower part of Shasta series, as since defined, in belief then prevalent that it formed representative part of Knoxville series. Later investigation has shown that Knoxville is distinctly Jurassic, whereas Paskenta group has chronological range strictly within the Cretaceous-Berriasian-Valanginian and is distinct from Knoxville. Paskenta forms lower part of Shasta series and underlies Horsetown group. In its type district (Elder Creek to Thomas Creek and southward), group begins at south with massive lenses of conglomerate, above which it is prevailingly sandy with alternating beds of sandstone and sandy shales. Group has been identified stratigraphically and faunally on both sides of delta area—that is, in its type area and in Cottonwood district. Thickness 11,000 feet in axial area of delta; 8,000 feet on Middle Fork of Cottonwood; about 4,000 feet on Roaring River; and 5,300 feet in type district. In most sections, line of division between Paskenta and Horsetown has been determined faunally although in some places separation is aided by lithological changes. Includes several faunal zones.

F. M. Anderson, 1943, California Div. Mines Bull. 118, pt. 2, p. 184 (fig. 68) [preprint 1941]; 1945, Geol. Soc. America Bull., v. 56, no. 10, p. 916. Overlies Newville group (new) of Knoxville series.

N. L. Taliaferro, 1944, Am. Assoc. Petroleum Geologists Bull., v. 28, no. 4, p. 458–459. Discussion of Cretaceous of Santa Lucia Range. In northern California, the Lower Cretaceous has been divided into two groups, Paskenta and Horsetown. It is believed that names Paskenta and Horsetown should be used as approximate faunal stages rather than group terms. Name Marmolejo formation is proposed for Lower Cretaceous of Santa Lucia Range.

F. G. Wells, 1955, U.S. Geol. Survey Mineral Inv. Field Studies Map MF–38. Paskenta formation of Anderson (1902) mapped in southern Oregon.

M. A. Murphy, 1956, Am. Assoc. Petroleum Geologists Bull., v. 40, no. 9, p. 2101 (fig. 2), 2103. Term Paskenta is used as stage name for lower part of Shasta series; occurs below Horsetown which is redefined as stage and discussed in detail. Rocks included in Anderson's "Horsetown group" and uppermost strata of his "Paskenta group" in vicinity of Ono have been subdivided into Ono and Rector formations (both new), the boundaries of which are not coincident with Anderson's group.

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 to be an upper shaly phase of Franciscan group, and the two to be overlain unconformably by detrital strata of Cretaceous age. Paleontologic evidence indicates this view to be incorrect. Franciscan group seems mainly to have been deposited contemporaneously with the Knoxville, Paskenta, Horsetown, and lower Upper Cretaceous.

W. D. Wilkinson and others, 1959, Oregon Dept. Geology and Mineral Industries Bull. 50, p. 16. Paskenta formation listed in catalog of pre-Tertiary formations of Oregon. The 4,000 feet of dark or yellowish Cretaceous clay shales forming upper part of Knoxville of previous reports. Contains typical subtropical fauna with abundant *Aucella*.

Type district (Anderson, 1938): Immediately above village of Paskenta in western Tehama County, Calif., extending northward beyond Elder Creek, and southward toward Newville.

Paso Robles facies (of San Ardo Group)

Pliocene: Western California.

T. A. Baldwin, 1950, Am. Assoc. Petroleum Geologists Bull., v. 34, no. 10, p. 1986 (fig. 6), 1988. Marine and nonmarine pebble beds, silica-cemented sands, and fresh-water clays, in part equivalent to original Paso Robles formation. Paso Robles is uppermost of three overlapping facies in group. Overlies and grades laterally into Etchegoin facies.

Exposed on slopes of Pancho Rico Canyon and nearby gulches which drain westward to Salinas River near San Ardo, Monterey County.

**Paso Robles Formation**[1]

Pliocene and Pleistocene (?) : Western California.

Original reference: H. W. Fairbanks, 1898, Jour. Geology, v. 6, p. 565–566.

R. G. Frame, 1938, California Oil Fields, v. 24, no. 2, p. 27–47. Described in Santa Maria oil district as interbedded unconsolidated fine- to coarse, bluish- to buff-colored sands and gravels, and beds of bluish-colored clay. Unconformably underlies surface alluvium and gravels; overlies Foxen formation. Thickness 250 to 500 feet (determined from well records).

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), 1358–1359. Conformably overlies Careaga sandstone; unconformably underlies Orcutt sand. Maximum exposed thickness about 2,000 feet. Upper Pliocene to lower Pleistocene (?).

T. W. Dibblee, Jr., 1950, California Div. Mines Bull. 150, p. 39 (fig. 3), 47–50, pls. 1–5. Described in southwestern Santa Barbara County as a series of terrestrial gravels, sands, and clays of probable uppermost Pliocene and lower Pleistocene age conformably overlying Careaga sand. Extensively exposed in San Rafael foothills where it attains a maximum thickness of 4,500 feet; thins to southwest to about 2,000 feet in vicinity of Los Alamos Valley and to about 700 feet under Santa Rita Valley. Underlies Orcutt sand; discordance.

W. P. Woodring and M. N. Bramlette, 1950, U.S. Geol. Survey Prof. Paper 222, p. 49–51. Maximum exposed thickness 2,000 feet in Santa Maria district. Underlies Orcutt sand; overlies Careaga sandstone. Late Pliocene and early Pleistocene (?). Type region designated.

W. E. Ver Plank, 1952, California Div. Mines Bull. 163, p. 40. Discussed in connection with gypsum deposits in San Benito County. Contains lenses of gypsum 3 to 6 feet thick and up to 300 yards in diameter.

Type region: Salinas Valley in Coast Ranges northwest of Santa Maria district.

**Paspotansa Greensand Marl Member** (of Aquia Formation)[1]

Eocene, lower: Eastern Virginia and eastern Maryland.

Original reference: W. B. Clark and G. C. Martin, 1901, Maryland Geol. Survey, Eocene Volume, p. 58, 62–64.

R. A. Schmidt, 1948, Jour. Paleontology, v. 22, no. 4, p. 390, 392 (table 1), 393. Paspotansa greensand marl member (above) and Piscataway indurated marl member (below) are present at type locality of Aquia formation. They cannot be distinguished on basis of their ostracods. Lower Eocene.

Named for Paspotansa Creek, which enters Potomac River from Virginia bank, a mile below Potomac Creek.

Passaconaway Syenite

Carboniferous (?) : 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. Passaconway [Passaconaway] syenite described as coarse- to medium-grained green syenite. Belongs to White Mountain magma series.

A. P. Smith, Louise Kingsley, and Alonzo Quinn, 1939, Geology of Mount Chocorua quadrangle, New Hampshire: Concord, New Hampshire State Plan. Devel. Comm., p. 8, 18. Referred to as Passaconaway syenite.

Crops out in area bounded roughly by Mount Passaconaway, Mount Whiteface and Hibbard Mountain in northern part of Mount Chocorua quadrangle.

Pass Creek Sandstone

Pennsylvanian and (or) Permian: South-central Colorado.

D. W. Bolyard, 1956, Rocky Mountain Assoc. Geologists Guidebook to geology of the Raton Basin, Colorado, p. 52, 55–56; 1959, Am. Assoc. Petroleum Geologists Bull., v. 43, no. 8, p. 1903 (fig. 5), 1904 (fig. 4), 1918–1919. Nonfossiliferous, greenish-gray to grayish-green medium- to light-gray, and pink sandstones, with a few interbeds of dark gray to black shale, siltstone, and limestone; lamination, cross-lamination, and crossbedding common. Thickness about 1,000 feet. Overlies Madera formation; underlies Sangre de Cristo formation. Contact with Sangre de Cristo obscured by faulting. Brill (1952) included these beds in Sangre de Cristo.

Named from exposure about 1½ miles south of Pass Creek Pass on U.S. Highway 160, Sangre de Cristo Mountains, between La Veta Pass and Westcliffe.

Pass Peak Conglomerate

Eocene, middle: Northwestern Wyoming.

A. J. Eardley and others, 1944, Hoback-Gros Ventre-Teton Field Conf. [geologic map]. Privately printed. Coarse red and gray conglomerates that grade into sandstone and shale toward basin. Thickness 1,000 to 5,000 feet. Unconformable below Camp Davis conglomerate (new); unconformable above Hoback formation (new).

H. R. Wanless, R. L. Belknap, and Helen Foster, 1955, Geol. Soc. America Mem. 63, p. 74–75. Locally rests with angular unconformity on Hoback formation along eastern border of Hoback Range and near head of Little Granite Creek; in upper Horse Creek and Cache Creek drainages rests on Frontier formation. Derivation of name given.

J. A. Dorr, Jr., 1958, Geol. Soc. America Bull., v. 69, no. 10, p. 1218 (fig. 1). Early(?) Eocene.

Named from Pass Peak, a high point on Hoback basin-Green River divide about 4 miles north of point where U.S. Route 287 crosses divide.

Pasto Andesite

Eocene, pre-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. 109–112, geol. map. Light- to medium-gray hornblende andesite that contains abundant phenocrysts of hornblende and common xenoliths of amphibole or hornblendite. Intrudes Ildefonso formation (new) and Robles formation, does not intrude Eocene Jacaguas group (new).

Typically exposed at Pasto in southwestern part of Barranquitas quadrangle. Crops out largely in Coamo, Barranquitas, and Río Descalabrado quadrangles.

Pastoria Sand Member (of White Bluff Formation)

Eocene (Jacksonian): Southeastern Arkansas.

L. J. Wilbert, Jr., 1953, Arkansas Div. Geology Bull. 19, p. 39, 40–56. Name applies to one of three marine facies of formation. Includes the more clastic elements of the formation. Typically argillaceous sand containing glauconite and molluscan remains. At type locality, estimated thickness is about 65 feet, base not exposed; thins northward to about 20 to 25 feet at South Red Bluff. Stratigraphically equivalent with Caney Point marl member; underlies Rison clay member and, in some areas, the Redfield formation; contact with underlying Claiborne gradational.

Type locality: White Bluff on Arkansas River, 3½ miles east of Redfield, Jefferson County. Name is derived from Pastoria quadrangle.

Patagonia Group

Lower Cretaceous: Southeastern Arizona.

A. A. Stoyanow, 1937, (abs.) Geol. Soc. America Proc. 1936, p. 297 (table). Named on table. Contains Molly Gibson formation (new). Older than Santa Cruz group (new); younger than Bisbee group.

A. A. Stoyanow, 1949, Geol. Soc. America Mem. 38, p. 30–31, 53. Sequence composed mainly of dark shales sporadically interbedded with arenaceous strata and volcanics and, in the upper third, with bedded arenaceous limestones (Molly Gibson formation). Geographic area given. Total thickness about 5,850 feet.

In Patagonia Mountains.

Patagonia limestone

[Upper Devonian] (Tombstonian): Southeastern Arizona.

[C. R.] Keyes, 1942, Pan-Am. Geologist, v. 77, no. 3, p. 227, 228 (table). Name applied to the great median sector of the Martin limestone of Ransome (1904). Thickness 250 feet. Underlies Espinal formation (new); overlies Escacado limestone (new).

Name derived from well known mining camp in Santa Rita Mountains north [west-northwest] of Bisbee.

**Patapsco Formation** (in Potomac Group)[1]

Upper Cretaceous: Delaware, eastern Maryland, and eastern Virginia.

Original reference: W. B. Clark, 1897, Maryland Geol. Survey, v. 1, p. 156, 191.

C. W. Cooke, 1952, Maryland Dept. Geology, Mines and Water Resources Bull. 10, p. 7–8. Patapsco is of Upper Cretaceous age because it lies between Arundel clay, which contains reptiles having Upper Cretaceous affinities, and Monmouth formation, which carries large marine fauna of late Upper Cretaceous. Presumably occupies position well down in series because it seems more closely related to Arundel than to Monmouth, from which it is separated by a gap representing several marine and nonmarine formations (Matawan, Magothy, and Raritan). Estimated thickness 200 or 300 feet.

Erling Dorf, 1952, Am. Assoc. Petroleum Geologists Bull., v. 36, no. 11, p. 2169 (fig. 1), 2173–2177. Lower Cretaceous. Assignment is made on basis of both floral and faunal evidence. Detailed discussion of problem.

Named for occurrence in valley of Patapsco River, Md.

Patillas Quartz Monzonite[1]

Age (?): Puerto Rico.

Original reference: C. R. Fettke, 1924, New York Acad. Sci. Scientific survey of Porto Rico and Virgin Islands, v. 2, pt. 2, p. 161.

**Pato Red Member** (of Vaqueros Formation)[1]

Miocene, lower: Southern California.

Original reference: W. A. English, 1916, U.S. Geol. Survey Bull. 621, p. 191–215.

W. E. Ver Planck, 1952, California Div. Mines Bull. 163, p. 41. Mentioned in discussion of gypsum deposits in Ventura County. Gypsiferous zone occurs in the middle Miocene Caliente red beds which English designated the Pato member of the Vaqueros formation.

M. L. Hill, S. A. Carlson, and T. W. Dibblee, Jr., 1958, Am. Assoc. Petroleum Geologists Bull., v. 42, no. 12, p. 2995. These beds are here considered a part of Caliente formation.

Named for exposures in Pato Canyon, Cuyama Valley.

Patrick Greenstone[1]

Cretaceous (?) : Northwestern California.

Original reference: J. H. Maxson, 1933, California Jour. Mines and Geology, v. 29, no. 1–2, p. 134, map.

J. C. O'Brien, 1952, California Jour. Mines and Geology, v. 48, no. 4, p. 265. Mentioned in report on mineral resources of Del Norte County.

Occurs in Del Norte County. Map shows Patrick Creek cutting across the greenstone.

Patriot Limestone (in Conemaugh Formation)[1]

Pennsylvanian : Eastern Ohio.

Original reference : D. D. Condit, 1909, Ohio Nat., v. 9, p. 484.

Probably named for Patriot, Gallia County.

**Patterson 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, 1939, Virginia Geol. Survey Bull. 51–A, p. 14–15, pl. 1. Name Patterson, given by Butts (1933) to lower ribboned blue dolomite and limestone of Shady, is appropriate for these beds in main part of Great Valley north of Gleaves Knob overthrust because Patterson, the type locality, is located on these rocks. Name Patterson will be used in this sense in this report (Wythe and Carroll Counties) with understanding that it is not appropriate for the lower part of the Lower Cambrian rocks south of Gleaves fault, where sequence is different. Thickness about 620 feet. Underlies an unnamed massive white saccharoidal dolomite, 200 feet thick in upper part of the Shady; overlies Erwin quartzite.

Charles Butts, 1940, Virginia Geol. Survey Bull. 52, pt. 1, p. 41–42. In Wythe and Pulaski Counties, Patterson underlies Austinville dolomite member (new).

Type locality: Patterson, Wythe County, where more than 100 feet is exposed in bluff on west side of Little Reed Island Creek.

**Patterson Point Formation**

Quaternary : Southwestern Alaska.

G. L. Snyder, 1959, U.S. Geol. Survey Bull. 1028–H, p. 180–181, pl. 23. Dacitic ash and pumice and dacitic and andesitic pyroclastic debris. Upper unit 10 to 15 feet thick consists of light-grayish-white to bluish-gray, firmly consolidated ash and pumiceous lapilli. Lower unit as much as 25 feet thick consists of salmon-pink to grayish-white, very firmly consolidated or welded dacitic glass and pumice. Deposit several hundred feet thick. Generally massive. Overlies Double Point dacite (new).

Type section: In stream cut north of the 1,980 foot mountain at lat 51°57′40″ N., long. 178°30′50″ E., Little Sitkin Island, in Rat Islands group of Aleutian Islands. Extends 2 miles northwestward from Little Sitkin volcano toward Patterson Point.

Patterson Ranch Group

Ordovician: South-central Oklahoma.

C. E. Decker, 1942, Oklahoma Acad. Sci. Proc., v. 22, p. 153–155. Name proposed for limestone-shale series of formations—Viola, Fernvale, and Sylvan. Overlies Simpson group; underlies Silurian formations.

Name taken from Patterson Ranch on south edge of Arbuckle Mountains on east side of U.S. Highway 77. Formations are characteristically exposed on ranch and extend from highway eastward across it.

Pattiway Formation

Eocene (?): Southern California.

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), 2977–2981. At type locality, formation unconformably underlies Simmler formation, but base is unexposed. Total exposed thickness 3,680 feet. Upper 3,300 feet composed predominantly of light-gray to buff, hard medium-grained arkosic sandstones with minor interbeds of dark-gray carbonaceous siltstone; upper part of this sandstone unit contains several lentils up to 30 feet thick of brown conglomerate made up of rounded cobbles of quartzite and granitic and dark porphyritic rocks; sandstone series grades downward into dark-gray micaceous silty shale containing carbonaceous materials; approximately 380 feet of this shale crops out and forms lowest exposed part of Pattiway. Overlies unnamed Upper Cretaceous sandstones and conglomerates. Age of formation not known definitely because it is generally unfossiliferous; lower shale of Caliente Range section has yielded a foraminiferal fauna suggesting an Eocene or Cretaceous age; lithologically unlike Cretaceous strata of region, and field relations indicate an Eocene age as most probable.

Type locality: Extreme southeastern end of Caliente Range, T. 10 N., R. 25 E., east of Cuyama Ranch and Ballinger Canyon quadrangles. Name derived from former settlement of Pattiway, a few miles east.

Patton Limestone (in Greenbrier Limestone[1] or Series)

Middle Mississippian (Meramecian): Southwestern Virginia and southeastern West Virginia.

Original reference: D. B. Reger, 1926, West Virginia Geol. Survey Rept. Mercer, Monroe, and Summers Counties, p. 450, 480.

Dana Wells, 1950, Am. Assoc. Petroleum Geologists Bull., v. 34, no. 5, p. 903. Denmar formation (new) includes Sinks Grove and Patton limestones of Reger (1926). Age of Denmar Middle Mississippian (Meramecian series).

D. B. Reger, 1950, Am. Assoc. Petroleum Geologists Bull., v. 34, no. 9, p. 1910–1912. The Patton and Sinks Grove do not represent a single stratigraphic unit; in Monroe County, where they were named, they are separated by 10 to 20 feet of plant bearing shale [Patton shale]. Use of term Denmar for these two units is without merit. Middle Mississippian.

Type locality: On south side of Second Creek just south of Patton, Monroe County, W. Va.

Patton Shale (in Greenbrier Limestone)[1]

Mississippian: Southeastern West Virginia.

Original reference: D. B. Reger, 1926, West Virginia Geol. Survey Rept. Mercer, Monroe, and Summers Counties, p. 450, 483.

Type locality: Northeast of Union, Monroe County, along Pickaway-Hillsdale road 0.8 mile southeast of Pickaway. Named for association with Patton limestone.

**Patton Shale Member** (of Pocono Formation)[1]

Patton Formation or Shale

Mississippian: Western Pennsylvania.

Original reference: M. R. Campbell, 1904, U.S. Geol. Survey Geol. Atlas, Folio 110.

P. A. Dickey, R. E. Sherrill, and L. S. Matteson, 1943, Pennsylvania Geol. Survey, 4th ser., Bull. M–25, p. 14–15. Mississippian strata of Oil City quadrangle are classified (ascending) Cussewago group, Berea group (including Corry sandstone), Cuyahoga group, Shenango formation, and Patton formation. The Patton consists of light-bluish-gray clay shale with included layers or lenses of poorly bedded soft red and green shale and fine- to medium-grained greenish-gray argillaceous sandstone. Thickness 60 to 70 feet.

Charles Butts, 1945, U.S. Geol. Survey Geol. Atlas, Folio 227, p. 13. Member of Pocono formation. In Hollidaysburg-Huntingdon area underlies Burgoon sandstone member. Thickness about 40 feet.

J. M. Weller and others, 1948, Geol. Soc. America Bull., v. 59, no. 2, p. 160, chart 5 (columns, 82, 106). Column 82, northwestern Pennsylvania, shows Patton shale above Shenango formation; in Osagean series. Column 106, subsurface southwestern Pennsylvania, shows Patton shale above Second gas sand and below Squaw sand; Kinderhookian series. According to text explanation of column 82, beds termed Patton consist largely of shale and include red beds. There is little or no evidence that these beds are of equivalent age at different places, and the Patton of northwestern Pennsylvania might as readily be correlated with part of the Maccrady of West Virginia or even part of Mauch Chunk of eastern Pennsylvania.

B. N. Cooper, 1948, Jour. Geology, v. 56, no. 4, p. 259 (footnote). Name Patton shale, which appears on Mississippian correlation chart (Weller and others, 1948) is invalid by reason of prior use of Patton for an older shale of Pocono age in western Pennsylvania.

R. C. Bolger and C. E. Prouty, 1953, Pennsylvania Acad. Sci., v. 27, p. 125. In Cameron County, Patton formation, about 60 feet thick, directly underlies Burgoon sandstone.

Named for outcrops on Redbank Creek, at Patton, near west line of Jefferson County.

**Patuxent Formation** (in Potomac Group)[1]

Lower Cretaceous: Eastern Maryland, Delaware, and eastern Virginia.

Original reference: W. B. Clark, 1897, Maryland Geol. Survey, v. 1, p. 156, 190.

C. W. Cooke, 1952, Maryland Dept. Geology, Mines and Water Resources Bull. 10, p. 2–4, 5. Oldest formation of Coastal Plain in region of Prince Georges County and lies directly on crystalline rocks. Formation contains many unconformities, and there is presumably one at top separating it from overlying Patapsco formation. Locally, in District of Columbia, underlies red gravel thought to be the Bryn Mawr (Pliocene?). Unconformably underlies Arundel formation here considered Upper Cretaceous.

Erling Dorf, 1952, Am. Assoc. Petroleum Geologists Bull., v. 36, no. 11, p. 2173–2177. Reanalysis of Potomac group floras substantiates views expressed by earlier workers (especially Berry and Seward) that Patuxent and Arundel floras are essentially similar associations comparable in age and composition with Wealden flora of England, which at present is considered of Neocomian age. Detailed discussion of problem.

Named for development in upper valleys of Little and Big Patuxent Rivers, Md.

Pauba Formation

Pleistocene, upper: Southern California.

J. F. Mann, Jr., 1955, California Div. Mines Spec. Rept. 43, p. 3, 9, 13–14, pl. 1. Series of coarse fanglomerates and interbedded sands and silts about 500 feet thick. Unconformably underlies Dripping Springs formation (new); overlies Temecula arkose (new) with angular unconformity.

Occurs in Elsinore fault zone in western Riverside and northern San Diego Counties. Named from Pauba Rancho, east of Temecula, Riverside County.

**Paularino 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 primarily of a poorly exposed sequence of interbedded sandstone, siltstone, and breccia. Estimated maximum thickness 1,275 feet. Unconformably underlies Capistrano formation of late Miocene to early Pliocene age and unnamed sandstone of Pliocene and early Pleistocene(?) age. Overlies Los Trancos member (new) with probable disconformity.

Type area: North of Bonita Reservoir on Bonita Creek at northwest edge of San Joaquin Hills, Orange County. Name taken from Paularino Avenue near northwest margin of map.

Paulian glaciation

Paulian till[1]

Pleistocene (Wisconsin): Central Minnesota.

Original references: C. R. Keyes, 1932, Pan-Am. Geologist, v. 58, p. 203, 217; 1933, v. 60, p. 55.

C. R. Keyes, 1938, Pan-Am. Geologist, v. 69, no. 2, p. 108 (fig. 2), 129. Referred to as glaciation.

Paulina Peak Rhyolites

Pleistocene: Central Oregon.

Howel Williams, 1935, Geol. Soc. America Bull., v. 46, no. 2, p. 261, 265–266, 281. Discussion of history of Newberry volcano. Paulina Peak rhyolites consist of as many as 12 flows with total thickness of at least 1,000 feet. Earliest rhyolites are pale gray, porphyritic and platy lavas, some are so vesicular as to be almost pumiceous. Platy rhyolites are succeeded by dense flows in which banding is less pronounced, and these by black pitchstones overlain by finely laminated flows. Near summit are many varieties of obsidian.

The rhyolite flows form girdle of cliffs that rise to Paulina Peak and the high shoulder running toward southwest.

Paupack Sandstone (in Catskill Formation)[1]

Paupack parvafacies (in Shohola facies group)

Upper Devonian: Northeastern Pennsylvania.

Original reference: I. C. White, 1881, Pennsylvania 2d Geol. Survey Rept. $G_5$, p. 59, 68, 169, 170, 199, 200.

K. E. Caster, 1938, Jour. Paleontology, v. 12, no. 1, p. 45 (fig. 7). Shown as a parvafacies in Shohola facies group.

Named for Paupack Falls on Wallenpaupack Creek, Palmyra Township, Pike County.

Paupack Shales (in Catskill Formation)[1]

Upper Devonian: Northeastern Pennsylvania.

Original reference: I. C. White, 1881, Pennsylvania 2d Geol. Survey Rept. $G_5$, p. 68.

Name derived from Paupack Falls, Pike County.

**Pauwalu 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. 94, 95 (table). Oldest Hana lava in Keanae Valley. Dense fine-grained olivine aa basalt, jointed in columns 6 inches to 2 feet in diameter, with layer of clinker at top. Exposed thickness in sea cliff 130 feet; at Piinaau Falls, about 175 feet exposed, separated into two distinct layers by bed of clinker.

G. A. Macdonald and D. A. Davis *in* Jacques Avias and others, 1956, Lexique Strat. Internat., v. 6, Océanie, fasc. 2, p. 125. Pleistocene(?).

Named after Pauwalu Point, where it is exposed in sea cliff, filling valley cut into older alluvium. Valley is about 2,000 feet wide at coast and extends to unknown depth below sea level.

**Pavant Flow**

Pliocene, upper, or Pleistocene, lower: Central Utah.

G. B. Maxey, 1946, Am. Jour. Sci., v. 244, no. 5, p. 328, pl. 1. Oldest flow in area. Lava beds are horizontal, underlie Pleistocene lake beds and Recent deposits, and were extruded probably in late Pliocene or early Pleistocene. Underlies Tabernacle flow (new).

P. E. Dennis, G. B. Maxey, and H. E. Thomas, 1946, Utah State Engineer Tech. Pub. 3, p. 28, pl. 1. Thickness about 1,800 feet. Base not exposed.

Extends from southern end of Pavant Valley to Pavant Butte at northern extremity of valley, Millard County. More than 5 miles wide.

Pavlof 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 and flanks of Pavlof Volcano, Alaska Peninsula.

Pavlof Sister 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 flanks of Pavlof Sister Volcano, Alaska Peninsula.

**Pawhuska Limestone[1] or Formation[1]**

Pennsylvanian (Virgil Series): Northeastern and central northern Oklahoma.

Original reference: J. P. Smith, 1894, Jour. Geology, v. 2, p. 199.

W. F. Tanner, 1956, Oklahoma Geol. Survey Bull. 74, p. 98–99. Pawhuska formation does not crop out in Seminole County. Mentioned here because it has been mapped or traced across much of county by many geologists. Beds so mapped are ledges 9, 11, and 12 in upper part of Vamoosa formation. Pawhuska is truncated in or near sec. 20, T. 11 N., R. 7 E., in western Okfuskee County by overlying Ada formation.

M. C. Oakes, 1959, Oklahoma Geol. Survey Bull. 81, p. 48–51, pl. 1. Formation is about 150 feet thick in northern Osage County and comprises (ascending) Lecompton, Plummer, Deer Creek, Little Hominy, Pearsonia (new), and Turkey Run members. Of these six members, only the Lecompton at the base and Turkey Run at top continue across Pawnee County and into Creek County. Formation thins southward to 56 feet in southern Pawnee County. In Creek County, formation is 60 to 75 feet thick from north line to south part of T. 16 N., but is 20 feet thick at one locality near middle of T. 15 N. Farther south, Turkey Run limestone member could not be found; Lecompton limestone member at base, 5 to 10 feet thick, and about 30 feet of shale and sandstone belonging to formation could be mapped in sec. 6, T. 14 N., R. 7 E. Lecompton member continues to south line of Creek County and is only part of Pawhuska that Ries (1954, Oklahoma Geol. Survey Bull. 71) could map in Okfuskee County. Conformable with Vamoosa formation below and conformable with younger rocks above as far south as middle of T. 15 N. It seems that Turkey Run member was not deposited farther south. The Lecompton has been mapped southward across Okfuskee County to surficial deposits associated with North Canadian River, but no representative of Pawhuska has been recognized farther south, where Pawhuska was probably completely removed by post-Vamoosa, pre-Ada erosion. Ada formation rests on rocks older than Vamoosa on north flank of Arbuckle Mountains, truncates Vamoosa, and probably truncates the Lecompton beneath surficial deposits associated with North Canadian River. Intergrades laterally with Vanoss formation. Name credited to Herbert C. Hoover (unpub. ms.).

P. B. Greig, 1959, Oklahoma Geol. Survey Bull. 83, p. 37–44, pl. 1. Formation described in Pawnee County where it is included in Douglas-Shawnee group. Recent usage has placed bottom and top of formation at base of Lecompton limestone and top of Turkey Run limestone, respectively. Pawhuska can presumably be traced from Kansas-Oklahoma line southward into Creek County where one or both of bounding limestones pinches out. However, extent, correlation, and even status of the Pawhuska is open to question. In Kansas and northern Osage County, Okla., interval occupied by Pawhuska formation contains as many as 12 limestones separated by shale and a few thin coals and limestones. The limestones and coals thin and pinch out southward, and percentage of sandstone in section increases. Only Turkey Run and Lecompton limestones, which delimit formation, extend as far south as Pawnee County. No question has arisen on correlation of lower limit, but recent work has cast doubt on validity of upper correlation. According to Shannon (1954, unpub. thesis) and Carter (1954, unpub. thesis), Turkey Run limestone in Osage County is poorly developed and cannot be mapped; therefore, Moore's (1949, Kansas Geol. Survey Bull. 83) correlation of Turkey Run with Coal Creek limestone may be erroneous. South of Pawnee County, Lecompton member is thought to be equivalent to "Pawhuska" formation of Okfuskee County (Ries, 1954) which grades into basal part of Ada formation. An alternate theory by Tanner (1956, Oklahoma Geol. Survey Bull. 74) postulates that the "Pawhuska" is overlapped southward by Ada formation of Okfuskee County. Recent work has cast doubt on all these correlations. Some workers are of the opinion that the "Pawhuska" of Okfuskee County is southward extension of Bird Creek limestone of Wabaunsee group. Base of "Pawhuska" defines top of Vamoosa formation (Ries, 1954). If Pawhuska formation of Okfuskee County is in reality Bird Creek, Vamoosa formation extends upward into Wabaunsee group to base of Bird Creek and contains Pawhuska formation of Pawnee County. If such is the case, a difficult problem of subdivision and classification is posed. In Pawnee County, the Pawhuska rests conformably on Kanwaka shale of Vamoosa formation and is overlain conformably by Severy shale of Wabaunsee group.

Type locality: About 3 miles northwest of Pawhuska, formerly spelled Pawhuski, Osage County. Formation crops out in band 1 to 3 miles wide from Kansas-Oklahoma line, T. 29 N., Rs. 8 and 9 E., across Osage County and eastern Pawnee County; across west side of Creek County to middle of T. 15 N., R. 7 E., and representatives continue along west side of Creek County and west side of Okfuskee County to North Canadian River in T. 11 N., R. 7 E.

Pawling Gneiss[1]

Precambrian: Southeastern New York.

Original reference: T. N. Dale and L. M. Prindle, 1904, New York State Mus. 23d Ann. Rept., map; text by F. J. H. Merrill.

D. W. Fisher, 1956, Internat. Geol. Cong., 20th, Mexico, Cambrian Symposium, pt. 2, p. 329. Listed with names rejected by virtue of synonymy and (or) lack of usage.

Occurs in part of Pawling Township, Dutchess County.

Pawnee Limestone[1]

Pennsylvanian(?): Central northern Oklahoma.

Original reference: N. F. Drake, 1897, Am. Philos. Soc. Proc., v. 36, p. 326–387.

Named for Pawnee, Pawnee County.

**Pawnee Limestone**[1] (in Marmaton Group)

**Pawnee Limestone Member** (of Oologah Limestone)

Pawnee Limestone (in Henrietta Group)

Pawnee Limestone Member (of Henrietta Formation)[1]

Pennsylvanian (Des Moines Series): Eastern Kansas, southwestern Iowa, western Missouri, and northeastern Oklahoma.

Original reference: G. C. Swallow, 1866, Kansas Geol. Survey Prelim. Rept., p. 24–25.

J. M. Jewett, 1941, Kansas Geol. Survey Bull. 38, no. 11, p. 312–321. Subdivided into (ascending) Anna shale (new), Myrick Station limestone, Mine Creek shale (new), and Laberdie limestone (new) members. Thickness at type exposure, herein designated, 30 feet. Overlies Labette shale; underlies Bandera shale. Included in Marmaton group.

L. M. Cline, 1941, Am. Assoc. Petroleum Geologists Bull., v. 25, no. 1, p. 37. Subdivided into two members. Lower member named Myrick Station; upper member to be named with type locality in Kansas. Included in Henrietta group.

F. C. Greene and W. V. Searight, 1949, Missouri Geol. Survey and Water Resources Rept. Inv. 11, p. 6–7; L. M. Cline and F. C. Greene, 1950, Missouri Geol. Survey and Water Resources Rept. Inv. 12, p. 7–15, columnar sections and measured sections. Formation, as recognized in Missouri, includes beds from base of Anna shale to top of Coal City limestone member. Term Coal City has priority over Laberdie, and Laberdie is suppressed in favor of Coal City. Marmaton group.

M. C. Oakes, 1952, Oklahoma Geol. Survey Bull. 69, p. 29. Term Oologah is extended to Kansas-Oklahoma line to include (ascending) Pawnee limestone, Bandera shale, and Altamont members.

H. G. Hershey and others, 1960, Iowa Highway Research Board Bull. 15, p. 31–32, fig. 5. In southwestern Iowa, comprises (ascending) Anna shale, Myrick Station limestone, Mine Creek shale, and Coal City limestone members. Marmaton group.

Type exposure: Near center N½S½ sec. 7, T. 27 S., R. 24 E., Bourbon County, Kans. Named for exposures on Pawnee Creek, near village of Pawnee (now Anna), Bourbon County.

†Pawnee limestone series[1]

Pennsylvanian: Eastern Kansas.

Original reference: G. C. Swallow, 1866, Kansas Geol. Survey Prelim. Rept., p. 24–25.

Probably named for Pawnee Creek, near village of Pawnee, Bourbon County.

†Pawnee Creek Beds[1]

Pawnee Creek Formation

Miocene, middle, to Pliocene, lower: Northeastern Colorado.

Original reference: W. D. Matthew, 1900, Am. Mus. Nat. History Bull., v. 12, p. 24–25.

E. C. Galbreath, 1953, Kansas Univ. Paleont. Contr. 13, Vertebrata, art. 4, p. 14 (fig. 4), 15 (fig. 5), 18–19, 20–21, 22, 23, 24, 25, 26, 27 (fig. 8). Matthew did not designate type section for Pawnee Creek beds. [See this report for discussion of problem.] Pawnee Creek formation used in this paper as a mapping unit for known Miocene beds in Logan and Weld Counties. As used here, term includes Matthew's Pawnee Creek beds and Pawnee Creek fauna and upper part of his Martin Canyon beds with its fauna. This is an expedient to avoid further confusion in use of term Martin Canyon and to avoid introduction of new term prior to solving stratigraphic and correlation problems in area. 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 Martin Canyon area. Formation is represented in northeastern Colorado by series of valley fills. Oldest deposits are in bottoms of canyons cut into Oligocene surface and consist of massive silt or fine consolidated sand in thin layers; capping the silts is widespread coarse rubble bed; overlying channel rubble are beds of massive, sandy silts containing layers of nodular concretions, gravel lenses, and thin channel sandstone; locally rubble is overlain by olive-gray silt followed by massive silts, and in still other localities rubble seems to be replaced by olive-gray silt in the depositional sequence. Thickness at type section herein designated 144 feet. Underlies Ogallala formation; overlies Cedar Creek member or Vista member (new) of White River formation.

Type locality: At Eubanks ranchhouse, Pawnee Buttes, NE¼ sec. 1, T. 10 N., R. 59 W., Weld County. Named for Pawnee Creek, Logan and Weld Counties.

**Pawpaw Formation** (in Washita Group)

Pawpaw Sandy Member (of Denison Formation)[1]

Pawpaw Shale Member (of Denison Formation)

Pawpaw Shale Member (of Georgetown Limestone)

Lower Cretaceous (Comanche Series): Northeastern and central Texas and central southern Oklahoma.

Original reference: R. T. Hill, 1894, Geol. Soc. America Bull., v. 5, p. 302, 303, 328–335.

R. W. Imlay, 1944, U.S. Geol. Survey Oil and Gas Inv. Prelim. Chart 3. Chart shows Pawpaw formation in Washita group. Occurs above Weno limestone and below Main Street limestone. [Term Denison formation abandoned.] Lower Cretaceous.

D. L. Frizzell, 1954, Texas Univ. Bur. Econ. Geology Rept. Inv. 22, p. 28–29, table 4. Foraminifera of Pawpaw formation described.

B. F. Perkins, 1960, Geol. Soc. America Mem. 83, p. 9 (fig. 3), 12 (fig. 4), 32–34. In Tarrant County, Tex., name Pawpaw is applied to shale sequence between Weno marly limestone member and Main Street limestone member of Denison formation. Consists chiefly of gray and bronze calcareous shale with few thin sandstone partings and several ironstone layers. Thickness 12 to 30 feet.

W. J. Fox and O. N. Hopkins, Jr., 1960, Baylor Geol. Soc. Guidebook 5th Field Conf., p. 88, 92. In central Texas, termed shale member of Georgetown limestone. Overlies Weno limestone member; underlies Main Street limestone member. In north Texas, composed predominantly of sandstone, which changes to marl near Waco. Marl is relatively soft, thinly bedded, with shale partings. Recognized as a 7-foot receding zone consisting of two shale beds separated by a 4-foot limestone.

Named for Pawpaw Creek, in southern and eastern part of Denison, Grayson County, Tex.

Pawtuckaway Complex (in White Mountain Magma Series)

Mississippian(?): Southeastern New Hampshire.

C. J. Roy and Jacob Freedman, 1944, Geol. Soc. America Bull., v. 55, no. 7, p. 908–914. Includes a variety of rocks ranging from gabbro to syenite, principal constituents being diorite and monzonite. Rocks become progressively less mafic from earlier gabbroic intrusion to latest monzonite and syenite. Structural character is best accounted for by cauldron subsidence mechanism of emplacement.

Named for occurrence in Pawtuckaway Mountains in Deerfield and Nottingham Townships, Rockingham County.

†Pawtucket Formation[1]

Pennsylvanian: Eastern Rhode Island.

Original reference: C. H. Warren and S. Powers, 1914, Geol. Soc. America Bull., v. 25, p. 439–475.

Named for Pawtucket, R.I.

Pawtucket Shale[1]

Pennsylvanian: Eastern Rhode Island.

Original reference: J. B. Woodworth, 1899, U.S. Geol. Survey Mon. 33, p. 134, 159–164.

Well exposed in banks of Blackstone River on Division Street, Pawtucket, and at Valley Falls, Providence County.

**Paxton Quartz Schist[1]**

Carboniferous: Central Massachusetts, northern Connecticut, and south-central New Hampshire.

Original reference: B. K. Emerson, 1898, U.S. Geol. Survey Mon. 29, p. 18.

W. G. Foye, 1949, Connecticut Geol. Nat. History Survey Bull. 74, p. 73, 74, pl. 1. Discussed together with Hebron schist under heading of Hebron, or Paxton quartz schist. Probably early Paleozoic.

John Rodgers and others, 1956, Preliminary geological map of Connecticut (1:253,440): Connecticut Geol. Nat. History Survey. Refers to Woodstock (Paxton) quartz schist phase of Hebron gneiss of pre-Triassic age.

Named for development at Paxton, northwest of Worcester, Mass.

Paxton Creek Conglomerate (in Martinsburg Shale)

Ordovician: South-central Pennsylvania.

Bradford Willard and A. B. Cleaves, 1938, Pennsylvania Geol. Survey, ser. 4, Bull. G–8, p. 5, 6. Name proposed for a pebbly unit in the Martinsburg shale in the Harrisburg area. Consists of ill-sorted, poorly rounded white quartz pebbles and shale chips in a muddy matrix. Very hard rock; in places, true conglomerite.

Named for outcrop near Paxton Creek in Harrisburg, Dauphin County.

**Payette Formation[1]**

Miocene and Pliocene(?): Southwestern Idaho, northeastern Nevada, southeastern Oregon, and northwestern Utah.

Original reference: Waldemar Lindgren, 1898, U.S. Geol. Survey 18th Ann. Rept., pt. 3, p. 632–634.

D. W. Scharf, 1935, Carnegie Inst. Washington Pub. 453, p. 99. Future geologic mapping may show that Sucker Creek beds (new) are an integral part of Payette formation.

B. N. Moore, 1937, U.S. Geol. Survey Bull. 875, p. 67–71, 97–100, pls. 8, 11. Subdivided into six unnamed members in Harper district, Malheur County, Oreg.: lower agglomerate and tuff member, 100 to 200 feet; lower diatomite member, 450 feet; gray ash member, 60 to 150 feet; upper diatomite member, 0 to 175 feet; rhyolite porphyry member, 0 to 10 feet; and yellow tuff member, 100 to 500 feet. Overlies flows of olivine basalt and hypersthene andesites correlated with Columbia River lava; capped by basalts. Only four members recognized in Otis Basin to the west. On basis of vertebrate fossils, upper member considered lower Pliocene; remainder of formation generally assigned to Miocene.

J. C. Bayless, 1950, Michigan Acad. Sci., Arts, and Letters, Papers, v. 34, p. 214–215. Term Camp Davis formation used in Snake River Plains, Idaho, in preference to term Payette formation, although term Payette has priority. Conglomerates are lithologically similar to those of Camp Davis formation of western Wyoming, and on that basis name Camp Davis is retained.

H. E. Corcoran, 1954, The Ore-Bin, v. 16, no. 12, p. 79–84. Lindgren did not designate type section; name apparently was suggested by exposures along Payette River in western Idaho. Because fossil leaves used by Knowlton (1898, U.S. Geol. Survey 18th Ann. Rept., pt. 3; 1902, U.S. Geol. Survey Bull. 204) for original dating were found in vicinity of Marsh post office, it is proposed here that this locality be used as type section. Kirkham (1931, Jour. Geology, v. 39, no. 3) found that Payette and Idaho formations in Idaho, as well as in adjacent areas of Oregon, are separated by great thicknesses of rhyolite and basaltic lavas. He measured a maximum thickness of Payette of about 1,200 feet in vicinity of Lindgren's leaf locality near Marsh post office and a thickness of Idaho formation on south side of downwarp along Little Squaw Creek of 7,275 feet and on north side along Little Willow Creek of 18,633 feet. He reported fossil leaves of Miocene from Payette and flora and fauna of Pliocene or later age from Idaho. Recent study in Vale-Buchanan area, Oregon, shows that lake beds in area dip gently northeast into Snake River downwarp and that these sediments are separated from another underlying unit of terrestrial lake beds, which crop out farther to west, by series of lavas at least 5,000 feet thick. Upper lake beds assigned to Idaho formation and lower to Payette formation. Payette formation dated as middle to upper Miocene.

F. B. Van Houten, 1956, Am. Assoc. Petroleum Geologists Bull., v. 40, no. 12, p. 2811. In Goose Creek area of northwesternmost Utah, and adjacent Idaho and Nevada, a 2,000-foot sequence characterized by carbonaceous and brittle bituminous shale and petroliferous limestone has been assigned to upper Miocene Payette formation. These deposits are well exposed on east flank of Goose Creek Range (T. 13 N., R. 18 W.) 8 to 10 miles north-northeast of village of Grouse Creek, Utah, as well as in scattered outcrops on west flank of Grouse Creek Range (S½, T. 12 N., R. 17 W.), several miles east of Grouse Creek.

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). Payette formation and related strata exposed principally along border of western part of Snake River Plain but continue at intervals and in relatively smaller masses into northern Idaho. Lack of adequate information led to somewhat arbitrary separation in which the unit that includes Payette formation is mostly west of 114° West longitude, and unit that includes Salt Lake formation is east of that meridian. This corresponds practically to current usage but some components of the two assemblages are nearly equivalent to each other. 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, Jour. Geology, v. 39, no. 3) desired to restrict the Payette to sedimentary rock that generally occurs interbedded with Columbia River basalt, commonly about 600 feet below top of the basalt unit—a suggestion that has much to commend it in areas in which he worked. He mapped the Payette on this basis in area in southwestern Idaho comprising T. 1 S., to T. 13 N., R. 5 W. to R. 1 E., inclusive, and the area within bend of Snake River northwest of Weiser. Evidence now available suggests that there is much local variation in stratigraphic positions of sedimentary rocks associated with Columbia River basalt and that in places it is still difficult to distinguish these from similar but younger rocks nearby. Uncertainty remains as to precise stratigraphic relation between strata of Payette age and those in northern Idaho that contain Latah flora. In general way, term Idaho formation is applied to those Cenozoic rocks in and near western part of Snake River Plain that have broad lithologic and genetic resemblances to Payette formation but are younger.

W. J. Mapel and W. J. Hail, Jr., 1959, U.S. Geol. Survey Bull. 1055–H, p. 221 (chart 1), 224–229. In Goose Creek district, rocks similar in many respects to Payette formation are herein designated Payette(?) formation. Thickness of Payette(?) in Cassia County, Idaho, 855 feet. Underlies Salt Lake formation.

Type section (Corcoran): Vicinity of Marsh post office, Boise County, Idaho. Named for exposures along Payette River in western Idaho.

Payne Sandstone[1]

Permian: Central Oklahoma.

Original reference: C. T. Kirk, 1904, Oklahoma Dept. Geology and Nat. History 3d Bienn. Rept., p. 9–11.

Named for Payne County.

Payne Branch Sandstone (in Hinton Formation[1] or Group)

Mississippian (Chesterian): Southeastern West Virginia.

Original reference: D. B. Reger, 1926, West Virginia Geol. Survey [Rept.] Mercer, Monroe, and Summers Counties, p. 296, 352.

J. M. Weller and others, 1948, Geol. Soc. America Bull., v. 59, no. 2, chart 5 (column 98). Shown on correlation chart as Payne Branch sandstone in Hinton group, Mauch Chunk series. Underlies Avis limestone; stratigraphically above Stony Gap sandstone.

Type locality: On north side of Payne Branch of Fivemile Creek, 0.8 mile southwest of Caperton School and 2.2 miles north of Hatcher, Mercer County.

Payne Branch 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, 353.

Type locality: On north side of Payne Branch of Fivemile Creek, 0.8 mile southwest of Caperton School and 2.2 miles north of Hatcher, Mercer County.

Paynes Shale and Sandstone Member (of Panoche Group)

Upper Cretaceous: Northern California.

I. F. Wilson, 1943, California Jour. Mines and Geology, v. 39, no. 2, p. 201–202, 226 (fig. 5), pl. 3. Consists largely of interbedded dark-colored clay-shales, greenish sandstones, and limestones. In Browns Valley area, a conglomeratic layer about 150 feet thick occurs in middle of section. Thickness at type locality 2,100 feet; 5,200 to 8,500 feet thick on southwest limb of Butts Ranch syncline. Basal member of group; underlies Call sandstone member (new); overlies Paskenta and Knoxville formation, undifferentiated.

Type locality: Along Paynes Creek, on northeast side of syncline, 2½ miles north of Butts Ranch, San Benito County.

Paynes Creek Basalt[1]

Pleistocene, late, or Recent: Northern California.

Original reference: H. Hamlin, 1921, Dept. Int., U.S. Reclamation Service in cooperation with State of California and Iron Canyon Project Association, App. 1, p. 47, 50, 58, pl. 2.

Probably named for Paynes Creek, Chico quadrangle.

**Paynes Hammock Sand**

Miocene: Alabama and Mississippi.

F. S. MacNeil, 1944, Am. Assoc. Petroleum Geologists Bull., v. 28, no. 9, p. 1346–1354. Name applied to unit termed Upper Chickasawhay member (Blanpied and others, 1934). At type locality, consists of about 13 feet of greenish sand containing one indurated limestone ledge; sand is faulted against Marianna limestone in small side fault to main Jackson fault. Overlies Chickasawhay limestone (Lower Chickasawhay member of Blanpied and others). Intertongues at west with nonfossiliferous beds referred to Catahoula sandstone. Basal Miocene.

Type locality: Along branch entering Tombigbee River at Paynes Hammock, Ala., in SW¼ sec. 16, T. 5 N., R. 2 E. Recognized as far west as Keys Mill, Smith County, Miss.

Payson Drift

Payson Substage

Pleistocene (Illinoian): Illinois.

M. M. Leighton and H. B. Willman, 1949, *in* Itinerary State Geologists Field Conf. on late Cenozoic Geology of Mississippi Valley, p. 9 (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), 136–137, geol. sections 46, 58, 59, 64, 66, 68. Till plain in area outside Jacksonville and Buffalo Hart moraines is referred to as Payson drift. It is surface drift of northwestern and west-central parts of Beardstown quadrangle and approximately western one-fourth of Vermont quadrangle. Generally less than 20 feet thick over Pleasanton Ridge; at least 140 feet thick in vicinity of Bader where it obliterates pre-Illinoian Valley of Sugar Creek; 110 feet thick in sec. 34, T. 6 N., R. 1 W., Vermont quadrangle where it obliterates a pre-Illinoian Valley. Derivation of name given.

Named for Payson, Pike County, which is on outermost Illinoian moraine.

Payton Ranch Limestone Member (of Gazelle Formation)

Upper Silurian: Northern California.

Michael Churkin, Jr., and R. L. Langenheim, Jr., 1960, Am. Jour. Sci., v. 258, no. 4, p. 259 (fig. 1), 260–266. Fairly continuous limestone layer, dissected by erosion and repeated by faulting; present in upper part of formation. Base of member thin-bedded and with thin interbeds of shale. Above basal part, limestone is poorly stratified, very thick bedded, fairly pure calcium carbonate; excepting local intraformational conglomerate and brecciated recrystallized areas along faults, limestone is finely crystalline or microcrystalline. Sparsely fossiliferous. Thickness at type locality 188 feet; other measured sections 85 to 134 feet. Over 600 feet of shales, sandstone, bedded chert, conglomerate, and scattered lenses of similar limestone occur below member; upper contact is everywhere either an erosional surface or a fault contact.

Type locality: On east side of high peak (elev. 4,320 feet) in NE¼SW¼ sec. 6, T. 42 N., R. 6 W., Yreka quadrangle, Siskiyou County.

**Peabody Granite**[1]

Late Paleozoic(?): Northeastern Massachusetts.

Original reference: C. H. Clapp, 1910, Igneous rocks of Essex County, Massachusetts.

U.S. Geological Survey has revived the term Peabody Granite on basis of a study now in progress.

In Peabody Township, Essex County.

†Peaceable Sand[1]

Pleistocene(?): Central Oklahoma.

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

C. C. Branson, Oklahoma Geology Notes, v. 17, no. 11, p. 102. Abandoned by Oklahoma Geological Survey. The name Gerty sand is contemporaneous and is the established name.

Named for exposures along Peaceable Creek, Pittsburg County.

†Peace Creek Beds[1]

Pliocene, lower: Southern Florida.

Original reference: W. H. Dall, 1891, Philadelphia Acad. Nat. Sci. Proc. 1891, p. 120.

Named for exposures on Peace Creek, De Soto County.

Peace Valley Beds

Pliocene, middle: Southern California.

J. C. Crowell, 1950, Am. Assoc. Petroleum Geologists Bull., v. 34, no. 8, p. 1625 (fig. 4), 1629 (fig. 5), 1631–1632. Name applied to about 4,000 feet of soft gray-green sand, siltstone, and shale intercalated with thin-bedded buff and white sandstone. Underlies Hungry Valley formation (new). Base of section not exposed. In northeastern part of area, Peace Valley beds abut against the quartz monzonite basement.

Occurs in Hungry Valley area which is in Transverse Ranges about 55 miles northwest of Los Angeles.

**Peach Bottom Slate**[1]

Ordovician(?): Southeastern Pennsylvania and western Maryland.

Original reference: J. P. Lesley and P. Frazer, Jr., 1880, Pennsylvania 2d Geol. Survey Rept. $C_3$, map of Lancaster County.

G. W. Stose and A. I. Jonas, 1939, Pennsylvania Geol. Survey, 4th ser., Bull. C–67, p. 96–103, 106. Removed from Glenarm series. Ordovician(?).

S. L. Agron, 1950, Geol. Soc. America Bull., v. 61, no. 11, p. 1265–1306. Detailed discussion of structure and petrology of Peach Bottom slate which lies in center of Peach Bottom syncline. Underlain by Cardiff conglomerate and Peters Creek schist.

Carlyle Gray and others, 1960, Geologic map of Pennsylvania (1:250,000): Pennsylvania Geol. Survey, 4th ser. Probably Lower Paleozoic.

Named for exposures at Peach Bottom, York County, Pa.

Peach Lake Diorite[1]

Age(?): Eastern New York.

Original reference: R. Balk, 1936, Geol. Soc. America Bull., v. 47, no. 5, pl. 1.

Dutchess County.

Peach Orchard Sandstone (in Pottsville Formation)[1]

Peach Orchard Sandstone (in Breathitt Formation)

Pennsylvanian: Northeastern Kentucky.

Original reference: L. C. Robinson, 1927, Kentucky Geol. Survey, ser. 6, v. 26, p. 239.

H. R. Wanless, 1939, Geol. Soc. America Spec. Paper 17, p. 93, 97, 106. Three sandstones in Breathitt formation: Lower Peach Orchard, Upper Peach Orchard, and Peach Orchard (sometimes called Upper Peach Orchard). All occur in Lawrence and Martin Counties.

First described in Morgan County. Type locality not stated. Peach Orchard is in Lawrence County.

Peach Springs 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, 99–101. In area of type locality, consists of thin-bedded gray limestone, some of which is aphanitic and some fine grained. Much mottled with brown siltstone. This locality apparently relatively near margin of limestone facies because in sections to north and west the rock is more aphanitic, medium to dark gray, much less mottled with brown siltstone, and thicker bedded. Thicknesss uniform in central Grand Canyon between Fossil Rapids and Toroweap; westward is slightly thicker; ranges from 42 to 90 feet. Older than Kanab Canyon member (new); younger than Spencer Canyon member (new).

Type locality: Approximately 8 miles south-southwest of mouth of Diamond Creek in Peach Springs Wash. Unit extends from vicinity of Fossil Rapids westward through the Grand Canyon.

†Peacock Formation (in Double Mountain Group)[1]

Permian: Central northern Texas.

Original reference: L. T. Patton, 1930, Texas Univ. Bull. 3027, p. 45.

U.S. Geological Survey has abandoned both the Peacock Formation and Double Mountain Group.

Named for exposures at town of Peacock, Stonewall County.

**Peale Formation**[1]

Mississippian : 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. Mapped with Mississippian marine-sedimentary and metasedimentary rocks and Paleozoic metavolcanic rocks. May include some Pennsylvanian rocks.

Well exposed on trail from Wards Creek to Peale diggings, Taylorsville region.

Peanut Peak Member (of Chadron Formation)

Oligocene, lower : Southwestern South Dakota.

John Clark, 1954, Carnegie Mus. Annals, v. 33, art 11, p. 197. Designated as upper member of formation. Overlies the Crazy Johnson member (new). Author previously described unit as "Upper Member" of Chadron.

Type locality : At standard section of Chadron formation in Big Badlands on south fork of Indian Creek, Pennington County, sec. 34, T. 3 S., R. 12 E. Named from prominent butte in southern part of sec. 10, T. 4 S., R. 12 E.

**Pearce Volcanics**

Miocene or Pliocene : Southeastern Arizona.

James Gilluly, 1956, U.S. Geol. Survey Prof. Paper 281, p. 9, 116–118, pl. 5. At west end of hill in north center sec. 1, T. 18 S., R. 25 E., hornblende andesite forms basal member and rests unconformably on Bisbee formation. Within a few hundred feet toward the east, however, andesite is overlapped by rhyolite which rests on Bisbee formation. In most other exposures of formation, rhyolites either overlie the andesites or are in fault contact with them. Andesitic parts of volcanics mostly normal flows, with subordinate flow breccias and a few thin water-laid andesitic tuffs. Flows are light pinkish gray to dark gray and weather to rather dark brown. Rhyolites include thick, massive flows, flow breccias, agglomerates, and tuffs, with fragmental rocks probably predominant. Flows range from light pinkish gray through pink to purplish and weather dark brown commonly glassy, with spherulites and lithophysae as much as 8 centimeters in diameter present in some of them. A few flows are lithic, and some are porphyritic black obsidian. In Sulphur Hills, 3,000 feet is probably minimum thickness for formation. Base exposed only in hills east and northeast of Township Butte. Upper limit of formation throughout map area is simply overlap of alluvium, and because the volcanic rocks have been highly deformed, it is impossible to estimate maximum orginal thickness.

Form a group of conspicuous isolated hills rising above alluvium of Sulphur Springs Valley in neighborhood of Pearce, from which name is derived. Six Mile, Pearce, and the Sulphur Hills, Township and Three Sisters Buttes, and Turkey Creek Ridge are all composed of these rocks. Central Cochise County.

Pearisburg Limestone[1]

Lower and Middle(?) Ordovician : Southwestern Virginia.

Original reference : R. S. Bassler, 1907, Mineral resources of Virginia by T. L. Watson, 137–138.

At Pearisburg, Giles County.

Pearl Shale (in Sumner Group)[1]

Pearl Shale Member (of Wellington Formation)

Permian : Eastern Kansas and southeastern Nebraska.

Original reference: J. W. Beede, 1909, Kansas Acad. Sci. Trans. v. 21, pt. 2, p. 255.

W. A. VerWiebe, 1937, Wichita Municipal Univ. Bull., v. 12, no. 5, p. 5. Included in Willington formation. Thickness 43 feet.

Named for exposures at Pearl, Dickinson County, Kans.

Pear Lake Quartz Monzonite

Jurassic-Cretaceous : Central California.

D. C. Ross, 1958, California Div. Mines Spec. Rept. 53, p. 13, pl. 1. Light-colored coarse-grained rock that contains prominent pink potash feldspar, as well as white calcic oligoclase, gray quartz, and minor amount of biotite. In some respects resembles Lodgepole granite (new). Relation to other named plutonic rocks of area not determined.

Well exposed around Pear Lake in eastern part of area, Sequoia National Park.

**Pearlette Ash Member** (of Sappa Formation)

Pearlette Ash[1] Member (of Crooked Creek Formation and Meade Formation)

Pleistocene: Southwestern Kansas, Nebraska, Oklahoma, southeastern South Dakota to northwestern Texas.

Original reference: F. W. Cragin, 1896, Colorado Coll. Studies, v. 6, p. 53, 54.

J. C. Frye and C. W. Hibbard, 1941, Kansas Geol. Survey Bull. 38, pt. 13, p. 411. Cragin's Pearlette ash included in Meade formation (redefined).

C. W. Hibbard, 1944, Geol. Soc. America Bull., v. 55, no. 6, p. 742. Referred to as member of Meade formation.

G. E. Condra, E. C. Reed, and E. D. Gordon, 1947, Nebraska Geol. Survey Bull. 15, p. 22, 23, Pearlette ash has wide occurrence in Nebraska, Kansas, South Dakota, Iowa, and is perhaps best horizon marker in the Pleistocene. In Kansas, occurs between Upland and Crete (new) formations. Iowa places the volcanic ash exposed northeast of Little Sioux, Harrison County, in Loveland formation.

J. C. Frye, Ada Swineford, and A. B. Leonard, 1948, Jour. Geology, v. 56, no. 6, p. 501–523. Ash lentils, collectively called Pearlette, can be differentiated petrographically from other late Cenozoic ash deposits of Plains region and have been studed at localities extending from southeastern South Dakota to northwestern Texas. Associated molluscan fauna possesses a great degree of uniformity and stratigraphic significance. Pearlette ash and faunal zone occurs above Kansas till and below Loveland loess and Iowa till in Missouri Valley region and is judged to be early Yarmouthian in age.

C. W. Hibbard, 1949, Michigan Univ. Mus. Paleontology Contr., v. 7, no. 4, p. 69 (fig. 1), 71. Reallocated to member status in Crooked Creek formation (new). Thickness about 7 feet.

G. E. Condra, E. C. Reed, and E. D. Gordon, 1950, Nebraska Geol. Survey Bull. 15–A, p. 22–24. Pearlette ash, thickness 15 feet, occurs in Sappa formation.

R. C. Moore and others, 1951, Kansas Geol. Survey Bull. 89, p. 14–15. Bed in Sappa member of Meade formation.

J. C. Frye and A. B. Leonard, 1957, Texas Univ. Bur. Econ. Geology Rept. Inv. 32, p. 8 (fig. 2), 22. Included in Tule formation in western Texas.

C. W. Hibbard, 1958, Am. Jour. Sci, v. 256, no. 1, p. 55 (fig. 1), 58. Lentil in Atwater member (new) of Crooked Creek formation.

Named for old post office of Pearlette, Meade County, Kans.

Pearl Harbor Series[1]

*See* Pearl River Series.

Pearl River Series[1]

Pleistocene and Recent: Oahu Island, Hawaii.

Original reference: C. H. Hitchcock, 1900, Geol. Soc. America Bull., v. 11, p. 31–34.

G. A. Macdonald and D. A. Davis *in* Jacques Avias and others, 1956, Lexique Strat. Internat., v. 6, Océanie, fasc. 2, p 125–126. Series of stratified rocks, about 1,000 feet thick, consisting of interbedded coral limestone, lagoon marl, poorly sorted terrigenous clays, silts, sands, and conglomerates, and beds of tuff. Locally interbedded with flows of Honolulu volcanic series. Overlies lavas of Koolau and Waianae volcanic series. Same as Pearl Harbor series (Hitchcock, 1912). Neither name (Pearl River series or Pearl Harbor series) now used.

Named after Pearl River, which drains into Pearl Harbor on south side of island.

**Pearsall Formation** (in Trinity Group)

Lower Cretaceous (Comanche Series): Southern Texas (subsurface).

R. W. Imlay, 1944, U.S. Geol. Survey Oil and Gas Inv. Prelim. Chart 3; 1945, Am. Assoc. Petroleum Geologists Bull., v. 29, no. 10, p. 1441–1449. Defined for a sequence of dominantly shaly beds lying above the Sligo formation and below the Glen Rose limestone and representing the subsurface equivalents of the Travis Peak formation of the outcrop area. Type section extends from depths of about 8,835 to 9,360 feet, is 525 feet thick, and divisible into three members (ascending): Pine Island shale, 100 feet thick; Cow Creek limestone, 85 feet thick; and Hensell shale, 340 feet thick.

J. M. Forgotson, Jr., 1957, Am. Assoc. Petroleum Geologists Bull., v. 41, no. 10, p. 2340–2350. In this study, defined as a sequence of dominantly shaly beds stratigraphically above the Sligo formation and below the base of either the Glen Rose limestone or the Rodessa formation. Divisible into three members (ascending): Pine Island, Cow Creek or James limestone, Bexar shale. Undifferentiated where neither the James nor the Cow Creek member is recognized.

Type well: Amerada Petroleum Corp.'s Halff and Oppenheimer No. 8, in Pearsall field about 10 miles southwest of Pearsall, Frio County.

Pearson Glauconite Member (of Sabinetown Formation)

Eocene, lower (Wilcox): Western Louisiana and northeastern Texas.

Richard Wasem and L. J. Wilbert, Jr., 1943, Jour. Paleontology, v. 17, no. 2, p. 182 (footnote). Term Pierson glauconite was first used in field notes of Justin Rukas as a name for glauconite sands (first marine sand of

Sabinetown faunal unit) cropping out near railway station of Pierson, north of Natchitoches, La. Name is applied in this paper to westward extension of bed into Sabine County, Tex.

G. E. Murray, Jr., and E. P. Thomas, 1945, Am. Assoc. Petroleum Geologists Bull., v. 29, no. 1, p. 63. Rank raised to member status in Sabinetown formation (restricted). Typically a fine-grained greensand or glauconitic sand which commonly contains considerable concretionary ironstone; fossiliferous. Thickness 32 feet. Reaches maximum development in Sabinetown area, thinning both northeastward and northwestward along strike. Underlies an upper unnamed member of the Sabinetown; overlies High Bluff member of Pendleton formation; in most exposures both upper and lower contacts are conformable and gradational.

First described from occurrence in Natchitoches Parish, La.

Pearsonia Limestone Member (of Pawhuska Formation)

Pennsylvanian (Virgil Series): Northeastern Oklahoma.

M. C. Oakes, 1959, Oklahoma Geol. Survey Bull. 81, p. 49. Name applied to member of Pawhusk. Overlies Little Hominy member; underlies Turkey Run member. Name credited to J. A. Carter (unpub. thesis) who applied name to "red" limestone of Heald (1918, U.S. Geol. Survey Bull. 691–C).

Type locality and derivation of name not stated. Map shows town of Pearsonia in northern Osage County. The limestone extends only to sec. 28, T. 26 N., R. 8 E., Osage County.

**Pease River Group**

Permian (Leonard Series): Western Texas.

H. C. Fountain, 1939, *in* Am. Assoc. Petroleum Geologists Bull., v. 23, no. 5, p. 764. Name applied to the series of stratigraphic units from base of San Angelo up to base of Custer group. In tracing group northward to Mangum, Okla., it was demonstrated that it contained a part if not all of the Duncan sandstone, all of the Flowerport shale, Blaine, and Dog Creek shale up to base of Marlow or Custer group in Oklahoma and Kansas. Type exposure given.

Robert Roth, 1942, Am. Assoc. Petroleum Geologists Bull., v. 26, no. 8, p. 1412, 1413. Rocks of Leonard age that overlie the Clear Fork group have been designated varyingly as San Andres group, El Reno group, Pease River group, and "Blaine of Texas". Pease River is adopted here because its upper and lower limits are easily recognized over much of east side of Permian basin. Includes beds from base of San Angelo sandstone up to base of Custer group which is 10 to 30 feet below base of Childress limestone. Average thickness 870 feet. Disconformable at base and regional unconformity at top.

Robert Roth, 1945, Geol. Soc. America Bull., v. 56, no. 10, p. 893–907. Includes San Angelo, Flowerpot, Blaine, and Dog Creek formations as exposed in Texas. Correlation with Cherry Canyon formation (Guadalupe series) suggested. Thickness 874 feet at type locality which is herein stated.

Type exposure (Fountain): Along Pease River in Hardeman and Cottle Counties.

Type locality: South Fork of Wichita River and Little Croton Creek in King and Knox Counties, about 40 miles south of Pease River.

**Peasley Member** (of Highland Peak Formation)

Peasley Limestone

Middle Cambrian: Southeastern Nevada and western Utah.

H. E. Wheeler, 1940, Nevada Univ. Bull., Geology and Mining Ser., no. 34, p. 12 (fig. 2), 14, 17–27. Chiefly dark-gray (carbonaceous) medium-grained thickly bedded to massive limestone commonly with numerous calcite veinlets in areas of appreciable deformation; topmost strata variable in character in consequence of differential erosion during post-Peasley hiatus. Thickness at type section about 120 feet; in Ely Range 150 feet. Unconformably overlies Chisholm shale; unconformably underlies Burrows dolomite (new). This is unit "A" of Highland Peak limestone as described by Wheeler and Lemmon (1939); Burrows dolomite is unit "B" and Highland Peak is herein restricted to exclude these units.

H. E. Wheeler, 1948, Nevada Univ. Bull., Geology and Mining Ser., no. 47, p. 33–35, fig. 5. Recognized from Groom, Nev., to Wah Wah Range, western Utah. Chisholm shale thins out and disappears between Wah Wah and House Ranges, thus bringing similar Lyndon and Peasley limestone into contact. In House Range, their combined counterpart is herein named Millard limestone.

A. H. McNair, 1951, Am. Assoc. Petroleum Geologists Bull., v. 35, no. 3, p. 508. Thickness of Peasley given as 791 feet in section measured in Virgin Mountain, Clark County, Nev.; overlies Chisholm shale; underlies unnamed dolomitic limestone (Middle and Upper? Cambrian).

M. S. Johnson and D. E. Hibbard, 1957, U.S. Geol. Survey Bull. 1021–K, p. 339, 340. Name Jangle limestone (new) substituted for Peasley limestone of Wheeler (1940) in Pioche and Groom districts.

R. A. Robison, 1960, Intermountain Assoc. Petroleum Geologists Guidebook 11th Ann. Field Conf., p. 50 (fig. 4). Chisholm formation, as redefined in Wah Wah Range, includes Peasley limestone as used in that area by Wheeler (1948).

U.S. Geological Survey currently classifies the Peasley as a member of Highland Peak Limestone on basis of a study now in progress.

Type locality: On northwest spur of Comet Peak, on west side of Highland Range, Pioche district, Nevada. Spur forms secondary divide immediately south of Peasley Canyon.

**Peavy Pond Complex**

Peavy Complex

Precambrian: Northwestern Michigan.

R. W. Bayley, 1956, Dissert. Abs., v. 16, no. 8, p. 1427. Composed of gabbro with minor ultrabasic parts and fringed with intermediate and acid differentiates and hybrids. Intruded Hemlock and Michigamme formations during late middle Precambrian orogeny and metamorphism.

R. W. Bayley, 1959, U.S. Geol. Survey Bull. 1077, p. 10, 75–80, 82–92, pl. 1. Peavy Pond complex as designated here includes all intrusive rocks exposed on shores and islands of Peavy Pond. Cuts Hemlock and Michigamme formations in south part of Lake Mary quadrangle.

On shores and islands of Peavy Pond in secs. 14–17, 19–22, and 27–30, T. 42 N., R. 31 W., Iron County.

**Peay Sandstone Member** (of Frontier Formation)[1]

Upper Cretaceous: Southern Montana and northern Wyoming.

Original reference: F. F. Hintze, Jr., 1915, Wyoming Geol. Survey Bull. 10, p. 21.

J. H. Heathman, 1939, Wyoming Geol. Survey Bull. 28, p. 7 (table 2), 13. On south and east sides of Bighorn Basin, consists of concretionary sandstone about 87½ feet thick in lower part of formation.

Named for Peay Hills, Big Horn County, Wyo.

**Pecan Gap Chalk Member** (of Taylor Marl)[1]

Pecan Gap Chalk (in Taylor Group)

Upper Cretaceous: Northeastern Texas.

Original reference: L. W. Stephenson, 1918, U.S. Geol. Survey Prof. Paper 120–H, p. 156.

H. B. Stenzel, 1938, Texas Univ. Bur. Econ. Geology Pub. 3818, p. 38, 39 (fig. 4), 42–43 [1939]. Rank raised to formation in Taylor group. Bluish-white hard massive; partly sandy chalk and bluish-gray soft pliable sandy and chalky marl. Average thickness in Leon County wells 150 feet. Lies above Wolfe City sand and below unit referred to as upper Taylor marl.

J. T. Rouse, 1944, Am. Assoc. Petroleum Geologists Bull., v. 28, no. 4, p. 525–527. Detailed surface mapping in belt of outcrop from Collin County eastward into Red River County, shows that Pecan Gap chalk thins and disappears north and east and that Wolfe City sand, which underlies Pecan Gap, is to be correlated with Annona chalk (previously correlated with Pecan Gap).

H. R. Blank, N. L. Stoltenberg, and H. H. Emmerich, 1952, Texas Univ. Bur. Econ. Geology Rept. Inv. 12, p. 5, 10 (table 1), 12–15. Member described in Blacklands experimental watershed, near Waco. Consists of lower chalk, 8 to 25 feet; lower highly calcareous marl, 90 to 100 feet; upper chalk, about 13 feet; and upper highly calcareous marl (not known how much of this should be included in member). Overlies Wolfe City member with unconformity; underlies upland gravel (Ulvade formation).

D. L. Frizzell, 1954, Texas Univ. Bur. Econ. Geology Rept. Inv. 22, p. 45–46, table 4. Pecan Gap chalk (Taylor group) has been considered tongue of Annona chalk, with lower marl and Wolfe City sand being lateral equivalents of lower part of Annona chalk (the interpretation accepted here). Alternative hypothesis has been presented: that the chalk is transgressive formation, younger than the marl and sand units. Foraminifera described.

Typically exposed in cut of Gulf, Colorado, and Santa Fe Railway, one-half mile east of Pecan Gap, Delta County, Tex.

**Pecatonica Dolomite Member**[1] (of Platteville Formation)

Pecatonica Formation (in Platteville Group)

Middle Ordovician: Southern Wisconsin, northwestern Illinois, northeastern Iowa, and southeastern Minnesota.

Orginal reference: O. H. Hersey, 1894, Am. Geologist, v. 14, p. 175.

C. A. Bays, 1938, (abs.) Geol. Soc. America Proc. 1937, p. 269. Underlies Miffin limestone member (new) of Platteville formation.

J. S. Templeton and H. B. Willman, 1952, Tri-State Geol. Soc. Guidebook 16th Ann. Field Conf., p. 6, 11 (fig. 3). In Dixon-Oregon area, Illinois, considered a formation in Platteville group. Consists of about 30 feet of dolomite and limestone, relatively pure, locally cherty, finely crystalline, and thick bedded; slightly argillaceous and has weak shale films in middle. Subdivided into (ascending) Hennepin, Chana, Dane, New Glarus, Medusa, and Oglesby members (all new). Underlies Mifflin formation; overlies Harmony Hill formation (new) in Ancell group (new).

A. F. Agnew and others, 1956, U.S. Geol. Survey Prof. Paper 274–K, p. 275, 277–279. At designated type outcrop, Pecatonica dolomite member is 20 feet thick. Overlies Glenwood shale member; underlies McGregor limestone member.

M. P. Weiss, 1957, Geol. Soc. America Bull., v. 68, no. 8, p. 1030–1031. Pecatonica member ranges in thickness from about 7 feet east of Mabel, Minn. to featheredge about 20 miles northwest; thickens as it continues into Iowa, Wisconsin, and Illinois; about 1 foot thick at Minneapolis.

Type locality: Bluff along Pecatonica River at Lattice Bridges, NW¼NW¼ sec. 21, T. 1 N., R. 6 E., Green County, Wis.

Pecatonica glaciation

Pecatonica till[1]

Pleistocene (pre-Wisconsin): Illinois.

Original reference: C. R. Keyes, 1932, Pan-Am. Geologist, v. 58, p. 203, 217.

C. R. Keyes, 1938, Pan-Am. Geologist, v. 69, no. 2, p. 129. Referred to as glaciation.

Peckham Formation

Pleistocene, upper: Central California.

C. J. Leith, 1949, California Div. Mines. Bull. 147, p. 12 (fig. 2), 26–27, pls. 1, 2. Name proposed for nonmarine silts, sands, gravels, and limestone occurring near center of Quien Sabe quadrangle. Maximum thickness 300 feet. Formation flat lying and rests with as much as 90° angular discordance upon the Franciscan and as much as 25° upon Miocene [Quien Sabe] volcanics.

Name derived from Peckham Ridge, an eastward trending spur of Diablo Range which marks northern limit of exposures, Quien Sabe quadrangle, about 90 miles southeast of San Francisco.

Pecksport Member[1] of Marcellus Formation)

Middle Devonian: Central New York.

Original reference: G. A. Cooper, 1930, Am. Jour. Sci., 5th, v. 19, p. 134, 219.

G. A. Cooper and others, 1942, Geol. Soc. America Bull., v. 53, no. 12, pt. 1, chart 4. Shown on correlation chart above Solsville member and below Mottville member.

Type section: Livermore Gully, 1 mile east of railroad switch at Pecksport, Madison County.

†Pecos 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 exposures east of Pecos River, Roswell artesian basin.

Pecos shale[1]

Permian (?) : New Mexico.

Original reference: C. R. Keyes, 1909, Iowa Acad. Sci. Proc., v. 16, p. 159–163.

Rio Grande Valley.

Pecosan series[1]

Pecosian series[1]

Tertiary, upper : Eastern New Mexico and western Texas.

Original reference: C. R. Keyes, 1907, Iowa Acad. Sci. Proc., v. 14, p. 223–228.

Llano Estacado region.

Pecos Canyon Sandstone[1]

Permian : Northeastern New Mexico.

Original reference: J. K. Knox, 1920, Am. Assoc. Petroleum Geologists Bull., v. 4, p. 99–101.

In Santa Rosa-Tucumcari region.

†Pecos Valley Red Beds[1]

Permian and Triassic : Southeastern New Mexico.

Original reference : J. W. Beede, 1910, Am. Jour. Sci., 4th, v. 30, p. 131.

Crop out along foot of eastern flank of Sacramento Mountains and underlie alluvium in lower Pecos Valley. Well developed in walls of Rocky Arroyo, 20 miles west of Carlsbad, Eddy County.

Peculiar Shale (in Puente Formation)

Miocene, upper : Southern California.

M. L. Krueger, 1943, California Div. Mines Bull. 118, p. 363. Shown on structure section as underlying Mahala sandstone and conglomerate (new) and overlying Hunter sandstone and conglomerate (new).

A. O. Woodford, T. G. Moran, and J. S. Shelton, 1946, Am. Assoc. Petroleum Geologists Bull., v. 30, no. 4, p. 521. Micaceous sandy shale with poor stratification. Thickness 657 feet. Upper part of Puente. Measured section noted.

Exposed in Slaughter Canyon in southeastern Puente Hills, between Chino and Santa Ana River, San Bernardino County.

Pecursian series[1]

Picursian 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, 10.

**Pedee Group**[1]

Peedee Group[1]

Pennsylvanian (Missouri Series) : Northwestern Missouri and eastern Kansas.

Original reference: R. C. Moore, 1932, Kansas Geol. Soc. 6th Ann. Field Conf., Guidebook, p. 93, 97.

H. S. McQueen and F. C. Greene, 1938, Missouri Geol. Survey and Water Resources, v. 25, 2d ser., p. 28. Pedee recognized in northwestern Missouri where it includes Weston shale and Iatan limestone members.

L. W. Wood, 1941, Iowa Geol. Survey, v. 37, p. 295. Term Pedee dropped from Iowa nomenclature. Weston shale and Iatan limestone included in Lansing group. Later work may warrant reestablishment of Pedee as independent group.

R. C. Moore and others, 1951, Kansas Geol. Survey Bull. 89, p. 78. Pedee is topmost division of Missourian rocks; includes Weston shale below and Iatan limestone above and possibly a few feet of sandy and clayey shale above the Iatan. Occurs between Stanton limestone of Lansing group and disconformity that defines top of Missourian series. Average thickness 90 feet.

Named from stream near Weston, Platte County, Mo., opposite Leavenworth, Kans., on Missouri River.

Pedernal Chert Member (of Abiquiu Tuff)

Miocene(?): North-central New Mexico.

F. S. Church and J. T. Hack, 1939, Jour. Geology, v. 47, no. 6, p. 618, 620, 622. Thin veneer of remarkably pure chert that overlies the broad plateaulike surface which forms summit of San Pedro Mountain in many places. It passes laterally, without losing continuity, into poorly consolidated conglomerate, sandstone, shale, and tuff, which, in Cerro Pedernal, are obviously part of Abiquiu tuff.

Mapped on San Pedro Mountain, and its horizon followed eastward into the high mesas of northern part of Jemez Mountains. Named after Cerro Pedernal, a mountain whose Spanish mame means "flint" It [the mountain] presumably was so named from outcrops of chert long quarried by the Indians.

†Pedernales Dolomite Member (of Wilberns Formation)

Upper Cambrian: Central Texas.

Frederick Romberg and V. E. Barnes, 1944, Geophysics, v. 9, no. 1, p. 88, fig. 7. Gray to pinkish gray dolomite. Overlies San Saba member; underlies unnamed dolomite at base of Ellenburger formation. Name credited to Josiah Bridge and V. E. Barnes.

P. E. Cloud, Jr., V. E. Barnes, and Josiah Bridge, 1946, Texas Univ. Bur. Econ. Geology Pub. 4301, p. 148, 150, 155–156, pl. 4 [1945]. Uppermost member of formation; lies between San Saba limestone member below and Tanyard formation of Ellenburger group above. Grades downward and laterally into San Saba, an essentially equivalent facies if considered in regional sense. In type area, lower 86 feet is fine grained and evenly bedded, contrasting sharply with overlying massive coarse-grained part; coarse-grained dolomites are predominantly light gray and silvery gray with occasional intervals of yellowish gray or nutria; fine-grained dolomite is yellowish gray to beige; entire section speckled to mottled with dull dark reddish purple in varying degrees; glauconite, common elsewhere, is present only in basal few feet of member; some chert present, mostly near top of fine-grained part. Thickness in type area 187 feet; in Cherokee area 70 to 150 feet. Dolomites here named Pedernales were formerly included in Ellenburger limestone. Type section designated.

Josiah Bridge, V. E. Barnes, and P. E. Cloud, Jr., 1947, Geol. Soc. America Bull., v. 58, no. 1, p. 121–123, pls. 1, 2. Dolomite facies of upper part of Wilberns developed mostly in eastern part of Llano uplift. Commonly replaces and is equivalent to variable part of San Saba limestone member, which is characteristic of upper Wilberns in western part of uplift. In western Blanco County, replaces entire San Saba and includes beds equivalent to most of Point Peak shale member as well. Base extends lower in section in type area than at other places in uplift, but thicker sections have been measured elsewhere; this variation in thickness probably due to pre-Ordovician truncation of upper beds of Pedernales in vicinity of type section. Thickness on Backbone Ridge, Burnet County, 224 feet; at the Tanyard, Burnet County, 277 feet. Pedernales is that part of former Ellenburger limestone which Dake and Bridge (1932, Geol. Soc. America Bull., v. 43) called the Potosi and Eminence equivalents, and its removal from revised Ellenburger group and inclusion in Wilberns formation necessitated redefinition of Ordovician and Cambrian beds above and below systemic boundary (Cloud, Barnes, and Bridge, 1946 [1945]).

V. E. Barnes and W. C. Bell, 1954, San Angelo Geol. Soc. [Guidebook] March 19–20, p. 35, 36. Name Pedernales dolomite dropped.

Type section: Along Pedernales River from 1½ to 3 miles up stream from bridge on Johnson City-Marble Falls Highway 1 mile north of Johnson City, Blanco County.

Pedlar Formation (in Virginia Blue Ridge Complex)

Precambrian: Central Virginia.

R. O. Bloomer and H. J. Werner, 1955, Geol. Soc. America Bull., v. 66, no. 5, p. 582, pl. 1. Assemblage of granitic, granodioritic, syenitic, quartz dioritic, anorthositic, and unakitic rocks undifferentiable in the field. A green, white, or red coarse-grained granulose rock. Unconformably overlapped by sequence of Late Precambrian and Early Cambrian formations.

W. R. Brown, 1958, Virginia Div. Mineral Resources Bull. 74, p. 8 (fig. 2), 9–11, pl. 1. Included in Virginia Blue Ridge complex (new). Prevailing facies in Lynchburg area is gray to gray-green massive medium- to coarse-grained hypersthene or hornblende quartz monzonite. Typical exposures cited.

Typical exposures found along upper reaches of Pedlar River of northwestern Amherst County. Named from the river. Forms most of the basement complex of the Blue Ridge northeast of Roanoke and many masses surrounded by the Marshall and Lovingston formations in the Piedmont.

Pedregosa Member (of Lowell Formation)

Lower Cretaceous: Southeastern Arizona.

A. A. Stoyanow, 1949, Geol. Soc. America Mem. 38, p. 8–9, 17–18, pl. 27. Consists of (ascending) buff sandstone, white platy sandstone, gray and buff limestone, calcareous sandstone, white and yellow shale, greenish sandstone, and thin layers of argillaceous limestone, sandstone, and shale. Thickness 182 feet. Overlies Perilla member (new); underlies Mural limestone.

In standard section of Lowell formation in the Ninety One Hills. Type locality of formation also designated at 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.

**Pedro Bentonite Bed** (in Gammon Ferruginous 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. 106. Present at base of member in vicinity of Osage, Weston County, Wyo. Thickness 30 feet in Weston County. Thins laterally and a few miles north is less than 1 foot thick or is absent.

Named for exposures near Pedro, sec. 5, T. 45 N., R. 63 W., Weston County, Wyo.

Pedroian[1]

Pleistocene, lower: California.

Original reference: J. E. Eaton, 1928, Am. Assoc. Petroleum Geologists Bull., v. 12, p. 138.

**Pedro Miguel Agglomerate**

Pedro Miguel Agglomerate Member (of Panama Formation)

Miocene, lower: Panama.

[T. F. Thompson], 1943, Panama Canal, Spec. Eng. Div., 3d Locks Proj., pt. 2, chap. 3, p. 17–18. Pedro Miguel agglomerate proposed for extensive occurrence of this rock type in vicinity of Pedro Miguel Lock and its approach channels. In this area, associated with Cucaracha formation; in La Boca region, occurs near base of La Boca sediments (new) which are considered to be slightly younger than the Cucaracha.

W. P. Woodring and T. F. Thompson, 1949, Am. Assoc. Petroleum Geologists Bull., v. 33, no. 2, p. 242, 246 (fig. 2). Lens of pyroclastics formerly referred to Las Cascadas agglomerate. In type region, pyroclastics overlie Cucaracha formation, but lower part apparently equivalent to upper part of Cucaracha sections. Farther south, pyroclastics occur as tongue in basal part of La Boca formation. Thickness varies; maximum averages about 300 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 Panama formation.

Type region: Pedro Miguel area. Recognized along and near Panama Canal from Pedro Miguel area to Pacific terminus.

Peebles Dolomite[1]

Silurian (Niagaran): Southwestern Ohio.

Original reference: A. F. Foerste, 1929, Ohio Jour. Sci., v. 29, no. 4, p. 168–169.

C. K. Swartz and others, 1942, Geol. Soc. America Bull., v. 53, no. 4, chart 3. Shown on correlation chart below Greenfield dolomite and above Cedarville dolomite of Durbin group.

Type section: Between Peebles, Adams County, and base of Greenfield dolomite, several miles east.

Peebles granite facies (of Ogishke 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), 1034–1035. One of three facies in Ogishke conglomerate. Contains a wide assortment of pebbles in which 36 rock types have been recognized. Thickness 2,100 feet. Underlies West Gull facies; unconformably above Dike Lake slate.

Described in Kekequabic-Ogishkemuncie area.

**Peedee Formation**[1]

Upper Cretaceous: Eastern South Carolina and eastern North Carolina.

Original reference: E. Ruffin, 1843, Agric. Survey South Carolina, 1st Rept., p. 6–7, 24–27.

J. L. Stuckey and S. G. Conrad, 1958, North Carolina Div. Mineral Resources Bull. 71, p. 44; J. L. Stuckey, 1958, Geologic map of North Carolina (1:500,000): North Carolina Div. Mineral Resources. Mapped in North Carolina where it crops out in a belt extending from Tar River at Greenville, Pitt County, southwest to South Carolina line. Near Greenville, only 3 or 4 miles wide, but to the southwest reaches maximum width of more than 25 miles. Variable gray to green argillaceous sands and impure limestones; locally, massive marine clays and interbedded sands. [Spelled Pee Dee.]

Named for exposures on Great Peedee River, S.C., the exposure at Burches Ferry, on west side of Peedee River in Florence County, being a typical one.

†Peedee Marl[1]

Miocene, upper: Northeastern South Carolina.

Original reference: E. Ruffin, 1843, Agric. Surv. South Carolina 1st Rept., p. 28.

Named for exposures in Peedee River region from Darlington to Allisons Ferry, Darlington and Florence Counties.

†Peedee River Marls[1]

Upper Cretaceous: Eastern South Carolina.

Original reference: F. S. Holmes, 1870, Phosphate rocks of South Carolina, p. 12, 13.

Peekskill Diorite Gneiss[1]

Precambrian: Southeastern New York.

Original reference: C. P. Berkey and Marion Rice, 1921, New York State Mus. Bull. 225–226, p. 28.

Type locality: Along Peekskill Creek, Westchester County.

Peekskill Granite[1]

Precambrian: Southeastern New York.

Original reference: C. P. Berkey, 1907, New York State Mus. Bull. 107, p. 377.

D. T. O'Connell, 1937, Geological excursions in New York City and vicinity Trip II: New York City Coll. Dept. Geology, p. 23. Considered to be acid differentiate of Cortlandt series.

Type locality: About 3 miles east-northeast of Peekskill, Westchester County.

Peekskill Norite[1]

Age(?): Eastern New York.

Original reference: R. Balk, 1936, Geol. Soc. America Bull., v. 47, no. 5, pl. 1.

Dutchess County.

Peekskill Phyllite[1]

Ordovician: Southeastern New York.

Original reference: C. R. Fettke, 1914, New York Acad. Sci. Annals, v. 23, p. 245–257.

Well exposed on northwest side of Peekskill Creek valley, Peekskill region.

Peekskill Creek Limestone[1]

Lower Cambrian to Middle Ordovician: New York.

Original reference: C. R. Fettke, 1914, New York Acad. Sci. Annals, v. 23, p. 201.

Peekskill Creek region.

Pe Ell Volcanics 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. Overlies Stillwater Creek member and underlies Olequa Creek member (both new).

D. A. Henriksen, 1956, Washington Div. Mines and Geology Bull. 43, p. 38, 46–48, pl. 1. Series of lapilli tuffs, agglomerates, breccia, and thin interbedded tuffaceous siltstones intercalated with lower part of Stillwater Creek member. Attains maximum thickness of 1,200 to 1,500 feet at type locality; thins eastward wedging out at surface about 4 miles southeast of Pe Ell.

Type locality: In banks of Chehalis River in sec. 4, T. 12 N., R. 5 W., and secs. 33 and 34, T. 13 N., R. 5 W., W. M., Lewis County.

**Peerless Formation**

Peerless Shale Member (of Sawatch Formation)[1]

Upper Cambrian: Central Colorado.

Original reference: C. H. Behre, Jr., 1932, Colorado Sci. Soc. Proc., v. 13, no. 3, p. 58.

Q. D. Singewald, 1947, Preliminary geologic map and section of the upper Blue River area, Summit County, Colorado (1:31,250): U.S. Geol. Survey; 1951, U.S. Geol. Survey Bull. 970, p. 9 (table). Rank raised to formation. In Summit County, consists of two parts. Lower, equivalent to "Transition shale" at Leadville; basal quartzite is purple to nearly black, faintly crossbedded, and 2 to 10 feet thick; middle part, 10 to 12 feet thick, is brownish weathering dolomite in beds 3 inches to 3 feet thick; upper 10 to 20 feet is green platy shale with intercalated thin dolomites, highest of which contain red casts. Upper part equivalent to basal "White limestone" at Leadville; thin-bedded drab-weathering to brownish-weathering dolomite; uppermost beds slightly shaly and locally contain partings of thin layers of green shale. Thickness about 60 feet on North Star Mountain (composite section); 85 feet south side Spruce Creek. Underlies Manitou limestone, upper boundary indefinite; overlies Sawatch quartzite, hiatus.

Ogden Tweto, 1949, Colorado Sci. Soc. Proc., v. 15, no. 4, p. 152 (table 1), 161–165. Formation described in Pando area where it is 35 to 112 feet thick and consists of thin-bedded, buff, green, purple, and pink sandy dolomite and dolomitic sandstone. Conformably overlies Sawatch quartzite; unconformably underlies Harding quartzite.

I. H. Mackay, 1953, Colorado School Mines Quart., v. 48, no. 4, p. 8, 13–14, 15, 16, pls. Peerless member described in Thomasville-Woods area, Eagle and Pitkin Counties. Term "shale" is misnomer because unit here consists chiefly of thin-bedded gray to buff fine- to coarse-crystalline dolomites with numerous partings and stringers of arenaceous material, sandstones, and some shale. Thickness 50 to 102 feet. Basal part of formation. Upper part of formation; underlies Manitou dolomite.

R. R. Berg and R. J. Ross, Jr., 1959, Jour. Paleontology, v. 33, no. 1, p. 106–108. On basis of lithology and stratigraphic position, unit termed Ute Pass dolomite (Maher, 1950) in Missouri Gulch area is correlated with Peerless formation, and term Ute Pass is abandoned.

Typical occurrence on northwestern slope of Peerless Mountain, 6 miles east-southeast of Leadville.

Peerless Sandstones (in Kanawha Formation[1] or Group)

Pennsylvanian: Southern West Virginia.

Original reference: C. E. Krebs and D. D. Teets, Jr., 1914, West Virginia Geol. Survey Rept. Kanawha County, p. 281, 282.

H. R. Wanless, 1939, Geol. Soc. America Spec. Paper 17, p. 98. Considers the Kanawha a group.

Named for its association with the Peerless coal which was named for a mining village (now abandoned) on south side of Kanawha River just east of Lewiston, Kanawha County.

**Peers Spring Formation[1]**

Peers Spring Formation (in White Pine Group)

Peers Spring Formation (in White Pine Shale)

Lower Mississippian: Eastern Nevada.

Original reference: L. G. Westgate and A. Knopf, 1932, U.S. Geol. Survey Prof. Paper 171, p. 7, 20, map.

J. M. Weller and others, 1948, Geol. Soc. America Bull., v. 59, no. 2, chart 5 (column 25). Shown in Osagean series on correlation chart.

R. L. Langenheim, Jr., and J. H. Peck, Jr., 1957, (abs.) Geol. Soc. America Bull., v. 68, no. 12, pt. 2, p. 1833; 1959, Cahiers Géol., no. 56, p. 537–548. At Dutch John Mountain, formation consists of basal calcareous siltstone unit (about 140 feet thick), middle black fissile shale unit (about 420 feet thick) which includes ledge-forming limestone, and an upper poorly exposed silty shale unit (about 460 feet thick). These units, except the limestone, are present at Peers Spring, but faulting prevents satisfactory mesurement. Middle unit of the Peers Spring resembles the bulk of Chainman shale at Ely, Nev., but all three units together are lithologically similar to White Pine shale at Hamilton, Nev. Single specimen of *Cravenoceras hesperium* and single specimen of *Rayonnoceras* were collected from lower Peers Spring unit at Dutch John Mountain. *C. hesperium* fauna, including *Brachycycloceras*, present in rocks of presumed similar stratigraphic position at Peers Spring. Westgate's report of Lower Mississippian fossils in Peers Spring apparently based on collections from fault block of Bristol Pass limestone at Peers Spring. Available paleontologic evidence suggests Upper Mississippian age for Peers Spring and biostratigraphic correlation with White Pine, Chainman, and Perdido formations. Underlies Scotty Wash quartzite at Dutch John Mountain.

R. L. Langenheim, Jr., and Herbert Tischler, 1960, California Univ. Pubs., 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 discussion and description of rocks in area. On the other hand, Joana limestone, Peers Spring formation, and Chainman shale, with somewhat different limits, are formations to which these same rocks would be assigned in regional discussion of Mississippian stratigraphy in Great Basin. For purposes of expressing regional stratigraphic relationships, many already proposed names are redundant. Figure 5 presents a condensed set of already proposed names as restricted and applied to units of regional significance. Names Peers Spring formation and Chainman shale are retained for formational units within a White Pine group, although these three names have frequently been employed in a synonymous sense.

R. L. Langenheim, Jr., and others, 1960, Intermountain Assoc. Petroleum Geologists Guidebook 11th Ann. Field Conf., p. 151. Rank reduced to member status in White Pine shale. Constitutes lower 50 feet of formation; underlies Chainman member. Age of White Pine shale, Upper Mississippian. Report is on geology of Ely No. 3 quadrangle.

Named for occurrence in hills east and north of Peers Spring, 3 miles northwest of Bristol Pass, Pioche district, Lincoln County.

Peery Limestone (in Cliffield Group)

Peery Limestone Member (of Cliffield Formation)

Middle Ordovician: Southwestern Virginia.

B. N. Cooper and C. F. Prouty, 1943, Geol. Soc. America Bull., v. 54, no. 6, p. 830–832, 863–864, 884 (fig. 3). In Tazewell County, strata embraced by the Chazyan and Black River groups of Butts (1940, Virginia Geol. Survey Bull. 52, pt. 1) are subdivided into 29 zones (ascending). Name Peery limestone member of Cliffield formation is applied to zones 8 and 9. The lower zone is dark-bluish-gray to black fine-grained argillaceous limestone containing *Lophospira;* upper zone is a succession of thick-bedded taupe- and dove-gray, rather pure calcilutites. Thickness about 50 feet; locally, as at Maxwell, Cliffield, and Gratton, the calcilutite alone exceeds 100 feet. Overlies Ward Cove member (new); underlies Shannondale limestone member of Benbolt limestone (both new).

B. N. Cooper, 1944, Virginia Geol. Survey Bull. 60, p. 68–69, pl. 8. In area between Brushy and Walker Mountains, the Peery is considered a formation in Cliffield group. In this area, the Peery overlies Athens formation. Thickness 10 to 18 feet.

G. A. Cooper, 1956, Smithsonian Misc. Colln., v. 127, pt. 1, p. 83. On southeast side of Clinch Mountain, overlies Rich Valley limestone (new) and underlies Benbolt shale.

Type locality: At south end of Peery Lime Co.'s quarry near State Highway 61, about three-fourths mile east of railroad station at North Tazewell, Tazewell County, Va.

**Pegram Limestone**[1]

Pegram Formation

Middle Devonian: Western Tennessee.

Original reference: A. F. Foerste, 1901, Geol. Soc. America Bull., v. 12, p. 400, 425.

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

C. W. Wilson, Jr., 1949, Tennessee Div. Geology Bull. 56, p. 312–315. Pegram formation varies in thickness from featheredge to maximum of 30 feet in Cheatham County. Unit referred to as sandstone, limestone, shale, and so on, depending upon phase of occurrence of lithologic type. Unconformably overlain by Chattanooga shale. Major overlapping unit in central Tennessee; at the Whirl of Buffalo River and at Standing Rock Creek, rests on Camden limestone, on Mill creek, it is on Beech River; in Davidson and Cheatham Counties, rests on the Lego, Dixon, Bob, Beech River, and Bledsoe(?) formations; in Trousdale and Sumner Counties, overlies the Laurel.

Named for exposures at Pegram, Cheatham County.

**Pejepscott Gneiss**

Pejepscot Formation

Cambrian(?): Southwestern Maine.

L. W. Fisher, 1938, (abs.), Geol. Soc. America Proc. 1937, p. 81. Incidental use of term Danville-Pejepscot series of gneisses. Middle Silurian.

L. W. Fisher, 1941, Geol. Soc. America Bull., v. 52, no. 1, p. 113–115, pl. 1, table 1 (facing p. 112). Formation described. Consists of three phases: coarse-grained quartz-feldspar-biotite gneiss, fine-grained quartz-biotite schist, and amphibolite. Maximum thickness approximately 10,000 feet. Underlies Taylor Brook formation. Cambrian(?). Type locality given.

V. E. Shainin, 1948, Maine Geol. Survey Bull. 5, p. 10–11. Referred to as gneiss.

Type locality: Roadcut one-half mile west of village of Pejepscot, Sagadahoc County.

**Pekin Formation** (in Newark Group)[1]

Upper Triassic: Central North Carolina.

Original reference: M. R. Campbell and K. K. Kimball, 1923, North Carolina Geol. and Econ. Survey Bull. 33, p. 20–25.

J. A. Reinemund, 1955, U.S. Geol. Survey Prof. Paper 246, p. 28–31, pl. 1. Lowest of the three Triassic formations in Deep River basin; lies unconformably on pre-Triassic metamorphic and igneous rocks at bottom of the Triassic sedimentary wedge and crops out in a belt along northwest side of basin; underlies Cumnock formation. Rocks vary greatly from place to place but in general consist of gray conglomerate, red or brown coarse-grained sandstone, red or brown siltstone and claystone in lenticular beds, gray coarse-grained sandstone, and gray siltstone. Thickness 1,750 to 1,800 feet in northern part of Sanford basin; 3,000 to 4,000 feet in western part of basin.

Named for exposures at Pekin, Montgomery County. Outcrop ranges in width from 3/5 of a mile to 3½ miles in Sanford basin and attains width of 4½ miles in Colon cross structure and southern part of Durham basin.

Peleliu (Pelilieu) Limestone

Pleistocene to Recent: Caroline Islands (Peleliu, Ngemelis, and Angaur).

Risaburo Tayama, 1939, Correlation of the strata of the 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. 67, table 4 [English translation in library of U.S. Geol. Survey, p. 80]. Raised coral reef limestone. Consists primarily of *Halimeda* limestone and secondarily of coral limestone. Older than Ngarekeukl limestone. Pleistocene.

U.S. Army Corps of Engineers, 1956, Military geology of Palau, Caroline Islands: U.S. Army Corp of Engineers, Far East, p. 59–60, pls. 4, 10, 11. Estimated thickness 100 feet; upper surface commonly at an altitude of 30 feet or less. In many areas overlie Palau limestone. Pleistocene to Recent. Has been called Angaur limestone on Angaur.

Crops out on Peleliu, Ngemelis, and Angaur in southern part of Palau Islands.

†Pelham Granite[1]

Upper Carboniferous or post-Carboniferous: Central Massachusetts.

Original reference: B. K. Emerson, 1898, U.S. Geol. Survey Mon. 29, p. 48.

Robert Balk, 1956, U.S. Geol. Survey Geol. Quad. Map GQ–92. Name abandoned for rocks of the Pelham dome gneissic complex. These now subdivided and termed Dry Hill granite gneiss and Poplar Mountain gneiss.

Crops out in Pelham Township, Hampshire County.

†Pelham Limestone[1]

Ordovician: Alabama.

Original reference: E. A. Smith, 1890, Alabama Geol. Survey Rept. on Cahaba coal field, p. 152, section opposite p. 162, map.

G. A. Cooper, 1956, Smithsonian Misc. Colln., v. 127, pt. 1, p. 83. Broad name that is nearly equivalent to Chickamauga limestone as it embraces interval from top of Knox to Clinton. Name long neglected while Chickamauga was becoming entrenched in the literature. Neither name now has any value because Chickamauga sequence of Georgia and Pelham of Alabama can be divided into several formations ranging in age from Marmor to Trenton or higher.

Named for Pelham, Shelby County.

†Pelham Quartzite[1]

Upper Carboniferous or post-Carboniferous: Western central Massachusetts.

Original reference: B. K. Emerson, 1898, U.S. Geol. Survey Mon. 29, p. 18, pl. 34, map.

Crosses Pelham Township, Hampshire County.

†Pelham Saxonite[1]

Late Carboniferous or post-Carboniferous: Western central Massachusetts.

Original reference: B. K. Emerson, 1898, U.S. Geol. Survey Mon. 29, p. 47–55, pl. 34, map.

In Shutesbury Township, Franklin County and Pelham Township, Hampshire County.

Pelier 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, 91 (fig. 1). Tan sericite-quartz schist. Contains thin quartzites. Biotite porphyroblasts characteristic. Cloritoid facies common. Thickness 400 feet. Underlies Mount Athos formation and overlies Arch Marble (new), all in Evington group (new) of Paleozoic(?) age. Type locality designated.

W. R. Brown, 1958, Virginia Div. Mineral Resources Bull. 74, p. 29, 34–35, pl. 1. Proposed that schist phase of Mount Athos formation be separated and named Pelier schist. Age shown on columnar section as Lower Paleozoic(?).

Type locality: Railroad cuts at Six Mile Bridge ½ mile northwest of Mt. Pelier Church, 4½ miles east of Lynchburg, Campbell County. Lynchburg quadrangle.

Pella Beds[1]

Mississippian: Central southern and southeastern Iowa.

Original reference: H. F. Bain, 1895, Am. Geologist, v. 15, p. 318.

J. M. Weller and A. H. Sutton, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 5, p. 815. Beds consist of a thin basal sandstone, overlain by 5 feet of shale and 25 feet of compact thin-bedded limestone which grades into shale to the northwest. Unconformably overlie Verdi member of St. Louis formation.

Named for exposures near Pella, Marion County.

Pellisier Granite[1]

Middle or Late Mesozoic: Central eastern California.

Original reference: G. H. Anderson, 1935, Pan-Am.Geologist, v. 64, no. 1, p. 66.

G. H. Anderson, 1937, Geol. Soc. America Bull., v. 48, no. 1, p. 8–11. The granites [Pellisier and Boundary Peak] are probably equivalent in age to the Sierra batholith—middle or upper Mesozoic. Derivation of name given.

Typically exposed on a surface of low relief, designated as Pellisier Flats, which occupies large area along the crest of Inyo Range.

Pelly Gneiss[1]

Precambrian: Central eastern Alaska, and Yukon Territory, Canada.

Original reference: A. J. Collier, 1903, U.S. Geol. Survey Bull. 218, p. 16.

J. T. Dutro, Jr., and T. G. Payne, 1957, Geologic map of Alaska (1:2,500,000): U.S. Geol. Survey. Mapped as Lower Precambrian in Tanana region.

Named for exposures on Pelly River.

**Pelona Schist**[1]

Precambrian(?): Southern California.

Original reference: O. H. Hershey, 1902, California Univ. Pub. Dept. Geol. Bull., v. 3, pl. 1, map.

L. F. Noble, 1954, U.S. Geol. Survey Geol. Quad. Map GQ–50. Mapped in Valyermo quadrangle where it is overthrust by Pleasant View complex (new). Age relations of the two units unknown.

G. B. Oakeshott, 1958, California Div. Mines Bull. 172, p. 49–50, pl. 1. In San Fernando quadrangle, Pelona schist is present only north of San Gabriel fault. Thickness about 7,500 feet. Many workers have suggested a probable Precambrian age for the Pelona, and others have considered age to be more likely Mesozoic than Precambrian. Age of schist must be considered in doubt because none of evidence presented to date has been entirely satisfactory. Map bracket shows pre-Cretaceous.

Named for Sierra Pelona, Los Angeles County.

†Pelton Basalt Member (of Deschutes Formation)[1]

Miocene, Pliocene, or Pleistocene, lower: Central northern Oregon.

Original reference: H. T. Stearns, 1931, U.S. Geol. Survey Water-Supply Paper 637, p. 139.

Exposed in Deschutes Canyon from line between Tps. 12 and 13 S., R. 12 E., to northern boundary of area; forms bench nearly one-quarter mile wide on both side of Deschutes River in northern part of T. 11 S., R. 12 E., and extends north and underlies former railroad station of Pelton.

**Pembroke Formation**[1]

Silurian: Southeastern Maine.

Original references: E. S. Bastin and H. S. Williams, 1913. Maine Water Storage Comm. 3d Ann. Rept., p. 168; 1913, Geol. Soc. America Bull., v. 24, p. 378, 379.

C. K. Swartz and others, 1942, Geol. Soc. America Bull., v. 53, no. 4, chart 3. Assigned to Cayugan series [Upper Silurian].

Named for exposures near Pembroke, Washington County.

Pemigewasset Series[1]

Devonian or Carboniferous: Northwestern New Hampshire.

Original reference: C. H. Hitchcock, 1877, Geology New Hampshire, pt. 2, p. 142–148, 257–261.

Exposed over large areas along Pemigewasset River.

Pena Blanca Marls[1]

Oligocene: Panamá.

Original reference: E. Howe, 1907, Isthmian Canal Comm. Ann. Rept. 1907, App. E, pl. 147.

W. P. Woodring *in* R. Hoffstetter and others, 1960, Lexique Strat. Internat., v. 5, Amérique Latine, fasc. 2a, p. 343. In original reference, name appeared only on map explanation. That it was not intended as formal name is indicated by expression "marls of Pena Blanca" in text (p. 113). Strata at Pena Blanca are presumed to represent part of Caimito formation. Notes on locality.

Pena Blanca was village on Rio Chagres at site off northwest end of present Barro Colorado Island. Site is now submerged by waters of Gatun Lake, C. Z.

Pen Argyl Beds (in Martinsburg Shale)[1]

Upper Ordovician: Southeastern Pennsylvania.

Original references: C. H. Behre, Jr., 1926, Jour. Geology, v. 34, p. 485–487; 1927, Pennsylvania Geol. Survey, 4th ser., Bull. M9, p. 33, 104–107, maps.

Exposed at Pen Argyl, Northampton County.

Penasco quartzite[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.

Exposed near Pecuris, north of Santa Fe, Santa Fe County. Derivation of name not stated.

**Pence Ferruginous Slate Member** (of Ironwood Iron-Formation)[1]

Precambrian (Animikie Series): Northwestern Wisconsin and northwestern Michigan.

Original reference: W. O. Hotchkiss, 1919, Eng. Mining Jour., v. 108, p. 501, 505.

N. K. Huber, 1959, Econ. Geology, v. 54, no. 1, p. 104 (table 10), 106 (table 11), 107 (fig. 6). Underlies Anvil member; overlies Norrie member. Thicknesses (taken from drill holes) 102 and 122 feet.

Named for Pence mine, west of Hurley, Iron County, Wis.

Pendejo Tongue (of Hueco Formation)

Permian (Wolfcampian): Southeastern New Mexico.

L. C. Pray, 1954, New Mexico Geol. Soc. Guidebook 5th Field Conf., p. 93. Appears only on columnar section. Shown as tongue of thin bedded limestone and gray shale between unnamed tongues of arkose, and red mudstone of the Abo formation.

In southern part of Sacramento Mountains, Otero County.

Pendleton Formation (in Wilcox Group)

Eocene, lower: Eastern Texas and western Louisiana.

Richard Wasem and Louis J. Wilbert, Jr., 1943, Jour. Paleontology, v. 17, no. 2, p. 182–195. Proposed for lower Eocene sediments cropping out around southern margin of Sabine uplift in Louisiana and Texas which have been referred to previously as Pendleton faunal unit. Sediments are mainly nonmarine with a few interbedded shallow-water marine fossiliferous sands. Thickness 275 to 300 feet. Typically developed along Sabine River. Best exposed over wide area drained by two Louisiana tributaries Bayou Lenann and Slaughter Creek; in this region, subdivided into (ascending) Bayou Lenann, Slaughter Creek, and High Bluff members. Overlies Marthaville formation and underlies the Pearson (Pierson) glauconitic sand of the Sabinetown faunal unit. Pendleton faunal unit of earlier reports.

G. E. Murray, Jr., and E. P. Thomas, 1945, Am. Assoc. Petroleum Geologists Bull., v. 29, no. 1, p. 50 (fig. 4), 56 (footnote), 61–63. Underlies Sabinetown formation (restricted). Term Pendleton is preoccupied. If in future it is considered advisable to abandon Tertiary name Pendleton, term Pendleton Ferry is suggested since the type locality is the old Pendleton Ferry Landing.

H. V. Andersen, 1960, Louisiana Dept. Conserv., Geol. Bull. 34, p. 71–81. Recent subsurface studies indicate that Wasem and Wilbert's 275- to 300-foot thickness for Pendleton is grossly underestimated and that their mappable lithologic sequences, or members, as these sequences were designated, cannot be recognized in subsurface. There are 17 glauconite units ranging from 1 to 18 feet thick in the 975 feet of Pendleton sediment Wilcox core (obtained by Carter Oil Co.) which could alter their biostratigraphic zones appreciably.

Type locality: At old Pendleton Ferry, Sabine County, Tex. Formation has been traced westward across Sabine County, Tex., and eastward to Red River in Natchitoches Parish, La.

**Pendleton Sandstone**[1]

Pendleton Formation

Middle Devonian: Eastern Indiana.

Original reference: E. T. Cox, 1879, Indiana Geol. Survey 8th, 9th, and 10th Ann. Repts., p. 62.

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

A. H. Sutton, 1944, Illinois Geol. Survey Bull. 68, p. 166–167. All beds at Pendleton considered as a unit, the Pendleton formation; regarded as essentially equivalent to lower Geneva and Jeffersonville, a third lithologic facies of same stratigraphic unit. Conclusion based on similarity of fossils and on paleographic considerations which seem to make correlation with Schoharie untenable.

Exposed at Pendleton, southern Madison County.

Pendleton Ferry Formation

Eocene (Midway): Northeastern Texas and northwestern Louisiana.

G. E. Murray, Jr., and E. P. Thomas, 1945, Am. Assoc. Petroleum Geologists Bull., v. 29, no. 1, p. 56 (footnote). Term Pendleton is preoccupied by Pendleton sandstone of middle Devonian of Indiana. If, in future, it is considered advisable to abandon the Tertiary name Pendleton, the name Pendleton Ferry is suggested since the type locality of Pendleton is the old Pendleton Ferry Landing.

Old Pendleton Ferry Landing is in Sabine County, Tex.

Pendola Shale

Upper Cretaceous: Southern California.

B. M. Page, J. G. Marks, and G. W. Walker, 1951, Am. Assoc. Petroleum Geologists Bull., v. 35, no. 8, p. 1729 (fig. 2), 1733 (fig. 3), 1734 (fig. 4), 1743–1744. Consists chiefly of dark-gray to greenish-gray silty thin-bedded shale with irregularly interbedded layers of dark-gray limestone or fine calcareous sandstone. Thickness 440 feet at type locality; 1,000 feet 1 mile north of type locality; sections are incomplete, top having been eroded. Unconformably overlain by Juncal formation (new), which overlaps it on south; overlies Debris Dam formation (new) with contact possibly unconformable.

Type locality: On nose of Agua Caliente anticline 1.8 miles northeast of Pendola Guard Station in small canyon tributary to Agua Caliente Canyon, Santa Barbara County. Base of section is 9,100 feet N. 50° E. of guard station and eroded top of section is 10,200 feet N. 55° E. of guard station.

Pend Oreille Andesite

Pend Oreille Valley Andesite

Miocene(?): Northeastern Washington.

M. C. Schroeder, 1949, (abs.) Northwest Sci., v. 23, no. 1, p. 39–40. Pend Oreille Valley andesite proposed for volcanics consisting of valley flows of dark-gray trachytic andesite.

M. C. Schroeder, 1952, Washington Div. Mines and Geology Bull. 40, p. 7 (chart), 24–25. Described as Pend Oreille andesite. Occurs as flows in an old valley that has been cut into the metamorphics of Newport group (new). Thickness about 1,100 feet. North of Skookum Creek unconformably underlies Tiger formation.

Crops out 1½ miles north of Furport along eastern edge of Pend Oreille River valley and forms valley wall for distance of 7 miles to Skookum Creek valley, Pend Oreille County.

Pend Oreille Group[1]

Carboniferous(?) and older(?): Southern British Columbia, Canada, and northeastern Washington.

Original reference: O. E. Le Roy, 1912, Canada Geol. Survey Summ. Rept. 1911, p. 142.

Pend d'Oreille River empties into Columbia River just north of Washington-British Columbia boundary.

**Penholoway Formation** (in Columbia Group)[1]

Pleistocene: Atlantic Coastal Plain from Delaware to Florida.

Original reference: (Penholoway terrace): C. W. Cooke, 1925, Georgia Geol. Survey Bull. 42, p. 24–26.

G. G. Parker and C. W. Cooke, 1944, Florida Geol. Survey Bull. 27, p. 75–77, pls. 2, 3. In southern Florida, Talbot, Penholoway, and Wicomico formations comprise conformable sequence of deposits whose differentiation is based mainly on location of their respective shore lines, namely 42, 70, and 100 feet above present sea level. Presumably Penholoway everywhere merges downward into deposits of Wicomico age, and Talbot into Penholoway and Wicomico successively. Sequence unconformably overlies Caloosahatchee marl and is likewise separated by a stratigraphic break from the Pamlico formation, which fringes around it.

Name derived from Penholoway Creek, Wayne County, Ga. Well exposed in Florida along Highway 18, the Childs-Okeechobee Road and west of Lake Okeechobee.

†Peninsular Limestone[1]

Eocene, upper: Northern Florida.

Original reference: W. H. Dall, 1903, Wagner Inst. Sci. Trans., v. 3, pt. 6, p. 1554.

Named for development in peninsular Florida.

Peñitas Formation

Pliocene(?): Panamá.

H. N. Coryell and R. W. Mossman, 1942, Jour. Paleontology, v. 16, no. 2, p. 233. Believed to correlate with Charco Azul formation.

In Burica Peninsula, Chiriquí Province.

Penman Formation

Pliocene, lower(?): Northeastern California.

Cordell Durrell, 1957, Pacific Petroleum Geologist, v. 11, no. 3, p. 3. Hornblende andesite mudflow breccia and volcanic conglomerate. Thickness 1,350 feet. Unconformable below Warner basalt; rests unconformably on Bonta formation (new) and all older rocks; unconformities marked by faulting.

Cordell Durrell, 1959, California Univ. Pubs. Geol. Sci., v. 34, no. 3, p. 165 (fig. 1), 174–177. Consists of three members. Lower, hypersthene andesite tuff with biotite dacite obsidian, pumice, and flow-banded lithic rocks, 150 feet thick. Middle, white-weathering hornblende andesite breccia, 250 feet thick. Upper, hornblende andesite mudflow breccia, volcanic conglomerate and fanglomerate, some volcanic sand and tuff, 950 feet thick. Rests directly on Calaveras formation in southwest corner of Blairsden quadrangle; in eastern part of quadrangle, rests across faults between older units, so that in different fault blocks it lies on granitic rocks, the Ingalls, Delleker, and Bonta formations; elsewhere rests on the Lovejoy; unconformably underlies Warner basalt. Lower Pliocene.

Named for Penman Peak in south-central part of Blairsden quadrangle.

†Pennell sandstone[1]

Upper Cretaceous: Eastern Utah.

Original reference: C. R. Keyes, 1924, Pan-Am. Geologist, v. 41, p. 36, 64, 65.

Named from Mount Pennell.

**Pennington Shale,[1] Formation,[1] or Group**

Upper Mississippian: Southwestern Virginia, northern Alabama, northwestern Georgia, eastern Kentucky, and eastern Tennessee.

Original reference: M. R. Campbell, 1893, U.S. Geol. Survey Bull. 111, p. 28, 37.

Paul Averitt, 1941, Virginia Geol. Survey Bull. 56, p. 11–14, pls. 1, 2. Greater part of formation in Scott and Washington Counties, Va., is nonfossiliferous shale and sandstone. Full thickness not known because top is concealed by Saltville overthrust block, but about 2,250 feet is exposed. Overlies Cove Creek limestone.

B. N. Cooper, 1944, Virginia Geol. Survey Bull. 60, p. 172–180. Formation described in Burkes Garden quadrangle. Comprises (ascending) Stony Gap sandstone, Avis limestone, and Falls Mills sandstone members. Thickness 1,000 to 1,700 feet. Overlies Bluefield shale and underlies Bluestone formation, both contacts conformable. Reger (1926, West Virginia Geol. Survey [Rept.] Mercer, Monroe, and Summers Counties) subdivided the Pennington [Hinton] into 45 units of which only three can be recognized with certainty in area of present report.

J. M. Weller and others, 1948, Geol. Soc. America Bull., v. 59, no. 2, p. 166 chart 5 (column 90). Chart shows Pennington formation overlies Floyd shale and underlies Parkwood formation in east-central Alabama. Text states that relations of these formations are not clear and Pennington may grade laterally into either or both the Floyd and the Parkwood.

John Rodgers, 1953, Tennessee Div. Geology Bull. 58, pt. 1, pls.; pt. 2, p. 110–112. Formation mapped and described in eastern Tennessee where it is heterogeneous and varicolored, including red, purple, and green clay shale, pink, red, green, and brown (normally calcareous) sandstone, and yellow shaly or silty fossiliferous limestone. Limestone is everywhere minor in amount; proportions of shale and sandstone vary widely. Overlies Newman limestone. Upper contact in northwestern belts not clearly defined except northeast of Jacksboro fault, where base of Pennsylvanian system is drawn at base of thick layer of pebbly white sandstone, which may be disconformable on Mississippian rocks. Elsewhere contact is drawn in transitional zone between red clay shale with scattered fossiliferous limestone beds and gray or brown sandy and silty shale with scattered coal beds. Contact thus records change from marine to nonmarine deposition, but it may not be drawn at same level everywhere, and possibly some beds included in Pennington northeast of Jacksboro fault are equivalent to some included in Pennsylvanian farther southwest.

Hence, thickness is not consistent; 200 feet or less near Chattanooga; 450 feet near Dayton; 150 feet at Cumberland Gap.

G. T. Malmberg and H. T. Downing, 1957, Alabama Geol. Survey County Rept. 3, p. 64–67. Formation, in Madison County, composed of about 80 to 100 feet of red, green, and purple earthy shales interbedded with thin layers of limestone; a massive bed of hard fossiliferous light-gray crystalline limestone about 20 feet thick occurs near top of formation. Overlies Bangor limestone and underlies Pottsville formation. In Alabama, name Pennington has not been used widely in older publications; rock units now designated as Pennington formation have been included in Bangor limestone.

K. J. Englund, 1957, U.S. Geol. Survey Coal Inv. Map C–39. Formation, in Pioneer quadrangle, Scott and Campbell Counties, Tenn., consists of fine-grained gray to buff sandstone interbedded with grayish-green and grayish-red shale. Thickness about 650 feet. Overlies Newman limestone; underlies Lee formation.

L. D. Harris and R. L. Miller, 1958, U.S. Geol. Survey Geol. Quad. Map GQ–111. Because term Pennington has been extensively used and is still accepted in Tennessee and Kentucky, it is proposed to raise Pennington to rank of group to include Hinton, Princeton, and Bluestone formations. Overlies Bluefield formation. Wilpolt and Marden's work (1949, U.S. Geol. Survey Oil and Gas Inv. Prelim. Chart 38) indicates that the Pennington in Big Stone Gap area contains lithologic equivalents of Hinton formation, Princeton sandstone, and Bluestone formation of West Virginia. Wilpolt and Marden used these West Virginia names at both type locality and type section of the Pennington shale of Campbell, thus abrogating use of Pennington as formation name.

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 areas of Kentucky and Tennessee. The 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. Pennington-Lee contact, as determined lithologically in field, rises stratigraphically northward in this intertonguing sequence. According to literature, 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 Pennington and Lee formations suggests that these formations are partly contemporaneous.

Named for Pennington Gap, Lee County, Va., about 40 miles northeast along strike from Cumberland Gap.

**Penn Yan Shale Member** (of Genesee Formation)

Penn Yan Tongue (of West River Shale)

Upper Devonian: West-central New York.

W. L. Grossman, 1944, Geol. Soc. America Bull., v. 55, no. 1, p. 64–65. Name Penn Yan tongue proposed for lower shales of West River shale. Lower part consists of interbedded black and blue-black shales, blue-gray shales and thin limy argillaceous beds; unfossiliferous flags interbedded in dark shales. In upper part, shales generally lighter colored and more fossiliferous. Concretions plentiful; marcasite nodules present. Thickness about

140 feet in type area; thins eastward. In type region, contact with underlying Geneseo shale is difficult to determine but is placed at base of sequence of dark limy shales and interbedded shaly limestone layers. Top is placed arbitrarily at base of Crosby lentil of Starkey tongue (new), although Starkey-type flags being lower.

Wallace de Witt, Jr., and G. W. Colton, 1959, Am. Assoc. Petroleum Geologists Bull., v. 43, no. 12, p. 2814 (fig. 3), 2815, 2817 (fig. 4), 2818. In vicinity of Canandaigua Lake, a 50- to 60-foot sequence of dark-gray shale and mudrock containing thin beds of black shale, many layers of nodular limestone and calcareous nodules, and a few very thin beds of siltstone overlies Geneseo shale member of Genesee and underlies *Styliolina*-bearing Genundewa limestone member of Genesee. Traced eastward to Keuka Lake, this sequence of dark shaly rocks is Grossman's Penn Yan tongue of West River shale. Unit is here redesignated Penn Yan shale member of Genesee formation, because it is not a tongue of the West River. In its type area, the Penn Yan underlies Crosby sandstone of Torrey and others (1932), which can be traced westward into Genundewa limestone member. In type area, overlies Geneseo member and underlies Ithaca member. About 170 feet thick near Penn Yan; thins westward to Lake Erie where it is 9 inches thick. In Cayuga Lake area, underlies Sherburne flagstone member. Thickness about 105 feet near Ithaca.

Named from outcrops in streams along south side of Keuka Lake outlet near town of Penn Yan, Yates County. Well exposed in middle gully of three draining north into outlet at Seneca Mills.

**Penobscot Formation**[1]

Cambrian(?): South-central Maine.

Original reference: G. O. Smith, E. S. Bastin, and C. W. Brown, 1907, U.S. Geol. Survey Geol. Atlas, Folio 149, p. 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; Battio 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.

R. S. Houston, 1956, Maine Geol. Survey Bull. [7], p. 59. Upper Cambrian.

L. A. Wing, 1957, Maine Geol. Survey GP. and G. Survey 1, sheet 1. In Hancock and Penobscot Counties, appears to be overlain by Bucksport formation (new).

Named for exposures along western shore of Penobscot Bay, especially between Belfast Bay and Sandy Point, Waldo County.

Penobscot Bay Granite[1]

Upper Silurian or Lower Devonian: Maine.

Original reference: F. W. Toppan, 1932, Geology Maine, Dept. Geol. Union Coll., Schenectady, p. 44.

†Penokee Series[1]

Precambrian (upper Huronian): Northwestern Wisconsin and northwestern Michigan.

Original reference: E. T. Sweet, 1876, Wisconsin Acad. Sci., Arts, and Letters Trans., v. 3, p. 40–45.

Penokee region, Wis.

**Penon Blanco Volcanics** (in Amador Group)

Upper Jurassic: East-central California.

Original reference [Penyon Blanco agglomerate]: 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, 284. Assigned to Amador group. In Merced River section, Penon Blanco volcanics underlie Agua Fria formation and overlie Hunter Valley cherts. Thickness about 9,000 feet. Age of Amador group believed to be upper Middle to lower Upper Jurassic.

Present in southern type section of Amador group along Merced River.

**Pensauken Formation** (in Columbia Group)[1]

Pleistocene: New Jersey and northern Delaware.

Original reference: R. D. Salisbury, 1894, New Jersey Geol. Survey Ann. Rept. State Geologist 1893, p. 57–60, 67–72.

C. W. Cooke, Julia Gardner, and W. P. Woodring, 1943, Geol. Soc. America Bull., v. 54, no. 11, chart 12. Correlation chart shows Cape May (part) and Pensauken (part) as Sangamon and Pensauken (part) and Bridgeton (part) as Yarmouth.

H. G. Richards, 1945, Geol. Soc. America Bull., v. 56, no. 4, p. 401–402. Correlation chart discussed. Writer does not agree with the combining of Cape May (part) and Pensauken (part) in the Sangamon interglacial nor with the combining of the Pensauken (part) with the Bridgeton (part) in the Yarmouth interglacial. Evidence indicates that Cape May is of late Pleistocene age, whereas Pensauken is mid-Pleistocene or older. There is no unconformity within the Pensauken nor any field evidence of a hiatus within the Cape May. Lithologically, the Pensauken and Bridgeton are practically inseparable although the latter has been more eroded and occurs at higher elevations; they are regarded as Pensauken-Bridgeton complex of early Pleistocene, probably Nebraskan to Yarmouth.

W. C. Rasmussen and others, 1957, Delaware Geol. Survey Bull. 6, pl. 3. Mapped in northern Delaware. Sand and clay on margin of Piedmont, forming terrace deposits at altitudes of less than 180 feet.

Carlyle Gray and others, 1960, Geologic map of Pennsylvania (1:250,000): Pennsylvania Geol. Survey, 4th ser. Mapped in eastern Pennsylvania. Illinoian stage.

Named for exposure at mouth of Pensauken Creek, at Hylton's pits [Burlington County], New Jersey.

**Pentagon Shale**[1]

Middle Cambrian: Northwestern Montana.

Original reference: C. F. Deiss, 1933, Montana Bur. Mines and Geology Mem. 6, p. 38.

Charles Deiss, 1938, Geol. Soc. America Bull., v. 49, no. 7, 1074–1075, 1089, 1090 (fig. 2); 1939, Geol. Soc. America Spec. Paper 20, p. 42–45. As here defined, overlies Pagoda limestone and underlies Steamboat limestone. Thickness at type locality 290 feet. Middle Cambrian.

Type locality: On Continental Divide, in NE¼ sec. 24, T. 25 N., R. 12 W., Lewis and Clark Range. Named for Pentagon Mountain which lies approximately 2 miles northwest of type locality.

**Penters Chert**[1]

Lower or Middle Devonian: Central northern Arkansas.

Original reference: H. D. Miser, 1920, U.S. Geol. Survey Bull. 715–G.

D. M. Kinney, 1946, Am. Assoc. Petroleum Geologists Bull., v. 30, no. 4, p. 611–612. Discovery of fossils in a thin gray argillaceous limestone in Penters chert confirms the earlier suggested Lower or Middle Devonian age for the Penters. The Penters is unfossiliferous at its type locality.

Named for exposures at Penters Bluff Station, Izard County.

Pentoga Greenstones (in Quinnesec Schist)

Precambrian (Huronian): Northern Michigan.

H. M. Martin, 1936, The centennial geological map of the northern peninsula of Michigan (1:500,000): Michigan Dept. Conserv., Div. Pub. 39, Geol. Ser. 33. Shown on map legend. Occurs in Iron River district.

Peñuelas Shale[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. 251.

R. C. Mitchell, 1954, Puerto Rico Univ. Agr. Expt. Sta. Tech. Paper 13, p. 36 (table 2), 60 (table 7). Thickness 2,000 feet. Underlies Coamo tuff limestone; overlies San Germán limestone.

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. Mitchell (1922) used name Peñuelas shale for rocks correlated with Rio Yauco formation of this report.

Typically exposed along military road from Ponce to Peñuelas at kilometer 67+ (10+ by old numbers), Ponce district.

Penutian Stage

Eocene, lower: Western and southern California.

V. S. Mallory, 1959, Lower Tertiary biostratigraphy of the California Coast Ranges: Tulsa, Okla., Am. Assoc. Petroleum Geologists, p. 18 (fig. 3), 34–40, 76, 93, fig. 7. Replaces stage name Juniperan. Change made to avoid confusion with Junipero sandstone in Reliz Canyon area. In sequence, the Penutian includes interval between the younger Ulatisian and the older Bulitian stages. Type includes the 20 feet of olive to greenish-gray siltstone and shale whose lower part constituted the type of the Bulitian stage and the 25-foot sandstone "reef" containing orbitoidal foraminifera and megascopic fossils, in the NE¼ sec. 21, T. 28 S., R. 19 E., in vicinity of Media Agua Creek, Kern County. Comprises two zones, *Plectofrondicularia kerni* below and *Alabama wilcoxensis* above.

Represented on Santa Barbara coast, in Simi Valley, along west side of San Joaquin Valley, vicinity of and north of San Francisco Bay area. Name refers to a linguistic stock of northern California Indians. The Yokut Indians, who occupied territory around Media Agua Creek, were of this linguistic stock.

Penyon Blanco Agglomerate[1]

*See* **Penon Blanco Volcanics.**

**Peorian Loess**[1]

Peoria (n) Formation

Peoria Formation (in Sanborn Group)

Peoria Silt Member (of Sanborn Formation)

Pleistocene: Illinois, Iowa, Kansas, and Nebraska.

Original reference: Frank Leverett, 1898, Jour. Geology, v. 6, p. 244–249.

G. E. Condra and E. C. Reed, 1943, Nebraska Geol. Survey Bull. 14, p. 6. Shown in stratigraphic section as Peorian formation (loess). Overlies Loveland formation; underlies Recent. Thickness 5 to 80 feet. Some dune sand of Peorian age.

G. B. Schultz and T. M. Stout, 1945, Am. Jour. Sci., v. 256, p. 55 (fig. 1). Peorian loess underlies Bignell formation (new).

G. E. Condra, E. C. Reed, and E. D. Gordon, 1947, Nebraska Geol. Survey Bull. 15, p. 25, 31–33; 1950, Nebraska Geol. Survey Bull. 15–A, p. 25, 32–33. Peorian formation, as exposed at type locality of Crete formation, consists of light-brownish-gray to buff loess in upper part, medium-light-gray in middle part, and light-gray to brownish, partly iron-stained in lower part. Thickness, including soil at top, 11 feet. Overlies Loveland formation. Peorian loess of middle to late Wisconsin age deposited to variable thickness widely on Loveland loess in Nebraska and other areas and on exposed areas of Todd Valley sand, and older formations. However, term Peorian, as now used, represents time interval between the Iowan and Mankato substages in Iowa and should not be applied formationally where this interval includes both till and loess substages, as in Illinois and parts of South Dakota. Contact with Bignell loess indicated by buried soils.

J. C. Frye and O. S. Fent, 1947, Kansas Geol. Survey Bull. 70, p. 45–50. Peorian loess has been described in western Illinois and Iowa and is exposed unconformably above Loveland loess in Missouri Valley area of Iowa and Nebraska. Unit has been traced westward from Missouri Valley across Nebraska and southward as far as central Kansas. Since term Peorian is now generally used in time sense, adjectival ending dropped for stratigraphic unit here called Peoria silt member of Sanborn formation. Member in upland areas may be a complex of loesses of slightly different ages, at a few places separated by feebly developed soils. Its lithologic continuity in Kansas and Nebraska warrants inclusion of the complex of loesses, associated colluvial silts on some slopes, and fluvial-eolian silts on lower levels within a single member. Buried soil on Peoria silt member has been named Brady. Peoria silt occurs extensively in northern tier of Kansas counties in upland areas and on slopes, overlain by deposits of Bignell silt above Brady soil. Thickness more than 100 feet at type locality of Sanborn. Overlies Loveland silt member.

R. L. Schreurs, 1956, U.S. Geol. Survey Water-Supply Paper 1358, p. 14 (table), 23. Peorian loess, in Buffalo County and adjacent areas, Nebraska, consists of wind deposits of grayish-yellow silty clay (loess), locally grading into dune sand; contains several buried soils. Thickness 0 to 75 feet. Overlies Todd Valley formation; underlies post-Iowan terrace deposits.

C. W. Hibbard, 1958, Am. Jour. Sci., v. 256, p. 55 (fig. 1). Rank raised to formation in Sanborn group.

J. M. Jewett, 1959, Graphic column and classification of rocks in Kansas: Kansas Geol. Survey. Peoria formation shown on correlation chart in Bradyan stage [Kansas does not use Sanborn group.]

J. C. Frye and H. B. Willman, 1960, Illinois Geol. Survey Circ. 285, p. 7, 10, 12, 13. Beyond limit of Shelbyville till the Peoria loess serves as a supplementary type for Woodfordian substage (new). Peoria loess has been called Peorian, but it is here used as rock-stratigraphic rather than time-stratigraphic unit and adjectival ending is dropped. Stratigraphically overlies Farmdale silt; overlies Roxana silt (new) of Altonian substage (new). Thickness 15 to 25 feet.

M. M. Leighton, 1960, Jour. Geology, v. 68, no. 5, p. 536. Frye and Willman's (1960) type section of "Roxana silt" reinterpreted. "Roxana silt" is Peorian loess (basal part Iowan). Thickness 43 feet. Occurs above Farmdale loess. Unit termed Peoria loess by Frye and Willman is possibly Bignell loess.

Named for exposures in vicinity of Peoria, Tazewell County, Ill.

†Peorian Stage[1] (of deglaciation)

Pleistocene: Midcontinent.

Original reference: Frank Leverett, 1898, Jour. Geology, v. 6, p. 244–249.

C. W. Cooke, Julia Gardner, and W. P. Woodring, 1943, Geol. Soc. America Bull., v. 54, no. 11, p. 1714. Under previous usage by U.S. Geological Survey, the Iowan drift was regarded as representing a distinct stage of glaciation separated from the Wisconsin by Peorian stage of deglaciation. Geological Survey now classifies the Iowan drift as representing an early substage of the Wisconsin stage, and name Peorian is not used either for a distinct stage or substage.

Named for exposures near Peoria, Tazewell County, Ill.

Pepino Formation[1]

Miocene: Puerto Rico

Original reference: R. T. Hill, 1899, Natl. Geog. Mag., v. 10, p. 109.

J. D. Weaver, 1956, *in* R. Hoffstetter and others, Lexique Strat. Internat., v. 5, Amérique Latrine, fasc. 2b, p. 336. Term no longer used.

Forms Pepino Hills in northern Puerto Rico.

**Pepper Shale Member** (of Woodbine Formation)

Pepper Formation[1]

Upper Cretaceous (Gulf Series): Eastern Texas.

Original reference: W. S. Adkins, 1933, Texas Univ. Bull. 3232, p. 239, 270, 417–422.

L. W. Stephenson, 1953, U.S. Geol. Survey Prof. Paper 242–E, p. 57–66. Rank reduced to member of Woodbine formation. Thickness 23½ feet. Unconformably underlies Eagle Ford shale; unconformably overlies Grayson marl (formerly Del Rio clay). Mollusks described. Fossil evidence confirms conclusion that Pepper shale is southward extension of the Woodbine and probably an extension of Lewisville member.

Type locality: Exposure on small branch of Pepper Creek south of Belton-Temple Highway, Bell County, and 1.6 miles east of easternmost of two passes of highway under Santa Fe Railway.

Peppersauce Sandstone[1]

Peppersauce Canyon Sandstone[1]

Upper Cambrian: Southeastern Arizona.

Original reference: A. A. Stoyanow, 1936, Geol. Soc. America Bull., v. 47, no. 4, p. 476–477, 480, 481, 482.

D. L. Bryant, 1952, Arizona Geol. Soc. Guidebook for Field Trip Excursions in Southern Arizona, p. 37. Thickness of 20 feet in Peppersauce Canyon.

In Peppersauce Canyon, Santa Catalina Mountains.

†Pequanac Shale[1]

Middle Devonian: Northern New Jersey.

Original reference: H. B. Kummel, 1908, U.S. Geol. Survey Geol. Atlas, Folio 161.

Well developed along upper Pequanac River.

Pequawket Breccia[1]

Devonian(?): Northern New Hampshire.

Original reference: C. H. Hitchcock, 1877, Geology New Hampshire, pt. 2, p. 235, 239, 262, 675, pl. 11.

On southern slope of Mount Pequawket, now North Moat Mountain, North Conway quadrangle, White Mountain.

Pequop Formation (in Carbon Ridge Group)

Permian (lower Leonard to lower Guadalupe): Northeastern Nevada and northwestern Utah.

Grant Steele, 1959, (abs.) Am. Assoc. Petroleum Geologists Bull., v. 43, no. 5, p. 1105. Purplish-gray irregularly bedded platy silty limestones with interbedded fusuline coquinas. Thickness 1,525 feet at type section. Lower contact placed at red silt member, which overlies massive Wolfcampian limestones (unnamed formation), and upper contact placed at base of unnamed massive dolomite sequence, which is overlain by Phosphoria formation.

J. S. Berge, Apr. 1960, Brigham Young Univ. Research Studies, Geology Ser., v. 7, no. 5, p. 10 (fig. 2), 11 (fig. 3), 27–29, pl. 4, chart (strat. section). (Footnote on chart refers to Steele's article in Intermountain Assoc. Petroleum Geologists Guidebook 11th Ann. Field Conf.) Formation, in Ferguson Mountain area. Elko County, consists of interbedded calcareous quartzite and silty limestones. Thickness 681½ feet. Overlies Ferguson Mountain formation (new): underlies Kaibab limestone of Park City group. Correlation chart, in column credited to Steele (1959, unpub. thesis) shows Pequop formation overlies Ferguson Springs formation (new): in column credited to Bissell (1960), the Pequop overlies Carbon Ridge formation and underlies Moorman Ranch formation. Leonardian.

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. In Utah, underlies the Kaibab and overlies Arcturus; in Moorman Ranch area, Nevada, underlies Moorman Ranch formation and overlies Murry [formation] (new); in Ferguson Mountain area, overlies Ferguson Mountain formation and underlies Plympton.

Grant Steele, 1960, Intermountain Assoc. Petroleum Geologists Guidebook 11th Ann Field Conf., v. 93 (chart 1), 106. (Road logs dated Sept. 8–10). Formal proposal of name. Overlies Ferguson Springs formation and in some areas Riepetown sandstone (new); underlies Loray formation. Includes Moorman Ranch member and Summit Springs evaporite member (new). Included in the Carbon Ridge herein raised to group status.

Type section: Sec. 3, T. 33 N., R. 65 E., Elko County, Nev. Section measured 1½ miles north of Jasper Railroad Tunnel in central part of Pequop Mountains.

**Percha Shale**[1]

Percha Formation

Upper Devonian: Southern New Mexico, southeastern Arizona, and southwestern Texas.

Original references: C. H. Gordon, 1907, Am. Jour. Sci., 4th, v. 24, p. 58–64; Science, new ser., v. 25, p. 824–825; Jour. Geology, v. 15, p. 91–92.

L. A. Nelson, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 1, p. 163 (fig. 3). Overlies progressively, Fusselman limestone and Canutillo shale from Silver City, N. Mex., to El Paso, Tex.

L. R. Laudon and A. L. Bowsher, 1941, Am. Assoc. Petroleum Geologists Bull., v. 25, no. 12, p. 2122, figs. 21, 22. Formation unconformably underlies Caballero formation (new) in Sacramento Mountains, N. Mex.

F. V. Stevenson, 1944, Dallas Digest (Am. Assoc. Petroleum Geologists, Soc. Econ. Paleontologists and Mineralogists, and Soc. Explor. Geophysicists Joint Ann. Mtg.), p. 95. Shale subdivided into lower Ready Pay member and upper Box member. Box member confined to Mimbres Mountain regions, whereas Ready Pay member believed to occur throughout southern New Mexico.

F. V. Stevenson, 1945, Jour. Geology, v. 53, no. 4, p. 241–244. Neotype section designated. Shale overlies Sly Gap formation in San Andres Canyon, N. Mex.

M. A. Stainbrook, 1947, Jour. Paleonotology, v. 21, no. 4, p. 297–302. Two members recognized in Percha by Keyes (1908). Basal black shale termed Silver and upper lighter colored shales termed Bella. There is little doubt that these names were proposed for identical divisions of Percha named Ready Pay and Box by Stevenson (1944), and there is little reason to replace earlier names. Early Mississippian. Shale recognized near top of Mount Martin, at Bisbee, Ariz.

V. C. Kelley and Caswell Silver, 1952, New Mexico Univ. Pub. Geology 4, p. 72–78. fig. 8. In Caballo Mountains, N. Mex., Percha has several lithologies not all of which occur in every outcrop. Predominantly gray-weathering calcareous claystone, olive-drab-weathering shale, and rusty-weathering sandstone and siltstone. Thin limestone lentils and beds irregularly distributed. Thickness ranges from thin edge to 105 feet. Although dominantly a shale unit at type locality, it includes more than shale elsewhere and would be more usefully termed Percha formation. Proposed units such as Onate and Sly Gap are not distinguishable lithologically, and hence are not mappable in New Mexico. These are no more than faunal zones at best, and the prior and well-established term Percha formation should be retained and applied widely to this lithologically and topographically distinct unit as it crops out in New Mexico. Does not rest everywhere on same formation. In most places, as along main scarp of Timber Mountain, it rests on the Fusselman, in other places rests on dolomite of Montoya group. Commonly overlain by beds of Magdalena group, but in southern end of mountains, Lake Valley rocks intervene. Includes beds of Devonian (Middle and Upper) and Mississippian (Kinderhook) age.

F. E. Kottlowski and others, 1956, New Mexico Bur. Mines and Mineral Resources Mem. 1, p. 31. Beds of Percha aspect overlie a thin "Three Forks" zone in Rhodes Canyon and are probably the beds above the Contadero in Hembrillo Canyon. In Rhodes Canyon, the Percha formation is pale- to dark-olive-gray calcareous silty micaceous shale, with a few lenses and nodules of medium-gray or olive-gray calcareous micaceous siltstone. Beds referred to Percha are 75 feet thick in Rhodes Canyon including a basal 18 inches of possible Three Forks equivalent. Thickness 67 feet in Hembrillo Canyon. Formation thins north of Rhodes Canyon and is absent at Sly Gap.

Neotype section: In SW¼SW¼SE¼ sec. 14, T. 16 S., R. 7 W., 2½ miles southeast of Hillsboro, Sierra County, N. Mex. This exposure approximately one-half mile south of narrow canyon called "The Box," through which Percha Creek flows eastward into Rio Grande.

Perchan series[1]

Devonian: New Mexico.

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

**Perdido Formation**

Mississippian: Southern California.

J. F. McAllister, 1952, California Div. Mines Spec. Rept. 25, p. 3, 14 (fig. 6), 22–25, pls. 1, 2, 3. Consists of siltstone, shale, limestone, chert, and conglomerate; pale red to dark gray weathering reddish brown, brown, or gray; siltstone predominant in upper part, limestone predominant in lower part, characterized also by bedded chert. Lithology is greatly diversified within one section and also from place to place so that heterogeneity is an outstanding characteristic. Thickness about 610 feet at type locality; 220 feet in canyon below Ubehebe mine, west of Quartz Spring area. Underlies Pennsylvanian(?) Rest Spring shale (new); overlies Tin Mountain limestone (new).

R. L. Langenheim, Jr., and Herbert Tischler, 1960, California Univ. Pub. Geol. Sci., v. 38, no. 2, p. 97–99, 137–140. In Quartz Spring area, consists of a lower limestone member and an upper siltstone member. Thickness about 424 feet (section incomplete). Overlies Tin Mountain formation. Late Mississippian.

Type locality: Extending south from Perdido Canyon, Inyo County. In the canyon, a fault between Perdido and Rest Springs formations cuts out uppermost part of Perdido, but this segment is well exposed south of Rest Spring. Type locality is supplemented by a second locality, about 3,000 feet south of Rest Spring. Named for Perdido Canyon, where formation is exposed from foot of southern wall, about 9,000 feet southeast of Quartz Spring, over hill to underlying Tin Mountain limestone.

Pereira Shale Member (of Alhambra Formation)

Eocene, upper: Northwestern California.

C. E. Weaver, 1953, Washington [State] Univ. Pubs. in Geology, v. 7, p. 19 (chart), 55–56, pl. 4A. Lowermost part consists of interbedded silty shale and silty sandstone which grades up from Roop sandstone (new) with no sharp break near middle of lower third of exposed section brownish-gray silty shales are replaced by thinly stratified light-gray to white shale with occasional thin layers of interbedded silty gray sandstone. Exposed basal part is 290 feet thick; approximately 200 feet of higher beds are concealed.

Type section: West limb of Pacheco syncline, in Santa Fe cuts and ditches east of Muir Tunnel, near Martinez, Contra Costa County.

Perilla Member (of Lowell Formation)

Lower Cretaceous: Southeastern Arizona.

A. A. Stoyanow, 1949, Geol. Soc. America Mem. 38, p. 9, 17, pl. 27. Consists of (ascending) friable light-yellow shale, brown crystalline limestone, light-yellow shale and argillaceous limestone, and brown crystalline limestone. Thickness 251 feet. Underlies Pedregosa member (new): overlies Quajote member (new).

In standard section of Lowell formation in the 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.

Perini Hill Flows (in Clear Lake Volcanic Series)

Quaternary: Northern Califonrnia.

J. C. Brice, 1953, California Div. Mines Bull. 166, p. 12 (fig. 2), 36, 41, pls. 1. 7. Andesitic flows bearing xenocrysts of quartz and xenoliths of aluminous rocks. Thickness 100 to 500 feet. Shown on columnar section above olivine basalt and below Boggs Mountain flows (new), but age relations of individual units of series are imperfectly know because some units are isolated and contacts of contiguous flows are commonly obscured by sliding.

Located on Perini Hill, about 3 miles southwest of Lower Lake. Lower Lake quadrangle, in Coast Ranges, about 70 miles north of San Francisco.

**Perkasie Member** (of Brunswick Formation)

Perkasie Shale (in Newark Group)[1]

Upper Triassic: Southeastern Pennsylvania and northwestern New Jersey.

Original references: B. S. Lyman, 1893, Geological and topographical map of Bucks and Montgomery Counties: Pennsylvania Geol. Survey; 1895, Pennsylvania 2d Geol. Survey Summ. Final Rept., v. 3, pt. 2, p. 2589–2638.

M. E. Johnson and D. B. McLaughlin *in* Erling Dorf, ed., 1957, Geol. Soc. America Guidebook Atlantic City Mtg., p. 46, 50. Rank reduced to member status in Brunswick formation. Geographically extended to New Jersey where it consists of about 145 feet of red and dark-gray shale. Probably extends almost to western Montgomery County, Pa., but for part of extent is merged with thick hornfels aureole beneath large diabase sills and is indistinguishable.

Occurs near Perkasie Tunnel, Montgomery County, Pa.

Perkins Canyon Formation

Ordovician: 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. Underlies Gatecliff formation (new).

Toquima Range, Nye County.

**Perkinsville Formation**

Pliocene(?) to Pleistocene(?): Central Arizona.

R. E. Lehner, 1958, U.S. Geol. Survey Bull. 1021–N, p. 563–566, pls. 45, 47. Sedimentary rocks and intercalated lava flows. Sedimentary rocks primarily of coarse to fine gravel, but sand, silt, and some limestone also present. Gravel is increasingly coarse toward source areas north and south of Verde River. Bedding less evident to north and south, away from river. Lava is normal olivine basalts—except for one flow which is andesite. Basalt flows generally holocrystalline and porphyritic. Lava flows spread over part of Clarkdale quadrangle with uniform thickness of about 50 feet. Thickness of formation about 300 to 500 feet. Unconformably overlies all older formations in quadrangle; underlies Quaternary terrace gravel beds along Verde River at Perkinsville. Tentatively correlated with Verde formation.

Named from exposures on north side of Verde River near Perkinsville, Clarkdale quadrangle, Yavapai County.

Permenters Farm Beds (in Choctawhatchee Formation)

Miocene, middle: Western Forida.

H. R. Smith, 1941, Am. Assoc. Petroleum Geologists Bull., v. 25, no. 2, p. 269–274. Proposed to designate beds that lie above the *Arca* zone beds in Walton County. Lie below *Ecphora* zone and had been included in *Ecphora* by earlier workers. At type locality, consists of about 25 feet of fossiliferous marl. About 80 feet thick in well at Niceville.

H. S. Puri, 1953, Florida Geol. Survey Bull. 36, p. 31. Choctawhatchee redefined as stage to include all Miocene sediments of post-Alum Bluff age in Florida panhandle and their equivalents in Central and Western Gulf States. In Florida panhandle, four biofacies, *Yoldia*, *Arca*, *Ecphora*, and *Cancellaria*, are recognized. Beds referred to as Permenters Farm beds are included in *Arca* facies. Recommended that term Permenters Farm beds be dropped.

Type locality: Roadcut on east bank of Alaqua Creek in sec. 17, T. 1 N., R. 19 W., Walton County.

**Perote Member** (of Providence Sand)

Upper Cretaceous: Eastern Alabama and western Georgia.

D. H. Eargle, 1948, Southeastern Geol. Soc. [Guidebook] 6th Field Trip, p. 44, 51–53; 1950, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 105; 1955, U.S. Geol. Survey Bull. 1014, p. 70, 71 (fig. 11), 72. Consists chiefly of fine sand and silt which is carbonaceous and highly micaceous. Conformable with a coarser unnamed upper member. At type locality, approximately 150 feet thick and constitutes about half of entire Providence section. Overlies Ripley formation. Merges westward into Prairie Bluff chalk. Thins eastward, and at type locality of Providence (in Georgia) member is about 40 feet thick.

Type locality: Along U.S. Highway 29 in vicinity of village of Perote, southern Bullock County, Ala.

**Perris Quartz Diorite**[1]

Late Mesozoic(?): Southern California.

Original reference: P. H. Dudley, 1935, California Jour. Mines and Geology, v. 31, no. 4, p. 491, 501, map.

E. F. Osborn, 1939. Geol. Soc. America Bull.; v. 50, no. 6, p. 926. Noted as being the same as Val Verde tonalite (Wilson, 1937).

W. J. Miller, 1946, Geol. Soc. America Bull., v. 57, no. 5, p. 481, table 4. Described as massive to moderately gneissoid with some irregularly distributed basic inclusions or schlieren arranged roughly parallel to the foliation. Listed in plutonic series, Perris and Estell quartz diorite (Val Verde tonalite) are older than Lakeview quartz monzonite and younger than Virginia quartz norite. Cuts Box Springs complex (new). Late Mesozoic.

Richard Merriam, 1948, California Div. Mines Bull. 177, p. 14. Considered equivalent to Bonsall tonalite.

U.S. Geological Survey considers the Perris Quartz Diorite as Late Mesozoic(?).

Occurs in Perris fault block, in parts of Elsinore and Corona quadrangles, Riverside County.

Perry Formation[1]

Middle Devonian: Central Pennsylvania.

Original reference: J. P. Lesley, 1892, Pennsylvania 2d Geol. Survey Final Rept., v. 2, p. 1236–1237.

In Perry County.

**Perry Formation**[1]

Upper Devonian: Southeastern Maine, and southwestern New Brunswick, Canada.

Original reference: C. H. Hitchcock, 1861, Maine Board Agr. 6th Ann. Rept., p. 247–256.

D. H. Amos, 1958, Dissert. Abs., v. 19, no. 5, p. 1053. Discussion of geology of Calais and Robbinston quadrangles, Maine. Youngest stratified unit is Upper Devonian Perry formation. Consists of thick sequence of coarse clastic sediments containing interbedded basalt flows. All diorites and granites in area were emplaced in post-Silurian-pre-Upper Devonian interval because they exhibit intrusive contacts toward rocks of Upper Silurian age and have contributed detritus to Perry formation.

Named for development at Perry, Washington County, Maine, and elsewhere in Perry Basin.

†Perry limestone[1]

Silurian and Devonian: Eastern Missouri.

Original reference: C. R. Keyes, 1896, Missouri Geol. Survey, v. 11, p. 41.

Named for Perry County.

Perry Branch Siltstone Member (of Brodhead Formation)

Lower Mississippian: Central Kentucky.

P. B. Stockdale, 1939, Geol. Soc. America Spec. Paper 22, p. 76, 179, 188, pl. 16. Uppermost member of Brodhead formation, Morehead facies (new). Thickness 25 to 40 feet. At type section underlies Floyds Knob formation and overlies Haldeman siltstone member (new) of Brodhead formation.

Type section: Along U.S. Highway 60 at spring 1½ miles west-northwest of Olive Hill; at hill along west side of Perry Branch, Carter County.

Perry Farm Shale 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, 340, pl. 1. Includes calcareous fossiliferous shale above Norfleet limestones member (new) and below Idenbro limestone member (new). Maximum thickness in Kansas about 10 feet; at type locality of Lenapah (Oklahoma) about 15 feet.

J. M. Jewett, 1955, Kansas Geol. Survey Bull. 58, p. 69. Discussed as a cyclothem in Lenapah megacyclothem.

Type locality: NW¼NE¼ sec. 7, T. 34 S., R. 18 E., Labette County, Kans.

Perry Mountain Formation

Silurian(?): Central western Maine.

A. R. Cariani, 1959, Dissert. Abs., v. 19. no. 10, p. 2577. Well-bedded quartzites intercalated with sandy biotite-muscovite schists and staurolite schists. Oldest formation in Anson quadrangle—underlies Parmachenee formation (new).

R. J. Willard, 1959, Dissert. Abs., v. 19, no. 11, p. 2918. Composed of basal conglomerates grading into cyclical argillaceous quartz siltstones in Kennebago Lake quadrangle. Thickness about 5,000 feet. Overlies Johns Pond formation (new). Lower part(?) of formation dated as Middle Silurian (Clinton).

In northwest corner of Anson quadrangle and in Kennebago Lake quadrangle.

**Perrysburg 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. Proposed for sequence between top of Hanover shale and base of Laona sandstone of Hall (1841). Clarke (1903) and Luther (1903) divided sequence into Dunkirk below and Portland above. Chadwick (1919) renamed upper part Gowanda beds as name Portland was preoccupied. Although Dunkirk and Gowanda can be traced from place to place in general way, they intergrade vertically to such an extent they cannot be mapped separately; hence, new name is proposed. In western New York, rocks of Perrysburg comprise wedge of Upper Devonian deltaic sediments that thickens to south and east; in this wedge, lithology varies from interbedded black and gray shales containing siltstones in area bordering Lake Erie to massive siltstones and sandstones containing some gray shale in vicinity of Pennsylvania-New York State line. Thickness at type locality 416 feet; in Chautauqua County 330 feet. Comprises seven members (described from northwest to southeast—the direction of increasing grain size and clastic content): Dunkirk shale. South Wales (new), Canaseraga sandstone, Gowanda, Hume shale (new), Caneadea, and Canisteo shale (new). Contact at base sharply defined wherever exposed; top of formation recognized with certainty only as far east as Laona sandstone of Hall can be identified. From Franklin Gulf eastward overlies Wiscoy sandstone.

Wallace de Witt, Jr., and G. W. Colton, 1953. U.S. Geol. Survey Geol. Quad. Map GQ-30. In Silver Creek quadrangle, includes Dunkirk shale, South Wales, and Gowanda members. Thickness about 400 feet.

L. V. Rickard, 1957, New York Geol. Assoc. 29th Ann. Mtg. Guidebook, p. 15 (footnote). In western New York, all recognized rock units present in interval between base of Dunkirk shale and base of Laona sandstone have been considered members of one encompassing unit, Perrysburg formation. Inasmuch as Laona or its correlate has not been traced eastward into Wellsville region, term Perrysburg cannot be applied to rocks of this interval in latter area.

Wallace de Witt, Jr., 1960, Am. Assoc. Petroleum Geologists Bull., v. 44, no. 12, p. 1935 (fig. 2). Overlies Hanover shale member of Java formation (new).

Type locality: On Big Indian Creek in Perrysburg Township, Cattaraugus County.

**Perryville Limestone**

Perryville facies (of Benson Formation)

Perryville Formation[1]

Middle Ordovician: Central Kentucky.

Original reference: J. M. Nickles, 1905, Kentucky Geol. Survey Bull. 5, p. 15.

A. C. McFarlan, 1938, Geol. Soc. America Bull., v. 49, no. 6, p. 989–996, pl. 1. Formation unconformably overlies the Lexington; unconformably underlies Cynthiana.

A. C. McFarlan and W. H. White, 1948, Am. Assoc. Petroleum Geologists Bull., v. 32, no. 8, p. 1635. Referred to as facies of Benson limestone.

D. K. Hamilton, 1948, Econ. Geology, v. 43, no. 1, p. 41 (fig. 2), 42. Perryville limestone in Lexington area consists of gray crystalline limestone ranging in thickness from 15 feet to knife edge, being thinnest or absent along crest of Cincinnati arch in Fayette County. Underlies Cynthiana formation; overlies Woodburn limestone.

Named for Perryville, Boyle County. Best developed on western and southern flanks of Jessamine dome.

**Perseverance Slate**[1]

Triassic or older: Southeastern Alaska.

Original reference: G. C. Martin, 1926, U.S. Geol. Survey Bull. 776, p. 93–94.

Named for Perseverance Camp, just east of Juneau.

Persimmon Gap Shale

Upper Ordovician: Southwestern Texas.

J. L. Wilson, 1954, Am. Assoc. Petroleum Geologists Bull., v. 38, no. 12, p. 2458 (fig. 2), 2462, 2470. Greenish and drab, light-brown and pink-weathering siliceous and gypsiferous shale. Thickness at type locality 28 feet; in sections in the Solitario 40 feet. In all sections of older Paleozoic southeast of Marathon region and in the Solitario, overlies Maravillas chert and underlies Caballos novaculite.

W. B. N. Berry and H. M. Nielsen, 1958, Am. Assoc. Petroleum Geologists Bull., v. 42, no. 9, p. 2254–2259. Van der Gracht published table of formations in the Solitario (furnished by Baker) in which name Solitario formation was applied to 15 to 20 feet of bright-green siliceous and argillaceous shale between Maravillas and Caballos formations. Sellards (1932) described a green shale, 25 or 50 feet thick, overlying Maravillas chert in the Solitario. King (1937) mentioned a few feet of dark-green shale between the Maravillas and Caballos in the Rough Creek exposure. Wilson (1954) proposed name Persimmon Gap shale for shale between Caballos and Maravillas formations. Thus, Solitario formation of Baker and Sellards and Persimmon Gap shale of Wilson are same rock unit. Caballos novaculite is herein restricted to the two lower members as described by King (1937), and term Santiago revived and applied to upper three members of King's Caballos novaculite; hence, there is no need for names Persimmon Gap shale and Solitario formation.

Well exposed three-fourths of a mile up gulch east of road and ranger station at Persimmon Gap entrance to Big Bend National Park, Brewster County.

Perth Limestone Member (of Brazil Formation)

Middle Pennsylvanian: Southwestern Indiana.

H. C. Hutchinson, 1960, Indiana Geol. Survey Bull. 16, p. 19–21, pl. 16. Name proposed for marine unit that closely overlies Minshall coal. Numerous references have been made to this limestone and Wanless (1939) referred to it as Minshall limestone. Name Minshall herein abandoned. At type locality, limestone is gray, hard, argillaceous, and fossiliferous; weathers brown. Thickness 6.3 feet. Member lies 0.2 foot to 15 feet above Minshall coal and 3 to 15 feet below Coal II, which lies near top of Brazil formation.

Type locality: Abandoned strip mine of G. & F. Corp. in SW¼NE¼ sec. 3, T. 13 N., R. 7 W., Clay County, one-half mile northwest of town of Perth.

Peru Beds[1]

Pleistocene: Northeastern Illinois.

Original reference: C. O. Sauer, 1916, Illinois Geol. Survey Bull. 27.

Occurs along sides of valley, west of Peru, near western line of La Salle County.

Peru Limestone[1]

Middle Devonian: Central Pennsylvania.

Original reference: J. P. Lesley, 1878, Pennsylvania 2d Geol. Survey Rept. F, p. xix.

Occurs for several miles east and west of Peru, Juniata County, in Tuscarora Valley.

Peru Sandstone[1]

Lower or Middle Devonian: Central Pennsylvania.

Original reference: J. P. Lesley, 1878, Pennsylvania 2d Geol. Survey Rept. F, p. xix.

Occurs at Peru, Juniata County.

†Pescadero Series[1]

Upper Cretaceous, Eocene and Miocene: Western California.

Original reference: G. H. Ashley, 1895, Jour. Geology, v. 3, p. 435–439.

Named for exposures at Pescadero Point and near Pescadero, San Mateo County.

**Pescado Tongue** (of Mancos Shale)

Upper Cretaceous: Northwestern New Mexico.

W. S. Pike, Jr., 1947, Geol. America Mem. 24, p. 9, 34–35, fig. 2. Consists mostly of gray marine shale; underlain by a regular massive cliff-forming sandstone 35 feet thick. Splits Gallup member of Mesaverde into upper and lower parts. Tongue is 50 feet thick in area of typical exposure, and its lower contact occurs 209 feet above top of main mass of Mancos shale.

Named from typical exposures on north side of valley of Pescado Creek, below Pescado village, in sec. 32, T. 11 N., R. 17 W., and sec. 5, T. 10 N., R. 17 W., McKinley County.

**Peshastin Formation**[1]

Pre-Tertiary: Central Washington.

Original reference: G. O. Smith. 1903. U.S. Geol. Survey Prof. Paper 19.

C. E. Weaver, 1937. Washington [State] Univ. Pubs. in Geology, v. 4, p. 19. Peshastin formation consisting of black slate and lenses of limestone and bands of chert has been mapped in both Mount Stuart and Snoqualmie quadrangles and was considered by Smith (1903) as of probable Jurassic age. Later investigations by W. S. Smith (1916, Jour. Geology, v. 24, no. 6) indicate that, on basis of fossil evidence, Peshastin rocks exposed in mountains at headwaters of south fork of Skyhomish River are of Ordovician age.

R. M. Pratt, 1959, Dissert, Abs., v. 19, no. 12, p. 3278. Oldest rocks in Mount Stuart area are Chiwaukum schist and Peshastin slate. Peshastin slate and Hawkins formation form an apparently conformable sequence.

Named for canyon of Peshastin Creek, near mouth of Negro Creek, Mount Stuart quadrangle.

Peshastin Glacial Stage

Pleistocene: Central Washington.

B. M. Page, 1939, Jour. Geology, v. 47, no. 8, p. 785, 787–795. Oldest of three successive stages of valley glaciation in Leavenworth area. Characterized by deposition of Peshastin till and Peshastin outwash. Followed by Leavenworth glacial stage (new).

Petaca Schist

Petaca schist phase (of Ortega Quartzite)

Precambrian (Proterozoic): Central northern New Mexico.

Evan Just, 1937, New Mexico School Mines Bull. 13, p. 13 (table 1), 43, pl. 3. Minor quartz-muscovite schist phase of Ortega quartzite. Locally contains quartzite members, some places conglomeratic, and in other places quite feldspathic. Along strike grades into typical Ortega quartzite.

Fred Barker, 1958, New Mexico Bur. Mines Mineral Resources Bull. 45, p. 34–36, pl. 1. Typical Petaca schist is light-gray schistose slabby to massive slightly muscovite quartzite. Represents altered parts of the Ortega quartzite, part of the lower Kiawa Mountain formation, and many layers of Burned Mountain metarhyolite. Mapped separately from Ortega quartzite.

Nearly restricted to Mesa la Jarita, Las Tablas quadrangle, Rio Arriba County.

**Petaluma Formation**[1]

Pliocene, lower: Northern California.

Original reference: R. E. Dickerson, 1922, California Acad. Sci. Proc., 4th ser., v. 11, no. 19, map.

F. A. Johnson, 1943, California Div. Mines Bull. 118, p. 623 (fig. 276), 624 (fig. 277), 625. In Petaluma region, consists chiefly of clays with some interbedded sandstone and rare bodies of thin beds and lenses of clayey limestone. Thickness about 4,000 feet. Unconformable beneath Sonoma volcanics and Merced formation. Middle Pliocene.

C. E. Weaver, 1949, Geol. Soc. America Mem. 35, p. 16 (table 3), 85–91, pls. 6, 10, 11. Described in area immediately north of San Francisco Bay where it is exposed in four areas. Largest exposure trends S. 40° E. from vicinity of Penn Grove into Tolay Creek valley where it abuts against sandstone of Franciscan group or is covered by sand and gravels of Merced formation; exposed thickness here about 4,000 feet. Northeast limits of formation (north of Petaluma Valley) lie along an irregular contact with the Sonoma volcanics; folded and beveled Petaluma beds are unconformable beneath Sonoma volcanics. Base not exposed at any locality investigated.

R. A. Stirton, 1952, Am. Assoc. Petroleum Geologists Bull., v. 36, no. 10, p. 2011–2025. Discussion of vertebrate remains in Petaluma. Fossil equine specimens indicate an age transitional between middle Pliocene (Hemphillian) and late Pliocene (Blancan).

G. T. Cardwell, 1958, U.S. Geol. Survey Water-Supply Paper 1427, p. 26 (table 6), 32–35, pl. 1. Described in Santa Rosa and Petaluma Valleys where it is composed of strongly folded continental and brackish-water clay, shale, sand, and sandstone and contains some conglomerate and nodular limestone. Exposed thickness probably exceeds 3,000 feet. May be in depositional contact with Franciscan group, but only fault contacts are mapped. Unconformably overlain by Sonoma volcanics, Merced formation, and alluvium. Table 6 shows age middle or early Pliocene; map bracket shows Pliocene. Includes Orinda formation of Johnson (1934, unpub. thesis). Exposures largely confined to belt 1 to 2 miles wide along southwestern flank of Sonoma Mountains, extending from north of Penn Grove to near mouth of Tolay Creek.

Apparently named for exposures in vicinity of Petaluma, Sonoma County.

Petan Trachyte or Basalt (in Vieja Group)

Tertiary: Southwestern Texas.

D. L. Amsbury, 1957, Dissert. Abs., v. 17, no. 9, p. 1981. Named in a stratigraphic sequence as younger than Moonstone rhyolite (new) and older than Chinati Mountain (emended).

R. K. DeFord, 1958, Texas Jour. Sci., v. 10, no. 1, p. 13, 28. Uppermost formation Vieja group redefined. Consists of trachyandesite porphyry, dark greenish-gray to brownish-gray on fresh exposures. Maximum thickness about 300 feet. Appears as erosion remnants in form of small hills on Brite ignimbrite (new); discordantly underlies post-volcanic gravel.

D. L. Amsbury, 1958, Texas Univ. Bur. Econ. Geology Geol. Quad. Map 22. Described in Pinto Canyon area where it overlies Brite rhyolite and underlies rocks of Chinati Mountain group. Type locality designated.

Type locality: Steep hill on which is Cleveland triangulation station. Named from Petan Ranch which occupies Capote Rim and Capote Draw from south fence of Brite Ranch to head of Pinto Canyon, Rim Rock country, Presidio County.

Pete terrane[1]

Cretaceous: Kansas.

Original reference: C. R. Keyes, 1915, Iowa Acad. Sci. Proc., v. 22, p. 255.

Derivation of name not stated.

**Petersburg Formation[1]**

Middle Pennsylvanian: Southwestern Indiana.

Original reference: M. L. Fuller and G. H. Ashley, 1902, U.S. Geol. Survey Geol. Atlas, Folio 84, p. 2.

C. E. Wier, 1950, U.S. Geol. Survey Coal Inv. Map C–1. Described in Clay, Greene, and Sullivan Counties. Petersburg formation, as used by Cumings (1922, Indiana Geol. Survey Spec. Pub. 21), included rocks between unconformity at top of Coal IV and unconformity at top of Coal VII. Formation here restricted to rocks in interval between unconformity above Coal IV and unconformity above Alum Cave limestone member which is above Coal V. Restricted Petersburg includes Coals IVa and V and averages 115 feet thick. Consists of 95 to 125 feet of sandstone, shale, limestone, and coal. Interval from unconformity above Coal IV and base of Coal IVa is composed of 30 to 50 feet of sandstone and shale which grade into each other laterally and vertically. Overlies Linton formation (new); underlies Dugger formation.

Named for Petersburg, Pike County.

†Petersburg Granite[1]

Late Paleozoic: Eastern Virginia.

Original reference: A. I. Jonas, 1928, Virginia Geol. Survey prelim. ed. of geol. map of Virginia.

R. O. Bloomer, 1939, Virginia Geol. Survey Bull. 51, p. 141–145. In Richmond area, Petersburg granite consists of three facies: most common is gray to pink, medium-grained granite; a blue, relatively fine-grained facies (just west of Richmond); and a porphyritic facies occurs in a belt which extends north and south along eastern margin of Triassic basin. Intrudes Wissahickon gneiss; contact forms a zone of apophyses approximately 1 mile wide. Underlies Triassic sediments. Late Paleozoic.

First described from occurrences near Petersburg, Dinwiddie County, Va. Petersburg granite is a batholithic intrusion that extends from Hanover County, Va., southward into North Carolina.

Peters Creek Breccia

Middle Mississippian: West-central Indiana.

C. L. Bieber, 1959, Indiana Acad. Sci. Proc., v. 68, p. 265–267. Intraformational limestone breccia in Middle Mississippian limestone. As exposed at waterfall in small branch valley of Peters Creek, bed is nearly 6 feet thick. Bedding is indistinct, but associated limestones above and below are well bedded and nearly horizontal except for local rolls and arches. Over 90 percent of blocks (phenoclasts) in matrix are limestone. Base of breccia is in sharp contact with a wavy laminated layer of limestone 4 inches thick. Based mainly on lithology and sequence, age of breccia is believed to be early St. Louis.

Well exposed in SW¼NW¼ sec. 36, T. 16 N., R. 5 W., southwest of Fincastle, Putnam County.

**Peters Creek Quartzite**

Peters Creek Schist[1] or Formation

Lower Paleozoic(?) (Glenarm Series): Southeastern Pennsylvania, northern Maryland, and northeastern Virginia.

Original reference: A. I. Jonas and E. B. Knopf, 1921, Washington Acad. Sci. Jour., v. 11, p. 447.

G. W. Stose and A. I. Jonas, 1939, Pennsylvania Geol. Survey, 4th ser., Bull. C–67, p. 90–91. Peters Creek quartzite described in York County, where it underlies a belt 6 miles wide that covers most of southeastern corner of area. Divided into two parts by narrow area underlain by Cardiff conglomerate and Peach Bottom slate. At its northwestern boundary, in contact with Wissahickon formation. No estimate of thickness made. Major structure of the Peters Creek is synclinal. Intruded by Sykesville granite. Precambrian(?).

G. W. Stose and A. J. Stose, 1948, Am. Jour. Sci., v. 246, no. 7, p. 405, 408. Quartzose mica schist beneath Arvonia slate should be called Peters Creek formation. If Peters Creek formation belongs in Taconic sequence, it is part of a series that ranges in age up to Lower Trenton.

S. L. Agron, 1950, Geol. Soc. America Bull., v. 61, no. 11, p. 1267–1268. Peters Creek is series of interbedded chlorite-sericite and quartz-albite schists which underlies and encloses Peach Bottom syncline. Peters Creek lies above the Wissahickon schist and underlies Cardiff conglomerate.

P. W. Choquette, 1960, Geol. Soc. America Bull., v. 71, no. 7, p. 1029 (table 1). Formation included in Glenarm series which is considered pre-Silurian.

Carlyle Gray and others, 1960, Geologic map of Pennsylvania (1:250,000): Pennsylvania Geol. Survey, 4th ser. Probably Lower Paleozoic.

Named for exposures along Peters Creek which enters Susquehanna River at Peach Bottom, Lancaster County, Pa.

Peters Mountain Sandstone (in Pocono Formation)[1]

Mississippian: Central Pennsylvania.

Original reference: B. Willard, 1936, Geol. Soc. America Bull., v. 47, no. 4, p. 573.

Bradford Willard and A. B. Cleaves, 1938, Pennsylvania Geol. Survey, 4th ser., Bull. G–8, p. 18. Platy gray sandstone with some pebble beds. Overlies Second Mountain member and underlies Cove Mountain member (both new).

Named for Peters Mountain, Dauphin County.

**Peterson Limestone** (in Gannett Group)[1]

Lower Cretaceous: Southeastern Idaho and western Wyoming.

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

R. E. Peck, 1941, Jour. Paleontology, v. 15, no. 3, p. 285–286. Considered Lower Cretaceous on basis of faunal studies.

G. R. Mansfield, 1952, U.S. Geol. Survey Prof. Paper 238, p. 17, 42–43, pl. 1. Described in Ammon quadrangle, Idaho, where it is chiefly massive dark dense limestone, underlies Bechler conglomerate and overlies Ephraim conglomerate. Locally in juxtaposition with Twin Creek limestone. Involved in folds and faults. Thickness appears to be about 200 feet. Lower Cretaceous.

C. A. Moritz, 1953, Intermountain Assoc. Petroleum Geologists [Guidebook] 4th Ann. Field Conf., p. 65 (table 1), 66–67. In Gannett Hills region, Wyoming, consists of about 125 feet of gray compact sublithographic limestone with a few conglomeratic and brecciated zones. Overlies Ephraim conglomerate; underlies Bechler formation.

W. L. Stokes, 1955, Wyoming Geol. Assoc. Guidebook 10th Ann. Field Conf., p. 80, 81 (fig. 1). Thickness along Idaho-Wyoming boundary about 200 feet; wedges out eastward.

H. R. Wanless, R. L. Belknap, and Helen Foster, 1955, Geol. Soc. America Mem. 63, p. 56, pl. 21. Described in Jackson Hole area as limestone member of Gannett group. Light- to medium-blue-gray and sublithographic. Thickness about 135 feet on Fall Creek; 113 feet in Snake River Bluff near mouth of Dog Creek. Overlies Ephraim conglomerate member; underlies Bechler "conglomerate" member.

Named for exposures east of Peterson's Ranch, along Tygee Creek, sec. 34, T. 7 S., R. 46 E., Boise meridian, Freedom quadrangle, Bannock County, Idaho.

Petersville Shale[1]

Mississippian: Northeastern Kentucky.

Original reference: W. C. Morse and A. F. Foerste, 1912, Kentucky Geol. Survey Bull. 16, p. 24.

Named for Petersville, Lewis County.

Petes Summit 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 is isolated by surrounding Tertiary volcanic rocks.

Clipper Canyon, Toquima Range, Nye and Lander Counties.

Petoskey Limestone[1] (in Traverse Group)

Middle Devonian: Northern Michigan.

Original reference: A. W. Grabau, 1902, Michigan Geol. Survey Rept. 1901, p. 201, 210.

G. A. Cooper and others, 1942, Geol. Soc. America Bull., v. 53, no. 12, pt. 1, p. 1776, chart 4. Contains several faunas of different age; at base is an assemblage suggestive of the Norway Point of Alpena County; above is a fauna resembling the Potter Farm formation; this is followed by an assemblage containing an element of the Thunder Bay fauna.

Probably named for exposures at Petoskey.

**Petrified Forest Member** (of Chinle Formation)

Upper Triassic: Northern Arizona, southeastern Nevada, west-central New Mexico, and southern Utah.

G. B. Maxey, 1946, Am. Jour. Sci., v. 244, no. 5, p. 337. Incidental mention in discussion of geology of Pavant Range, Millard County, Utah. Name credited to H. E. Gregory.

H. E. Gregory, 1947, Geol. Soc. America Bull., v. 58, no. 3, p. 223 (table 1), 228. Upper part light-red and brown, irregularly bedded sandstones and sandy, argillaceous, carbonaceous, and calcareous shales widely variable in composition; lower part brilliantly variegated friable shales of various composition and degrees of hardness, which weather into badland forms; contains fossil wood. Thickness 300 to 400 feet. Underlies Springdale sandstone member (new); overlies unnamed sandstone in basal part of formation.

H. E. Gregory, 1950, U.S. Geol. Survey Prof. Paper 220, p. 52 (table), 66, 67–68, strat. sections. Described in Zion National Park region where it is 650 to 800 feet thick. Derivation of name stated.

G. A. Kiersch, 1955, Mineral resources Navajo-Hopi Indian Reservations Arizona-Utah: Tucson, Univ. Arizona Press, v. 2, p. 4 (fig. 1), 5. In Navajo country, underlies Owl Rock member (new) and overlies Monitor Butte member (new). Locally overlies Shinarump conglomerate. Predominantly claystone but contains sandstone (Sonsela beds) in eastern part.

J. H. Stewart, 1957, Am. Assoc. Petroleum Geologists Bull., v. 41, no. 3, p. 457–458. Described in southeastern Utah where it conformably underlies Owl Rock member and in most areas conformably overlies Monitor Butte member; conformably overlies Moss Back member in part of White Canyon and Elk Ridge areas. Thickness in Monument Valley area 500 to 700 feet; 100 feet in White Canyon area and southern part of Elk Ridge area; north of these areas 70 feet or less. Near junction of Green and Colorado Rivers, loses identity probably by intertonguing and intergrading with Owl Rock member. Corresponds to "C" division of Chinle formation described by Gregory (1917, U.S. Geol. Survey Prof. Paper 93) in northeastern Arizona. Geographically extended into Nevada and New Mexico.

R. F. Wilson, 1959, Dissert. Abs., v. 19, no. 11, p. 2918. As result of this study, the Chinle is redefined to include only lower part of Petrified Forest member.

Named for fact that it contains band of fossil wood closely resembling dominant rock in Petrified Forest of Arizona. Present in all of northern Arizona and southern Utah, extends into southeastern Nevada and west-central New Mexico. In most of these areas, forms thickest and most characteristic part of formation.

Petros 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. Two sandstones separated by a shale break that includes Petros coal. Thickness 50 to 60 feet in type area; 45 feet in Cross Mountain section. Underlies a shale interval 40 to 170 feet thick that includes Blue Gem coal and in turn underlies Sand Gap sandstone (new); overlies a shale interval 40 to 190 feet thick that contains Coal Creek coal and in turn overlies the Stephens sandstone (new).

Named from town of Petros, Morgan County.

**Pewabic Amygdaloid**[1] (in Ashbed Group)

Precambrian (Keweenawan): Northern Michigan.

Original reference: R. Pumpelly, 1873, Michigan Geol. Survey, v. 1, pt. 2, p. 21–25, 28.

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 Pewabic mine, Houghton County.

**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).

Copper district of Keweenaw Point.

Pewabic Quartzite[1]

Precambrian (Huronian) : Northeastern Minnesota.

Original reference: N. H. Winchell, 1888, Minnesota Geol. Nat. History Survey 16th Ann. Rept., p. 79, 86.

Occurs in region of Gunflint Lake to Ogishke Muncie Lake. Named for Chippewa word meaning iron.

**Pewabic West Conglomerate**[1] (in Portage Lake Lava Series)

Precambrian (Keweenawan) : Northern Michigan.

Original reference: A. R. Marvine, 1873, Michigan Geol. Survey, v. 1, pt. 2, p. 82, chart.

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.

Probably named for occurrence in old Pewabic West mine, Houghton County.

**Pfeifer Shale Member** (of Greenhorn Limestone)[1]

Upper Cretaceous: Northwestern Kansas.

Original reference: N. W. Bass, 1926, Kansas Geol. Survey Bull. 11, p. 32.

R. C. Moore, J. C. Frye, and J. M. Jewett, 1944, Kansas Geol. Survey Bull. 52, pt. 4, p. 153. Chalky shale and chalky limestone in alternating layers, "Fencepost limestone bed" at top; blue gray, weathers to light tan. In Hamilton County, Pfeifer shale member and the underlying Jetmore chalk member are thicker than farther east; they cannot be distinguished and have been together designated the Bridge Creek limestone member. Thickness of Pfeifer shale typically 19 to 21 feet in Ellis and Russell Counties. Includes Fencepost limestone bed. Underlies Fairport chalky shale member of Carlile formation.

Named for exposures 2½ miles northwest of Pfeifer, Ellis County.

Phalen Lake Volcanics[1]

Tertiary(?) : Northeastern Washington.

Original reference: C. E. Weaver, 1920, Washington Geol. Survey Bull. 20, p. 101, map.

Forms steep escarpment overlooking west side of Phalen Lake, Stevens County.

Phantom Flows, Lavas

Pleistocene: Southwestern Oregon.

Howel Williams, 1942, Carnegie Inst. Washington Pub. 540, p. 30, pl. 6. Oldest of visible lavas of former Mount Mazama seems to have issued from vent close to the Phantom Ship, on south wall of caldera. How high

Phantom cone rose is impossible to tell; after activity ceased, summit was eroded and buried by flows and other ejecta from central vents of Mount Mazama. Unconformity separates Phantom flows from those of Mazama proper.

Phantom Ship, probably remnant of Phantom Cone, is on south wall of caldera of Crater Lake.

Phantom Migmatite

Precambrian: Northern Arizona.

Ian Campbell and J. H. Maxson, 1937, 17th Internat. Geol. Cong. Abs. of Papers, p. 65 (1939, Rept., v. 2, p. 260); 1938, Carnegie Inst. Washington Year Book 37, p. 363. Mentioned in discussion of Archean rocks of Grand Canyon.

Type locality: Phantom Creek, Grand Canyon area.

Phantom Canyon Quartzite

Precambrian (Algonkian): South-central Colorado.

J. D. Martinez, 1959, Dissert. Abs., v. 20, no. 3, p. 995. Incidental mention only.

In vicinity of Canyon City.

Phelan Limestone

Carboniferous(?): Northwestern Utah.

V. E. Peterson, 1942, Econ. Geology, v. 37, no. 6, p. 471 (table 1). Consists of coarse to finely crystalline, light blue-gray, massive-bedded limestone, locally cherty. Thickness 1,000 to 1,500 feet. Overlies newly named Wardlaw shale.

In Ashbrook mining district on west side of Goose Creek Range.

Phelps Sandstone[1]

Lower Mississippian: Southwestern Missouri.

Original reference: E. M. Shepard, 1898, Missouri Geol. Survey, v. 12, pt. 1, p. 49, 77–82.

E. B. Branson and M. G. Mehl, 1939, (abs.) Missouri Acad. Sci. Proc., v. 4, no. 6, p. 167. Bushberg is equivalent to the Phelps and should be called Phelps. The Phelps is basal Mississippian.

M. G. Mehl, 1960, Denison Univ. Jour. Sci. Lab., v. 45, art. 5, p. 71–72. Phelps sandstone as defined by Shepard has not proven useful unit in stratigraphic studies except, perhaps, as a subsurface catchall. In light of uncertainty of stratigraphic connotation of Phelps, it is here recommended that term be dropped from list of names in Missouri columnar section.

Named for Phelps mines, Greene County.

**Phi Kappa Formation**[1]

Lower Ordovician and later(?): Central Idaho.

Original reference: L. G. Westgate and C. P. Ross, 1930, U.S. Geol. Survey Bull. 814, p. 10, 18.

C. P. Ross and J. D. Forrester, 1958, Idaho Bur. Mines and Geology Bull. 15, p. 8. Phi Kappa formation, largely argillaceous quartzite, and the unnamed argillite beneath it are together probably broadly equivalent to Ramshorn slate, Kinnikinic quartzite, and Saturday Mountain formation.

Named for exposures along Phi Kappa Creek, Hailey quadrangle.

Philadelphia Brick Clay[1]

Pleistocene: Southwestern New Jersey and southeastern Pennsylvania.

Original reference: H. C. Lewis, 1881, Philadelphia Acad. Nat. History Sci. Proc., v. 32, p. 258–272, 296–309.

Philadelphia is in part built on this clay.

†Philadelphia Mica Schist and Gneisses[1]

Precambrian (Glenarm Series) : Southeastern Pennsylvania.

Original reference: C. E. Hall, 1881, Pennsylvania 2d Geol. Survey Rept. $C_6$, p. 28–31, map.

Extends from Delaware River at Trenton westward across Schuylkill River into Delaware County.

Philadelphia Red Gravel[1]

Pleistocene: Southeastern Pennsylvania.

Original reference: H. C. Lewis, 1881, Philadelphia Acad. Nat. Sci. Proc., v. 32, p. 258–272, 296–309.

Well exposed near University of Pennsylvania in Philadelphia.

†Philipsburg Formation[1]

Lower Ordovician: Eastern New York and northwestern Vermont.

Original reference: R. P. Whitfield, 1890, Am. Mus. Nat. History Bull., v. 3, p. 25–28.

Philipsburg Series[1]

Lower Ordovician and older(?) : Southern Quebec, Canada, and northwestern Vermont.

Original reference: W. E. Logan, 1863, Canada Geol. Survey, p. 273–280, 844–854.

Named for village of Philipsburg, Quebec, where lower formations of series are well exposed.

Philson Limestone (in Conemaugh Formation)[1]

Pennsylvanian: Southwestern Pennsylvania.

Original reference: F. and W. G. Platt, 1877, Pennsylvania 2d Geol. Survey Rept. $H_3$, p. 286, 292.

Probably named for exposures at or near Philson, Somerset County.

Phipsburg Limestone[1]

Age(?) : Maine.

Original reference: C. T. Jackson, 1838, Rept. on geology of Maine, v. 2, p. 61–62.

Phipsburg Basin.

Phoenix Beds[1]

Cretaceous: Oregon.

Original reference: F. M. Anderson, 1902, California Acad. Sci. Proc., 3d ser., v. 2, p. 1–62.

Southern part of Oregon Basin.

**Phoenix Limestone Lentil** (of Bingham Quartzite)[1]

Pennsylvanian: Central northern Utah.

Original reference: A. Keith, 1905, U.S. Geol. Survey Prof. Paper 44, map, sections.

Crops out at mouth of Phoenix mine, Bingham district.

Phoenix Volcanic Group[1]

Mesozoic(?) and older(?): Southern British Columbia, Canada, and northeastern Washington.

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

The town of Phoenix is in midst of this large though interrupted area of basic volcanics.

Phoenix or Schroeppel Shale[1]

Silurian: Central New York.

Original reference: G. H. Chadwick, 1918, Geol. Soc. America Bull., v. 29, p. 327–368.

D. W. Fisher, 1959, New York State Mus. Sci. Service Map and Chart Ser. No. 1. Gillette (1947) in his detailed study of Clinton group ignored Chadwick's (1918) Phoenix and Schroeppel shales, probably because they were so loosely defined. Instead he introduced name Willowvale for the green fossiliferous shale beneath the Herkimer and above the Kirkland. Gillette's view is followed in present report.

Type locality: At Phoenix, Schroeppel Township, on Oswego River, Oswego County.

†Phoenix Mine Group[1]

Precambrian (Keweenawan): Northern Michigan.

Original reference: R. D. Irving, 1883, U.S. Geol. Survey Mon. 5, p. 175–178. Exposed in Phoenix mine in Keweenaw County.

**Phoenix Park Quartz Latite**[1] (in Alboroto Group)

Tertiary, middle or late: 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. Upper part is biotite-hornblende latitic rhyolite; includes Equity and Phoenix Park quartz latites [both part of Alboroto group] of Creede district.

Named for development about Phoenix Park, Creede district.

†Phoenixville Shale (in Newark Group)[1]

Upper Triassic: Southeastern Pennsylvania.

Original reference: B. S. Lyman, 1894, Am. Philos. Soc. Proc., v. 33, p. 197–215.

At Gwynedd and Phoenixville tunnels, Bucks and Montgomery Counties.

**Phosphoria Formation**[1]

Phosphoria Group

Permian: Idaho, western Montana, northeastern Utah, and western Wyoming.

Original reference: R. W. Richards and G. R. Mansfield, 1912, Jour. Geology, v. 20, p. 683–689.

H. D. Thomas, 1934, Am. Assoc. Petroleum Geologists Bull., v. 18, no. 12, p. 1655–1697. Marine limestone and sandstone tongues extend southeastward from the Phosphoria and Dinwoody formations of Wind River Mountains and Owl Creek Mountains, interfingering with red shales in base of Chugwater formation in central and southeastern Wyoming. Intercalated marine beds and red shales constitute the red-bed "Embar" of central Wyoming. Phosphoria includes Sybille tongue (new), Forelle tongue, and Ervay tongue (new).

G. E. Condra E C. Reed, and O. J. Scherer, 1940, Nebraska Geol Survey Bull. 13, p. 2, 6, 9; 1950, Nebraska Geol. Survey Bull. 13–A, p. 2, 3, 6, 9. Group comprises (ascending) Opeche shale, Minnekahta limestone, Glendo shale (new), Forelle limestone, and Freezeout shale. Overlies Cassa group (new); underlies Dinwoody formation or Spearfish formation (redefined). Permian.

N. D. Newell, 1948, Geol. Soc. America Bull., v. 59, no. 10, p. 1056 (fig. 2), 1057. In Confusion Range, Utah, Phosphoria formation, 4,555 feet thick, overlies the Kaibab and underlies Woodside.

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.

J. J. McCue, 1955, (abs.) Wyoming Univ. Pubs., v. 19, no. 2, p. 82. In southeastern part of Big Horn Basin includes Nowood member (new).

V. E. McKelvey and others, 1956, Am. Assoc. Petroleum Geologists Bull., v. 40, no. 12, p. 2844–2852; 1959, U.S. Geol. Survey Prof. Paper 313–A, p. 20–31. Phosphoria formation consists of chert, carbonaceous mudstone and phosphorite in its typical area in southeastern Idaho. These rocks intertongue with, and pass laterally into, sandstone in south-central Montana and northwestern Wyoming, carbonate rock in west-central Wyoming, and carbonate rock and subordinate sandstone in northeastern Utah; thin tongues of phosphatic and cherty rocks persist over all of these areas. Carbonate rocks in turn intertongue with, and pass laterally into, greenish-gray and red beds in eastern Wyoming, southeastern Montana, eastern Utah, and northwestern Colorado. Plan of nomenclature developed to describe these rocks has following elements: (1) retains name Phosphoria formation for chert-mudstone-phosphorite facies and identifies as tongues of the Phosphoria rocks of these lithologic types that interfinger with sandstone and carbonate rock along fringe of phosphate field; (2) retains name Park City formation for sequence of carbonate rock and sandstone in Utah, restores this name for similar carbonate rock in west-central Wyoming, and identifies as tongues of the Park City formation beds of carbonate rock that interfinger with other formations in Idaho, western Wyoming, and Montana; (3) introduces name Shedhorn sandstone, for sandstones of Phosphoria age in northwestern Wyoming and southwestern Montana. Three members recognized at type locality—Meade Peak phosphatic shale, Rex chert, and cherty shale. Three other members—the lower cherty member (laterally continuous with lower beds of Meade Peak), Retort phosphatic shale member, new, (laterally continuous with the cherty shale member), and Tosi chert member, new, (laterally continuous with upper part of the Retort and cherty shale member)—are not present in broader area of typical development of the Phosphoria. Eastward, parts of Phosphoria grade laterally into sandstone of Shedhorn and carbonate rock of Park City formations, but other parts extend as tongues over most of field. Thickness at type locality 250 to 450 feet; thickens to about 1,300 feet in south-central Idaho. Underlying formations: Quadrant quartzite, Montana; Tensleep sandstone, Wyoming; Wells formation, Idaho; Weber quartzite or sandstone, Utah and Colorado.

Named for typical exposures in Phosphoria Gulch, which joins Georgetown Canyon, 2½ miles northwest of Meade Park, Idaho.

Piasa Limestone Member (of Modesto Formation)

Piasa Limestone (in McLeansboro Formation)[1]

Piasa Limestone (in McLeansboro Group)

Pennsylvanian: Southeastern and southwestern Illinois.

Original reference: H. E. Culver, 1925, Illinois Geol. Survey Coop. Min. Ser. Bull. 29, p. 20.

J. R. Ball, 1952, Illinois Geol. Survey Bull. 77, p. 21 (table), 30–31. Included in Sparland cyclothem, McLeansboro group. Overlies Danville (No. 7) coal; underlies unnamed shales.

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 37, 48 (table 1), pl. 1. Rank reduced to member status in Modesto formation (new). In southeastern area, occurs below De Graff coal member (new); in southwestern area occurs below Rock Branch coal member (new), Piasa limestone, De Graff coal, Pond Creek coal, and Lake Creek coal members may be included in complex West Franklin limestone member in eastern part of area. 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: E½ sec. 25, T. 8 N., R. 10 W., Jersey County. Named for Piasa Creek.

†Picacho Limestone[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 Picacho, Lincoln County, in vicinity of which lower part is well exposed.

Picacho de Calera Formation[1]

Upper Devonian: Southeastern Arizona.

Original reference: A. A. Stoyanow, 1936, Geol. Soc. America Bull., v. 47, no. 4, p. 485, 488.

W. D. Pye, 1959, Arizona Geol. Soc. Guidebook 2, p. 277. Age given as Upper Devonian in catalog of formation names in southern Arizona and northern Sonora.

In Picacho de Calera Hills, 25 miles northwest of Tucson.

Picard Shale Member (of Nesson Formation)

Jurassic: Subsurface in Montana and North Dakota, and Manitoba, Canada.

J. W. Nordquist, 1955, Billings Geol. Soc. Guidebook 6th Ann. Field Conf., p. 104, 105, fig. 2. Shale unit that conformably overlies Poe evaporite member (new) and underlies Kline member (new). In type section, consists of 40 feet of dark-red shale which is slightly silty in part and contains masses or thin interbeds of white earthy gypsum in lower half of unit. Thins laterally toward margins of Williston basin.

Type section: Interval 6,610 to 6,650 feet in Deep Rock Oil Corp. No. 1 Picard well, center NW NE sec. 6, T. 29 N., R. 52 E., Roosevelt County, Mont.

**Picayune Formation** (in Silverton Volcanic Group)

Picayune Quartz Latite (in Silverton Volcanic Series)

Picayune Volcanic Group (in Silverton Volcanic Series)[1]

Tertiary, middle and upper: Southwestern Colorado.

Original reference: W. Cross and E. Howe, 1905, U.S. Geol. Survey Geol. Atlas, Folio 120.

E. S. Larsen, Jr., and Whitman Cross, 1956, U.S. Geol. Survey Prof. Paper 258, p. 14, 76–77, pl. 1. Picayune quartz latite made up of interlayered flows, tuffs, breccias, and agglomerates of a quartz latite of intermediate silica content, in San Juan region. Rocks chiefly dark-purple or greenish quartz latites grading into rhyolites on one hand and into darker quartz latites on the other. Thickness 1,800 feet.

Pickens Sandstone[1]

U.S. Geological Survey currently classifies the Picayune as a formation in Silverton Volcanic Group and designates the age as middle and late Tertiary on basis of a study now in progress.

Small exposures in Animas Valley and in its minor tributary, Picayune Gulch, from which unit takes its name.

Pickaway Limestone (in Greenbrier Limestone)[1]

Mississippian (Meramecian): Southeastern West Virginia and southwestern Virginia.

Original reference: D. B. Reger, 1926, West Virginia Geol. Survey Rept. Mercer, Monroe, and Summers Counties, p. 450–473.

P. H. Price and E. T. Heck, 1939, West Virginia Geol. Survey [Rept.] Greenbrier County, p. 272–277; J. M. Weller and others, 1948. Geol. Soc. America Bull., v. 59, no. 2, chart 5 (columns 98, 99). Limestone in Greenbrier series. Underlies Union limestone; overlies Taggard formation [shale]. Meramecian series.

D. B. Reger, 1950, Am. Assoc. Petroleum Geologists Bull., v. 34, no. 9, p. 1910–1912. Discussion of paper by Wells (1950, Am. Assoc. Petroleum Geologists Bull., v. 34, no. 5). Butts (1927, Oil and gas possibilities at Early Grove, Scott County, Virginia) ignored writer's [Reger] previous terminology. He used names Cove Creek limestone and Fido sandstone for certain stages of Mauch Chunk and assigned everything between the Gasper (Upper Union) and St. Louis (Hillsdale) to the Ste. Genevieve. Use of Cove Creek and Fido was violation of custom because writer's names were already in print. Butts' classification of rocks to the Ste. Genevieve was merely an avoidance of Pickaway, Taggard, Patton, and Sinks Grove.

Type locality: Along State road between Pickaway and Union, Monroe County, W. Va.

Pickens Sandstone[1]

Pennsylvanian: Northern West Virginia.

Original reference: J. A. Taff and A. H. Brooks, 1896, U.S. Geol. Survey Geol. Atlas, Folio 34.

Named for Pickens, Randolph County.

**Pickering Gneiss**[1]

Precambrian: Eastern Pennsylvania and New Jersey.

Original references: B. L. Miller, 1912, Econ. Geology, v. 7, p. 767; 1925, Pennsylvania Geol. Survey, 4th ser., Bull. $M_7$, p. 61–66; F. Bascom, 1932, U.S. Geol. Survey Geol. Atlas, Folio 223.

W. S. Bayley, 1941, U.S. Geol. Survey Bull. 920, p. 12–45, pl. 5. Area of report is Delaware Water Gap and Easton quadrangles, New Jersey and Pennsylvania. There is in the Highlands a series of schists and gneisses which are different from predominating gneisses of district and which at many places are evidently closely associated with Franklin limestone and at some places apparently grade into the limestone. They are regarded as sedimentary. Their relations to Pochuck, Byram, and Losee gneisses are not clear, but, because the Pochuck, Byram, and Losee are believed to be intrusive in the limestone, it is inferred that they are also intrusive in sedimentary gneisses and schists associated with the limestone. The sedimentary schists, slaty rocks, and gneisses are here included under name Pickering gneiss; and the Pochuck gneiss of which they have heretofore been treated as a part is restricted to the black gneisses of igneous origin which are intrusive in the Franklin limestone and the sedimentary gneisses and schists.

Named for fact that Pickering Creek, Chester County, Pa., lies almost wholly within this gneiss area.

Pickhandle Formation

Miocene, middle: Southern California.

O. E. Bowen, Jr., 1954, California Div. Mines Bull. 165, p. 138. Mentioned in discussion of silver-barite veins at Waterman mine, Calico district. Principal vein roughly follows bedding of a sequence of dacitic tuffs, lakebed clays and siltstones, and granitic fanglomerate probably belonging to Pickhandle formation; jasper appears bedded and may have been an original member of Pickhandle. Name credited to Thane McCulloh (unpub. rept.).

Waterman mine is in NE¼ sec. 13, T. 10 N., R. 2 W., 4 miles north of Barstow, via Camp Irwin Road, Barstow quadrangle, San Bernardino County.

**Pico Formation**

Pico Formation (in Fernando Group)[1]

Pliocene: Southern California.

Original reference: B. L. Clark, 1921, Jour. Geology, v. 29, p. 608–609, chart facing p. 586.

G. B. Oakeshott, 1950, California Jour. Mines and Geology, v. 46, no. 1, p. 50 (table 1), 54 (fig. 2), 56–61, pls. 14, 16. Described in Placerita oil field. Consists of three members: lower Pico marine, middle Pliocene; upper Pico marine, upper Pliocene; and continental upper Pliocene Sunshine Ranch member. Marine members not recognized north of San Gabriel fault. Thickness about 3,000 feet. Unconformably underlies Saugus formation; overlies Elsmere member of Repetto siltstone, gradually overlaps it, and lies directly on crystalline rocks at Whitney Canyon and north.

G. B. Oakeshott, 1958, California Div. Mines Bull. 172, p. 23 (fig. 2), 24 (fig. 3), 74–75, 81–83, pls. 1–3. Term Pico is here applied to members of middle and upper Pliocene age. Three members recognized: marine middle Pliocene Lower Pico, marine upper Pliocene Upper Pico, and continental upper Pliocene Sunshine Ranch member. Underlies Saugus formation; overlies Repetto formation. Present both north and south of San Gabriel fault in San Fernando quadrangle.

E. L. Winterer and D. L. Durham, 1958, U.S. Geol. Survey Oil and Gas Inv. Map OM–196. In Ventura Basin, Pico formation consists of light-olive-gray and bluish-gray siltstone and fine-grained sandstone, light-brown and gray sandstone and conglomerate. Upper part interfingers with Saugus formation; lower part interfingers with Towsley formation. Thickness about 5,000 feet in western part of area; only a few hundred feet to the east, near Placerita oil field. Many beds that are here referred to Pico formation were included in the Saugus by Kew (1924, U.S. Geol. Survey Bull. 753).

D. L. Durham and R. F. Yerkes, 1959, U.S. Geol. Survey Oil and Gas Inv. Map OM–195. Term Pico in Los Angeles Basin should be replaced by a new formational name. Strata not named in present report.

Named for exposures in Pico Canyon, Los Angeles County.

Pico Peak Series

Cambrian(?): Central Vermont.

H. E. Hawkes, Jr., 1941, Geol. Soc. America Bull., v. 52, no. 5, p. 653, 654, 657. Local unit consisting of quartz schists, quartzites, quartzose gneisses and dolomitic marble. Replaces Mount Holly series in this area. Underlies Plymouth Union series (new). Age difficult to determine without fossil evidence.

Type locality: East side of Green Mountain Range in Plymouth and Bridgewater Townships, Windsor County. Distinctive marble bed best exposed in valley east of Blue Ridge Mountain.

Picton Granite[1]

Precambrian: Northern New York.

Original reference: J. M. Clarke, 1909, New York State Mus. Bull. 133, p. 9–10.

Crops out on Grindstone and Wellesley Islands. Named for Picton Island (also called Robbins Island) in St. Lawrence River.

Pictonian Stage

*See* Trenton Stage.

**Pictured Cliffs Sandstone**[1]

Upper Cretaceous: Northwestern New Mexico and southwestern Colorado.

Original reference: W. H. Holmes, 1877, U.S. Geol. and Geog. Survey Terr. 9th Ann. Rept. for 1875, p. 248, 250, 251, pl. 35.

E. C. Beaumont, C. H. Dane, and J. D. Sears, 1956, Am. Assoc. Petroleum Geologists Bull., v. 40, no. 9, p. 2159. Discussion of revised nomenclature of Mesaverde group in San Juan basin and its bearing on problem of nomenclature of Pictured Cliffs and Cliff House sandstones. As result of southward thinning and termination of Lewis shale, Pictured Cliffs and Cliff House sandstones are in direct contact and for several miles southeast of Newcomb form an inseparable unit. It seems advisable, however, to maintain name Pictured Cliffs and its identity as a distinct formation for the following reasons: its long-standing and well-understood usage; it represents closing stages of marine Cretaceous deposition in San Juan basin, and there is some suggestion that part of it may have had a northern source differing from that of underlying Mesaverde; everywhere separated from Mesaverde in subsurface; known intertonguing relations with both Lewis shale and overlying Fruitland formation suggest that there may develop a need for named tongues of Pictured Cliffs.

Named for Pictured Cliffs on San Juan River, in northwestern New Mexico.

Picuris Basalts

Precambrian (Proterozoic) : Central northern New Mexico.

Evan Just, 1937, New Mexico School Mines Bull. 13, p. 13 (table 1), 23–24, 44. Series of basalt and andesite flows that occur principally interspersed with the sedimentary schists of the Hopewell series in Picuris and Petaca areas. The basalts could be grouped definitely as part of the Hopewell series, except that they persist up into Ortega quartzite, especially in Petaca area; therefore, the basalt intrusives have been given a distinctive name. Although basalts are schistose, their igneous nature is definitely established by presence of lath-shaped phenocrysts of plagioclase. Half a mile thick in Picuris Canyon.

Most readily recognizable exposure observed in Picuris area is near mouth of Picuris Canyon. Also recognized in Petaca area, Rio Arriba and Taos Counties.

Picuris Tuff

Miocene (?) : Northern New Mexico.

E. C. Cabot, 1938, Jour. Geology, v. 46, no. 1, p. 91. In Badito locality, consists of (ascending) about 680 feet of buff water-laid tuff interbedded with cemented gravel; 190 feet of salmon-pink sandy clay with layers of cemented gravel; 10 feet of giant conglomerate characterized by rounded boulders having maximum size of about 4 feet; 100 feet of gravel similar to unit below but with smaller pebbles and cobbles; 40 feet of basaltic lava; and some gravels above basalt. Total thickness about 1,000 feet. About 2 miles east of Badito section, red and green silts and clays and a giant conglomerate, totaling 200 feet in thickness, lie below the tuff so that total thickness of Picuris in this area seems to be in excess of 1,200 feet. Overlies Magdalena formation unconformably. Tertiary (pre-Santa Fe).

Arthur Montgomery, 1953, New Mexico Bur. Mines Mineral Resources Bull. 30, p. 52, pl. 1. Probable Miocene. Maximum thickness estimated to be from 1,250 to 1,750 feet. Exposed on northeast, southeast, and across central parts of Picuris Range.

Brewster Baldwin, 1956, New Mexico Geol. Soc. Guidebook 7th Field Conf., p. 118. Although Cabot (1938) extended Picuris tuff southward to include exposures just north of Santa Fe, Kottlowski is proposing name Bishops Lodge member of Tesuque formation.

Beds crop out typically in the Picuris reentrant near towns of Badito and Placita, Taos County.

†Piedmont Group[1]

Precambrian and Cambrian : Western North Carolina.

Original reference: W. C. Kerr, 1869, North Carolina Geol. Survey Rept. 2, p. 13–35.

Named for development in Piedmont Plateau of North Carolina.

Piedmont Sandstone

Permian: Western Oklahoma.

Henry Schweer *in* O. E. Brown, 1937, Am. Assoc. Petroleum Geologists Bull., v. 21, no. 12, p. 1553 (fig. 9). Shown on cross section at top of Cedar Hills member of Hennessey formation. Underlies Flowerpot shale.

Type locality and derivation of name not stated.

†Piedmont Sandstone (in Pottsville Formation)[1]

Pennsylvanian: Northern West Virginia, Maryland, and western Pennsylvania.

Original reference: C. A. Ashburner, 1877, Am. Philos. Soc. Proc., v. 16, p. 519–560.

Probably named for Piedmont, Mineral County, W. Va.

†Piedra Formation[1]

Upper Cretaceous: Southwestern Colorado.

Original reference: W. Cross and A. C. Spencer, 1899, U.S. Geol. Survey Geol. Atlas, Folio 60.

**Piedra Rhyolite** (in Potosi Volcanic Group)

Piedra Rhyolite or Group (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. 144–156. Piedra rhyolite included in Potosi volcanic series. Thickness 2,000 to 3,000 feet. Made up of four distinct members: lower rhyolite, tridymite rhyolitic latite, tuff, rhyolitic latite.

E. S. Larsen, Jr., and others, 1958, U.S. Geol. Survey Bull. 1070–B, table 2. Lead-alpha dating of Piedra rhyolite shows age to be about 16 million years.

U.S. Geological Survey tentatively assigns a middle or late Tertiary age to the Piedra.

Named for exposures in Piedra Peak, San Cristobal quadrangle.

Piedras Altas Formation (in Asuncion Group)

Upper Cretaceous: West-central California.

N. L. Taliaferro, 1943, California Div. Mines Bull. 118, pt. 2, p. 132 [preprint 1941]. Lower formation of Asuncion group (new) in southern Santa Lucia Range. Underlies Godfrey shale (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.

**Piegan Group**

Precambrian (Belt Series): Western Montana.

C. L. Fenton and M. A. Fenton, 1937, Geol. Soc. America Bull., v. 48, no. 12, p. 1890–1892. Limestones, dolomites, and dominantly argillaceous clastics which lie between Missoula and Ravalli groups. Despite variations, they form the sole dominantly calcareo-magnesian group in the Meagher facies and the second in the Glacier Park. Characterized by great development of calcareous algae. Contains Siyeh, Spokane, and Sheppard formations in ascending order at type locality.

C. P. Ross, 1949, (abs.) Washington Acad. Sci. Jour., v. 39, no. 3, p. 112–113. Restricted at top to exclude Shepard formation which is included in Missoula group. Where Helena limestone is recognizable, it is regarded as upper formation of group. Greyson, Spokane, and Empire shales (named in ascending order), which overlie the Newland and underlie the Helena in vicinity of Helena, may be local units or may correspond to argillaceous rocks of other regions. Principal component of group has been variously called Siyeh, Newland, and Wallace limestone or formation, and these names are retained locally. In Glacier Park, Piegan group, as herein defined, consists largely of massive dolomite and dolomitic limestone with interbedded argillite, quartzite, oolite, and mud breccia. Maximum reported thickness 5,400 feet. Overlies Ravalli group.

C. P. Ross, D. A. Andrews, and I. J. Witkind, 1955, Geologic map of Montana (1:500,000): U.S. Geol. Survey. As mapped, includes Wallace formation, Newland limestone, Siyeh limestone, Greyson shale, Spokane shale, Empire shale, and Helena limestone.

C. P. Ross, 1959, U.S. Geol. Survey Prof. Paper 296, p. 33–43, pls. 1, 2. Restricted to include only Siyeh limestone. As far as Glacier National Park and neighboring areas are concerned, name "Piegan group" as restricted might well be dropped. At present, name is retained because of its usefulness in correlation throughout Montana and because of Siyeh limestone is expected to be divided into several units of formational rank when more detailed mapping is done. At that time, Siyeh limestone may be restricted in its application or abandond.

Type locality: Piegan Mountain, Glacier National Park. Well exposed on Mounts Gould, Wilbur, Cleveland, Lineham, and other high peaks of Glacier-Waterton region.

Pie Knob Andesite[1]

Pleistocene: Western California.

Original reference: A. C. Lawson and C. Palache, 1902, California Univ. Pub., Dept. Geol. Bull., v. 2, p. 403–404, map.

Forms large part of Pie Knob, north of University Campus, Berkeley, Alameda County.

**Pierce Limestone** (in Stones River Group)[1]

Middle Ordovician: Central Tennessee.

Original reference: J. M. Safford, 1869, Geology of Tennessee, p. 258–267.

C. W. Wilson, Jr., 1949, Tennessee Div. Geology Bull. 56, p. 32–34. Gray and blue to light-blue and dove-colored thinly bedded limestone separating the more massively bedded overlying Ridley limestone and underlying Murfreesboro limestone. Thickness 23 to 28 feet. Type section was at Pierce's Mill which has now been replaced by a power plant located on north bank of East Fork of Stones River one-half mile south of Walterhill on Murfreesboro-Lebanon Highway. Formation is nearly completely exposed, base and lower part being exposed on west side of power plant, and the top few feet and contact with overlying Ridley occurring east of power plant.

Type section: Pierce's Mill, point at which Murfreesboro and Lebanon Turnpike crosses Stones River, Rutherford County.

Pierce shales[1] (in Tusayan series)

Pennsylvanian (?) : Northwestern Arizona.

Original reference: C. [R.] Keyes, 1922, Pan-Am. Geologist, v. 38, no. 3, p. 251, 337.

Charles Keyes, 1936, Pan.-Am. Geologist, v. 66, no. 3, p. 215 (table). Underlies Seligman limestones; unconformably overlies Elden limestones. In Tusayan series (new) of Carbonic age.

Exposed in section at mouth of Grand Canyon near Pierce's ferry.

†Pierce Canyon Redbeds[1] (in Dockum Group)

Permian or Triassic: Southeastern New Mexico and western Texas.

Original reference: W. B. Lang, 1935, Am. Assoc. Petroleum Geologists Bull., v. 19, no. 2, p. 262–270.

A. M. Morgan, 1942, Am. Geophys. Union Trans., v. 23, pt. 1, p. 33 (figs. 5, 6). Cross sections show Pierce Canyon redbeds in Dockum group below Santa Rosa sandstone and above Rustler formation.

U.S. Geological Survey has abandoned Pierce Canyon Redbeds in favor of Dewey Lake Redbeds.

Named for exposures in vicinity of Pierce Canyon, southeast of Loving, Eddy County, N. Mex.

Pierce Estate Sands

Oligocene: Southern Texas (subsurface).

Alexander Deussen and K. D. Owen, 1939, Am. Assoc. Petroleum Geologists Bull., v. 23, no. 11, p. 1630 (fig. 5), 1631 (fig. 6), 1632, 1634. Name suggested for the thick body of sand above an Oligocene marine shale wedge [Old Ocean sand] and below the Fleming, or zone of reworked Cretaceous foraminifera, now loosely designated as *Discorbis*. Name Flour Bluff also suggested for this unit.

Named for well No. 20 in east section Wharton County (Pierce Estate Fee No. 2).

Piercefield Gneiss[1]

Precambrian: New York.

Original reference: H. P. Cushing, 1907, New York State Mus. 60th Ann. Rept., pt. 2, p. 463, 469–470.

Named for exposures about Piercefield, St. Lawrence County.

Piermont Group

Precambrian: Eastern Nevada.

J. C. Young, 1960, Intermountain Assoc. Petroleum Geologists Guidebook 11th Ann. Field Conf., p. 158–159, 160. Sequence of clastic rocks. Thickness approximately 10,000 feet. Four mappable units (ascending): A, B, C, and D recognized. Base not exposed. Underlies Prospect Mountain quartzite. Cambrian-Precambrian boundary arbitrarily placed at top of ledge-forming shaly interval about 100 feet thick at top of unit D.

Named for Piermont Creek on eastern side of Schell Creek Range, Ely quadrangle. Well exposed on second ridge north of creek.

**Piermont Member** (of Albee Formation)

Ordovician: 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. Consists of dark-gray quartz-mica schist, mica schist, staurolite schist and local beds of fine conglomerate, of volcanic origin in part, interbedded with the schists and quartzites of the Albee formation. Upper Ordovician(?).

J. B. Hadley, 1942, Geol. Soc. America Bull., v. 53, no. 1, p. 117, 119 (fig. 2), 126–127. Maximum thickness estimated 1,000 feet. Occurs about 1,000 feet above base of Albee formation. Type locality cited.

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

Type locality: Mount Cube area. Occurs in and near village of Piermont, Grafton County.

Pierpont Sandstone (in Pocahontas Group)

Pierpont Sandstone (in Pottsville Group)[1]

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. 218.

H. R. Wanless, 1939, Geol. Soc. America Spec. Paper 17, p. 98; P. H. Price and E. T. Heck, 1939, West Virginia Geol. Survey [Rept.] Greenbrier County, p. 217, 244. Included in Pocahontas group, Pottsville series.

Exposed at Pierpont Station on Slab Fork of Guyandot River, Wyoming County.

**Pierre Shale** (in Montana Group)[1]

Upper Cretaceous: South Dakota, eastern Colorado, western Minnesota, Montana, Nebraska, New Mexico, North Dakota, and eastern Wyoming.

Original reference: F. B. Meek and F. V. Hayden, 1862, Philadelphia Acad. Nat. Sci. Proc., v. 13, p. 419, 424.

K. F. Mather, James Gilluly, and R. G. Lusk, 1928, U.S. Geol. Survey Bull. 796–B, p. 77, 86–92. Pierre shale, in northeastern Colorado, includes (ascending) Hygiene sandstone, Terry sandstone, Rocky Ridge sandstone, Larimer sandstone, and Richard sandstone members and unnamed higher beds. Thickness 4,500 to 10,000 feet. Overlies Niobrara formation; underlies Fox Hills sandstone.

W. W. Rubey, 1930, U.S. Geol. Survey Prof. Paper 165–A, p. 3–4. Pierre shale, in Black Hills area, includes (ascending) Gammon ferruginous member with Groat sandstone bed, Mitten black shale member, unnamed mudstone and shale, Monument Hill bentonitic member, and unnamed dark-gray fissile shale and mudstone. Overlies Niobrara formation; underlies Fox Hills sandstone.

M. K. Elias, 1931, Kansas Univ. Bull., v. 32, no. 7. Pierre shale, in northwestern Kansas, includes (ascending) Sharon Springs, Weskan, Lake Creek, Salt Grass, and Beecher Island members. Overlies Niobrara chalk.

C. S. Lavington, 1933, Am. Assoc. Petroleum Geologists Bull., v. 17, no. 4, p. 399. Pierre shale, in eastern Colorado, contains Apache sandstone in basal part.

W. V. Searight, 1937, South Dakota Geol. Survey Rept. Inv. 27, p. 5–63. Pierre formation, in region along Missouri River, divided into (ascending) Gregory, Sully, Virgin Creek, Mobridge, and Elk Butte members (all new). Thickness 361 to 1,204 feet. Overlies Niobrara formation; underlies Fox Hills formation.

D. R. Crandell, 1950, Am. Assoc. Petroleum Geologists Bull., v. 34, no. 12, p. 2337–2346. Pierre shale, as herein revised for central South Dakota, comprises (ascending) Sharon Springs, Gregory, Crow Creek, DeGrey (new), Verendrye, Virgin Creek, Mobridge, and Elk Butte.

R. C. Moore and others, 1951, Kansas Geol. Survey Bull. 89, p. 22–23. Pierre shale, northwestern Kansas, is 1,000 to 1,400 feet thick. Includes the following members (ascending): Sharon Springs shale, 155 feet; Weskan shale, 170 feet; Lake Creek shale; Salt Grass shale; unnamed shale; and Beecher Island shale. Overlies Niobrara formation.

S. P. Fisher, 1952, North Dakota Geol. Survey Bull. 26, p. 8–10. Oldest formation exposed in Emmons County. Most of unit belongs to Elk Butte member although some Mobridge may be present. Thickness 135 feet. Underlies Fox Hills formation.

J. C. Frye and A. B. Leonard, 1952, Kansas Geol. Survey Bull. 99, p. 109. Underlies Sanborn formation at type section of Sanborn.

G. C. Prescott, Jr., 1953, Kansas Geol. Survey Bull. 100, p. 53–54. In Cheyenne County where it is poorly exposed and is oldest outcropping in formation, the Pierre underlies Ogallala formation.

G. H. Wood, Jr., S. A. Northrop, and R. L. Griggs, 1953, U.S. Geol. Survey Oil and Gas Inv. Map OM–141. Described in eastern Colfax County, N. Mex., where it is 1,600 to 1,700 feet thick. Overlies Smoky Hill marl member of Niobrara formation. Interfingers with overlying Trinidad sandstone.

R. B. Johnson and J. G. Stephens, 1954, U.S. Geol. Survey Oil and Gas Inv. Map OM–146. In La Veta area, Huerfano County, Colo., the Pierre shale is about 2,000 feet thick. A 10-foot bed of sandstone that forms ledge about 500 feet above base of Pierre is exposed on western flank of Greenhorn anticline. This sandstone may be Apache sandstone of Prommel (Lavington, 1933). Overlies Smoky Hill marl member of Niobrara formation; underlies Trinidad sandstone.

C. S. Robinson, W. J. Mapel, and W. A. Cobban, 1959, Am. Assoc. Petroleum Geologists Bull., v. 43, no. 1, p. 101–123. Marine Pierre shale, on northern and western flanks of Black Hills, consists of dark-gray shale with some sandy shale and sandstone, and many beds of bentonite. Thickness 2,000 to 2,700 feet. In this area, divided into several members on basis of lithologic differences in the shale and presence of sandy and bentonitic units. These are (ascending) Gammon ferruginous member (including Groat sandstone bed), Mitten black shale member, an unnamed upper part that consists of half or more of formation, and near top Monument Hill and Kara bentonitic (new) members. Overlies Niobrara formation; underlies Fox Hills sandstone.

Named for exposures at old Fort Pierre, in either Stanley or Hughes County, S. Dak.

Pierson Glauconite

*See* Pearson Glauconite Member (of Sabinetown Formation).

Pierson Limestone[1] (in St. Joe Group)

Pierson Limestone Member (of Chouteau Formation)

Mississippian (Osage): Southwestern Missouri.

Original reference: S. Weller, 1901, Jour. Geology, v. 9, p. 140, 144.

E. B. Branson, 1944, Missouri Univ. Studies, v. 19, no. 3, p. 193. Rank reduced to member of Chouteau formation. Overlies Northview member;

underlies Reeds Spring member. Maximum thickness about 30 feet. Cannot be distinguished from rest of Chouteau north of Greene County; continues at least as far as Barry County. Lower Mississippian.

C. P. Kaiser, 1950, Am. Assoc. Petroleum Geologists Bull., v. 34, no. 11, p. 2157–2160. Recommended that term Pierson be dropped as a synonym of St. Joe; both St. Joe and Pierson occupy same stratigraphic position; fauna of both formations are identical.

T. R. Beveridge and E. L. Clark, 1952, Missouri Geol. Survey and Water Resources Rept. Inv. 13, p. 71, 72 (fig. 1), 75, 76. Uppermost formation in St. Joe group. Overlies Northview formation. Kinderhookian-Osagean line is defined as contact between Northview and Pierson. Pierson is extended northward to include silty dolomitic limestone unit which lies between Northview and Burlington in west-central Missouri. This unit was included in Sedalia by Moore (1928) and Kaiser (1950). In Greene County, Northview is included in Chouteau group. Note on type area.

Type area: North side of county road D in NE¼SW¼SW¼ sec. 29, T. 29 N., R. 20 W., near Turner Station, Greene County. Named from exposures on Pierson Creek.

Pierson Point Shale (in Wabaunsee Group)[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. 80.

G. E. Condra and E. C. Reed, 1943, Nebraska Geol. Survey Bull. 14, p. 42. "Pierson Point" shale, as defined by Condra (1927), includes at its type locality the section between Dover and Tarkio limestones and not from Maple Hill limestone as was originally supposed. This makes it part of "Table Creek shale;" however, Maple Hill limestone is missing at "Pierson Point" type locality leaving the latter without an upper boundary marker, but the Maple Hill is well developed at other places. Name "Pierson Point" is dropped, and name Wamego (new) applied to shale between Maple Hill and Tarkio limestones.

G. E. Condra, 1949, Nebraska Geol. Survey Bull. 16, p. 15. Reference made to Pierson Point shale by Condra and Reed (1943) is in error and name is retained because recent excavation at type locality exposes full thickness of the member, about 9 feet. Thickness in Missouri 3 to 4 feet.

H. G. O'Connor, 1953, Kansas Geol. Survey [Repts.], v. 12, pt. 1, p. 18–19, pl. 1. In eastern Kansas, name Stormont limestone member (new) is applied to lowest of three limestones occurring near middle of Pierson Point. The Stormont at its type locality occurs about 12 feet below Maple Hill limestone and 13½ feet above Tarkio limestone.

H. G. Hershey and others, 1960, Iowa Highway Research Board Bull. 15, p. 12. In N½SE¼SW¼ sec. 36, T. 70 N., R. 43 W., Fremont County, beds are exposed which are here tentatively correlated with part of Table Creek-Willard shale interval. At top of section, 3½ feet of blocky green shale is identified as basal part of Pierson Point shale. Overlies Tarkio limestone.

Type locality: Pierson's Point, a spur of upland about 2 miles southeast of Falls City, Richardson County, Nebr. Well exposed on east flank of Pony Creek near Pony Creek Bridge, 1½ miles south of Falls City.

Cotype locality: Upland 4 miles west of Wamego, Kans.

**Pigeon Slate**[1] **or Siltstone** (in Snowbird Group)

Precambrian (Ocoee Series): Eastern Tennessee and western North Carolina.

Original reference: A. Keith, U.S. Geol. Survey Geol. Atlas, Folio 16, p. 2.

P. B. King, 1949, Am. Jour. Sci., v. 247, no. 8, p. 639–640. Term Pigeon siltstone used in this report (base of the Cambrian in southern Appalachian). Name derived from same type locality as Pigeon slate of Keith's early work.

P. B. King and others, 1958, Geol. Soc. America Bull., v. 69, no. 8, p. 955 (table 1), 956–957. Pigeon siltstone included in Snowbird group (herein rank raised). Thickness at designated type locality 10,000 to 15,000 feet. Consists of uniform body of gray to greenish-gray thin- to thick-bedded siltstone, composed of recrystallized quartz and feldspar silt in a matrix altered to sericite and chlorite. Siltstone is well exposed along Pigeon River northwest of Waterville; it is not represented in Snowbird group farther south, where it disappears by intertonguing with Roaring Fork sandstone (new). Contact with Roaring Fork is placed at top of highest persistent sandstone bed at any locality, but sandstones finger out westward so that the base of the Pigeon as thus defined descends in this direction. At east end of mountains, the Pigeon is overlain conformably by Rich Butt sandstone (new) and other unclassified formations.

Type section (siltstone): Along Little Pigeon River between Richardson Cove and Pittman Center, Sevier County, Tenn. Pigeon slate was named for exposures near West Fork of Little Pigeon River, Sevier County.

**Pigeon Point Formation**

Upper Cretaceous: Northern California.

C. A. Hall, Jr., D. L. Jones, and S. A. Brooks, 1959, Am. Assoc. Petroleum Geologists Bull., v. 43, no. 12, p. 2855–2859. Dominantly brown and greenish-gray sandstone interbedded with siltstone, mudstone, and conglomerate; convoluted bedding and sole markings common. Estimated thickness more than 8,500 feet; base not exposed. Formation is both faulted against and unconformably overlain by Vaqueros(?) and Purisima formations of Tertiary age. Sedimentary rocks of Cretaceous age exposed along Pacific Coast south of Pesadero Point were originally assigned to the Chico formation by Branner, Arnold, and Newsom (1909, U.S. Geol. Survey Geol. Atlas Folio 163). However, application of this term to beds lithologically different, located nearly 200 miles from type locality of Chico, is unwarranted in absence of established continuity between the two sections; hence, new name is proposed.

Type section: All rocks exposed in sea cliffs from Pescadero Point to midway between Franklin Point and Ano Nuevo Point, or between lat 37°07′45″ N. and long 122°20′ and 122°25′ W. Named from prominent headland on Pacific Coast, approximately 5 miles south of town of Pescadero, San Mateo County. Rocks crop out in a belt a little less than 2 miles wide.

**Piinaau 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. Dense dark-gray nonporphyritic basalt.

G. A. Macdonald and D. A. Davis *in* Jacques Avias and others, 1956, Lexique Strat. Internat., v. 6, Océanie, fasc. 2, p. 126. Pleistocene(?)

Named for exposures along banks of Piinaau Stream. Flow followed gulch cut into older alluvium along foot of west wall of Keanae Valley, and at sea spread out to form terrace on each side of gulch.

**Pike Gravel** (in Trinity Group)

Pike Gravel Member (of Trinity Formation)[1]

Lower Cretaceous (Comanche Series) : Southwestern Arkansas.

Original reference: H. D. Miser and A. H. Purdue, 1918, U.S. Geol. Survey Bull. 690–B.

R. W. Imlay, 1944, U.S. Geol. Survey Oil and Gas Inv. Prelim. Chart 3. Pike gravel, basal formation in Trinity group in Arkansas. Underlies Delight sand (new). Subsurface equivalents discussed.

Named for Pike, Pike County.

**Pike Creek Volcanic Series**[1]

Pliocene, lower : Southeastern Oregon.

Original reference: R. E. Fuller, 1931, Washington [State] Univ. Pub. in Geology, v. 3, no. 1, p. 7–130.

Howel Williams and R. R. Compton, 1953, U.S. Geol. Survey Bull. 995–B, p. 24 (table), 25–27, pls. 8, 9. Rhyolitic and dacitic flows and tuffs. Thickness more than 1,500 feet. Overlies Alvord Creek formation; unconformably underlies basalts and lavas and Steens Mountain volcanic series. Early Pliocene. In addition to exposures at type locality, unit here considered to include siliceous volcanic rocks that crop out west of Alvord Lake, on Red Hill, along Cottonwood Creek, and at Tumtum Point.

Type locality : West of Alvord Desert, Harney County.

Pike River Granite[1]

Precambrian : Wisconsin.

Original reference: C. C. Wang, 1932, Geol. Soc. China Bull., v. 11, no. 4, p. 426–428.

**Pikes Peak Granite**[1]

Pikes Peak Group

Precambrian : Eastern Colorado.

Original reference : W. Cross, 1894, U.S. Geol. Survey Geol. Atlas, Folio 7.

J. M. Bray, 1942, Geol. Soc. America Bull., v. 53, no. 5, p. 769–770. In this report, Pikes Peak group (Algonkian) includes (ascending) Boulder Creek granite and Overland Mountain granite (new).

M. G. Dings and C. S. Robinson, 1957, U.S. Geol. Survey Prof. Paper 289, p. 7–8. Granite described in Garfield quadrangle where it is cut by a granite referred to as Silver Plume(?).

Forms main mass of Pikes Peak.

Piketon Gravel[1]

Tertiary : Southeastern Missouri.

Original reference: C. F. Marbut, 1902, Missouri Univ. Studies, v. 1, no. 3, p. 18, 27, 32.

Named for exposures at Piketon, Stoddard County.

Pikian series[1]

Precambrian : Colorado.

Original reference : C. R. Keyes, 1924, Pan-Am. Geologist, v. 41, p. 281, 284.

Pilar Phyllite Member (of Ortega Formation)

Precambrian : Central northern New Mexico.

Arthur Montgomery, 1953, New Mexico Bur. Mines Mineral Resources Bull. 30, p. 8 (fig. 2), 19–21, pl. 1. Name proposed to replace Hondo slate because the latter name had been applied to other rocks prior to Just's usage. The rock is dense, homogeneous, and hard, and is gray-black to black in color, with a gray sheen on cleavage surfaces. Has irregular slaty cleavage. Minimum thickness appears to be 2,300 feet in Picuris Range. Overlies Rinconada schist member and underlies Vadito formation.

Name derived from village of Pilar, situated at north-central border of Picuris Range at a point several miles east and north of prominent outcrops of the phyllite. Occurs in two main east-west belts of half a mile width that extend from upper Hondo Canyon to Piedra Lumbre Canyon, and thence offset to the south to continue as a single, westward tapering belt; Picuris Range, Taos County.

Pilarcitos Sandstone (in Franciscan Group)[1]

Jurassic(?) : Western California.

Original reference: A. C. Lawson, 1902, Science, new ser., v. 15, p. 416 (table).

Along Pilarcitos Creek and Pilarcitos Lake, in San Mateo County.

**Pilcher Quartzite** (in Missoula Group)

Precambrian (Belt Series) : Western Montana.

W. H. Nelson and J. P. Dobell, 1959, U.S. Geol. Survey Misc. Geol. Inv. Map I–296. Reddish quartzite with strongly accentuated crossbedding. Overlies Garnet Range quartzite.

Mapped in Bonner quadrangle. Type locality and derivation of name not given.

**Pilchuck Clay Member** (of Vashon Drift)

Pleistocene : Northwestern Washington.

R. C. Newcomb, 1952, U.S. Geol. Survey Water-Supply Paper 1135, p. 18–19, pl. 1. Largely an advance outwash deposit, characteristically fine-grained; some sediments are dirty sands and gravels with thick clay beds and peat streaks; some clays are massive and yellow and nearly white in color. In some areas, overlies Admiralty clay (new).

Exposed in scattered areas in western part of Snohomish County.

**Pilgrim Limestone**[1] or **Dolomite**

Upper Cambrian : Montana.

Original references: W. H. Weed, 1899, U.S. Geol. Atlas, Folio 55; Folio 56; 1900, U.S. Geol. Survey 20th Ann. Rept., pt. 3, p. 284–287.

Charles Deiss, 1936, Geol. Soc. America Bull., v. 47, no. 8, p. 1280–1281, 1333–1335. Weed's definition emended. Pilgrim is basal formation of Upper Cambrian in Montana and Yellowstone Park. Overlies Park shale (emended); underlies Dry Creek shale (emended). At emended type locality herein designated, consists of thick- and thin-bedded light- and dark-gray crystalline to fine-grained irregularly bedded limestones; variable amounts of tan and buff clay irregularly disseminated; interbedded limestones are 2- to 20-inch beds of hard gray crystalline intraformational conglomerates whose flat pebbles consist of gray-green, tan, and maroon, argillaceous lithographic limestone. Lower part of formation in north-central Montana contains more shale than upper and middle parts; in western and southern part of State, lower-middle and upper parts of formation consists of massive thick-bedded hard finely crystalline dark-gray limestone, which is oolitic and mottled drab tan or buff. Thicknesses: 315 feet, type locality; 661 feet, Big Snowy Mountains; 175 feet, Big Belt Mountains; 172 feet, Crowfoot Ridge, Yellowstone Park. Lower part of Pilgrim in north-central Montana contains more shale than upper and middle parts and also more than in western and southern parts of State and in Yellowstone Park. In latter areas, the lower-middle and upper parts of Pilgrim consist of massive thick-bedded hard finely crystalline dark-gray limestone, which is oolitic and mottled drab tan or buff. These are the beds Peale (1893, U.S. Geol. Survey Bull. 110) called "Mottled limestones" in Gallatin formation in his Three Forks section. [See Flathead quartzite.]

Erling Dorf and Christina Lochman, 1940, Geol. Soc. America Bull., v. 51, no. 4, p. 551. Unit termed Pilgrim by Deiss (1936) in Crowfoot Ridge section is the Maurice formation (new).

Christina Lochman and Donald Duncan, 1944, Geol. Soc. America Spec. Paper 54, p. 2–3, 4 (fig. 1), 6–9. Dry Creek-Pilgrim boundary discussed. Dry Creek shale partly emended by restricting all limestone pebble conglomerates and gray-green shales to the Pilgrim formation. This restriction gives lithologic unity to both Dry Creek and Pilgrim in all sections and restricts the fossil horizons to the Pilgrim. Park-Pilgrim contact is boundary between Middle and Upper Cambrian.

A. M. Hanson, 1952, Montana Bur. Mines and Geology Mem. 33, p. 16–17. As used in this report, the Pilgrim is a carbonate unit, essentially Dresbachian in age, underlain by Park shale and overlain by Red Lion or Snowy Range formation. Locally, where post-Cambrian erosion has removed Red Lion, the Pilgrim may be directly overlain by Maywood formation. Consists of four rock types: limestone conglomerate; crystalline limestone; oolitic limestone, some of which has distinctive mottling; and dolomite. Lochman and Duncan draw Park-Pilgrim boundary to coincide with Middle-Upper Cambrian time boundary; in present report, the boundary is drawn to conform with lithologic change from shale to limestone; the boundary thus drawn differs from late Middle Cambrian to early Upper Cambrian. Term Maurice has been used for Pilgrim equivalent, but distinction between the two is presence of mottled oolitic limestone in the Maurice. Name Maurice considered unnecessary.

P. W. Richards, 1957, U.S. Geol. Survey Bull. 1021–L, p. 397, 398–399. Described in area east and southeast of Livingston, Mont., where it is 175 feet thick and crops out as first cliff-forming unit above Precambrian rocks. Underlies Snowy Range formation. Name used in preference to Maurice in this area.

M. R. Klepper, R. A. Weeks, and E. T. Ruppel, 1957, U.S. Geol. Survey Prof. Paper 292, p. 10–12, pls. 1, 2, 3. Five lowest Cambrian natural 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. Pilgrim dolomite is 380 to 510 feet thick. Threefold subdivision recognized. Lower unit, typically about 50 feet, is principally mottled light-gray and dark-gray crystalline dolomite. Middle unit, typically about 175 feet, is light-gray and medium-gray crystalline limestone with irregular ribbons of yellowish-gray silty dolomite. Upper unit, 150 to 225 feet thick, is light-gray medium-crystalline to sugary dolomite that weathers to rough cuspate surface; beds typically between 6 inches and 4 feet but rather indistinct. Underlies Maywood or Red Lion formation. Upper Cambrian.

Type locality (emended section): North side Dry Wolf Creek, Little Belt Mountains. Section measured on spur east of eastern small unnamed creek, which heads on Big Baldy Mountain, and on Dry Wolf Creek. Locality lies in sec. 14, T. 14 N., R. 9 E. Section begins at point 350 feet up the small stream from its mouth at Dry Wolf Creek, 2 miles west of mouth of Lion Gulch. Section was not measured opposite Lion Gulch where Weed said he measured his section because at that place Cambrian rocks are largely covered with glacial drift and lower beds of emended section are beneath floor of that part of Dry Wolf Creek valley. Named for exposures in valley of Pilgrim Creek, southwestern corner Fort Benton quadrangle.

Piliguilla Conglomerate

Pliocene(?): Panamá.

Karl Sapper, 1937, Mittelamerika, Handbuch der regionalen Geologie: Heidelberg, v. 8, Abt. 4a, no. 29, p. 134 (correlation chart), pl. 10 (map). Name appears on correlation table. Overlies Chucunaque formation. Pliocene.

W. P. Woodring *in* R. Hoffstetter and others, 1960, Lexique Strat. Internat., v. 5, Amérique Latine, fasc. 2a, p. 343. Undefined name. Pliocene(?).

In Darién area.

**Pillar Bluff Limestone**

Lower Devonian: Central Texas.

V. E. Barnes, P. E. Cloud, Jr., and L. E. Warren, 1946, Texas Univ. Bur. Econ. Geology Pub. 4301, p. 166–169 [1945]. Proposed for calcitic rocks carrying a fauna of Helderberg age. Predominantly of two types: One a fine- to coarse-grained yellowish-gray to ivory-colored fairly pure highly fossiliferous limestone; the second type of limestone is fine to very fine grained, gray, dull yellow, or olive drab, ranging to gold and light bronze with roan splotches; slightly dolomitic, few or no fossils. Finer grained limestone occurs below the more coarsely granular coquinalike limestone. Because of manner in which Pillar Bluff is preserved, no estimation of thickness is practical.

Type locality: Ancient joint or cave filling at Pillar Bluff on Pillar Bluff Creek, 5 miles southwest of Lampasas and just south of Lampasas County line in northern Burnet County. This pocket of Lower Devonian rocks, replete with fossils, is surrounded by limestone and dolomite of Ellenburger group (Lower Ordovician) of the *Ceratopea* "*keithi*" zone. Lies 30 feet vertically below lower margin of covering debris which conceals overlap of Carboniferous strata on the Ellenburger.

†Pillar Falls Mud Flow[1]

Miocene, 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. 32, 38–39, pl. 5. Thickness about 40 feet. Rests on eroded surface of Shoshone Falls andesite.

H. T. Stearns, 1955, Geol. Soc. America Bull., v. 66, no. 4, p. 463. Suggested that the Pillar Falls mud flow represents the typical block lava top of the underlying Shoshone Falls andesite.

Type section: At Pillar Falls on Snake River, in Jerome and Twin Falls Counties.

**Pillsbury Shale** (in Wabaunsee Group)

Pennsylvanian (Virgil Series): Northeastern Kansas.

R. C. Moore and M. R. Mudge, 1956, Am. Assoc. Petroleum Geologists Bull., v. 40, no. 9, p. 2274 (fig. 1), 2275–2276. Defined to include strata between Stotler limestone (new) above and Zeandale limestone (new) below. Replaces Langdon shale of Condra and Reed (1943). Thickness ranges from about 1 foot to 50 feet; average thickness 25 feet.

Type exposure: In roadcut in SE¼NE¼NE¼ sec. 28, T. 10 S., R. 9 E., Riley County. Name derived from Pillsbury Crossing, a ford across Deep Creek in NE¼NW¼ sec. 5, T. 11 S., R. 9 E., Riley County. Sections typical of facies changes of formation, designated as paratype sections, are exposed in stream bank in center of SW¼NE¼ sec. 32, T. 10 S., R. 9 E., Riley County, and in NE¼NE¼ sec. 19, T. 11 S., R. 13 E., Wabaunsee County.

Piloncillo Formation

Tertiary: Southwestern New Mexico.

W. E. Elston, 1957, New Mexico Bur. Mines Mineral Resources Bull. 38, p. 10–11, 17 (table 1), pl. 1. Sediments occur as small alluvial fans, windblown tuffaceous dune sands, tuffs, and stream-channel sandstones and conglomerates. At type locality, tuffaceous and fluvial sediments reach maximum thickness of 400 feet in a buried valley. Elsewhere formation is either absent or much thinner. All clastic sediments of similar age and lithology in Dwyer quadrangle have been mapped as Piloncillo, even where their outcrops are not continuous with the type locality.

Type locality: Given in text as Piloncillo Hill, after which the sediments were named, in sec. 18, T. 18 S., R. 10 W., Dwyer quadrangle. Shown on plate 1 as sec. 18, T. 19 S., R. 10 W.

Pilot 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, 195. Cherokee group is divided into 15 cyclic formational units. The Pilot, seventh in the sequence (ascending), occurs below the Scammon and above the Weir. Includes Pilot coal. [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.

**Pilot Shale**[1]

Pilot Shale Member (of White Pine Shale)

Upper Devonian and Lower Mississippian: Eastern Nevada and 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. 22. Geographically extended into Confusion Range, Millard County, Utah, where it is from 900 to 1,200 feet thick and consists of buff papery shales interbedded with thin black platy limestone. Overlies Guilmette formation; underlies Joana (Joanna) limestone. Upper Devonian.

W. H. Easton and others, 1953, Am. Assoc. Petroleum Geologists Bull., v. 37, no. 1, p. 147 (fig. 2), 149. Rank reduced to member status in White Pine shale. Basal member of formation; underlies Joana member.

T. B. Nolan, C. W. Merriam, and J. S. Williams, 1956, U.S. Geol. Survey Prof. Paper 276, p. 52–53. Described east of Eureka where there are four narrow bands of outcrop. Where exposures are good, two units can be distinguished. Lower one, which makes up one-third or more of formation, is more calcareous, and some of the beds are thin-bedded shaly limestones rather than platy calcareous shales; commonly pinkish or reddish; sandy limestone contains conodont fauna. Upper unit is lithologically more uniform; it is yellowish-brown- or dark-gray-weathering black platy shale, which in most places is calcareous. Thickness ranges from about 315 feet in Packer Basin to 425 feet in Water Canyon; poorly exposed section in Pancake Range is approximately 1,000 feet; it is probable that formation has localized fault movement within it that may account for variations in thickness. Overlies Devils Gate limestone; underlies Joana limestone; both contacts sharp. Faunal evidence indicates Late Devonian age; stratigraphic relations suggest that beds of early Mississippian age are also present in upper part of formation. Pilot shale is basal part of White Pine shale as defined by Hague (1892, U.S. Geol. Survey Mon. 20) at Eureka.

R. L. Langenheim, Jr., 1960, Illinois Acad. Sci. Trans., v. 53, nos. 3, 4, p. 122–131. Discussion of Pilot shale, West Range limestone, and Devonian-Mississippian boundary in eastern Nevada. At reference section, herein designated, Pilot shale consists of upper unit of 190 feet of nonfossiliferous black fissile shale and a lower unit, 193.1 feet thick, of black calcareous siltstone with interbedded silty limestone and minor amounts of fine-grained gray limestone. Overlies Guilmette limestone, contact sharp; underlies Joana limestone, contact sharp. The 383.1 feet of Pilot shale at reference section are comparable to the 350 feet of covered rock assigned to Pilot shale just north of Pilot Knob. It is assumed that the members present at Willow are also present at Pilot Knob and underlie the bench between Joana limestone and Guilmette on west side of Ward Mountain as mapped by Langenheim and others (1959). At type locality of West Range limestone, 32 feet of lower Pilot shale overlies the West Range. At this locality, the lower Pilot is disconformably overlain by Bristol Pass (Joana) limestone.

Reference section: Exposure south-southwest of triangulation station "Willow," sec. 6, T. 13 N., R. 63 E., on west flank of Egan Range about 2 miles north of south boundary of Ely No. 3 quadrangle. Named for Pilot Knob in western part of Ely quadrangle, Nevada.

Pilot Creek Basalt Member (of Cove Mountain Formation)

Tertiary : Southwestern Utah.

E. F. Cook, 1960, Utah Geol. and Mineralog. Survey Bull. 70, p. 18 (fig. 1). Thickness 0 to 400 feet. Underlies Cedar Spring member (new) ; overlies Racer Canyon tuff member (new).

Occurs in Washington County.

Pilot Knob conglomerate[1]

Upper Cambrian : Southeastern Missouri.

Original reference : C. R. Keyes, 1894, Missouri Geol. Survey, v. 4, p. 30, 31.

Occurs on Pilot Knob, Iron County.

Pilot Knob facies (of Brodhead Formation)

Lower Mississippian : Central Kentucky.

P. B. Stockdale, 1939, Geol. Soc. America Spec. Paper 22, p. 76, 146–148. Consists mainly of shale and siltstone. Average thickness approximately 200 feet. Comprises, in lower part, Culver Springs shale below and Lebanon Junction siltstone members (both new) of Brodhead formation. Merges with Holtsclaw Hill facies (new) on west and Athertonville facies (new) on east. Underlies Floyds Knob formation; overlies New Providence formation, Keith Knob facies (new).

Named for Pilot Knob, 4½ miles northeast of Lebanon Junction, southern Bullitt County. Pilot Knob is one of many "knobs" characteristic of region.

Pilot Knob Formation[1]

Precambrian : Southeastern Missouri.

Original references : E. R. Buckley, 1908, Am. Min. Cong. Rept. Proc. 10th Ann. Sess., p. 286; 1909, Missouri Bur. Geology and Mines, 2d ser., v. 9, pt. 1, p. 15–17.

Pilot Knob Iron Formation[1]

Precambrian : Southeastern Missouri.

Original reference : G. W. Crane, 1912, Missouri Bur. Geology and Mines, v. 10, 2d ser.

Pilot Knob Sandstone[1] Member (of Anderson Formation)

Pennsylvanian : Northern Tennessee.

Original reference : L. C. Glenn, 1925, Tennessee Geol. Survey Bull. 33–B, p. 23, 33, 319.

C. W. Wilson, Jr., J. W. Jewell, and E. T. Luther, 1956, Pennsylvanian geology of the Cumberland Plateau: Tennessee Div. Geology [folio], p. 11, pl. 4. Renamed Pilot Mountain sandstone because name Pilot Knob is preoccupied.

Occurs in Tennessee coal field in Briceville region.

Pilot Knob Tuff (in Dessau Formation)

Upper Cretaceous : South-central Texas.

C. O. Durham, Jr., 1955, Corpus Christi Geol. Soc. [Guidebook] Ann. Field Trip, Mar. 11–12, p. [58, 59], pl. 16. Tuff mentioned in discussion of Upper Cretaceous volcanics in Travis County. Stratigraphic section shows Pilot Knob ash in Dessau formation below St. Edwards tuff (new) in Burditt formation. Page [59] refers to Pilot Knob mudflows. [Durham refers to article published by him (1949, Shreveport Geol. Soc. Guidebook 17th Ann. Field Conf.) entitled "Stratigraphic relationships of the Pilot Knob volcanics." However, in copy of guidebook used by compiler title reads "Pilot Knob pyroclastics"].

Pilot Knob is 6 to 8 miles south-southwest of State Capitol, Austin, Travis County.

Pilot Mountain Andesite

Age not stated: Northern California.

J. A. S. Adams, 1955, Geochim. et Cosmochim. Acta., v. 8, p. 77 (table 2). Listed on table accompanying report on uranium geochemistry of Lassen volcanic rocks.

Pilot Mountain is in southeastern part of Lassen Volcanic National Park.

Pilot Mountain Sandstone (in Vowell 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, pls. 2, 3, 4. New name for Pilot Knob sandstone (Glenn, 1925). Name Pilot Knob preoccupied. Thickness at designated type locality 60 feet; in Cross Mountain section 35 feet. Overlies a shale interval about 100 feet thick at base of group and underlies shale interval 35 to 90 feet thick which in turn underlies Frozen Head sandstone.

Type locality: Pilot Mountain in Duncan Flats quadrangle. Also well developed in Petros, Windrock, Fork Mountain, Lake City, Norma, and Block quadrangles.

Pima Sandstone[1] or Formation

Middle Cambrian: Southeastern Arizona.

Original reference: A. A. Stoyanow, 1936, Geol. Soc. America Bull., v. 47, no. 4, p. 466, 482.

B. F. Howell and others, 1944, Geol. Soc. America Bull., v. 55, no. 8, chart 1 (column 41). Listed as formation.

Traced from Whetstone Mountains, Cochise County to Picacho de Calera Hills, Pima County.

Pimoe Flow

Recent: Maui Island, Hawaii.

Grote Reber, 1959, Geol. Soc. America Bull., v. 70, no. 9, p. 1246, 1247, pl. 1 (fig. 4). May have been extruded during earthquake in 1938. Radiocarbon dating gives $<$ 100 years.

On southwest side of Haleakala.

Pimple Hill Conglomerate[1] (in Cherry Ridge Red Beds)

Upper Devonian: Northeastern Pennsylvania.

Original reference: Bradford Willard, 1936, Geol. Soc. America Bull., v. 47, no. 4, p. 571, 578.

Bradford Willard *in* Bradford Willard, F. M. Swartz, and A. B. Cleaves, 1939, Pennsylvania Geol. Survey, ser. 4, Bull. G–19, p. 279 (table 30), 284. Upper Devonian.

Named for Pimple Hill, a knob in Monroe County.

**Pinal Schist**[1]

Precambrian : Southeastern Arizona.

Original reference : F. L. Ransome, 1903, U.S. Geol. Survey Prof. Paper 12.

N. P. Peterson, 1954, U.S. Geol. Survey Geol. Quad. Map GQ–41. Mapped in Globe quadrangle. Early Precambrian.

James Gilluly, 1956, U.S. Geol. Survey Prof. Paper 281, p. 8–9 (table), 10–11, pl. 5. Described in central Cochise County where it is oldest formation exposed. Contains several small intrusive masses of albite granite, quartz diorite, gneissic granite, and sausuritic quartz monzonite which are also referred to the Precambrian. Base on which the Pinal was deposited not exposed in area; hence, no reliable estimate of thickness possible. Underlies Bolsa quartzite. In areas of intense metamorphism, distinguished with difficulty from metamorphosed Bisbee formation.

F. F. Sabins, Jr., 1957, Geol. Soc. America Bull., v. 68, no. 10, p. 1320–1322, table 1, pl. 1, Several rock types included in Pinal schist in Cochise Head and Vanar quadrangles. Unnamed quartzite member, of light-pink to light-gray medium- to coarse-grained quartzite, is most conspicuous unit for it forms rugged precipice of Bowie Mountain and ridge southwest of Helens Dome. Underlies Bolsa quartzite.

D. W. Peterson, 1960, U.S. Geol. Survey Geol. Quad. Map GQ–128. Mapped in Haunted Canyon quadrangle. Probably intruded by Ruin granite but contacts not exposed in quadrangle.

R. L. DuBois, 1959, Arizona Geol. Soc. Guidebook 2, p. 113. In fault contact with Samaniego granite (new).

Rocks well exposed in Pinal Mountains, whence their name.

Pina Vititos sandstone[1]

Upper Cretaceous : New Mexico.

Original reference. C. R. Keyes, Conspectus of geologic formations of New Mexico : Des Moines, Robert Henderson, State Printer, p. 2, 10.

Around southern end of the Rocky Mountains. Derivation of name not stated.

**Pinckneyville Granite**[1]

Pinckneyville Quartz Diorite Complex

Post-Carboniferous : Eastern Alabama.

Original references : W. F. Purdy, 1922, Elisha Mitchell Sci. Soc. Jour., v. 38, p. 16; 1922, Alabama Geol. Survey map of Clay County; 1923, Alabama Geol. Survey County Rept. 1, p. 51–62.

H. R. Gault, 1945, Geol. Soc. America Bull., v. 56, no. 2, p. 181–246. Quartz diorite complex, originally described as granite, is one of largest intrusions in Alabama. Underlies area extending from Coosa River in northwest Elmore County northeast through Coosa and Tallapoosa Counties into Clay County. Dark-gray coarse-grained quartz diorite gneiss constitutes major part of complex; smaller amounts of granodiorite and granite gneiss. Intrudes Ashland mica schist and Wedowee formation. Age uncertain.

Named for occurrence in vicinity of Pinckneyville, Clay County.

Pine Sand

Pleistocene, upper: Eastern North Carolina.

W. B. Wells, 1944, Elisha Mitchell Sci. Soc. Jour., v. 60, no. 2, p. 131–132, 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. Pine sand is a poorly consolidated stratum of highly variable thickness; thin superficial peaty medium-sand deposits in upper zone. Underlies Galveston sand (new); overlies Castalia sand (new).

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

**Pine Sandstone Member** (of Pottsville Formation)[1]

Lower Pennsylvanian: Central Alabama.

Original reference: Charles Butts, 1910, U.S. Geol. Survey Geol. Atlas, Folio 175, p. 10.

H. E. Rothrock, 1949, Alabama Geol. Survey Bull. 61, pt. 1, p. 22, fig. 2. Shown on columnar section (St. Clair County) as light-gray to light-brown friable conglomeratic sandstone 210 to 250 feet thick; in lower part of formation, stratigraphically above Shades sandstone member and separated from it by 200 to 230 feet of claystone, siltstone, and sandstone; underlies about 2,800 feet of sandstone, siltstone, and carbonaceous claystone with thin coaly beds.

Named for Pine Ridge, Jefferson County.

Pinean series[1]

Devonian: Nevada.

Original reference: C. R. Keyes, 1923, Pan-Am. Geologist, v. 40, p. 52, 55, 80.

Eureka district.

†Pine Barren beds[1]

Name applied in some early Alabama reports to the basal Eocene beds now known as Clayton formation, which are "best seen in eastern Wilcox County, on Pine Barren Creek and in adjoining part of Butler County in Little Texas region."

Statement above appeared in the Wilmarth lexicon. The compiler of present report searched several early Alabama publications but failed to find any reference that used the expression "Pine Barren beds." There were references to a "Pine Barren section" and "section on Pine Barren Creek." Therefore, it is believed that MacNeil's (1946) Pine Barren Member (see below) is the first formal usage of the term Pine Barren.

**Pine Barren Member** (of Clayton Formation)

Paleocene: Southwestern Alabama.

F. S. MacNeil, 1946, U.S. Geol. Survey Strategic Minerals Inv. Prelim. Rept. 3–195, p. 8–9. Proposed for lower member of Clayton. Hard crystalline fossiliferous coarse sandy limestone ["*Turritella* rock"] about 8 feet thick forms upper part of member; below this is sequence of limestone, sandy clay shale, and loose to moderately porous to tight fine-grained calcareous sand; beds of crystalline *Turritella*-bearing limestone occur at several levels in these lower beds; coarse-grained sandy channel limestone or calcareous sand occurs sporadically at base. Maximum thickness about 175 feet. Underlies McBryde limestone member (new).

Type locality: In roadcuts and ditches on south side of Pine Barren Creek, along State Highway 100, from southern junction with State Highway 11 to bed of creek at McConnicos Mill in SE¼ sec. 21, T. 12 N., R. 10 E., Wilcox County.

Pine Bluff Member (of Lewisville Formation)

Pine Bluff volcanic zone (in Eagleford Formation)

Cretaceous: Northeastern Texas.

R. T. Hazzard, 1939, Shreveport Geol. Soc. Guidebook 14th Ann. Field Trip, p. 138, 139–143. Lower most of three volcanic zones in the Medill-Woodland area. At Pine Bluff locality, zone is represented by 37 feet of tuffaceous sand which is characterized by the development of large concretionary masses, spherical to flattened ellipsoidal in shape; this persistent concretionary zone referred to as "Cannon Ball" zone. Westward from Pine Bluff, a clay shale-tuffaceous sand wedge breaks "Cannon Ball" zone into an upper and a lower "Cannon Ball" zone. Separated from overlying Kanawha volcanic zone by a shale interval that varies from 158 to 212 feet in thickness; overlies a shale and tuffaceous sand above the base of the Eagleford.

R. T. Hazzard, B. W. Blanpied, and W. C. Spooner, [1947], Shreveport Geol. Soc. 1945, Reference Rept., v. 2, p. 475, 476, 477. Reallocated to basal member of Lewisville formation. Unconformably overlies Euless formation.

L. W. Stephenson, 1952, U.S. Geol. Survey Prof. Paper 242, p. 4. Locally abandoned; as used in this report, the so-called Pine Bluff member is a part of the Lewisville member of the Woodbine formation.

First described in Medill-Woodland area where it is well exposed at Pine Bluff, Red River County.

†Pine Canyon Limestone[1]

Mississippian: 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. 18. Term Pine Canyon abandoned in favor of Deseret limestone, the more widely accepted stratigraphic name. Loughlin (1919) locally included within boundaries of Pine Canyon the upper cherty member of Gardner dolomite which is upper unit of upper member of Madison limestone of this report [East Tintic Mountains].

J. K. Rigby, 1958, Utah Geol. Soc. Guidebook 13, p. 38 (fig. 5), 40, 43–45. In Stansbury Mountains, subdivided into three units: lower and upper cherty limestone and a medial sandstone, siltstone, and argillaceous limestone unit. Lower cherty unit was placed in Madison group by Morris (1957). Thickness 170 to 950 feet. Unconformably overlies Gardner dolomite; underlies Humbug formation. Name Pine Canyon is used in preference to Deseret limestone as latter did not include the cherty beds.

H. J. Bissell, 1959, Utah Geol. Soc. Guidebook 14, p. 43–49, 158–161. Described in southern Oquirrh Mountains where it consists of a lower member, chiefly limestone, 258 feet thick, and an upper member, chiefly limestone with shale, 378 feet thick. Some of upper strata of what Gilluly (1932, U.S. Geol. Survey Prof. Paper 173) mapped as Madison limestone are included in lower member of Pine Canyon limestone of this report. A prominent phosphatic shale is used as key bed in marking base of upper member. Gilluly (1932) placed this bed as basal unit of his Deseret limestone; Deseret is herein restricted. Overlies Gardner dolomite (used in this area in preference to Madison). In Fivemile Pass quadrangle and northern Boulter Mountains, Pine Canyon is 1,289 feet thick and includes both lower and upper members; uppermost beds of upper member may represent southerly extension of Deseret limestone. Underlies Humbug formation; overlies Gardner formation.

Named for exposures in Pine Canyon, between Godiva Mountain and Sioux Peak, Tintic district.

Pinecate Formation[1] (in San Lorenzo Group)

Oligocene: Southern California.

Original reference: P. F. Kerr and H. G. Schenck, 1925, Geol. Soc. America Bull., v. 36, p. 470, 472, map.

J. E. Allen, 1946, California Div. Mines Bull. 133, p. 18 (fig. 2), 27, pls. 1, 2, 3. Described in San Juan Bautista quadrangle. Upper formation of San Lorenzo group. Thickness about 1,000 feet. Underlies Vaqueros sandstone; overlies San Juan Bautista formation.

Typically exposed at Pinecate Peak, 4 miles northwest of San Juan, and also near San Juan Cement Works, San Benito County.

Pinecone Formation

Ordovician: Central Nevada.

Marshall Kay, 1960, Internat. Geol. Cong., 21st, Copenhagen, pt. 12, p. 98 (fig. 4). Named on structure section in report on Paleozoic continental margin in central Nevada. Underlies Wildcat Peak formation (new).

Toquima Range, Nye County.

Pine Creek Conglomerate[1]

Cretaceous(?): Southeastern Iowa.

Original reference: J. A. Udden, 1899, Iowa Acad. Sci. Proc., v. 6, p. 54–56.

Leland Horberg, 1950, Illinois Acad. Sci. Trans., v. 43, p. 173. Incidental mention in report on correlation of preglacial gravels of Henry County, Ill., with gravels in other parts of Mississippi Valley region.

Named for Pine Creek, Muscatine County.

Pine Creek Limestone (in Conemaugh Group)

Pine Creek Limestone Member (of Conemaugh Formation)[1]

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

Original reference: I. C. White, 1878, Pennsylvania 2d Geol. Survey Rept. Q, p. 32.

M. N. Shaffner, 1952, Pennsylvania Geol. Survey, 4th ser., Prog. Rept. 141. Pine Creek limestone in Conemaugh group, shown on generalized columnar section below Woods Run limestone and above Buffalo sandstone.

Named for Pine Creek, Allegheny County, Pa.

†Pine Creek Sandstone (in Allegheny Formation)[1]

Pennsylvanian: Western Pennsylvania.

Original reference: J. P. Lesley, 1880, Pennsylvania 2d Geol. Survey Rept. $H_5$, p. xxi, 319.

Armstrong County.

Pinecrest Formation[1]

Lower Triassic: Central northern Utah.

Original reference: A. A. L. Mathews, 1929, Chicago Univ., Walker Mus. Mem., v. 1, no. 1, p. 1.

C. B. Richardson, 1941, U.S. Geol. Survey Bull. 923, p. 28. Thaynes formation, in Fort Douglas area east of Salt Lake, has been separated by Mathews on basis of fossil evidence, into Pinecrest and Emigration formations.

Named for Pinecrest Ridge, which lies between North and South Forks of Red Butte Creek in Fort Douglas area, east of Salt Lake City.

**Pinedale Glaciation, Drift, Till**

Pinedale glacial stage[1]

Pleistocene: Rocky Mountain region.

Original reference: E. Blackwelder, 1915, Jour. Geology, v. 23, p. 310, 324–340.

G. M. Richmond, 1953, Friends of the Pleistocene, Rocky Mountain Sec., [Guidebook] 2d Ann. Field Trip, Oct. 4–5, correlation chart. Pinedale stage comprises an early Pinedale substage, Pack Creek substage (new), and late Pinedale substage. Follows Lackey Creek stage (new) and precedes a Recent stage, the Castle Valley (new).

John de la Montagne, 1956, Wyoming Geol. Soc. Guidebook 11th Ann. Field Conf., p. 30. Glacial sequence in Jackson Hole area (ascending) Buffalo, Bull Lake, and Pinedale.

G. M. Richmond, 1957, Internat. Assoc. for Quaternary Research, 5th Cong., Madrid, p. 157. Pleistocene deposits in Rocky Mountain region are grouped into three stages: Buffalo (oldest), Bull Lake, and Pinedale, each with characteristic topographic expression and soil development. Pinedale stage consists of three substages whose moraines are youthful. Lower and middle substages, where superimposed, are separated by weak azonal soil. Upper substage (radiocarbon age slightly older than 6,170 240 years B. P.) probably represents subsidiary halt or minor readvance following the middle. Tills of all three substages, where not superimposed, have a moderately developed immature zonal soil, formed largely during post-glacial optimum.

G. M. Richmond, 1960, Geol. Soc. America Bull., v. 71, no. 9, p. 1371–1382. Discussion of glaciation of east slope of Rocky Mountain National Park, Colo. This area has been subjected to at least three Pleistocene glaciations, oldest to youngest correlated with Buffalo, Bull Lake, and Pinedale of Blackwelder (1915) in Wind River Mountains, Wyo. Deposits of Pinedale glaciation comprise three sets of moraines indicative of maximum advance of ice and two recessional halts or minor advances.

G. M. Richmond, 1960, U.S. Geol. Survey Prof. Paper 400–B, p. B223–B224. Discussion of correlation of alpine and continental glacial deposits of Glacier National Park and adjacent high plains, Montana. Deposits of two late Pleistocene alpine glaciations are correlated with Bull Lake and Pinedale glaciations of Wyoming. Pinedale glaciation consists of three advances separated by minor recessions. These are correlated with advances of classical Wisconsin glaciation of Illinois.

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Named for moraines around lakes near Pinedale, on southwest side of Wind River Range, Wyo.

Pine Hill Quartzite[1]

Lower Cambrian: Southwestern Vermont.

Original reference: J. E. Wolff, 1891, Geol. Soc. America Bull., v. 2, p. 331–338.

Pine Hill is a short distance northwest of Rutland and a short distance southeast of Proctor, in Proctor Township, Rutland County.

Pine Hill Quartzite[1]

Silurian: Southeastern New York.

Original reference: E. C. Eckel, 1902, New York State Mus. 54th Ann. Rept., pt. 1, p. r144–r150.

Well developed in Pine Hill, east of Highland Mills, Orange County.

**Pine Island Shale**

**Pine Island Shale Member** (of Pearsall Formation)

Pine Island Formation

Pine Island Member (of Glen Rose Formation)

Lower Cretaceous (Comanche Series): Subsurface in Louisiana, Arkansas, and Texas.

George Weber, 1938, Oil and Gas Jour., v. 37, no. 4, p. 30. Pine Island member of Lower Glen Rose formation proposed by Shreveport Geological Society. Black and green shale, brown shale in lower part; limestone at base locally. Underlies Rodessa member; overlies Travis Peak formation.

A. F. Crider, 1938, Am. Assoc. Petroleum Geologists Bull., v. 22, no. 12, p. 1665 (table 1), 1666–1667. Red, purple, and greenish shale, siltstone, and sand, with thin beds of calcareous shale and limestone, a part of which is fossiliferous, underlying lower Glen Rose, make up what is here called Pine Island formation. Has been called Travis Peak. In Bellevue Field, overlies Cotton Valley formation. Thickness 1,850 to 1,860 feet.

R. W. Imlay, 1940, Arkansas Geol. Survey Inf. Circ. 12, p. 32–33, cross sections. Pine Island formation was defined by Crider for beds here called Hosston. Pine Island was originally proposed by Shreveport Geological Society for beds above the Hosston (then called Travis Peak) and below James limestone lentil. The Society has further restricted Pine Island to dark shales with some interbedded limestone and sandstone lying above "Three Finger limestone" lentil and below James limestone member. Restricted Pine Island overlies Sligo formation (new); underlies Rodessa formation. Type section and boundaries of formation will be described by Nomenclature Committee of Shreveport Geological Society.

R. W. Imlay, 1944, U.S. Geol. Survey Oil and Gas Inv. Prelim. Chart 3. Lower member of Pearsall formation (new) in south Texas. Underlies Cow Creek member. Thickness about 100 feet. Occupies same stratigraphic position as Pine Island shale in Arkansas-Louisiana-east Texas area.

J. M. Forgotson, Jr., 1957, Am. Assoc. Petroleum Geologists Bull., v. 41, no. 10, p. 2340–2342. Herein defined as lowest member of Pearsall formation or its time-stratigraphic equivalent, including those rocks above top of Sligo formation and below base of James limestone member or its recognizable stratigraphic equivalents. Imlay (1940) published section which he termed Pine Island formation from Stanolind Oil and Gas Company's Dillon Heirs well No. 131, sec. 14, T. 21 N., R. 15 W. He selected top of Pine Island at 3,127 feet in this section. It is believed that in this well section called Pine Island formation by Imlay represents entire Pearsall formation. James limestone is not recognizable lithologic unit in this well. Imlay included in the Pine Island formation both the limestone and shale which are the time-stratigraphic equivalent of both the James limestone member and of the shale stratigraphically above James limestone member. James limestone member and lower part of Rodessa formation undergo facies change over Pine Island structure. They grade from characteristic lithologic type into black shale, dark calcareous shale, and thin beds of limestone. In Stanolind's Dillon Heirs well No. 1313, both lower Rodessa and James limestone member time-stratigraphic equivalents are lithologically similar to Pine Island shale member. Pine Island is not recognized beyond limits of either James or Cow Creek limestone members.

Type locality: Pine Island field, northwestern Louisiana. Formation completely penetrated in Dixie Oil Co.'s Dillon No. 92, sec. 13, T. 21 N., R. 15 W., Pine Island field, Caddo Parish, La., from a depth of 3,897 to 5,919 feet.

Pine Knob Sandstone

Lower Mississippian (Oil Lake) : Southwestern Pennsylvania.

W. M. Laird, 1941, Pennsylvania Topog. and Geol. Survey Progress Rept. 126, p. 14–15. Name will probably be used following more definitive study of area for unit here termed Sandstone G and described as a sandstone and shale sequence. At type locality, unit is shaly at bottom, grading upward with slight unconformity into gray-brown sandstone. As a whole, it is thin bedded and indistinctly ripple marked. Thickness 35 to 75 feet; 42 feet at type locality. Disconformably underlies Sandstone H; conformably overlies Sandstone E (Linderman sandstone) or its equivalent, Conglomerate F (Hopwood conglomerate).

Type section: In highway cut at scenic lookout below Summit Hotel on Route 40 east of Hopwood, Fayette County.

**Pinelog Conglomerate**[1]

Lower Cambrian: Northwestern Georgia.

Original reference: L. LaForge, 1919, Georgia Geol. Survey Bull. 35, p. 40.

G. W. Crickmay, 1936, Geol. Soc. America Bull., v. 47, no. 9, p. 1383. Pinelog conglomerate of Bartow County is claimed by LaForge (1919) to be lower part of the Weisner quartzite, but the Pinelog appears to lie at base of Talladega series, where as the Weisner is the top of the Lower Cambrian arenaceous series.

G. W. Stose and A. J. Stose, 1949, Geol. Soc. America Bull., v. 60, no. 2, p. 277. Basal conglomerate beds of Pine Log conglomerate of east end of Pine Log Mountain, which lies north of the Corbin granite and east of the fault [Cartersville] are derived from the Corbin granite and rest on that granite which is brought up in an anticline.

T. L. Kesler, 1950, U.S. Geol. Survey Prof. Paper 224, p. 9. For purposes of this report, Pinelog conglomerate is included in the Weisner formation.

First described in Cartersville district. Forms Pinelog, Pine, and eastern part of Brushy Knob and Signal Mountains.

Pine Mountain Complex[1]

Devonian or Carboniferous: East-central New Hampshire.

David Modell, 1936, Geol. Soc. America Bull., v. 47, no. 12, p. 1898, 1911–1913, pl. 1. Chief rock type is granite porphyry with abundant quartz phenocrysts; color varies, black, green, pink, and yellow. Porphyritic quartz syenite and granite occur locally. Composes an independent subsidiary stock; not part of main intrusion of Belknap Mountains. Assigned to White Mountain magma series, but age relative to other units in series unknown.

Occurs in Pine Mountain-Rocky Mountain area of Belknap Mountains.

Pine Mountain Formation[1]

Pine Mountain Group or Series

Precambrian(?): Central western Georgia.

Original reference: S. L. Galpin, 1915, Georgia Geol. Survey Bull. 30, p. 74–76.

G. W. Crickmay, 1935, *in* L. M. Prindle, Georgia Geol. Survey Bull. 46, p. 32. Pine Mountain series includes Hollis quartzite below and Manchester formation (new).

G. W. Crickmay, 1952, Georgia Geol. Survey Bull. 58, p. 22–23. Discussion of crystalline rocks of Georgia. Rocks are grouped into 11 belts, in part using names proposed by Adams (1933, Jour. Geology, v. 41, no. 2). Pine Mountain series includes quartzites and schists of Pine and Oak Mountains in southwestern part of Wacoochee belt. Four formations recognized (ascending): Sparks schist, Hollis quartzite, Chewacla marble and Manchester schist. Chewacla marble (type locality Alabama) not known in Georgia. Adams believes that series is Paleozoic. It is here assigned to Precambrian.

J. W. Clarke, 1952, Georgia Geol. Survey Bull. 59, p. 6 (table). Referred to as Pine Mountain group. In Thomaston quadrangle, includes Hollis quartzite below and Manchester formation above. Overlies Woodland gneiss; underlies schist-gneiss migmatite. Precambrian(?).

Named for occurrence on Pine Mountain, from western part of Harris County to eastern part of Pike County.

†Pine Mountain Group (in Pottsville Group)[1]

Pennsylvanian: Southeastern Kentucky.

Original reference: A. R. Crandall, 1889, Kentucky Geol. Survey Whitley County Rept.

Named for Pine Mountain.

Pine Mountain Porphyry

Precambrian: Central Arizona.

E. D. Wilson, 1939, Geol. Soc. America Bull., v. 50, no. 7, p. 1129, 1139, pl. 11. Rhyolite porphyry which is typically a fine-grained porphyritic gray rock that weathers pale yellowish gray. Maximum width 1 mile. Occurs sparsely as dikes at various places in Yaeger greenstone and Alder series.

Prominent only in vicinity of Pine Mountain in central part of Mazatzal Mountains.

**Pine Nut Limestone Member** (of Gold Hill Formation)[1]

Cambrian: Central Nevada.

Original reference: H. G. Ferguson, 1924, U.S. Geol. Survey Bull. 723.

Exposed on Pine Nut claim, Manhattan district.

**Pine Plains Formation**

Upper Cambrian : Southeastern New York.

E. B. Knopf, 1946, (abs.) Geol. Soc. America Bull., v. 57, no. 12, pt. 2, p. 1212. Mainly dark impure dolomites; lower beds carry cryptozoon reefs, some edgewise conglomerate, and oolite. Thickness 1,300 feet. Occurs below Briarcliff dolomite (new) and above Stissing dolomite. Upper Cambrian.

E. B. Knopf, 1956, (abs.) Geol. Soc. America Bull., v. 67, pt. 2, p. 1817. Variable assemblage comprising dark, sandy, and argillaceous dolomites at three horizons with intervening heavier bedded and lighter colored dolomites accompanied by edgewise conglomerates, oolitic beds, and cryptozoon reefs. Upper (?) Cambrian.

J. D. Weaver, 1957, Geol. Soc. America Bull., v. 68, no. 6, p. 730–734, pl. 1. Described in Copake quadrangle as Pine Plains formation or group. Complete section not present in area, but group constitutes much of the carbonate belt. Presence of heterogeneous lithologies associated with much of the very dark-gray compact dolomite distinguishes it from other carbonate units. Thickness 406 feet to possibly as much as that given at type area. Upper Cambrian.

First described in Stissing Mountain area, Dutchess County.

**Pine Ridge Sandstone Member** (of Mesaverde Formation)[1]

Pine Ridge Sandstone (in Mesaverde Group)

Upper Cretaceous : Southeastern Wyoming.

Original reference: C. E. Dobbin and others, 1929, U.S. Geol. Survey Bull. 806, p. 140.

J. R. Bergstrom, 1959, Rocky Mountain Assoc. Geologists 11th Field Conf., Symposium, p. 114. Informally named Mesaverde group consists of (ascending) Allen Ridge formation (new) and Pine Ridge sandstone. Underlies Lewis formation. Thickness 400 feet.

Named for exposures in Pine Ridge, about 2 miles southeast of Rock River, Albany County.

**Pinery 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 582–583, 585 (fig. 7), pl. 2. Consists of dark-gray fine-grained somewhat cherty limestone in thin straight beds, with several thicker lighter colored granular layers toward base At type locality and along foot of Reef escarpment, lies about 30 feet above base of formation and is 150 feet thick; southeastward in Delaware Mountains, and out in Delaware Basin, member thins to about 25 feet; here, dark thin straight-bedded limestones persist, the lighter gray beds are absent, and much sandstone is interbedded. Lies above the Hegler limestone member and below the Rader limestone member.

P. B. King, 1948, U.S. Geol. Survey Prof. Paper 215, p. 55–56, pl. 3 [1949]. Mapped in New Mexico.

Type section: On slope above Pine Spring, 2½ miles east of Guadalupe Peak, Culberson County, Tex. Named for "The Pinery", an old stage stand on the Butterfield trail at Pine Spring.

Pinesburg Member (of Shippensburg Formation)

Middle Ordovician (Bolarian): Western Maryland and south-central Pennsylvania.

L. C. Craig, 1949, Geol. Soc. America Bull., v. 60, no. 4, p. 715 (fig. 1), 718–722. Name proposed for basal member of formation. Described as dark-gray fine- to medium-grained limestone, cobbly below and platy above. Contains three metabentonites. At base in type section, is dark-gray to black medium-grained dark platy-weathering limestone with irregular partings; above is thicker unit consisting largely of dark-gray fine-grained cobbly blue-weathering limestone with prominent thick silty partings; at top is dark-gray fine- to medium-grained platy to slabby limestone. Similar lithologic zoning recognized throughout Cumberland Valley. Thickness 21 to 238 feet; 114 feet in type section. Conformably underlies Fannettsburg member (new); disconformably overlies "Stones River" limestone.

Type section: Exposure on south side of U.S. Route 30, 1 mile southwest of St. Thomas, Franklin County, Pa. Named for exposures along Western Maryland Railroad at Pinesburg Station, Washington County, Md.

**Pinesburg Station Dolomite** (in Beekmantown Group)

Lower Ordovician: Western Maryland.

R. H. Flower, 1956, Jour. Paleontology, v. 30, no. 1, p. 78. Incidental mention. Name credited to W. J. Sando.

W. J. Sando, 1956, Geol. Soc. America Bull., v. 67, no. 7, p. 935, 936. Formally proposed. Name applied to succession of dolomites overlying Rockdale Run formation (new) and underlying Row Park limestone. Top of formation is placed at base of lowest limestone bed in overlying Row Park formation. Thickness averages 450 feet.

W. J. Sando, 1957, Geol. Soc. America Mem. 68, p. 6 (table 1), 28–32, pls. 1, 3, 5. Consists of unfossiliferous cherty dolomite, most of which is laminated; mottled varieties occur throughout formation and are particularly common in lower half; chert nodules and irregular masses abundant. Thickness 372 to 503 feet.

Type section: On Suffecool Farm about 0.8 mile northwest of Pinesburg Station, Washington County. Total outcrop area is 2½ square miles; 75 percent of area is in western belt; eastern belt exposures are confined to narrow strip along northeast margin of Conococheague syncline.

**Pinetop Chert**[1]

Lower or Middle Devonian: Southeasten Oklahoma.

Original reference: H. D. Miser, 1934, Am. Assoc. Petroleum Geologists Bull., v. 18, no. 8, p. 974, 975.

G. A. Cooper and others, 1942, Geol. Soc. America Bull., v. 53, no. 12, chart 4. Included in Onesquethaw stage (new) [considered to be Lower or Middle Devonian].

Named for Pinetop School, sec. 5, T. 2 N., R. 15 E., about 20 miles south of McAlester, Pittsburg County.

Pine Valley Latite

Tertiary: Southwestern Utah.

E. F. Cook, 1957, Utah Geol. and Mineralog. Survey Bull. 58, p. 16 (fig. 2a), 18, 63–69. An augite-biotite latite porphyry, hard and heavy, with a rough fracture surface. Varies in color from dark gray to red purple. Phenocrysts compose 60 percent of the rock. Well developed platy partings. Basal glass 10 to 150 feet thick averaging about 50 feet. Maximum thickness more than 2,000 feet. Basal contact unconformable. Generalized section of formation in area shows Pine Valley latite stratigraphically above Page Ranch formation (new) and below Eight Mile dacite and Culbert breccia (both New).

Exposed in upper parts of the northern Pine Valley Mountains, Washington and Iron Counties.

**Pine Valley Quartzite**

Cambrian: Northeastern Utah.

J. D. Forrester, 1937, Geol. Soc. America Bull., v. 48, no. 5, p. 638–639, pls. 2, 3. Conformably overlying Ophir shale in Uinta Mountains is the 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 named Pine Valley quartzite. Thickness approximately 1,200 feet; tends to pinch out gradually to eastward. Underlies Mississippian limestones considered to be equivalent of Madison limestones of Wasatch Range; well defined angular unconformity.

A. A. Baker, J. W. Huddle, and D. M. Kinney, 1949, Am. Assoc. Petroleum Geologists Bull., v. 33, no. 7, p. 1166 (fig. 3), 1168. About 400 feet thick in vicinity of Duchesne River where it overlies Ophir(?) shale.

N. C. Williams, 1953, Am. Assoc. Petroleum Geologists Bull., v. 37, no. 12, p. 2738–2739. In western Uinta Mountains, two formations, Ophir and Pine Valley, heretofore assigned to Cambrian and thought to be conformable, are separated by a 20° angle of disconcordance. Plane of disconformity is proposed as proper position for Precambrian contact. Rocks earlier mapped as Ophir(?) are here named Red Pine shale. Name Pine Valley is superfluous, for if Pine Valley is lowermost Cambrian, as considered in this paper, it can be properly correlated, at least in part with the Tintic of the Oquirrh and Wasatch Mountains.

Named from exposures near Stewarts' Ranch on Provo River, Uinta Mountains. Present in discontinuous exposures as far east as Blacks Fork of Green River, Summit County.

Pineville Sandstone (in New River Group)

Pineville 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. 211.

P. H. Price and E. T. Heck, 1939, West Virginia Geol. Survey Greenbrier County, p. 216, 241. Generally massive, grayish-white, coarse-grained. Thickness 30 to 50 feet. Locally its position in column is occupied by shale. Occurs below Little Fire Creek coal and above Pocahontas No. 9 coal. In New River group, Pottsville series.

Forms cliffs nearly 100 feet high at Pineville, Wyoming County.

**Piney Formation**[1]

Upper Cretaceous: Northern Wyoming.

Original reference: N. H. Darton, 1906, U.S. Geol. Survey Prof. Paper 51, p. 13, 59–60.

Named for exposures on Piney Creek, northwest of Buffalo, Johnson County.

**Piney Creek Alluvium**

Recent: North-central Colorado.

C. B. Hunt, 1954, U.S. Geol. Survey Bull. 996–C, p. 114–117. Alluvium well stratified; individual beds commonly several inches thick. Material largely silt but contains many thin layers of silty sand and some gravel. Contains a few pebbles or cobbles. Locally, especially in deep and narrow valleys like Lakewood Gulch, alluvium includes layers of coarse cobbly gravel in silt matrix. Layers of clean sand uncommon. Stratification rises toward mouths of tributaries, and composition of sediments varies according to kind of sediments furnished by tributaries. Charcoal, hearths, and stone artifacts found in alluvium. About 7 feet of alluvium exposed at the section. Overlies Wisconsin alluvium.

Type locality: Along Piney Creek, an eastern tributary to Cherry Creek in NW¼NW¼ sec. 25, T. 5 S., R. 66 W., in Denver area, Arapahoe County.

Piney Creek Conglomerate (in Pottsville Group)[1]

Pennsylvanian: Southern West Virginia.

Original reference: D. White, 1895, Geol. Soc. America Bull., v. 6, p. 305–320.

On Piney Creek along New River.

**Piney Point Formation**

Eocene, upper: Subsurface in Maryland and Virginia.

E. G. Otton, 1955, Maryland Dept. Geology, Mines and Water Resources Bull. 15, p. 85–89, pls. 1, 5. 14. Name applied to glauconitic sands and interspersed shell beds of Jackson age that lie above Nanjemoy formation and below Calvert formation; contacts conformable. Occurs as a wedge shaped unit; attains maximum thickness of 60 feet in wells near Lexington Park and Breton Beach, Md.

Type well: St. M–Fe 24, drilled for Curtiss Steuart in 1950 near tip of Piney Point Peninsula 0.8 mile northeast of Piney Point lighthouse, St. Marys County, Md. Present in southern Maryland southeast of a line extending southwestward from Kenwood Beach across Calvert and St. Marys Counties to vicinity of Cobb Island in Charles County; recognizable in Northumberland and Westmoreland Counties, Va.

**Piney Ridge Sandstone Member** (of Chemung Formation)[1]

Upper Devonian: Central Pennsylvania.

Original reference: C. Butts, 1918, Am. Jour. Sci., 4th, v. 46, p. 535.

Charles Butts, 1945, U.S. Geol. Survey Geol. Atlas, Folio 227. Member of Chemung formation. A persistent bed about 50 feet thick, 30 to 200 feet above base of the Chemung. Allegrippis sandstone member occurs about 1,400 feet above the Piney Ridge.

Named for exposures along Piney Ridge, Huntingdon County.

**Pinkard Formation**[1]

Upper Cretaceous: Southeastern Arizona.

Original reference: W. Lindgren, 1905, U.S. Geol. Survey Prof. Paper 43.

Exposed in vicinity of Pinkard Gulch, west of Morenci, Clifton region.

†Pink Cliff series[1]

Eocene: Southwestern and central southern Utah.

Original reference: C. E. Dutton, 1880, Geology of High Plateaus of Utah, p. 143–159, 188–210.

Exposed at the Pink Cliffs, northern part of Kane County.

**Pinkerton Sandstone**[1] (in Pocono Group)

Lower Mississippian: Northeastern West Virginia.

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 sandstone in Pocono group. Underlies Maccrady formation; overlies Myers 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 the post-Hedges formations should be restudied. Lithologic evidence favors correlation of the Myers with Mauch Chunk, and Pinkerton with basal Pennsylvanian.

Occurs on Pinkerton Knob, W. Va.

Pinkerton Trail Limestone or Formation (in Hermosa Group)

Pennsylvanian (Atoka and Des Moines): Colorado and Utah.

S. A. Wengerd and J. W. Strickland, 1954, Am. Assoc. Petroleum Geologists Bull., v. 38, no. 10, p. 2161 (fig. 2), 2167 (fig. 7), 2168–2169. Proposed to separate a limestone-dolomite-clastic sequence of Atoka and earliest Des Moines age from underlying Molas shale and overlying Paradox evaporite sequence. Widespread throughout Paradox Salt basin region as dark-gray fine to coarsely crystalline crinoidal and fusulinid-bearing limestone with some dark-gray shale. Thickness ranges from wedge-edge to more than 200 feet where intra-formational detrital section is best developed in Cedar Mesa anticline of Monument upwarp. Formerly referred to as "lower Hermosa member".

S. A. Wengerd, 1957, New Mexico Geol. Soc. Guidebook 8th Field Conf., p. 134, 135. Table shows Pinkerton Trail formation as lowermost unit in Hermosa group. Thickness at type locality 84 feet.

J. R. Clair, 1958, Rocky Mountain Assoc. Geologists Symposium on Pennsylvanian rocks of Colorado and adjacent areas, p. 34. In subsurface, stratigraphically restricted below to exclude unit herein named Lime Ridge formation.

Type locality: Pinkerton Trail near Denver and Rio Grande Railroad tracks, in sec. 26; T. 37 N., R. 9 W., approximately 12 miles north of Durango, Colo., on west side of U.S. Highway 550.

**Pinnacle Formation** (in Camels Hump Group)

Pinnacle Graywacke,[1] Arkose, or Formation

Cambrian(?): Southern Quebec, Canada, and northwestern Vermont.

Original reference: T. H. Clark, 1931, Geol. Soc. America Bull., v. 42, pt. 1, p. 225–226.

T. H. Clark, 1936, Royal Canadian Inst. Trans., v. 21, pt. 1, p. 137, 140–143. Feldspathic sandstone containing much detrital magnetite and ilmenite; usually some shale of gray tinged with green. Well bedded; thickness of beds variable. Crossbedding prominent. Maximum thickness 400 feet. Underlies White Brook dolomite; overlies Call Mill slate. Type locality cited.

V. H. Booth, 1950, Geol. Soc. America Bull., v. 61, no. 10, p. 1135, 1136, 1141–1145. Extended to Vermont where known as Pinnacle formation because of lithologic variations. If a few feet of Call Mill slate are present in Vermont they are included in Pinnacle.

Phillip Fowler, 1950, Vermont Geol. Survey Bull. 2, pl. 1. Precambrian(?).

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. 16, 39. Pinnacle arkose makes up lower part of Mendon series of Vermont Valley sequence.

P. H. Osberg, 1959, New England Intercollegiate Geol. Assoc. Guidebook 51st Ann. Mtg, p. 47. Pinnacle formation of this report [Coxe Mountain area, Vermont] includes rocks called Mendon and Nickwaket.

Type locality: In Lot 1, Range 1, Dunham Township, Sutton quadrangle, Quebec, on north side of road and on western limb of same syncline that caps Pinnacle Mountain and Spruce Hill. Named for Pinnacle Mountain which has capping of graywacke.

Pinnacle[1] (System)

Cenozoic (pre-Pliocene): Southeastern Alaska.

Original reference: I. C. Russell, 1891, Nat. Geog. Mag., v. 3, p. 167–175.

D. J. Miller, 1953, Jour. Geology, v. 61, no. 1, p. 32. Deposits of system between Icy Bay and Yakutat Bay formerly thought to be either Pliocene or Pleistocene (Smith, 1939, p. 59), but collections of fossils made recently from some of the beds previously correlated with Pinnacle system probably not younger than Miocene.

Best exposed in cliffs of Pinnacle Pass and along northern and western borders of Samovar Hills, St. Elias region.

Pinnacle Point Beds or Formation

Miocene, upper: Southeastern Oregon.

E. M. Baldwin, 1959, Geology of Oregon: Ann Arbor, Mich., Edwards Bros., Inc., p. 108–109. Quartzose sandstone; locally interbedded with friable sandstone and siltstone. Sparsely fossiliferous. Unconformably overlies truncated or channeled Owyhee basalt; where Owyhee is missing, it is difficult to distinguish Pinnacle Point beds from Payette formation. Capped by Grassy Mountain basalt. Tentatively assigned to late Miocene (Barstovian).

Well exposed along eastern margin of Owyhee Reservoir from Burnt Ridge, Pinnacle Point, Dry Creek Butte, along margins of Oxbow Basin, Mitchell Brown and Vale Buttes.

Pinnacles Formation

Miocene, middle(?): West-central California.

Philip Andrews, 1936, California Univ. Pubs., Dept. Geol. Sci. Bull., v. 24, no. 1, p. 19, 25, 26, map 1. Volcanic breccias and tuffs, chiefly rhyolite. Miocene(?).

I. F. Wilson, 1943, California Jour. Mines and Geology, v. 39, no. 2, p. 217–218, 224 (fig. 3), pl. 4. In San Benito quadrangle, underlies Monterey group; overlies Gabilan limestone. Thickness as much as 2,600 feet. Middle(?) Miocene.

Named for exposures in Pinnacles National Monument, near King City, southeast of Salinas.

**Pinney Hollow Formation** (in Camels Hump Group)

Pinney Hollow Schist[1] or Formation

Lower Cambrian: East-central and west-central Vermont.

Original reference: E. L. Perry, 1927, Vermont State Geologist 15th Rept., p. 161.

P. H. Osberg, 1952, Vermont Geol. Survey Bull. 5, p. 55–61, 116, geol. map. Formation described in eastern sequence in Green Mountain anticlinorium near Rochester and East Middlebury. Thickness 1,000 to 1,500 feet. Includes Hancock member (new) in middle part. Overlies Granville formation (new); underlies Ottauquechee formation. Cambrian.

W. F. Brace, 1953, Vermont Geol. Survey Bull. 6, p. 48–50, tables 2, 3. In Rutland area, overlies Grahamville formation (new); underlies Ottauquechee formation. Consists of three parts: lower, white green phyllite, green albitic phyllite and grit, thin black phyllite, middle, green white phyllite, thin greenstone, black phyllite; upper, green phyllite, finely banded green and gray siltstone. Thickness 3,500 to 4,000 feet. Cambro-Ordovician.

Type exposures in Pinney Hollow, Plymouth Township, Windsor County.

Pinnick Coal Member (of Mansfield Formation)

Pennsylvanian: South-central Indiana.

H. H. Gray, R. D. Jenkins, and R. R. M. Weidman, 1960, Indiana Geol. Survey Bull. 20, p. 26–27. Important stratigraphic marker or key bed at top of lower unit of Mansfield. Average thickness about 1 foot. Coal named by D. W. Franklin (1939, unpub. thesis). Franklin's type section no longer exposed. Other good exposures noted.

Type section (Franklin): Mine on Pinnick property in SE¼SW¼ sec. 32, T. 2 N., R. 2 W., Orange County.

**Pinole Tuff**[1]

Pliocene: Western California.

Original reference: A. C. Lawson, 1902, Science, new ser., v. 15, p. 416 (table).

C. E. Weaver, 1949, Geol. Soc. America Mem. 35, p. 110 (table 24), 118–121, pls. 11, 12. Overlies Neroly sandstone. Type section designated because no type exposure had been designated previously; tuff exposed along Pinole Valley has been dropped by faulting and is not representative of the entire sequence. Thickness at type locality nearly 1,000 feet.

Type section: Exposures along shore of San Pablo Bay between Oleum and Rodeo; tuff exposed on both limbs of a synclinal fold. Named for exposures near town of Pinole, on San Pablo Bay, Contra Costa County.

†Pinos Altos limestones[1]

Ordovician: Southwestern New Mexico.

Original reference: C. R. Keyes, 1904, Am. Jour. Sci., 4th, v. 18, p. 360–362.

Probably named for town in Grant County.

Pinto Diorite[1]

Pinto Metadiorite

Precambrian: Central Montana.

Original reference: W. H. Weed, 1899, U.S. Geol. Survey Geol. Atlas, Folio 56.

E. W. Heinrich, 1953, (abs.) Geol. Soc. America Bull., v. 64, no. 12, pt. 2, p. 1432. A number of post-Cherry Creek intrusives, all of which show varying degrees of metamorphism, include among others, Dillon granite gneiss, widespread in Beaverhead and Madison Counties, granite of Jardine district, and Pinto metadiorite in Little Belt Mountains.

Pinto Formation[1]

Pleistocene: Southern California.

Original reference: D. Scharf, 1935, Southwest Mus. Paper 9, p. 11–20.

Exposed in hill between Eagle Mountains and the Coxcombs and in Pinto Wash; also occurs in Pinto Basin, north-central part of Riverside County.

Pinto Gneiss

Precambrian: Southern California.

W. J. Miller, 1938, Geol. Soc. America Bull., v. 49, no. 3, p. 419 (fig. 2), 424–428. Comprises a complex of rocks, chief constituents of which are metamorphic facies of Gold Park gabbro-diorite (new) and Palms granite (new) and pegmatitic granite, together with some metasediments. Cut by White Tank monzonite (new).

Named because of its widespread, typical development in the Pinto Mountains, Riverside County.

†Pinto Limestone[1]

Upper Cretaceous (Gulf Series): Southwestern Texas.

Original reference: E. T. Dumble, 1892, Geol. Soc. America Bull., v. 3, p. 222, 229, 230.

Named for Pinto Creek, Val Verde County.

†Pinto Sandstone[1]

Cretaceous: Southwestern Utah.

Original reference: C. K. Leith and E. C. Harder, 1908, U.S. Geol. Survey Bull. 338, p. 37.

J. H. Mackin, 1954, U.S. Geol. Survey Mineral Inv. Field Studies Map MF–14. Pinto sandstone, as defined by Leith and Harder (1908) included all sedimentary rocks between Homestake limestone and overlying Claron formation. The dominantly maroon sandstone and shale which forms lower part of Pinto, however, rests gradationally on Homestake and is separated by an unconformity from dominantly gray and brown sandstone, shale, and conglomerate that forms bulk of Pinto. Maroon beds beneath unconformity are now correlated with the Entrada. Term Pinto is abandoned, and portion of that formation between the Entrada and Claron designated Iron Springs formation.

Probably named for Little Pinto Creek, which appears to cross formation just south of Iron Springs quadrangle.

Pintoan series[1]

Lower Cambrian: Southeastern California and western Nevada.

Original reference: C. R. Keyes, 1923, Pan-Am. Geologist, v. 40, p. 51, 53, 80.

Named for Pinto Mountains, near Waucoba Springs, in White Mountain Range, Calif.

Pinto Canyon Formation

Permian (Leonard and lower Guadalupe) : Southwestern Texas.

D. L. Amsbury, 1957, Dissert. Abs., v. 17, no. 9, p. 1981; 1958, Texas Univ. Bur. Econ. Geology Geol. Quad. Map. 22. Proposed for all Permian rocks above Alta formation in area. Divided into four unnamed members (ascending): regularly medium-bedded chert and limestone; irregularly bedded chert; regularly bedded chert and limestone with fossiliferous limestone lenses; thin-bedded siltstone with large limestone concretions. Thickness about 600 feet. Underlies Yucca formation.

Type section: In bed of Pinto Creek; base is three-sixteenth mile upstream from fourth creek crossing of Marfa-Ruidosa Road, Pinto Canyon area, Presidio County.

**Pinyon Conglomerate**[1]

Paleocene: Northwestern Wyoming.

Original reference: W. H. Weed, 1896, U.S. Geol. Survey Geol. Atlas, Folio 30.

J. D. Love, 1947, U.S. Geol. Survey Oil and Gas Inv. Prelim. Chart 27. Consists almost entirely of rounded red, black, gray, and yellow pebbles, cobbles, and boulders of Precambrian quartzites and other hard Cambrian metamorphic and igneous rocks. Contains fragments of wood. In southeastern part of area, thickness ranges from 1,000 to more than 1,500 feet; near Turpin Meadows about 500 feet; on Gravel Mountain at least 2,000 feet. Rests on Upper Cretaceous sandstones, shales, and thin coal beds of Mesaverde age in southeastern part of area and on successively younger strata of Cretaceous age along outcrops to northwest. Paleocene.

J. D. Love, 1956, Am. Assoc. Petroleum Geologists Bull., v. 40, no. 8, p. 1903, 1906. Uncomformably overlies Harebell formation (new) and unconformably underlies Colter formation (new).

Well exposed on Pinyon Peak, Yellowstone Park. Forms broad outcrops along eastern margin of Jackson Hole area, and is well developed along both forks of Fish Creek in Mount Leidy Highlands, and on Gravel Mountain.

Pinyon series[1]

Ordovician: Nevada.

Original reference: C. R. Keyes, 1923, Pan-Am. Geologist, v. 40, p. 53.

Derivation of name not stated.

†Pinyon Mesa Group[1]

Eocene and older(?): Northwestern New Mexico and southwestern Colorado.

Original reference: W. H. Holmes, 1877, U.S. Geol. and Geog. Survey Terr. 9th Ann. Rept. 1875, p. 248, 249, 251.

Forms escarpment of Pinon Mesa in northwestern part of San Juan County, N. Mex.

†Pinyon Peak Conglomerate[1]

Eocene: Yellowstone National Park.

Original reference: A. Hague, 1899, U.S. Geol. Survey Mon. 32, pt. 2, p. 184.

**Pinyon Peak Limestone**[1]

Upper Devonian and Lower Mississippian: Central northern Utah.

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

K. C. Bullock, 1951, Utah Geol. and Mineralog. Survey Bull. 41, p. 11–14. In Lake Mountain area, crops out north of mouth of Rock Canyon in fault block that rests unconformably on Humbug limestone. Thickness 331 feet. Conformably underlies Gardner dolomite. Devonian.

T. S. Lovering and others, 1951, (abs.) Geol. Soc. America Bull., v. 62, no. 12, pt. 2, p. 1506. Stratigraphic location of Upper Devonian Pinyon Peak was incorrectly designated in original description as between Bluebell dolomite and Victoria quartzite. However, it lies above the Victoria and below the Gardner. As redefined, comprises beds formerly included in the three lower units of the Gardner dolomite, now known to contain an Upper Devonian fauna.

H. T. Morris, 1957, Utah Geol. Soc. Guidebook 12, p. 11 (fig. 3), 13–14, pl. 1. In East Tintic Mountains, consists chiefly of thin-bedded, fine-grained, medium- to light-blue limestone seamed with veinlets and partings of buff- to brown-weathering clay and mudstone. Thickness 70 to 300 feet. Gradational with overlying Madison limestone, contact arbitrarily placed at base of thin bed of calcareous sandstone or sand-streaked limestone referred to as "sand-grain" or "ant-egg" marker by mining geologists of district. (Name Madison preferred to Gardner in this area). Loughlin (1919) did not recognize Pinyon Peak limestone in Tintic district where he believed Victoria formation to be of Mississippian age and to overlie an unconformity at base of Mississippian sequence. Consequently he included Pinyon Peak with his Gardner formation in this area. Data obtained since 1947 show that Pinyon Peak limestone occurs throughout East Tintic Mountains immediately above Victoria formation. Fossil evidence indicates that Devonian-Mississippian boundary is in upper part of Pinyon Peak; thus, age is considered to be Late Devonian and Mississippian(?).

J. K. Rigby, 1958, Utah Geol. Soc. Guidebook 13, p. 38 (fig. 5), 39. In Stansbury Mountains, overlies Stansbury formation (new). Underlies Gardner dolomite. Thickness as much as 85 feet.

H. J. Bissell, 1959, Utah Geol. Soc. Guidebook 14, p. 152–153. Recognized in Fivemile Pass and North Boulter Mountains quadrangles where it is as much as 105 feet thick, conformably underlies Gardner formation and disconformably overlies Victoria formation.

Named for exposures on Pinyon Peak, Tintic district.

**Pinyon Ridge Granodiorite**

Jurassic(?): Southern California.

L. F. Noble, 1954, U.S. Geol. Survey Geol. Quad. Map GQ–50. Prevailingly dark granodiorite, varying to quartz diorite, commonly gneissic; intruded locally by quartz monzonite and pegmatite and at some places complexly by fine-grained white aplite. May be related to Pleasant View complex (new).

Type locality: Pinyon Ridge, Valyermo quadrangle.

Pioa Rhyolite (quartz trachyte) and Breccia

Pleistocene(?): Samoa Islands (Tutuila).

R. A. Daly, 1924, Carnegie Inst. Washington Pub. 340, p. 100, 106–108, 129–130. Rhyolite (quartz trachyte) dome and associated breccia. In

Tutuila, a long stage of basaltic development was followed by series of explosions that produced Pioa and Matafao breccias; this stage was followed by eruptions of Pioa rhyolite and Matafao, Papatele, Afono, and Vatia trachytes, which seem to have been erupted contemporaneously or nearly so.

H. T. Stearns, 1944, Geol. Soc. America Bull., v. 55, no. 11, p. 1285–1286 (table 1), 1300–1302. Pioa trachyte plug is associated with Pago volcanic series (new). Pliocene and early Pleistocene(?).

G. A. Macdonald *in* Jacques Avias and others, 1956, Lexique Strat. Internat., v. 6, Océanie, fasc. 2, p. 191. Pleistocene(?). Late unit in Pago volcanic series; unconformably overlies basaltic tuffs, breccias, and flows forming floor of Pago caldera.

Occurs on Pioa Peak, east of Pago Pago Bay. Covers about 0.01 square mile.

**Pioche Shale**[1]

Lower and Middle Cambrian: Eastern Nevada, northwestern Arizona, eastern California, and western Utah.

Original reference: C. D. Walcott, 1908, Smithsonian Misc. Colln., v. 53, no. 1804, p. 9–12.

J. F. Mason, 1936, *in* A. W. Grabau, Paleozoic formations in the light of the pulsation theory, v. 1, Lower and Middle pulsation: 2d ed., Peiping, China, University Press, Natl. Univ. Peking, p. 274–276. Restricted to exclude two newly named units: Forlorn Hope shale and Comet shale. Restricted Pioche is 305 feet thick and includes "Combined Metals bed" of miners. Overlies Prospect Mountain quartzite.

Charles Deiss, 1938, Geol. Soc. America Bull., v. 49, no. 7, p. 1139, 1141 (fig. 3), 1143, 1154–1156, 1158 (fig. 6), 1159. Walcott's House Range, Utah, section emended. Here Pioche is 265 feet thick, overlies Prospect Mountain quartzite and underlies Tatow limestone (new). Westgate's (1932, U.S. Geol. Survey Prof. Paper 171) Highland Range, Nev., section emended. Here Pioche shale restricted to the 600 feet below Comet shale (redefined). Overlies Prospect Mountain quartzite. Lower-Middle Cambrian boundary placed at top of Pioche beneath the *Kochaspis liliana* zone at base of Comet shale. Term Forlorn Hope rejected in this report. Type locality of emended Pioche on north side of Lyndon (Shodde) Gulch, Nev.

H. E. Wheeler and D. W. Lemmon, 1939, Nevada Univ. Bull., Geology and Mining Ser., no. 31, p. 33, 34. Thickness in Pioche district 970 feet. Underlies Lyndon limestone; overlies Prospect Mountain quartzite. Mason's term Comet shale rejected.

H. E. Wheeler, 1943, Geol. Soc. America Bull., v. 54, no. 12, pt. 1, p. 1786, 1788–1789, 1790 (fig. 2), 1793, 1800, 1803, 1805, 1811–1815. Pioche shale is recognized from Eureka to western Grand Canyon and eastward throughout most of western Utah. In southeastern Nevada and northwesternmost Arizona, Pioche has been regarded as part of Bright Angel shale, and in western Utah it has been called Ophir and Cabin. Formation is both Lower and Middle Cambrian over most of Great Basin area, but it is Lower Cambrian at Eureka and Cave Valley(?), Nev., and in House and Deep Creek(?) Ranges, western Utah, and Middle Cambrian in Tintic and Sheeprock Ranges, central Utah.

H. E. Wheeler, 1948, Nevada Univ. Bull., Geology and Mining Ser., no. 47, p. 29. Uppermost 70 feet of beds previously assigned to Pioche shale in Wah Wah Range (Wheeler, 1943) are here assigned to Busby shale.

D. F. Hewett, 1956, U.S. Geol. Survey Prof. Paper 275, p. 28, 31–32, pl. 1. Mapped in Ivanpah quadrangle, California. Together with Prospect Mountain quartzite and Noonday dolomite, comprises what is termed western facies of the Cambrian.

A. R. Palmer, 1958, Jour. Paleontology, v. 32, no. 1, p. 154. At Pioche, Nev., includes Combined Metals member.

G. B. Maxey, 1958, Geol. Soc. America Bull., v. 69, no. 6, p. 668–669. Data presented in this report [northern Utah and southeastern Idaho] prove presence of Pioche formation throughout most of west-central and northern Utah and suggest its presence in the northern Wasatch, in part of Bear River Range, and in southeastern Idaho.

K. F. Bick, 1959, Am. Assoc. Petroleum Geologists Bull., v. 43, no. 5, p. 1066. In Deep Creek Mountains, Utah, replaces name Cabin shale.

R. E. Cohenour, 1959, Utah Geol. and Mineralog. Survey Bull. 63, p. 12 (table 1), 32, 35–39. Included in Ophir group. Underlies Busby quartzite.

H. K. Stager, 1960, U.S. Geol. Survey Prof. Paper 400–B, p. B70–B71. At Mount Wheeler mine, Pine County, Nev., the Pioche overlies Prospect Mountain quartzite and is about 450 feet thick. Consists mainly of micaceous, siliceous, highly indurated shale but includes several beds and lenses of limestone. Thickest limestone bed, known locally as "Wheeler limestone," is about 50 feet above quartzite contact and may be equivalent to Combined Metals limestone at Pioche. It is 20 to 50 feet thick.

Type locality: Southeast of Pioche, Nev., on road to Panaca, Utah.

Pioneer Group

Upper Cretaceous (Chico): 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 Pioneer group 7,500 feet.

F. M. Anderson, 1943, California Div. Mines Bull. 118, pt. 2, p. 183, 185 (fig. 69) [preprint 1941]. Shown as lowest group in Chico series; underlies Panoche group; overlies Horsetown group.

L. I. Briggs, Jr., 1953, California Div. Mines Bull. 167, p. 24, 32. Taliaferro and Anderson proposed divisions of Panoche group wherein Anderson's Pioneer group is approximately the equivalent of Taliaferro's Pacheco group and Anderson's Panoche and Moreno groups are inclusive of Taliaferro's Asuncion group. In area of present report [Ortigalita Peak quadrangle], both the Pacheco and Asuncion groups of Taliaferro or Pioneer and Panoche groups of Anderson are represented though they have not been satisfactorily separated.

Crops out in Cottonwood district and southward along the border of Sacramento Valley.

Pioneer Sandstone[1] (in Indian Bluff Group)

Pennsylvanian (Pottsville Series): Eastern Tennessee.

Original reference: L. C. Glenn, 1925, Tennessee Geol. Survey Bull. 33–B, p. 18–19, 21, 22.

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. Assigned to Indian Bluff group (new). Top of sandstone forms Poteet Gap, where it is about 55 feet thick; in Cross Mountain section 50 to 60 feet thick; in Petros section 4 feet. Separated from underlying Indian Fork sandstone (new) by shale interval that is as much as 80 feet thick in some places; separated from overlying Armes Gap sandstone (new) of Graves Gap group (new) by a shale interval that contains the Jordan coal and Norman Pond coal.

Named from exposures at Old Pioneer, near Poteet Gap, Pioneer quadrangle, Campbell County.

**Pioneer Shale,[1] Formation, or Quartzite** (in Apache Group)

Precambrian: Central and southeastern Arizona.

Original reference: F. L. Ransome, 1903, U.S. Geol. Survey Prof. Paper 12.

N. P. Peterson, 1950, Arizona Bur. Mines Bull. 156, Geol. Ser. 18, p. 100 (fig. 31). Shown as quartzite on columnar section of rocks in Globe-Miami district. Thickness 270 feet. Overlies Scanlan conglomerate; underlies Barnes conglomerate.

N. P. Peterson, C. M. Gilbert, and G. L. Quick, 1951, U.S. Geol. Survey Bull. 971, p. 15, fig. 3, pl. 1. Formation composed mainly of hard, fine-grained, reddish-brown arkosic sandstone in Castle Dome area. At least 165 feet thick. Mapped with Scanlan conglomerate.

Gordon Gastil, 1954, Am. Jour. Sci., v. 252, no. 7, p. 436–440. Pioneer rocks studied in southeastern Arizona consist of arkose grit and gravel conglomerate, feldspathic sandstone, argillaceous and feldspathic siltstone, silty mudstone, tuffaceous siltstone, and rhyolite tuff. At nine localities, sections consist predominantly of rhyolite tuff, and tuffaceous siltstone.

N. P. Peterson, 1954, U.S. Geol. Survey Geol. Quad. Map GQ–41. Formation mapped in Globe quadrangle where it is about 270 feet thick, overlies Scanlan conglomerate and underlies Barnes conglomerate.

D. W. Peterson, 1960, U.S. Geol. Survey Geol. Quad. Map GQ–128. Thickness approximately 300 to 500 feet in Haunted Canyon quadrangle. Overlies Scanlan conglomerate; underlies Barnes conglomerate.

U.S. Geological Survey currently classifies the Scanlan Conglomerate as a bed in the Pioneer Formation on basis of a study now in progress.

Named for exposures at old mining settlement of Pioneer, just south of Globe quadrangle.

**Pipe Creek Shale Member** (of Java Formation)

Pipe Creek Member (of Hanover Shale)

Pipe Creek Shale Member (of Wiscoy Formation)[1]

Upper Devonian: Western and west-central New York.

Original reference: G. H. Chadwick, 1923, Geol. Soc. America Bull., v. 34, p. 69.

W. H. Bradley and J. F. Pepper, 1938, U.S. Geol. Survey Bull. 899–A, p. 15, pl. 3. In southwestern New York, considered member of Wiscoy sandstone. Overlies Nunda sandstone.

J. F. Pepper and Wallace de Witt, Jr., 1950, U.S. Geol. Survey Oil and Gas Inv. Prelim. Chart 37. Reallocated to member status in Hanover shale. Overlies Angola shale to west and Nunda sandstone to east. Maximum thickness about 20 feet in Springfield quadrangle and northern part of Arcade quadrangle; thins westward to 2 feet in Silver Creek quadrangle;

thins eastward and interfingers with gray shale until in western part of Hornell quadrangle it cannot be identified.

I. H. Tesmer, 1957, New York State Mus. Bull. 362, p. 5, 9, 13. In surface referred to as member of Chemung formation.

Wallace de Witt, Jr., 1960, Am. Assoc. Petroleum Geologists Bull., v. 44, no. 12, p. 1933–1934, 1935 (fig. 2). Redefined as basal member of Java formation (new) in western and west-central New York. Underlies Hanover shale member; overlies Nunda sandstone member of West Falls formation.

Type exposure in Pipe Creek Glen, West Falls, Erie County.

**Pipeline Shale Member** (of Brushy Canyon Formation)

Pipeline Shale

Permian: Southwestern Texas.

W. C. Warren, 1955, *in* P. B. King, N.D. Newell, and D. W. Boyd, Permian field conference to the Guadalupe Mountains: Soc. Econ. Paleontologists and Mineralogists, p. 11. Name suggested for a black shale that intervenes between Bone Spring limestone below and the Brushy Canyon sandstone above. Has been correlated with Cutoff member [of Bone Spring] and name is used to distinguish shale from the type Cutoff. Contains fusulinids. Apparently transitional in time between Leonard and Guadalupe and is a "starved basin" shale.

U.S. Geological Survey currently classifies the Pipeline Shale as a member of Brushy Canyon Formation on basis of a study now in progress.

El Paso Natural Gas and the Pasotex pipelines cross outcrop of Pipeline shale a short distance north of Highway 62 in Delaware Mountains, Culberson County.

**Piper Formation** (in Ellis Group)

Middle Jurassic: Montana.

R. W. Imlay and others, 1948, U.S. Geol. Survey Oil and Gas Inv. Prelim. Chart 32. Defined to include all Middle Jurassic red beds, gypsum, and associated normal marine beds underlying Rierdon formation in eastern Montana east of Sweetgrass-Big Belt line of uplift. Basal part locally includes equivalents of type Gypsum Spring formation of central Wyoming as described by Love (1945); upper part includes beds that have been placed in lower part of lower Sundance in Wind River basin and central Wyoming. In Montana, consists of a lower red bed and gypsum member, a middle member of gray shale, limestone, and dolomite, and an upper red-bed gypsum member; these members grade into each other vertically, and to some extent the red beds grade laterally into middle marine member; upper member grades laterally into yellowish calcareous marine siltstone and sandstone. At type section, consists of (ascending) about 12 feet of massive white gypsum, 6 feet of brittle, chocolate-gray limestone, 57 feet of maroon and green siltstone and shale, 5 feet of gray, silty limestone, 9 feet of gray papery to chunky shale, and 4 feet of yellowish-gray sandy limestone. Thickness ranges from 0 to nearly 300 feet and varies considerably within short distances. Grades laterally into Sawtooth formation.

R. W. Imlay, 1952, Geol. Soc. America Bull., v. 63, no. 9, p. 967–968, chart 8C (columns 55, 57, 58, 60, 63, 64). Piper includes all Middle Jurassic beds underlying Rierdon formation in eastern Montana east of Sweetgrass-Big Belt-Bridger line of uplift. First identified as Gypsum Spring formation (Imlay, 1947) ; later fieldwork showed 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 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 age older than type Sundance. Because beds equivalent to type Gypsum Spring in Montana are not mappable, name Piper is used in that state for beds hitherto called Gypsum Spring. Middle member of Piper has furnished such ammonites as *Defonticeras* and *Teloceras*, which are of middle or upper Bajocian age; upper red-bed member grades laterally in western Montana into yellowish siltstone, sandstone, and limestone that contains *Arctocephalites* and *Procerites* and is considered of upper Bathonian age.

J. W. Nordquist, 1955, Billings Geol. Soc. Guidebook 6th Ann. Field Conf., p. 99–104, fig. 2. Subdivided to include (ascending) Tampico shale, Firemoon limestone, and Bowes members (all new). These units are recognized in subsurface and surface sections. In subsurface in Williston basin overlies Kline member of Nesson formation (both new).

T. P. Storey, 1958, Alberta Geol. Soc. Petroleum Geologists Jour., v. 6, no. 4, p. 90–104. Discussion of Jurassic of Williston basin and adjacent areas. On basis of faunal, environmental, and tectonic evidence, 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 sections 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 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.

Type section: About 1 mile southwest of Piper on northwest corner of an escarpment due east of Bacon Ranch in sec. 17, T. 14 N., R. 20 E., Fergus County.

Pipes Fanglomerate[1]

Pliocene, upper, or Quaternary, lower: Southern California.

Original reference: F. E. Vaughan, 1922, California Univ. Pub., Dept. Geol. Sci. Bull., v. 13, no. 9, p. 344, 379–380, map.

Named for occurrence near The Pipes, a watering place in San Bernardino County.

Pipestem Shale (in Bluestone Formation)[1]

Mississippian (Chesterian): Southeastern West Virginia and southwestern Virginia.

Original reference: D. B. Reger, 1926, West Virginia Geol. Survey Rept. Mercer, Monroe, and Summers Counties, p. 294, 322.

B. N. Cooper, 1944, Virginia Geol. Survey Bull. 60, p. 182, pl. 15. Geographically extended into Virginia and redefined as member of Bluestone formation. Thickness 10 to 20 feet. Overlies Pride shale member; underlies Glady Fork sandstone member. Chester series.

Type locality: In Tallery Mountain Road near foot of Davy Knob, about 1 mile northeast of Pipestem, Summers County, W. Va.

†Pipestone Quartzite[1]

Precambrian (Huronian): Southwestern Minnesota.

Original reference: N. H. Winchell, 1888, Minnesota Geol. Nat. History Survey Final Rept., v. 2, p. xxii.

Pipestone County.

Pipestone Canyon Formation

Eocene(?): Northwestern Washington.

J. D. Barksdale, 1948, Northwest Sci., v. 22, no. 4, p. 165, 175. Series of arkose, shale, and conglomerate. Basal member poorly sorted conglomerate of fairly well-rounded pebbles and boulders in massive bed approximately 20 feet thick. Succeeding sandstone is light gray to buff in color, in beds 6 inches to 4 feet thick interbedded with siltstones. These beds often tinged with purple. Upper part of formation shaly. Total thickness approximately 2,300 feet. Overlies Midnight Peak formation (new) unconformably.

Type locality: In Pipestone Canyon, Methow quadrangle.

†Pipestone Creek Beds[1]

Oligocene, lower: Western central Montana.

Original reference: E. Douglass, 1902, Am. Philos Soc. Trans., v. 20, new ser., pt. 3, p. 237–245.

On Pipestone Creek, just above Piedmont, Jefferson County.

Pipestone Springs Formation

Oligocene (Chadronian): Western central Montana.

H. E. Wood 2d and others, 1941, Geol. Soc. America Bull., v. 52, no. 1, p. 28, pl. 1. Pipestone Springs (also Pipestone, preoccupied, and Pipestone Creek), early Chadronian local fauna and inadequately described formation composed of confluent alluvial fans filling valleys in crystallines.

L. S. Russell, 1953, Billings Geol. Soc. Guidebook 4th Ann. Field Conf., p. 112. Pipestone Springs beds of Montana mentioned as approximately same age as Cypress Hills formation, Saskatchewan.

Present in Jefferson County.

†Piqua limestone member[1]

Pennsylvanian: Southeastern Kansas.

Original reference: G. I. Adams, 1904, U.S. Geol. Survey Bull. 328, p. 20.

Named for Piqua, Woodson County.

Piru Formation

Eocene: Southern California.

S. J. Kriz, 1955, Dissert. Abs., v. 15, no. 3, p. 393. Name given to Eocene sediments of area. Five members [unnamed] are differentiated. These range in age from early Maganos [Meganos] to late Domingene or Tejon. Uppermost member contains marine strata and unconformably underlies sediments of typical Sespe formation.

Area is Whitaker Peak-Reasoner Canyon in Ventura and Los Angeles Counties.

Piru Gorge Sandstone (in Ridge Basin Group)

Pliocene, middle: Southern California.

D. I. Axelrod, 1950, Carnegie Inst. Washington Pub. 590, p. 161, pl. 1. Made up of several massive, lenticular coarse-grained, crossbedded sandstones which range from 3 or 4 feet to as much as 30 feet in thickness. Unit as much as 150 feet thick. Underlies an unnamed shale zone below Peace Valley beds; overlies gray shales and blue-gray mudstones above French Flat sandstone (new).

Forms a conspicuous cuesta south of Pyramid rock on south bank of Piru Creek in Ridge Basin area along U.S. Highway 99, between Los Angeles and Bakersfield, in region from 5 miles north of Castaic to vicinity of Gorman.

**Piscataway Indurated Marl Member** (of Aquia 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. 58, 60–62.

R. A. Schmidt, 1948, Jour. Paleontology, v. 22, no. 4, p. 390, 392 (table 1), 393. The Piscataway indurated marl member below and Paspotansa greensand marl member above are present at type locality of Aquia formation. They cannot be distinguished on basis of their ostracods. Lower Eocene.

Named from Piscataway Creek which empties into the Potomac on Maryland bank about 10 miles below Washington, D.C.

†Piscataway Sands[1]

Eocene: Eastern Maryland

Original reference: A. Heilprin, 1884, Philadelphia Acad. Nat. Sci. Jour., 2d ser., v. 9, pt. 1, p. 120, 124–127.

**Pisgah Member** (of Kincaid Formation)[1]

Paleocene: Northeastern to southwestern Texas.

Original reference: F. B. Plummer, 1933, Texas Univ. Bull. 3232, p. 530, 535, 536, 540, 550.

Mackenzie Gordon, Jr., J. I. Tracey, Jr., and M. W. Ellis, 1958, U.S. Geol. Survey Prof. Paper 299, p. 13. Middle member of formation in Texas. Overlies Littig glauconite member; underlies Tehuacana member. Consists of yellow, gray, green, and buff clay and glauconitic sand containing several limestone beds. Beds equivalent to Pisgah member crop out at many localities in southwestern Arkansas.

G. R. Kellough, 1959, Gulf Coast Geol. Soc. Trans., v. 9, p. 152–153. At Tehuacana Creek, section consists of 148 feet of strata divisible into 3 units: basal, 20 feet thick, gray slightly sandy shale; middle, 53 feet thick, gray slightly sandy shale or shaly sand interbedded with thin layers of sandy shale containing small amounts of coarse dark-green glauconite; and upper, 75 feet thick, gray sandy shale with small amounts of very fine-grained light-green glauconite. Overlies Littig member; underlies Tehuacana member.

Named for exposures on Pisgah Ridge, Navarro County, on road between Richland and Wortham, 6 miles north of Limestone County line.

**Pismo Formation**[1]

Miocene, upper, and Pliocene: Southern California.

Original reference: H. W. Fairbanks, 1904, U.S. Geol. Survey Geol. Atlas, Folio 101.

B. M. Page and others, 1944, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 16. Thickness about 3,200 feet. Overlies Monterey formation; underlies Paso Robles. Upper Miocene and Pliocene.

Named for exposures at town of Pismo, San Luis Obispo County.

**Pit Shale[1] or Formation**

Middle and Upper Triassic: Northern California.

Original reference: H. W. Fairbanks, 1894, Am. Geologist, v. 14, p. 28.

J. P. Albers, 1953, California Div. Mines Spec. Rept. 29, p. 7–8, pls. 1, 3, 4, 5. Formation, in Afterthought Mine district, Shasta County, is about 500 feet thick. Consists of shale and tuff, with tuff making up more than half of formation. Overlies Bully Hill rhyolite.

A. H. Coogan, 1957, (abs.) Geol. Soc. America Bull., v. 68, no. 12, pt. 2, p. 1821. Conformably overlies Dekkas formation (restricted).

A. F. Sanborn, 1960, California Div. Mines Spec. Rept. 63, p. 5–7, pl. 1. Oldest formation exposed in area [southwest quarter Big Bend quadrangle, Shasta County]. Underlies Hosselkus limestone. Only upper part of formation studied. Middle Triassic.

A. H. Coogan, 1960, California Univ. Pubs. Geol. Sci., v. 36, no. 5, p. 243–255. Pit shale consists of black and gray siliceous shale which weathers to lighter shades of gray or white. Conformably overlies Dekkas formation of Bollibokka group (new). Owing to presence of middle Permian fusulinids in Dekkas and lack of diagnostic Triassic fossils in lower part of Pit, it is possible that Mesozoic-Paleozoic boundary is within Pit shale. [Spelled Pitt by J. P. Smith (1894), Jour. Geology, v. 2, p. 592, 601–604).]

Named for exposures at Silverthorns Ferry, on Pit River, Shasta County.

Pitcairn Gneiss Complex

Precambrian: Northeastern New York.

A. F. Buddington, 1939, Geol. Soc. America Mem. 7, p. 15–17. A belt of heterogeneous rock comprising gneiss skarn, granulite, feldspathic quartzite, and rock resembling artertic migmatite.

Extends along northwest border of Diana complex from just southeast of Harrisville, Lewis County, for about 10 miles or more to northeast.

**Pitchfork Formation**

Eocene, middle: Northwestern Wyoming.

R. L. Hay, 1956, Am. Assoc. Petroleum Geologists Bull., v. 40, no. 8, p. 1863–1898. Consists largely of detrital rocks—sandstones, siltstones, and conglomerates—containing volcanic debris from eruptive centers in Yellowstone Park-Absaroka volcanic province. Thickness 200 to about 1,200 feet; average about 1,000 feet. Interfingers northward with breccia; toward the south, pinches out against axis of Owl Creek Range. Almost everwhere underlain by Willwood and Tatman formations; overlain by basalt and equivalent breccia. West and south of Anchor post office, Masursky (1952, Wyoming Geol. Assoc. Guidebook 7th Ann. Field Conf., map) mapped beds equivalent to Pitchfork as Aycross formation. He showed Aycross strata extending as far south as Owl Creek Range, where, on axis of range, they pinch out between limestone of Paleozoic age and Tepee Trail formation. It is believed that use of Aycross for these beds is misleading because beds considered Aycross in Bighorn basin may never have been continuous with beds of Aycross south of Owl Creek

Range, in Wind River basin. As used here, Pitchfork formation includes beds in Bighorn basin named Aycross by Masursky. Vertebrate and plant remains indicate a probable middle Eocene age.

Name derived from Pitchfork post office in Greybull Valley. No single type section encompasses the lithologic variety of formation but exposures on cliff on east side of Francs Fork, in sec. 9, T. 47 N., R. 103 W., Park County, most nearly approach type section.

†Pithole Grit[1]

Mississippian: Northwest Pennsylvania.

Original reference: J. F. Carll, 1880, Pennsylvania 2d Geol. Survey Rept. $I_3$, p. 82, 93, 121, 130.

Well developed in and around Pithole, Venango County, and crops out along Allegheny River on south and along Oil Creek on west.

**Pitkin Limestone**[1]

Upper Mississippian: Northern Arkansas and eastern Oklahoma

Original reference: G. I. Adams and E. O. Ulrich, 1904, U.S. Geol. Survey Prof. Paper 24, p. 27, 109.

L. G. Henbest, 1953, Am. Assoc. Petroleum Geologists Bull., v. 37, no. 8, p. 1939. In Arkansas, underlies newly defined Cane Hill member of Hale formation.

G. G. Huffman and others, 1958, Oklahoma Geol. Survey Bull. 77, p. 14 (fig. 2), 71–75. Described on flanks of Ozark Uplift, northeastern Oklahoma, where it is conformable with the subjacent Fayetteville and unconformable with the overlying Hale formation. Maximum thickness 82 feet; average thickness 25 to 30 feet.

Named for exposures near Pitkin post office in Washington County, Ark.

Pitt Series[1]

Middle Triassic: North America.

Original reference: G. H. Ashley, 1923, Eng. Mining Jour.-Press, v. 115, p. 1106–1108.

Pittsburg Formation

Carboniferous: Central western Idaho and northeastern Oregon.

W. R. Wagner, 1945, Idaho Bur. Mines and Geology Pamph. 74, p. 4–5, pl. 1. Mainly conglomerates and sandstones with some argillaceous beds and here and there a dense tuffaceous bed. Conglomerates of subangular to rounded pebbles and boulders from 1 to 4 inches in diameter in coarse gray-green sandy matrix. Sandstones are coarse. Formation gray green to dark green in color and seems to have been formed mostly of debris eroded from Permian volcanics. Estimated thickness between 200 to 300 feet. Overlies Seven Devils volcanics.

Exposed near Pittsburg Landing on Snake River, Idaho County, Idaho. Covers area of approximately 1½ square miles on Idaho side of river and much larger but undetermined area on Oregon side.

†Pittsburg Formation[1]

Eocene: Western Washington.

Original reference: B. Willis, 1898, U.S. Geol. Survey 18th Ann. Rept., pt. 3, p. 424–430.

Named for Pittsburg.

Pittsburg Formation

Pleistocene: Northern California.

C. F. Tolman, 1931, California, California Dept. Public Works, Div. Water Resources Bull. 28, p. 354, pl. D–IX, D–X. Fine clayey sandstone and tawny-yellow to brown and brownish-yellow sandy silt; obscurely bedded. Grades into material designated as recent alluvium. Thickness about 500 feet.

O. P. Jenkins, 1938, Geologic map of California (1:500,000): California Div. Mines, sheet 4. Shown on map legend.

C. E. Weaver, 1949, Geol. Soc. America Mem. 35, p. 106. Replaced by Montezuma formation; name Pittsburg preoccupied.

Occurs in upper San Francisco Bay region.

**Pittsburg Bluff Formation**

Pittsburg Bluff Sandstone[1]

Oligocene: Northwestern Oregon.

Original reference: L. G. Hertlein and C. H. Crickmay, 1925, Am. Philos. Soc. Proc., v. 64, no. 2, p. 254.

C. E. Weaver, 1937, Washington [State] Univ. Pubs. in Geology, v. 4, p. 112–113. Term Pittsburg Bluff sandstone originally was intended to include the fossiliferous beds at town of Pittsburg. This stratigraphic horizon is probably near middle of Oligocene section exposed in Columbia County. Total thickness of middle Oligocene between Pittsburg and Clatskanie, approximates 4,000 feet. Seems desirable that term Pittsburg Bluff formation be applied to entire middle Oligocene sequence in county and that type section be considered along Nehalem River, between Pittsburg and Mist. Overlies Keasey formation. Also referred to as Pittsburgh Bluff.

W. C. Warren and Hans Norbisrath, 1946, Am. Assoc. Petroleum Geologists Bull., v. 30, no. 2, p. 220 (table 1), 228–231. Formation, in upper Nehalem River basin, consists of firm, sparingly fossiliferous, tuffaceous sandstone and shale with beds of fine-grained white tuff; stratified cross-bedded sandstone with pebble bands and carbonaceous material; massive loosely consolidated brown-weathering medium-grained concretionary sandstone; gray fine-grained fossiliferous sandstone with calcareous beds. Thickness 700 to 850 feet. Disconformably underlies Scappoose formation (new); overlies Keasey formation; actual contact not observed, evidence suggests unconformity with angular discordance of several degrees. Middle Oligocene.

Named for exposures at Pittsburg Bluff, Columbia County.

Pittsburgh clay member

Pennsylvanian (Conemaugh Series): Eastern Ohio.

D. L. Norling, 1958, Ohio Geol. Survey Bull. 56, p. 10 (fig. 3), 65. Subjacent to Pittsburgh (No. 8) coal is a thin zone of clay or clay shale known as the Pittsburgh clay member; overlies Upper Pittsburgh limestone member. Top of this clay marks top of Conemaugh series in Ohio. Thickness 1 inch to 4½ feet.

Well exposed in Union Township, Morgan County.

Pittsburgh cyclothem

Pennsylvanian (Monongahela Series); Southeastern Ohio.

M. T. Sturgeon and others, 1958, Ohio Geol. Survey Bull. 57, p. 159 (table 13), 161–166. Lowest cyclothem in Monongahela series. Succeeded by Upper Pittsburgh cyclothem (new). In normal successsion, includes seven members (ascending): Lower Pittsburgh (Bellaire) shale and (or) sandstone, Lower Pittsburgh redbed, Upper Pittsburgh limestone, Pittsburgh underclay and shale, Pittsburgh (No. 8) coal, roof shale, and Pittsburgh "rider" coal. Thickness about 40½ feet. In area of this report, Monongahela series is discussed on a cyclothemic basis; 12 cyclothems are listed (ascending): Pittsburgh, Upper Pittsburgh, Redstone, Fishpot, Lower Sewickley, Sewickley, Benwood, Arnoldsburg, Lower Uniontown, Uniontown, Little Waynesburg, and Waynesburg.

Present in Athens County. Members of cyclothem are named from Pittsburgh (No. 8) coal, which was first described from exposures in Pittsburgh, Pa., area, but was formerly referred to in Athens County as Federal Creek coal bed.

†Pittsburgh Limestone (in Conemaugh Formation[1] or Group)

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

Original reference: H. D. Rogers, 1858, Geology of Pennsylvania, v. 2, pt. 1, p. 628–635.

R. E. Lamborn, 1951, Ohio Geol. Survey, 4th ser., Bull. 49, p. 34, 48. Pittsburgh limestone, first named by Rogers for its occurrence immediately below the Pittsburgh coal seam in western Pennsylvania and generally known as Upper Pittsburgh limestone in West Virginia, is widely distributed across southeastern Ohio. Member may consist of a single irregular layer of limestone separated from base of Pittsburgh coal by thin bed of clay, nodular limestone embedded in clay or clay shales, or several layers of limestone interstratified with calcareous argillaceous shale. Thickness of limestone and associated beds ranges from 2 feet to more than 20 feet, but the usual thickness is 4 or 5 feet. Conemaugh series.

M. N. Shaffner, 1952, Pennsylvania Geol. Survey, 4th ser., Prog. Rept. 141. Shown on columnar section as Pittsburgh limestone in Conemaugh group. Above Clarksburg coal and below Pittsburgh coal.

Named for its occurrence immediately below Pittsburgh coal in western Pennsylvania.

Pittsburgh Member (of Monongahela Formation)[1]

Pennsylvanian: Western Pennsylvania.

Original reference: M. E. Johnson, 1929, Pennsylvania Geol. Survey Topog. and Geol. Atlas 27, p. 31.

Pittsburgh Red Beds, Red Shale, or Reds (in Conemaugh Formation[1] or Group)

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

[Original reference] (Pittsburgh red shale): I. C. White, 1903, West Virginia Geol. Survey, v. 2, p. 263–265.

M. T. Sturgeon, 1958, Ohio Geol. Survey Bull. 57, p. 130. Widespread variegated clays and shales occur at many places in Maryland, Ohio, Pennsylvania, and West Virginia in interval between Portersville (Friendsville) shale and limestone and Ames limestone. Thicknesses range up to 50 or even 100 feet. To these beds in Ohio, Condit (1912) gave name Round Knob. Elsewhere in northern Appalachian region these shales and clays are known as Pittsburgh red shale or redbed, a name given by White (1903) and a name which Condit deems unsatisfactory because of previous and general use of Pittsburgh for No. 8 coal and for its underlying limestone. Condit's opinion is valid, and name Round Knob is used for these beds in Ohio.

R. R. Dutcher and others, 1959, Geol. Soc. America Guidebook Pittsburgh Mtg., p. 69 (fig. 4). Pittsburgh redbed shown on generalized columnar section for Pennsylvanian of western Pennsylvania above Saltsburg sandstone and below Harlem coal. Conemaugh group.

Named for exposures along grade lines of many railroads at Pittsburgh, Pa.

Pittsburgh (Lower) Sandstone (in Conemaugh Formation)[1]

*See* Lower Pittsburgh Sandstone (in Conemaugh Formation)

**Pittsburgh Sandstone Member** (of Monongahela Formation)[1]

Pittsburgh sandstone member

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

Original reference: H. D. Rogers, 1858, Geology of Pennsylvania, v. 2, pt. 1, p. 503–507.

Wilber Stout, 1954, Ohio Geol. Survey Open File Rept. 1, p. 26–27. Described in Ohio as Pittsburgh or Upper Pittsburgh sandstone member of Monongahela series. Scattered in its occurrence in eastern Ohio. Where best developed, it is gray to drab, medium fine in texture, and commonly marked by crossbedding planes.

R. L. Nace and P. P. Bieber, 1958, West Virginia Geol. Survey Bull. 14, p. 19. Upper Pittsburgh sandstone listed in summary of stratigraphic section of Monongahela formation in Harrison County. Thickness as much as 15 feet. Underlies Redstone limestone and overlies unnamed limy shale above Pittsburgh coal.

First described in Greene County, Pa.

†Pittsburgh Series[1]

Pennsylvanian: Central western Pennsylvania.

Original reference: H. D. Rogers, 1839, Pennsylvania Geol. Survey 3d Ann. Rept., p. 88–108.

G. H. Ashley, 1945, Jour. Geology, v. 53, no. 6, p. 374–389; M. N. Shaffner, 1946, Pennsylvania Geol. Survey, 4th ser., Topog. and Geol. Atlas 55, p. 48, pl. 4. Discussion of Pittsburgh-Pottsville boundary. Pittsburgh series is equivalent to Monongahela, Conemaugh, and Allegheny groups.

Named for exposures in vicinity of Pittsburgh, Allegheny County.

Pittsburgh Underclay

Pittsburgh underclay and shale member

Pennsylvanian (Conemaugh Series): West Virginia and eastern Ohio.

J. B. McCue and others, 1948, West Virginia Geol. Survey, v. 18, p. 12. Pittsburgh underclay is topmost member of Conemaugh series. Thickness 2 to 12 feet.

M. T. Sturgeon and others, 1958, Ohio Geol. Survey Bull. 57, p. 158 (table 13), 163. Pittsburgh underclay and shale member of Pittsburgh cyclothem in report on Athens County. Average thickness about 2 feet. Above Upper

Pittsburgh limestone member and below Pittsburgh (No. 8) coal member. Monongahela series.

Probably named for association with Pittsburgh coal.

Pittsfield Member of (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. 8, 10 (table 1), geol. map. Oldest unit of Littleton formation in Gilmanton quadrangle. Coarse-grained schists and gneisses. Underlies Jenness Pond member (new).

Good exposures at Sabattus Heights and along Pleasant Street in Loudon.

**Pittsford Shale** (in Salina Group)

Pittsford Shale Member (of Salina Formation)[1]

Upper Silurian : Western to east-central New York.

Original reference: J. M. Clarke, 1908, New York State Mus. Bull. 69, p. 867.

C. K. Swartz and others, 1942, Geol. Soc. America Bull., v. 53, no. 4, chart 3. Correlation chart shows Pittsford shale at base of Salina group, Cayugan series. Underlies Vernon shale.

R. E. Griswold, 1951, New York State Water Power and Control Comm. Bull. GW–29, p. 10. Salina formation consists of (ascending) Pittsford shale, Vernon shale, Syracuse salt, Camillus shale, and Bertie limestone members. Of these, only the Vernon and Camillus have been recognized in Wayne County.

D. W. Fisher, 1957, New York State Mus. Bull. 364, p. 6, 11. Discussion of Vernon formation in its type locality. Name Pittsford shale is suppressed. It is not a widespread, clearly recognizable mapping unit. This discontinuous occurrence of greenish-black shale above Lockport dolomite is included within the Vernon.

Named for exposures in excavations in Erie Canal near Pittsford, Monroe County.

Pittsford Valley Dolomite

Cambrian : West-central Vermont.

G. W. Bain, 1938, New England Intercollegiate Geol. Assoc. [Guidebook] 34th Ann. Field Mtg., p. 8. Chiefly dolomite with about 30 percent graywacke beds occurring in cyclic series. Graywacke zones are about 10 feet thick and have buff-weathering dolomite "spacers" between. Thickness 800 feet. Overlies Florence dolomite (new).

Occurs in central Vermont marble belt, Rutland County.

Piutean series[1]

Pliocene : California.

Original reference : C. R. Keyes, 1923, Pan-Am. Geologist, v. 40, p. 52, 80.

Well exposed under Piute Point, in Furnace Canyon, east of Death Valley, Inyo County.

**Placer Creek Formation**

Pleistocene : Southeastern Utah.

G. M. Richmond, 1956, Dissert. Abs., v. 16, no. 6, p. 1128. Consists of two members that comprise nine lithofacies, including till and various alluvial. colluvial, and eolian deposits. Till forms two sets of lower canyon end moraines. Weakly developed Porcupine Ranch soil is formed on lower member where it is overlain by the upper member. Moderately developed Castle Creek soil is formed on upper member and on deposits of lower member not overlain by the upper member. Older than Beaver basin formation (new); younger than Harpole Mesa formation (new).

Located in La Sal Mountains area.

Placerita Formation[1]

Pre-Cretaceous: Southern California.

Original reference: W. J. Miller, 1934, California Univ. at Los Angeles Pub. in Math. and Phys. Sci., v. 1, no. 1, p. 3–12, 63–65, 83, map.

G. B. Oakeshott, 1937, California Jour. Mines and Geology, v. 33, no. 3, p. 220–223, pl. 3. Crystalline limestone; graphite, biotite, sillimanite, and tremolite schist; quartzite and schistose conglomerate. No estimate of thickness in Little Tujunga quadrangle; at least 5,000 feet in Placerita Canyon district. Intruded by Rubio diorite. Carboniferous(?).

G. B. Oakeshott, 1958, California Div. Mines Bull. 172, p. 22 (fig. 2), 50–52, pls. 1, 2. Mapped as pre-Cretaceous. Intruded by Upper Jurassic(?)-Lower Cretaceous(?) granitic rocks. Occurs south of San Gabriel fault.

Named for exposures in Placerita Canyon, at west end of San Gabriel Mountains.

†Placer Mountain Group[1]

Upper Cretaceous: Central northern New Mexico.

Original reference: F. V. Hayden, 1869, U.S. Geol. and Geog. Survey Terr. 3d Ann. Rept. p. 90, 190.

Occurs in Placer Mountain, about 30 miles south of Santa Fe, Santa Fe County.

**Placid Shale Member** (of Brad Formation)[1]

Placid Formation

Placid Shale (in Brad Group)

Upper Pennsylvanian: Central Texas.

Original references: F. B. Plummer and R. C. Moore, 1921, Texas Univ. Bull. 2132, p. 109–110, 115; 1922, Jour. Geology, v. 30, p. 24, 31, 35.

C. O. Nickell, 1938, Texas Univ. Bur. Econ. Geology Pub. 3801, p. 111. Cedarton shale and Winchell member (including Clear Creek limestone of Drake and lower or limestone-bearing part of Placid shale member of Plummer and Moore) have been found to be included in typical Graford formation. Beds here included in "shale member" of Brad formation represent upper part of Placid shale member of Plummer and Moore.

M. G. Cheney, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 1, p. 66 (fig. 1), 88. Rank raised to formation in Brad here raised to group status. Underlies Ranger limestone; overlies Winchell formation.

D. H. Eargle, 1958, San Angelo Geol. Soc. Guidebook, April 17–19, p. 51 (columnar section). Shown on columnar section as member of Brad formation. Consists of shale, gray to brownish red to orange red, locally silty and sandy; contains local channel deposits of chert conglomerate and sand, and cherty limestone reefs; includes Corn Creek limestone member of Placid formation of Jenkins (1952, unpub. thesis).

D. H. Eargle, 1960, U.S. Geol. Survey Prof. Paper 315–D, p. 66, pl. 27. Jenkins (1952, unpub. thesis) described Placid as a formation and, in

Mercury quadrangle, named persistent limestone beds in unit the Corn Creek limestone member. These beds can be traced north into Brown County to a point about 2 miles west of village of Brookesmith beyond which they are replaced by sandstone and conglomerate. In present report, the Placid is classified as basal member of Brad formation. Underlies Ranger limestone member; overlies Winchell limestone. Thickness 125 to 145 feet along Colorado River; about 95 feet in central and north-central parts of Brown County.

Named for town of Placid, McCulloch County.

Placita Marl[1]

Probably Miocene and Pliocene: Central northern New Mexico.

Original reference: E. D. Cope, 1875, Ann. Rept. Chief Engrs. U.S. Army, Rept. Secy. War to 44th Cong., v. 2, pt. 2, p. 997.

Occurs in region from Zandia [Sandia] Mountains to and beyond village of Placita [now Placitas], Sandoval County.

Placitos limestone[1]

Pennsylvanian: Central northern New Mexico.

Original reference: C. R. Keyes, 1903, Ores and Met., v. 12, p. 48.

In Sandia Mountains. Derivation of name not stated.

Plainfield Quartz Schist[1] or Quartzite

Plainfield Quartz Schist Member (of Putnam Series)

Pre-Triassic: Eastern Connecticut.

Original reference: H. E. Gregory, 1906, Connecticut Geol. Nat. History Survey Bull. 6, p. 114, 132, map.

W. G. Foye, 1949, Connecticut Geol. Nat. History Survey Bull. 74, p. 69, pl. 1. Rank reduced to member. Occurs near base of Putnam series which is probably Precambrian in age.

John Rodgers and others, 1956, Preliminary geologic map of Connecticut (1:253,440): Connecticut Geol. Nat. History Survey. Includes local occurrences of fine-grained feldspathic gneiss which grades into aplitic phase of Sterling granitic gneiss. Pre-Triassic. Derivation of name stated.

C. B. Sclar, 1958, Connectcut Geol. Nat. History Survey Bull. 88, p. 10. Not mapped as separate unit in New London County.

R. M. Perhac, 1958, Connecticut Geol. Nat. History Survey Bull. 89, p. 8–9, pls. Plainfield quartzite described in Voluntown and Oneco quadrangles. Varies in texture and composition from fine-grained muscovite-quartz schist to fine-grained massive quartzite. Latter is definitely more abundant type. Bedding visible in many areas. Maximum possible thickness about 2,000 feet.

Named for town of Plainfield, Windham County.

†Plainfield Schist[1]

Ordovician: Western Massachusetts.

Original reference: R. Pumpelly, 1894, U.S. Geol. Survey Mon. 23, p. 29–30.

Named for occurrence in Plainfield Township.

†Plains Marl[1]

Miocene, Pliocene, and Pleistocene: Western Kansas.

Original reference: R. Hay, 1893, Kansas State Bd. Agric. 8th Bienn. Rept., p. 101.

J. C. Frye, 1952, Kansas Geol. Survey Bull. 99, p. 110. Listed with locally named units which are properly classed at least in part as Sanford formation.

Occurs on High Plains of western Kansas.

†Plains Series[1]

Pleistocene: Nebraska.

Original reference: A. L. Lugn, 1935, Nebraska Geol. Survey Bull. 10, 2d ser., p. 128, etc., charts.

A. L. Lugn, 1939, Am. Jour. Sci., v. 237, no. 12, p. 853 (fig. 1), 854. Surface of loess plain of south-central Nebraska, an area of more than 8,000 square miles, west of the till-covered area is underlain by yellowish Peorian loess and the Loveland formation (the Plains series), which increase in total thickness westward to a maximum of about 300 feet.

**Plainview Sandstone Member** (of South Platte Formation)

Lower Cretaceous: North-central Colorado.

K. M. Waagé, 1955, U.S. Geol. Survey Prof. Paper 274–B, p. 28–30, figs. 10, 11, 17, 19. Persistent unit which forms characteristic brown- to rusty-brown-weathering ledge of markedly tabular cross-laminated sandstone. Includes the black shale and conglomerate at the base of the formation. Thickness about 45 feet. Basal member of South Platte formation (new); disconformably overlies Lytle formation.

Named for exposures which occur in cut of Denver and Salt Lake Railroad (Moffat Tunnel Route) through the Dakota hogback at Plainview, NE¼NE¼ sec. 12, T. 2 S., R. 71 W., Jefferson County.

Plateau gravel phase[1]

Quaternary: Southwestern Arkansas.

Original reference: R. T. Hill, 1888, Arkansas Geol. Survey Ann. Rept. 1888, v. 2, p. 29, 35–42, 188.

Plateau Valley Beds[1]

Paleocene: Central western Colorado.

Original reference: B. Patterson, 1936, Geol. Soc. America Proc. 1935, p. 397.

G. G. Simpson, 1937, Cambridge Philos. Soc. Biol. Rev., v. 12, no. 1, p. 9 (footnote). Name Plateau Valley has been applied by Patterson to Paleocene part of the Ruby formation.

H. E. Wood 2d and others, 1941, Geol. Soc. America Bull., v. 52, no. 1, p. 28, pl. 1. Paleocene, Tiffanian. Member (?) of DeBeque formation.

C. L. Gazin, 1959, Intermountain Assoc. Petroleum Geologists Guidebook 10th Ann. Field Conf., p. 134 (fig. 1). Chart shows Plateau Valley beds in lower part of DeBeque formation. Tiffanian.

First mentioned in Mesa County.

Platte channel facies (of North Park Formation)

Miocene, upper: Central northern Colorado.

J. de la Montagne and W. C. Barnes, 1957, Rocky Mountain Assoc. Geologists Guidebook to geology of North and Middle Parks Basin, Colorado, p. 58, fig. 2. Crossbedded conglomerate and sandstone comprised mostly of rounded fragments of Precambrian rock and fragments of volcanic flow-rock. Angular fragments only rarely present. Although individual strata of this material not persistent for more than a few hundred yards along the valley, the mean size grade of volcanic fraction increases southward, passing from grit size at north end of valley to boulder size 60 miles to south near Independence Mountain. Interbedded with overbank facies of North Park formation in central part of valley.

Restricted to central parts of Saratoga Valley in North Park area.

†Platte Series[1]

Upper Cretaceous: From Rocky Mountains eastward.

Original reference: F. W. Cragin, 1896, Colorado Coll. Studies, v. 6, p. 49.

Occurs in area of that segment of North American Interior Plateau which extends from Rocky Mountains eastward and constitutes the higher part of the Plains. Named for Platte River, which, in Colorado and Nebraska, cuts all divisions of the series.

†Platte Series[1]

Pleistocene: Nebraska.

Original reference: A. L. Lugn, 1935, Nebraska Geol. Survey Bull. 10, 2d ser., p. 88+, charts.

A. L. Lugn, 1939, Am. Jour. Sci., v. 237, no. 12, p. 853 (fig. 1). Shown on Pleistocene geologic map of Nebraska.

Platte shale[1]

Pennsylvanian: Southwestern Iowa and northwestern Missouri.

Original reference: C. R. Keyes, 1898, Am. Geologist, v. 21, p. 349.

Well exposed along Platte River of northwest Missouri. Named for exposures at mouth of Platte River at Nebraska-Iowa boundary.

Platte River Formation[1]

Upper Cretaceous or Eocene: Nebraska.

Original reference: H. Engelmann, 1876, Engr. Dept. U.S. Army, J. H. Simpson's Expl. of Great Basin of Terr. Utah, p. 247, 282–284.

On North Fork of Platte River.

**Platteville Limestone[1] or Formation**

Platteville Dolomite or Group

Middle Ordovician: Southwestern Wisconsin, northwestern Illinois, eastern Iowa, and southern Minnesota.

Original reference: H. F. Bain, 1905, U.S. Geol. Survey Bull. 246, p. 18–19.

C. A. Bays, 1938, (abs.) Geol. Soc. America Proc. 1937, p. 269. Formation subdivided to include Mifflin limestone member which overlies Pecatonica member and underlies Magnolia member.

A. F. Agnew and A. V. Heyl, Jr., 1946, Am. Assoc. Petroleum Geologists Bull., v. 30, no. 9, p. 1585–1588. Formation subdivided to include Quimbys Mill member which overlies McGregor member and underlies Spechts Ferry shale member of Decorah formation.

J. S. Templeton and H. B. Willman, 1952, Tri-State Geol. Soc. Guidebook 16th Ann. Field Conf., p. 6, 10–11 (fig. 3). Considered a group in Dixon-Oregon area, Illlinois, where it includes (ascending) Pecatonica, Mifflin, Grand Detour (new), Nachusa (new), and Quimbys Mill formations, Underlies Galena group; overlies Ancell group (new).

M. P. Weiss and W. C. Bell, 1956, Geol. Soc. America Guidebook for Field Trips Minneapolis Mtg., Field Trip 2, p. 57–64. Restricted below to exclude Glenwood shale herein given formation status. In southeastern Minnesota, includes (ascending) Pecatonica, McGregor, and Carimona members. In Twin City area, includes Mifflin, Hidden Falls (new), and Magnolia members; McGregor is used where these three latter units are absent or insufficiently distinct to permit use of their names.

A. F. Agnew and others, 1956, U.S. Geol. Survey Prof. Paper 274–K, p. 274–285. In zinc-lead district of Wisconsin, Illinois, and Iowa, formation includes (ascending) Glenwood shale, Pecatonica dolomite, McGregor limestone, and Quimbys Mill members. At reference section in roadcut, U.S. Highway 151, NW¼NE¼ sec. 12, T. 2 N., R. 2 W., Grant County, Wis., formation is about 54 feet thick. In eastern part of mining district and farther east, strata of Platteville, Decorah, and Galena age are dolomite, and gross lithology of the three formations is somewhat similar. This eastern area is the type for Sardeson's (1896) Beloit formation. However, since term Beloit has been virtually forgotten and terms Platteville and Decorah have been used consistently since 1906, they are retained in this report.

M. P. Weiss, 1957, Geol. Soc. America Bull., v. 68, no. 8, p. 1030–1033. Described in Fillmore County, Minn.

Reference section: Roadcut U.S. Highway 151, NW¼NE¼ sec. 12, T. 2 N., R. 2 W., Grant County, Wis.

†Platteville Stage[1]

Ordovician: Iowa.

Original reference: S. Calvin, 1906, Iowa Geol. Survey, v. 16, p. 60, 84.

Plattford Formation (in Scranton Shale)[1]

Pennsylvanian (Virgil Series): Southeastern Nebraska.

Original reference: G. E. Condra, 1927, Nebraska Geol. Survey Bull. 1, 2d ser., p. 41, 58.

G. E. Condra, 1949, Nebraska Geol. Survey Bull. 16, p. 30. Cotype locality designated. Here Plattford section is about 14 feet thick and includes the Vinland shale member. Westphalia limestone member is missing, and Tonganoxie sandstone member is recorded in the subsurface. Underlies Cass formation; Vinland shale in its outcrop areas in Cass County rests unconformably on the Stanton formation.

Type locality: In Platte River bluffs in west part of Plattford Township, Sarpy County. Cotype locality: In first and second Burlington quarries located northwest of South Bend, Cass County.

**Plattin Limestone[1]**

Plattin Group

Middle Ordovician: Eastern Missouri, central northern Arkansas, and western Illinois.

Original reference: E. O. Ulrich, 1904, Missouri Bur. Geology and Mines, v. 2, 2d ser., p. 111.

E. O. Ulrich, 1939, Kansas Geol. Survey Guidebook 13th Ann. Field Conf., p. 105–109. In sections near Cape Girardeau overlies Murfreesboro; underlies Kimmswick. Black River group.

J. G. Grohskopf, 1948, Am. Assoc. Petroleum Geologists Bull., v. 32, no. 3, p. 351–365. Name Rock Levee proposed for rocks which underlie basal Plattin oolitic and conglomeratic limestone and overlie a chert zone which occurs in the "Joachim" dolomite. Thus, it restricts the "Plattin" and "Joachim" and contains a part of each. Overlapped by "Decorah".

E. R. Larson, 1951, Am. Assoc. Petroleum Geologists Bull., v. 35, no. 9, p. 2041–2075. Rank raised to group. Comprises (ascending) Bloomsdale, Beckett, Hager, and Macy formations (all new). Overlies Rock Levee formation; underlies Decorah formation. Thins northward from about 400 feet at Cape Girardeau to about 125 feet in southern Lincoln County. Has been classified as Bolarian, Black River in age, and correlated with the Platteville of upper Mississippi Valley. Faunules from upper Macy suggest those beds are lower Trentonian. Lower formations resemble Bolarian.

G. A. Cooper, 1956, Smithsonian Misc. Colln., v. 127, pt. 1, p. 116. Underlies Barnhart formation (new).

Named for exposures near mouth of Plattin Creek, Jefferson County, Mo.

†Plattsburg Group[1]

Pennsylvanian: Northwestern Missouri.

Original reference: G. C. Broadhead, 1868, St. Louis Acad. Sci. Trans., v. 2, p. 317, 327.

Named for exposures at Plattsburg, Clinton County.

**Plattsburg Limestone** (in Lansing Group)[1]

Plattsburg Limestone Member (of Lansing Formation)[1]

Pennsylvanian (Missouri Series): Northwestern Missouri, eastern Kansas, southwestern Iowa, and southeastern Nebraska.

Original reference: G. C. Broadhead, 1868, St. Louis Acad. Sci. Trans., v. 2, p. 317, 327.

N. D. Newell, 1935, Kansas Geol. Survey Bull. 21, p. 70–75. Includes (ascending) Merriam limestone, Hickory Creek shale, and Spring Hill limestone members. Basal formation of Lansing group; underlies Vilas shale; overlies Bonner Springs shale of Kansas City group.

Above 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. 33–34. Thickness of formation 10 to 12 feet in Nebraska; 20 feet in Missouri; 20 to 24 feet in Kansas.

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 15 feet in Iowa. Members not recognized with certainty. Underlies Vilas formation; overlies Bonner Springs formation. Lansing group.

H. G. Hershey and others, 1960, Iowa Highway Research Board Bull. 15, p. 24, fig. 5. Formation in Lansing group. Exposed only in western Madison County where it is a highly fossiliferous gray to maroon nodular fine-grained algal limestone with interbedded red and green shale. Thickness about 4 feet. Overlies Bonner Springs shale; underlies Vilas shale.

Named for exposures at Plattsburg, Clinton County, Mo.

**Plattsmouth Limestone[1] Member** (of Oread Limestone)

Pennsylvanian (Virgil Series): Southeastern Nebraska, southwestern Iowa, eastern Kansas, and northwestern Missouri.

Original reference: C. R. Keyes, 1898, Am. Geologist, v. 21, p. 349, 350.

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), 149.

Plattsmouth limestone member of Oread formation; underlies Heumader shale member; overlies Leavenworth limestone member. This classification agreed upon by State Geological Surveys of Iowa, Kansas, Missouri, Nebraska, and Oklahoma.

T. L. Welp, L. A. Thomas, and H. R. Dixon, 1957, Iowa Acad. Sci. Proc., v. 64, p. 418 (fig. 1), 419. Thickness about 5½ feet in measured section near Winterset, Madison County; consists of blue-gray uneven beds separated by thin shales, some black chert; lower 1 foot a persistent massive bed.

H. G. O'Connor, 1960, Kansas Geol. Survey Bull. 148, p. 41, pl. 1. Thickness about 18 feet in Douglas County where it is composed almost entirely of light-gray to nearly white wavy-bedded limestone which weathers a light gray to tan; scattered blue-gray chert nodules persistent near middle of bed.

H. G. Hershey and others, 1960, Iowa Highway Research Board Bull. 15, p. 20–21, fig. 5. As exposed in quarries in Montgomery County, includes thin upper cherty limestone, thick section of shaly limestone containing abundant fusulinids, and lower unit containing less shale and fewer fusulinids. Thickness about 20 feet. In Cass County, thickness is about 13 feet and includes (descending) about 2 feet of thin-bedded limestone; 3 to 4 feet of fusulinid-bearing argillaceous limestone; 4 feet of calcareous olive shale weathering buff and containing abundant *Chonetes*, *Echinoconchus*, *Juresania*, *Neospirifer*, *Composita*, crinoid columnals, and large ramose bryozoans; and 3 feet of argillaceous to sublithographic cherty fossiliferous limestone. In Madison and Adair Counties, includes 4 feet of *Osagia*-bearing wavy-bedded sublithographic limestone, 2 to 3 feet of argillaceous shale, 3 to 4 feet of alternating dark-blue cherty limestone and platy shale, and 1½ feet of massive limestone containing *Ottonosia* at base. Overlies Heebner shale member; underlies Heumader shale member.

Type locality: In Missouri River bluffs in vicinity of Plattsmouth, Cass County, Nebr.

**Playas Peak Formation** (in Bisbee Group)

Lower Cretaceous: Southwestern New Mexico.

S. G. Lasky, 1938, Am. Assoc. Petroleum Geologists Bull., v. 22, no. 5, p. 534, figs. 2, 4; 1947, U.S. Geol. Survey Prof. Paper 208, p. 24–25, pl. 1. Sandstone and shale underlain in Eureka section by a basal conglomerate and capped by massive limestones. Basal conglomerate locally bouldery and unsorted. Thickness in Eureka section, where both contacts are disconformable, ranges from 800 to 2,000 feet; in Sylvanite section exposed section between 3,000 and 3,500 feet. In Eureka district, underlies Skunk Ranch conglomerate (new); overlies Corbett sandstone (new). Trinity age.

Named after Playas Peak in Eureka half of Little Hatchet Mountains.

**Pleasant Hill Limestone**[1]

Pleasant Hill Formation

Middle Cambrian: Central Pennsylvania.

Original reference: C. Butts, 1918, Am. Jour. Sci., 4th, v. 46, p. 528, 534, 537.

J. L. Wilson, 1952, Geol. Soc. America Bull., v. 63, no. 3, p. 278. Thickness at type locality 600 feet; 350 feet at Williamsburg, upper part of section exposed; sandy layers, some siltstone and shale occur rather high in section. Underlies Warrior limestone.

Carlyle Gray and others, 1960, Geologic map of Pennsylvania (1:250,000): Pennsylvania Geol. Survey, 4th ser. Mapped as formation.

Named for exposures of upper part at Pleasant Hill Church, 1 mile northwest of Henrietta, Blair County.

Pleasant Lake Gabbro

Precambrian: Northeastern New York.

A. F. Buddington, 1939, Geol. Soc. America Mem. 7, p. 59, 61. A folded sheet in limestone. Zone of basal contact with limestone is strongly injected by granitic pegmatite to form an arteritic migmatite. Intruded by a sheet of syenite in northern and uppermost part, as now exposed.

Crops out in an oval area about 2½ miles long and 1 mile wide just southeast of Pleasant Lake in Hammond quadrangle.

**Pleasanton Formation[1] or Group[1]**

Pennsylvanian (Missouri Series): Eastern Kansas, southwestern Iowa, northwestern Missouri, and northeastern Oklahoma.

Original references: E. Haworth, 1895, Kansas Univ. Quart., v. 3, p. 274, pl. opposite p. 290; 1895, Am. Jour. Sci., 3d, v. 50, p. 457, pl. opposite p. 466.

H. S. McQueen and F. C. Greene, 1938, Missouri Geol. Survey and Water Resources, 2d ser., v. 25, p. 20, 25–26, pl. 5. Upper boundary of Henrietta group has been placed at approximate position of unconformity which separates the Des Moines and Missouri, and base of Pleasanton group has been raised to correspond. Underlies Hertha limestone of Kansas City group. Thickness 100 to 200 feet.

L. M. Cline, 1941, Am. Assoc. Petroleum Geologists Bull., v. 25, no. 1, p. 26–27 (fig. 2). Thins northward from Missouri into Appanoose County, Iowa.

J. R. Clair, 1943, Missouri Geol. Survey and Water Resources, 2d ser., v. 27, pl. 1. Columnar section, Jackson and Cass Counties, Mo., shows Pleasanton group comprises (ascending) Warrensburg channel sandstone, Sni Mills limestone, Dawson coal horizon, Wayside sandstone, Exline limestone, and Knobtown sandstone. Thickness 120 to 262 feet. Overlies Henrietta group; underlies Kansas City group.

R. C. Moore, 1948, Am. Assoc. Petroleum Geologists Bull., v. 32, no. 11, p. 2028, 2031 (fig. 4). According to interstate agreement, lowermost deposits of Missourian age, mostly clastic in nature, are to be called Pleasanton, a name first applied in stratigraphic sense by Haworth (1895) for rocks between uppermost Pawnee limestone and base of Hertha formation. Pleasanton was similarly used in Missouri until 1938 (McQueen and Greene) when it was revised to exclude Desmoinesian strata. In Kansas (Moore, 1932) and Nebraska (Condra, 1935), name was dropped. Now accepted definition, which was first used by McQueen and Greene, precisely corresponds to Bourbon formation or group as recognized in Kansas and Nebraska. Name Bourbon will be suppressed. Overlies Marmaton group; underlies Kansas City group.

R. C. Moore, 1949, Kansas Geol. Survey Bull. 83, p. 69–74. Group includes Hepler sandstone at base, Checkerboard limestone, and some massive sandstones known collectively as Knobtown sandstone. Thickness 35 to 150 feet along outcrop in Kansas.

C. M. Cade 3d, 1953, Tulsa Geol. Soc. Digest, v. 21, p. 130–133. Boundary between Missouri series and Des Moines series in area investigated [Nowata and Craig Counties, Okla.] is marked by erosional unconformity, with Seminole formation lying unconformably on Lenapah limestone. Two members of Pleasanton group, Checkerboard and Seminole were mapped.

H. G. Hershey and others, 1960, Iowa Highway Research Board Bull. 15, p. 28–29, fig. 5. Group composed primarily of shale with some sandstone, thin limestones, and minor amounts of coal. Not subdivided into formations although distinctive units such as Exline limestone and Ovid coal are recognized. Top of Des Moines series is an erosional surface; hence, thickness of Pleasanton varies considerably. Thickness 19 feet in Madison County. Upper boundary at base of Hertha limestone.

Named for exposures at Pleasanton, Linn County, Kans.

**Pleasants Sandstone Member** (of Williams Formation)

Upper Cretaceous: Southern California.

W. P. Popenoe, 1937, Jour. Paleontology, v. 11, no. 5, p. 380. Named as upper member of Williams formation (new). Consists of light-colored shaly sandstones with intercalated beds of limy fossiliferous sandstone. Approximate thickness 320 feet. Unconformably underlies Eocene Martinez(?) formation; overlies Schulz member (new).

W. P. Popenoe, 1942, Am. Assoc. Petroleum Geologists Bull., v. 26, no. 2, p. 166, 168 (fig. 2), 175. Member discontinuous in its distribution, being cut out of the section in many places by faulting and by overlap. Derivation of name given.

W. P. Woodring and W. P. Popenoe, 1945, U.S. Geol. Survey Oil and Gas Inv. Prelim. Chart 12. Shown on stratigraphic sections as underlying Silverado formation (new). In this report, name Schulz member has been altered to Schulz Ranch sandstone member.

Named for Pleasants Ranch at mouth of Williams Canyon, northern Santa Ana Mountains, Orange County.

Pleasant Valley Member (of Cuyahoga Formation)

Mississippian (Kinderhook): Central Ohio.

F. T. Holden, 1941, Illinois Acad. Sci. Trans., v. 34, no. 2, p. 172. Included in Toboso conglomerate facies of the formation.

F. T. Holden, 1942, Jour. Geology, v. 50, no. 1, p. 48. Essentially a gray buff shale, about 16 feet thick, containing thin layers of medium-grained sandstone; base seldom exposed. Along Licking River, east of Newark, about 15 feet are exposed; here consists of massive tan siltstone, grading to tan and gray arenaceous shale with lenses of medium-grained sandstone. Underlies Black Hand conglomerate member. Derivation of name stated.

Named from exposures northwest of Pleasant Valley School on north valley wall of tributary of Clear Fork in SW sec. 5, T. 20 N., R. 19 W., Richland County.

**Pleasant View Complex**

Paleozoic and Mesozoic: Southern California.

L. F. Noble, 1954, U.S. Geol. Survey Geol. Quad. Map GQ–50. Name applied to a complex of deep-seated igneous intrusive and metamorphic rocks, some of which may be metasediments. Prevailing rocks are dark-gray quartz diorite gneiss and metadiorite. In large part probably represent San Gabriel complex.

Type locality: Pleasant View Ridge, Valyermo quadrangle.

Pleasant View 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, 105. Sediments vary from poorly bedded clays to arenaceous shales with occasional lenticular beds of gray friable medium- to coarse-grained sandstones, which are best developed in lower third. Dominantly light gray. Sandstones suggest channel deposits by their cross-laminated and poorly sorted composition. Thickness averages about 113 feet on Table Mountains. Base corresponds to Cretaceous-Tertiary boundary, and is marked by distinct color change from tan to light brown. Underlies Golden member (new).

Type section: On eastern extremity of South Table Mountain; NW¼ sec. 31, T. 3 S., R. 69 W., Morrison quadrangle. Recognized only on slopes of the Table Mountains, Jefferson County.

Pleasantview Sandstone Member (of Carbondale Formation)[1]

Pleasantview Sandstone (in Carbondale Group)

Pennsylvanian: Western and northern Illinois.

Original reference: H. R. Wanless, 1929, Illinois Geol. Survey Bull. 57, p. 49, 90–91, 124.

H. R. Wanless, 1957, Illinois Geol. Survey Bull. 82, p. 50 (fig. 22), 95, 98, 190. Consists of two types: channel sandstone and nonchannel or sheet sandstone. Nonchannel ranges in thickness from 2 or 3 to 15 or 20 feet and is commonly very fine grained and blue gray or yellow gray. Major part of channel sandstones consists of lenticular massive beds, alternating with thin shaly beds. Thickness as much as 80 feet. In some areas, channel sands rest unconformably on all beds down to Colchester (No. 2) coal. Included in Summum cyclothem, Carbondale group. Name credited to W. V. Searight (unpub. ms.). Type exposure given.

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 35, 47 (table 1), 66, pl. 1. Assigned member status in Carbondale formation (redefined). Occurs above Purington shale member and below Kerton Creek coal member (new). Thickness about 18 feet. Presentation of new rock-stratigraphic classification of Pennsylvanian strata in Illinois. Cyclical classification is retained but is entirely independent of rock-stratigraphic classification.

Type exposure: Mill Creek, sec. 36, T. 2 N., R. 1 W., and sec. 31, T. 2 N., R. 1 E., vicinity of Pleasantview, Beardstown quadrangle, Schuyler County.

†Pleito Formation[1]

Oligocene and Miocene: Southern California.

Original reference: C. M. Wagner and K. H. Schilling, 1923, California Univ. Pubs., Dept. Geol. Sci. Bull., v. 14, p. 235–252.

R. M. Kleinpell, 1938, Miocene stratigraphy of California: Tulsa, Okla., Am. Assoc. Petroleum Geologists, fig. 14. Chart shows Pleito as occurring in upper Refugian and lower Zemorrian stages; thus, age is Oligocene and lower Miocene.

Exposed on Pleito Creek, Kern County.

Plum Bentonite (in Manning Formation)

Eocene: Central Texas.

H. B. Stenzel, 1953, Am. Assoc. Petroleum Geologists Guidebook Field Trips Houston Mtg., p. 45, 46. Name applied to bentonite bed in Manning formation. Thickness 1½ feet. Bentonite can be traced as separate lenses southwestward for 50 miles to region of Hells Gate on Guadalupe River in Gonzales County.

Named for occurrence in vicinity of village of Plum, Fayette County.

Pluma Formation[1]

Precambrian: Southwestern South Dakota.

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

E. P. Rothrock, 1944, South Dakota Geol. Survey Bull. 15, p. 24. In vicinity of Homestake mine, consists of alternating beds of garnet schist and carbonaceous slates, some of which are pyritiferous. Thickness 4,000 feet. Overlies Garfield formation.

Named for exposures near Pluma, about 1½ miles east of Lead, Lawrence County.

Plumas Series[1]

Lower, Middle, and Upper Jurassic: Northern California.

Original reference: J. P. Smith, 1910, Jour. Geology, v. 18, table opposite p. 217.

Plumas County.

**Plumb Shale Member** (of Wood Siding Formation)

Pennsylvanian (Virgil Series): Eastern Kansas.

R. C. Moore and M. R. Mudge, 1956, Am. Assoc. Petroleum Geologists Bull., v. 40, no. 9, p. 2274 (fig. 1), 2275. Defined to include strata between Nebraska City limestone below and Grayhorse limestone above. Thickness at type locality about 20 feet; average thickness across Kansas 13 feet. Name credited to M. R. Mudge and R. H. Burton (work in preparation).

Type locality: In an east-west roadcut in SW¼SE¼SE¼ sec. 30, T. 14 S., R. 13 E., about 1½ miles west of Harveyville, Wabaunsee County. Name derived from Plumb Township.

Plum Brook Shale

Devonian: Northern Ohio.

G. A. Cooper, 1941, Washington Acad. Sci. Jour., v. 31, no. 5, p. 181. Proposed to replace Plum Creek shale of Grabau, 1917 (not Foerste, 1905, or Ulrich, 1917). Grabau derived his name from Plum Brook, 2 miles northeast of Prout Station, Sandusky quadrangle, but erroneously recorded the name as Plum Creek. The more accurate designation is therefore substituted.

E. C. Stumm, 1942, Jour. Paleontology, v. 16, no. 5, p. 549. Soft gray shale containing thin bands of argillaceous limestone. Exposed thickness (upper part) 20 feet; in wells 40 to 60 feet. Underlies Prout limestone.

K. V. Hoover, 1960, Ohio Geol. Survey Inf. Circ. 27, p. 8–15. Stratigraphic position and correlation of Olentangy shale discussed in detail. Here suggested that the Olentangy, Plum Brook shale, Prout limestone, Silica shale, and Ten Mile Creek are stratigraphically correlatable, with the reservation that the Olentangy is probably Upper Devonian. At various times and by different authors, the Plum Brook shale has been correlated with the Olentangy, and the so-called Prout limestone has been regarded as member of Olentangy. Olentangy stratigraphic interval is represented by Prout limestone and Plum Brook shale in northern Ohio. Regional information regarding thickness of Plum Brook shale-Prout limestone has not been worked out. Combined thickness of 36 feet of Plum Brook and Prout has been reported in outcrop area in Erie County. Eastward, this interval is represented by Plum Brook shale which has been reported to be 142 feet thick. Plum Brook is in apparent conformable contact with Huron shale.

Type locality: On Plum Brook, near Prout Station, Sandusky quadrangle, Erie County.

†Plum Creek Beds (in Chester Group)[1]

Mississippian: Southwestern Illinois.

Original reference: E. O. Ulrich, 1917, Mississippian formations of western Kentucky: Kentucky Geol. Survey, pt. 2, p. 44, 56, 230, pl. D.

J. M. Weller *in* Stuart Weller and J. M. Weller, 1939, Illinois Geol. Survey Rept. Inv. 59, p. 12; J. M. Weller and A. H. Sutton, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 5, p. 837. Name Baldwin formation proposed for preoccupied Plum Creek beds.

Occur in Randolph County.

Plum Creek Clay[1]

Plum Creek Member (of Brassfield Formation)

Silurian (Niagara): East-central Kentucky.

Original references: A. F. Foerste, 1905, Kentucky Geol. Survey Bull. 6, p. 145; 1906, Kentucky Geol. Survey Bull. 7, p. 10, 44, 61.

E. B. Branson and C. C. Branson, 1947, Jour. Paleontology, v. 21, no. 6, p. 549, 550 (fig. 1). Reallocated to member status in Brassfield formation. Underlies Oldham limestone; overlies dolomitic limestone in Brassfield formation.

Named for Plum Creek, Powell County.

Plum Creek Shale[1]

Middle Devonian: Northern Ohio.

Original reference: A. W. Grabau, 1917, Jour. Geology, v. 25, p. 337–343.

G. A. Cooper, 1941, Washington Acad. Sci. Jour., v. 31, no. 5, p. 181. Name Plum Brook shale proposed to replace Plum Creek shale. Grabau derived his name from Plum Brook, 2 miles northeast of Prout Station, Sandusky quadrangle, but erroneously recorded name as Plum Creek.

Locality is in Erie County.

**Plummer Limestone Member** (of Pawhuska Formation)[1]

Pennsylvanian (Virgil Series): Northeastern Oklahoma.

Original reference: D. E. Winchester, 1918, U.S. Geol. Survey Bull. 686–C, p. 11–12.

M. C. Oakes, 1959, Oklahoma Geol. Survey Bull. 81, p. 49–50. In Tps. 27, 28, and 29 N., northern Osage County, the Pawhuska is about 150 feet thick and contains six named limestone members (ascending): Lecompton, Plummer, Deer Creek, Little Hominy, Pearsonia, and Turkey Run. The Plummer limestone was not found south of center of sec. 35, T. 23 N., R. 7 E.

Named for exposures near house on Plummer Ranch, T. 26 N., R. 9 E., Osage County.

Plummer Hollow Mudstone Member (of Juniata Formation)

Upper Ordovician: Central Pennsylvania.

F. M. Swartz, 1957, Pennsylvania State Univ., Dept. Geology Contr. 3, 58 p. Consists of red silty mudstone with interbeds of red siltstone and sandstone. Overlies East Waterford red sandstone and shale member (new); underlies Run Gap red sandstone member. Thins eastward, and, at Waggoners Gap, beds lithologically referable to Plummer Hollow are not present and instead are about 360 feet of red sandstones of type that forms East Waterford member. [Swartz refers to his 1955 report *in* Pennsylvania Geologists Guidebook 21st Ann. Field Conf. Compiler was unable to locate this reference.]

Named for Plummer Hollow, in vicinity of Tyrone Gap.

**Plum Point Marl Member** (of Calvert Formation)[1]

Miocene, middle: Eastern Maryland.

Original reference: G. B. Shattuck, 1904, Maryland Geol. Survey, Miocene Volume, p. lxxiv.

Lincoln Dryden and R. M. Overbeck, 1948, Maryland Dept. Geology, Mines and Water Resources [Repts.] Charles County, p. 56–57. Upper member of formation. Overlies Fairhaven [diatomaceous earth] member; contact believed to occur just below oyster bed near south end of Calvert Cliffs. Contact with Choptank formation not definitely recognized, but it lies somewhere between Shattuck's "zones" 13 and 17. Thickness at least 50 feet and probably as much as 75 feet. Member believed to be present in Charles County near Hughesville, about 13 miles east of La Plata. Unit referred to here as Plum Point marls.

Named for Plum Point, Calvert County.

Pluto 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. 295, 334.

Named for association with Pluto coal in Summers County.

Pluto Shale (in Hinton Formation)[1]

Mississippian: Southern West Virginia and southwestern Virginia.

Original reference: D. B. Reger, 1920, West Virginia Geol. Survey Rept. Webster County, p. 214, 219–220.

Occurs in Mercer and Summers Counties, W. Va., and in Tazewell County, Va.

**Plutos Cave Basalt**

Recent: Northern California.

Howel Williams, 1949, California Div. Mines Bull. 151, p. 42–44, pl. 1. Uniform black vesicular olivine-rich augite basalt with fairly smooth crust marked by gentle swells and hollows. Oval schollendomes, a few feet to 20 feet high, scattered at random over surface of lower half of flow. Evidence concernimg thickness meager; thickest part probably median part that extends northwestward through Pluto's Cave; just north of cave approximately 290 feet of basalt encountered in well; locally may be 400 feet thick. Largest flow of any age in Macdoel quadrangle; seems to have issued from fissures near northeast base of Mount Shasta.

Seymour Mack, 1960, U.S. Geol. Survey Water-Supply Paper 1484, p. 20 (table), 41–43, pl. 1. Constitutes most prolific aquifer in Shasta Valley.

Occupies eastern half of Shasta Valley; covers more than 50 square miles and exceeds 20 miles in length. Named for Pluto's Cave, a large lava tube near its southern end. (Locality named The Caves on Williams' (1949) geol. map, pl. 1.)

Plymouth Conglomerate[1]

Lower Cambrian: Southeastern Vermont.

Original reference: C. H. Richardson, 1931, Vermont State Geologist 17th Rept., p. 220.

In Windham Township, Windham County.

**Plymouth 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, 502.

N. K. Huber, 1959, Econ. Geology, v. 54, no. 1, p. 105 (table 10), 106 (table 11), 107 (fig. 3). Underlies Yale member; overlies Palms quartzite. Thicknesses (taken from drill holes) 133 and 154 feet.

Named for Plymouth mine, Gogebic Range, Mich.

Plymouth Granite[1]

Late Paleozoic: Southeastern Vermont.

Original reference: E. L. Perry, 1929, Vermont State Geologist 16th Rept., p. 44–46.

Occurs on south slope of Morrison Hill in Plymouth, Woodstock quadrangle, about one-half mile northwest of Pinney Hollow road and an equal distance due west of Pinney Hollow Schoolhouse, east of road to abandoned Morrison Farm in Windsor County.

**Plymouth Marble**[1]

Plymouth Member (of Grahamville Formation)

Plymouth Member (of Hoosac Formation)

Lower Cambrian: East-central Vermont.

Original reference: E. J. Foyles and C. H. Richardson, 1929, Vermont State Geologist 16th Rept., table opposite p. 288.

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. 41. Rank reduced to member in upper part of Hoosac formation. Has approximately same stratigraphic position as Turkey Mountain member which occurs south of outcrop area of the Plymouth. Cambrian or Lower Ordovician.

W. F. Brace, 1953, Vermont Geol. Survey Bull. 6, p. 47, 48, tables 2, 3. Reallocated to member status at top of Grahamville formation (new). Includes massive gray dolomite and white vitreous thinly bedded quartzite. Maximum thickness 100 feet, typically 10 to 20 feet. Underlies Pinney Hollow formation. Cambro-Ordovician. Outcrop area mentioned.

Well exposed in lower slopes of Ottauquechee and Black River valleys south of West Bridgewater in Rutland area. Crops out in Plymouth Township, Windsor County.

Plymouth Union Series

Cambrian(?) : Central Vermont.

H. E. Hawkes, Jr., 1941, Geol. Soc. America Bull., v. 52, no. 5, p. 653, 654–656, 657. A local unit consisting of quartz schists, quartzites, quartz conglomerates, and dolomitic marbles. Replaces Mendon series in this area. Clean massive quartzite at base. Several massive dolomite beds in upper part near Plymouth. North of Sherburne includes Sherburne conglomerate. Underlies Pinney Hollow schist with transition zone; overlies Pico Peak series (new).

Type locality: East side of Green Mountain Range in Plymouth and Bridgewater Townships, Windsor County.

**Plympton Formation** (in Park City Group)

Permian: West-central Utah and eastern Nevada.

R. K. Hose and C. A. Repenning, 1959, Am. Assoc. Petroleum Geologists Bull., v. 43, no. 9, p. 2181–2184. Permian rocks in Confusion Range, Utah, above the Kaibab limestone are divisible into two formations, the older of which is herein named Plympton formation and the younger Gerster. Defined on basis of two partial sections, localities 7 and 8 of present report. Consists predominantly of dolomite and smaller amounts of chert. Five lithic zones differentiated. Aggregate thickness 690 feet. Park City group. Newell (1948, Geol. Soc. America Bull., v. 59, no. 10) applied name Phosphoria to all Permian rocks above the Kaibab. Term Phosphoria is herein considered inappropriate.

Grant Steele, 1960, Intermountain Assoc. Petroleum Geologists Guidebook 11th Ann. Field Conf., p. 93 (chart 1), 107–108. Geographically extended into east-central Nevada. In Pequop and Cherry Mountains and Ferguson Spring Mountains, the Plympton overlies Loray formation and underlies the Phosphoria. In Butte Mountains, overlies the Loray and underlies Gerster formation. Thickness 983 feet in Butte Mountains.

Has greatest areal extent in Millard and Plympton Ridges in Confusion Range, Utah. Locality 7 is 1.4 miles N. 60° E. of east end of Indian Pass. Locality 8 is 9 miles S. 20° W. of Granite Mountain. Section at locality 8 broken by several faults.

**Pocahontas Formation** (in Pottsville Group)[1]

Lower Pennsylvanian: Southwestern Virginia and southern West Virginia.

Original reference: M. R. Campbell, 1896, U.S. Geol. Survey Geol. Atlas, Folio 26, p. 3.

C. B. Read, 1947, Jour. Geology, v. 55, no. 3, pt. 2, p. 273. Formation mentioned in discussion of Pennsylvanian floral zones and floral provinces.

Named for Pocahontas, Tazewell County, Va.

†Pocahontas Group (in Pottsville Group)[1]

Pennsylvanian: Southwestern Virginia and southern West Virginia.

Original reference: I. C. White, 1908, West Virginia Geol. Survey, v. 2A, p. 13.

R. C. Moore and others, 1944, Geol. Soc. America Bull., v. 55, no. 12, chart 6 (column 12). Pocahontas group, lower Pottsville series, southern West

Virginia, includes (ascending) Squire Jim coal, No. 2 Pocahontas coal, No. 3 Pocahontas coal, Pocahontas sandstone, No. 4 Pocahontas coal, and Flattop Mountain sandstone. Underlies New River group.

Named for Pocahontas, Tazewell County, Va.

Pocahontas Sandstone (in Lee Formation)

Pocahontas Sandstone (in Pocahontas Group)

Pocahontas Sandstones (in Pottsville Group)[1]

Pennsylvanian: Southwestern Virginia and southern West Virginia.

Original reference: R. V. Hennen and R. M. Gawthrop, 1915, West Virginia Geol. Survey Rept. Wyoming and McDowell Counties, p. 224–232.

R. C. Moore and others, 1944, Geol. Soc. America Bull., v. 55, no. 6, chart 6 (columns 12, 19). Correlation chart shows Pocahontas sandstone in Pocahontas group in southern West Virginia and in Lee formation in Virginia.

Quarried at Pocahontas, Tazewell County, Va.

Pocatello Formation

Precambrian: Southeastern Idaho.

J. C. Ludlum, 1942, Jour. Geology, v. 50, no. 1, p. 89–92. Thick series of unfossiliferous metamorphosed sediments. Considerable variations in thickness and distribution of component sediments. Divided into two series: lower tillite series consisting of silicified sandstones, slates, intraformational limestone conglomerate, thin-bedded metamorphosed limestones, argillites, and tillites, approximately 1,100 feet thick; and an upper varved slate series consisting of alternating bands of dark and light slate with a few thin beds of sandstone in upper part, 350 feet thick. Underlies Blackrock limestone. Overlies Bannock volcanic formation of which it was formerly a part.

Exposed in Pocatello quadrangle.

**Pochnoi Volcanics**

Tertiary(?) or Quaternary: Alaska.

R. R. Coats, 1960, U.S. Geol. Survey Bull. 1028–0, p. 481–482, 486, 503–504, pl. 59. Sequence of tuff-breccia, lava, and agglomerate, and minor amounts of sandstone. Thickness in walls of caldera, 1,700 feet. Oldest rocks on island. Apparently erupted by volcano, which had approximately same dimensions as present island, whose center of eruption lay somewhere within area of present central depression.

Well exposed west and north of Pochnoi Point, Semisopochnoi Island, largest of young volcanic islands of western Aleutians. Exposed chiefly in northeast, south, and southwest parts of island, outside central lowland; elsewhere covered by products of later volcanic eruptions.

Pochuck Diorite[1]

Pochuck diorite phase (of Hudson Highlands Complex)

Precambrian: Eastern New York.

Original reference: C. P. Berkey and Marion Rice, 1919, New York State Mus. Bulls. 225–226, p. 51–52.

K. E. Lowe, 1950, Geol. Soc. America Bull., v. 61, no. 3, p. 143. Berkey and Rice (1919) showed oldest igneous representative distinguishable in Hudson Highlands as essentially a diorite but indicated that it is practically always intimately associated with Grenville metamorphics. Hornblende-plagioclase gneiss layers at Bear Mountain are believed to represent Grenville rocks reworked selectively by this diorite invasion. They correspond to Colony's (1921, New York State Mus. Bulls. 249–250) Pochuck-Grenville. Presence of a diorite parent rock of unquestionable magmatic origin could not be demonstrated in region, therefore, term "phase" is used for this earliest igneous interval. There is no intention to question the validity of the intrusive concept.

Report discusses area around Bear Mountain, a prominent summit of the Hudson Highlands, about 40 miles north of New York City.

**Pochuck Gneiss**

Pochuck Gabbro Gneiss[1]

Precambrian: Northern New Jersey and eastern Pennsylvania.

Original reference: J. E. Wolff and A. H. Brooks, 1898, U.S. Geol. Survey 18th Ann. Rept., pt. 2, p. 439.

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), 175–187. Described in Northampton County, Pa. In Chestnut Hill exposure, conformably underlies Moravian Heights formation (new); 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 rocks of Precambrian have been extensively disturbed. Pochuck may be older, younger, or interbedded with Moravian Heights. Intruded by Byram granite gneiss.

W. S. Bayley, 1941, U.S. Geol. Survey Bull. 920, p. 46, 47–49, pl. 5. Pochuck gneiss as heretofore defined includes two groups of dark gneisses of different age and different origin, one group comprising sedimentary gneisses that are older than the Byram and Losee types and of pre-Franklin age, and the other comprising igneous rocks that may be differentiates of Byram and Losee magmas. In this report name Pochuck gneiss is restricted to igneous rock; the older dark- and light-colored schists and gneisses and slaty rocks of sedimentary origin are mapped and described as Pickering gneiss. Formation to which name Pochuck gabbro gneiss is herein applied is a black or dark-gray rock with chemical composition of many diorites and gabbros, but differing from them mineralogically in containing orthoclase, microcline, and oligoclase rather than the more basic plagioclases. Considered to be older than the more granitoid Byram and Losee gneisses. Where the Pochuck is associated with Losee diorite gneiss, oligoclase is principal feldspar of the Pochuck; where it is closely associated with Byram gneiss, microperthite and microcline are prominent in the black gneiss and hornblende exceeds diopside.

Named for occurrences on east slope of Pochuck Mountain, N.J.

Pochuck Mountain Gneiss Series

Precambrian: Northern New Jersey.

J. M. Hague and others, 1956, Geol. Soc. America Bull., v. 67, no. 4, p. 468, 469, fig. 18. Sequence changes from thick series of oligoclase gneiss containing hornblende and microcline gneiss bands in Pimple Hills to interlayered hornblende gneiss, microcline gneiss, and biotite gneiss in Lake Lenape syncline, on Pochuck Mountain, and in Glenwood syncline. Thickness over 2,000 feet. Overlies Wildcat marble (new).

On Pochuck Mountain in Franklin-Sterling area.

Pocket Hollow Oolite (in Lutie Member of Theodosia Formation)

Lower Ordovician: Northern Arkansas and southern Missouri.

J. S. Cullison, 1944, Missouri Univ. School Mines and Metallurgy Bull., Tech. Ser., v. 15, no. 2, p. 31, pl. 2. Medium- to coarse-grained oolitic chert about 3 feet thick that occurs just below the top of the Lutie member. Lies stratigraphically above Hercules Tower sandstone bed (new) and separated from it by numerous beds of finely crystalline dolomite and "cotton rock".

Well exposed at the bottom of South Pocket Hollow in SE¼ sec. 29, T. 22 N., R. 14 W., Thornfield quadrangle, Ozark County. Mo.

**Pocono Formation,[1] Group,[1] or Sandstone**

Pocono Series

Lower Mississippian: Pennsylvania, eastern Ohio, western Maryland, Virginia, and West Virginia.

Original reference: J. P. Lesley, 1876, Pennsylvania 2d Geol. Survey Rept. L., app. E., p. 221, 222, pls.

C. A. Ashburner, 1885, Pennsylvania 2d Geol. Survey Rept. $R_2$, p. 104–105. Includes Benezette limestone.

M. R. Campbell, 1904, U.S. Geol. Survey Geol. Atlas, Folio 110. Includes Patton shale member (new).

Charles Butts, 1904, U.S. Geol. Survey Geol. Atlas, Folio 115. Includes Burgoon sandstone member (new).

G. W. Stose and C. K. Swartz, 1912, U.S. Geol. Survey Geol. Atlas, Folio 179. Group includes (ascending) Rockwell formation, Purslane sandstone, Hedges shale, Myers shale, and Pinkerton sandstone.

Bradford Willard, 1936, Geol. Soc. America Bull., v. 47, no. 4, p. 573. Formation includes Peters Mountain sandstone (new).

Bradford Willard and A. B. Cleaves, 1938, Pennsylvania Geol. Survey, 4th ser., Bull. G–8, p. 17–18, pls. Formation, in south-central Pennsylvania, consists of 1,600 feet of sandstones and pebble beds. Comprises (ascending) Second Mountain (new), Peters Mountain, and Cove Mountain (new) members. Underlies Mauch Chunk red beds; overlies Catskill red beds.

P. H. Price and E. T. Heck, 1939, West Virginia Geol. Survey [Rept.] Greenbrier County, p. 252, 283–294. Series consists of coarse reddish-brown micaceous sandstone, commonly crossbedded and conglomeratic, with brown, bluish-gray, and occasional red or green sandy shales, together with some impure and lenticular coals. Thickness 600 feet. Includes (ascending) Berea sandstone, shale and sandstone, Broad Ford sandstone, Merrimac coal, and sandstone and shale. Underlies Maccrady series; overlies Catskill series.

Charles Butts, 1940, Virginia Geol. Survey Bull. 52, pt. 1, p. 336–337. Names Pocono and Price are practically synonymous. In this report, name Pocono is applied in northern Virginia as far south as western Alleghany County, where the formation occurs on high knobs along State line. Name Price is applied throughout region from southern Alleghany and western Botetourt Counties to Tennessee.

M. N. Shaffner, 1952, Pennsylvania Geol. Survey, 4th ser., Prog. Rept. 141. Group in Donegal quadrangle, includes Burgoon sandstone in upper part. Thickness not determined. Underlies Loyalhanna limestone. Base of surface section in area.

R. C. Bolger and H. V. Gouse, 1953, Pennsylvania Geol. Survey, 4th ser., Bull. M-36, p. 5-7, pl. 3. Group in Driftwood quadrangle is 396 to over 500 feet thick. Includes Patton shale member (or formation) and Burgoon sandstone member (or formation) near top. Occurs below Mauch Chunk red shale and above Oswayo formation.

T. W. Amsden, 1954, Maryland Dept. Geology, Mines and Water Resources Bull. 13, p. 23-24. Formation described in Garrett County, where it is exposed on flanks of Deer Park and Accident anticlines. Consists largely of sandstone interbedded with some siltstone and shale. Thickness about 1,080 feet. Overlies Hampshire formation, contact gradational; underlies Greenbrier formation, contact placed where noncalcareous sandstones of Pocono are overlain by calcareous shales or sandy limestones.

J. L. Dally, 1956, Dissert. Abs., v. 16, no. 12, p. 2425. Group, in West Virginia, represented by (from base upward) Marlinton formation (new), Sunbury shale, and Matoaka formation (new) in southern part of State; Manheim formation (new) and Burgoon formation in northern part; Rockwell formation, Purslane sandstone, and Hedges shale in eastern part. In southern and eastern areas, sequences are continuous and contemporaneous and range in age from early Kinderhook to late Osage, and intertongue laterally with Hampshire red beds; sequence in northern part of State is younger, ranges in age from upper part of Osage through Meramec, is vertically transitional with Hampshire red beds, and intertongues laterally with lower Greenbrier limestone in south and Myers red shale in east.

H. H. Arndt and others, 1959, Geol. Soc. America Guidebook Field Trips Pittsburgh Mtg., p. 2-3. Formation rests unconformably on beds of Catskill formation in southern and western parts of anthracite region. Successively younger Catskill strata wedge in beneath Pocono in easterly and northerly directions. Contact between the two formations commonly placed at highest red bed of definite Catskill lithology. Pocono consists of 1,000 to 1,500 feet of conglomerate, sandstone, siltstone, shale, and coal beds. Sandstone and conglomerate are principal rock types. Color of beds light- to dark-gray olive, light-brown, and greenish-yellow. Formation appears to thin gradually to north and northeast in southern and western parts of anthracite region. Not certain that representatives of Burgoon and Griswold Gap conglomerates of central Pennsylvania are present in anthracite region. Unconformably overlies Mauch Chunk formation. Lower Mississippian.

Carlyle Gray and others, 1960, Geologic map of Pennsylvania (1:250,000): Pennsylvania Geol. Survey, 4th ser. Group includes, in Appalachian Plateau, Burgoon, Shenango, Cussewago, Corry, and Knapp formations; includes part of "Oswayo" in Potter and Tioga Counties.

No type locality designated by Lesley. Later workers have assumed type area to be in Pocono Mountains of northeastern Pennsylvania.

Poe Evaporite 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, fig. 2. Basal member of Nesson formation (new). Underlies Picard shale member (new); unconformably overlies Triassic(?) Spearfish formation. In type section, consists of basal 65-foot bed of massive salt overlain by 53 feet of white to pink gypsum and anhydrite and dark-red shale with a few thin interbeds of gray to red dense dolomite; thin bed of buff to brown very finely crystalline to earthy limestone present at top. Thins eastward from type well and appears to merge in Bowdoin dome area with younger members of formation. Unit exhibits rapid facies changes on east flank of Williston basin where member overlaps Spearfish formation and Madison limestone and rests on pre-Mississippian sediments.

Type section: Interval 6,947 to 7,065 feet in Phillips-Skelly-Gulf No. 1 Hoehn (Poe Unit) well, center NE SE sec. 13, T. 152 N., R. 102 W., McKenzie County, N. Dak.

**Pogonip Group**

Pogonip Formation (in Mount Hamilton Group)

Pogonip Limestone[1]

Lower and Middle Ordovician: Eastern and southern Nevada, southeastern California, and western Utah.

Original references: C. King, 1876, U.S. Geol. Expl. 40th Par. Atlas, Map IV; 1878, U.S. Geol. Expl. 40th Par., v. 1, p. 187–195, 248.

C. W. Merriam and C. A. Anderson, 1942, Geol. Soc. America Bull., v. 53, no. 12, pt. 1, p. 1682 (fig. 2), 1683–1684. Referred to as group. Pogonip limestone has been used broadly for strata in Great Basin lying between base of Eureka quartzite and top of Upper Cambrian Dunderberg shale (Eureka district). Following this interpretation, the Pogonip may embrace faunal zones ranging from Upper Cambrian to approximately Black River Middle Ordovician. In Antelope and Monitor Ranges, at least three recognizable formational units are present within vertical limits of the Pogonip. In Roberts Mountains, group is poorly represented and, even where best developed on west flank of Western Peak, shows little similarity to the thick section in Antelope and Monitor Mountains.

L. F. Hintze, 1951, Utah Geol. Soc. Guidebook 6, p. 38–42. Pogonip group geographically extended into Ibex area, Utah, where it underlies Swan Peak quartzite and overlies Upper Cambrian. Six lithologic units and 15 faunal zones recognized. Canadian and Chazyan.

L. F. Hintze, 1951, Utah Geol. and Mineralog. Survey Bull. 39, p. 11–96. In western Utah and eastern Nevada, Pogonip group comprises (ascending) House limestone, Fillmore limestone, Wahwah limestone, Juab limestone, Kanosh shale, and Lehman formation (all new). Restricted to Ordovician; lower boundary is lithologic change below the *Symphysurina* faunal zone; in western Utah, underlying unit is Notch Peak formation; in central Utah and several Nevada localities underlying rocks are dolomitic. Two Middle Ordovician quartzites overlie group in western Utah. In this sequence, the lower (Swan Peak) quartzite, 390 feet in central Utah, thins in western Utah to disappear in eastern Nevada, grading into successively younger Pogonip zones westward; the upper (Eureka) quartzite persists to west, halfway across Nevada. Thins by convergence from about 3,000 feet at Ibex, Utah, to about 1,700 feet near Scipio.

L. F. Hintze, 1952, Utah Geol. and Mineralog. Survey Bull. 48, p. 48. Complete typical Pogonip Ordovician section has not been found in fault blocks of Ely Springs Range, Nev. In addition to hiatus of 200 to 500 feet of beds between top of Yellow Hill and bottom of Tank Hill (top of Ordovician sequence), there is also a gap, probably of 500 feet or more, at bottom of Ordovician.

R. L. Langenheim, Jr., and others, 1956, Am. Assoc. Petroleum Geologists Bull., v. 40, no. 9, p. 2087 (fig. 3), 2091. In Independence quadrangle, California, group includes Mazourka formation. Underlies Barrel Spring formation of Eureka group. Chiefly early Ordovician in age.

T. B. Nolan, C. W. Merriam, and J. S. Williams, 1956, U.S. Geol. Survey Prof. Paper 276, p. 23–29. In Eureka district, Nevada, group includes (ascending) Goodwin limestone, Ninemile formation (new), and Antelope Valley limestone (new). Overlies Cambrian Windfall formation (new) and underlies Eureka quartzite. As now defined, group may range in age from earliest Ordovician to Chazy or Middle Ordovician. Note on type locality.

M. S. Johnson and D. E. Hubbard, 1957, U.S. Geol. Survey Bull. 1021–K, p. 345–349, pls. 32, 33. Considered as a group, the Pogonip of Eureka area embraces several mappable formations falling between top of Cambrian system and base of Eureka quartzite. In Nevada proving grounds area [this report] latter definition is applied arbitrarily. Present study does not favor formal naming of formational divisions within group, though such procedure may eventually be called for. Hence provisional subdivision is used with nine minor units designated A through I in ascending order. Total thickness about 3,150 feet. Overlies unnamed upper Cambrian rocks; underlies Eureka quartzite.

C. W. Merriam and W. E. Hall, 1957, U.S. Geol. Survey Bull. 1061–A, p. 4 (table 1). In Inyo Mountains, Calif., group is about 1,350 feet thick; base not exposed; underlies Eureka quartzite.

Harald Drewes, 1958, Geol. Soc. America Bull., v. 69, no. 2, p. 227. Group described in Snake Range, Nev., where it is about 3,000 feet thick; not subdivided. Conformably overlies Corset Spring shale. As used here, group includes at least 550 feet of Upper Cambrian rocks which could not be separated from lithologically similar Ordovician part.

F. L. Humphrey, 1960, Nevada Bur. Mines Bull., v. 57, p. 16, 18 (fig. 7), 19–23, pl. 1. Formation included in Mount Hamilton group (new). Upper formation in group; overlies Goodwin formation; underlies Eureka quartzite. Comprises four members: member 1, about 400 feet thick, consists of alternating thin-bedded shale-parted limestone and massive medium-gray limestone beds from 1 to 3 feet thick; member 2, about 600 feet thick, consists of thin-bedded reddish-brown weathered limestone, commonly with thin reddish, but locally buff, shale partings; member 3, about 160 to 210 feet, fairly massive medium- to dark-gray medium-grained limestone; member 4, about 800 feet, thin-bedded limestone, most fossiliferous member of formation. Lower Ordovician. [Editor's note states that Pogonip formation of this paper equals Pogonip group of Nolan, Merriam, and Williams, (1956)].

Marshall Kay, 1960, Internat. Geol. Cong. 21st, Copenhagen, pt. 12, p. 97 (fig. 3), 98 (fig. 4). Underlies Gatecliff formation (new) in Toquima Range.

Type locality: Pogonip Ridge in White Pine or Hamilton district, about 30 miles southeast of Eureka, Nev. On Pancake Summit and Green Springs 15-minute topographic quadrangle of U.S. Geological Survey, Pogonip Ridge of King's usage is shown as Mount Hamilton of the White Pine Range.

†Pogonipan series[1]

Ordovician: Nevada.

Original reference: C. R. Keyes, 1923, Pan-Am. Geologist, v. 40, p. 53, 80.

Pohakuloa Stage and Drift

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. 1207–1210. Four stages of glaciation, presumably correlative with Ice Age elsewhere, occurred on Mauna Kea. These are (beginning with latest) Makanaka, Waihu, Pohakuloa, and pre-Pohakula stages. Till 50 to 90 feet thick.

H. T. Stearns, 1945, Geol. Soc. America Bull., v. 56, no. 3, p. 269. Of glacial deposits described by Wentworth and Powers, only Makanaka deposits can be accepted as definitely glacial. Pohakuloa drift believed to be volcanic explosion deposits.

Drift occurs on walls of Pohakuloa Gulch between 8,750 and 9,500 feet.

**Pohono Granodiorite**[1]

Probably Cretaceous: East central California.

Original reference: F. C. Calkins, 1930, U.S. Geol. Survey Prof. Paper 160, p. 123.

Named for occurrence near Pohono Trail.

Poinsettan series[1]

Tertiary, upper: Illinois and Missouri.

Original reference: C. R. Keyes, 1915, Iowa Acad. Sci. Proc., v. 22, p. 252.

Point Arena Beds or Formation

Miocene, upper: Northern California.

C. E. Weaver, 1943, California Div. Mines Bull. 118, p. 630–632; 1944, Washington [State] Univ. Pubs. in Geology, v. 6, no. 1, p. 4, 19, 21–22, pl. 2. Alternating units of interstratified grayish-brown clay shales, foraminiferal shales, diatomaceous shales, cherty shales strongly contorted, and units of thinly laminated sandstones and cherty shales and clay shales; occasional layers of sandstone 50 feet thick. Thickness 3,355 feet. Underlies terrace deposits; overlies Gallaway beds (new).

Exposed in sea cliffs almost continuously from Abalone Cove northward to Point Arena Lighthouse, a distance of about 30,000 feet. Point Arena-Fort Ross area, Mendocino County.

Point au Gres Limestone

Point aux Gres Limestone[1]

Mississippian: Eastern Michigan.

Original reference: C. C. Douglass, 1839(?), Michigan Leg. House Doc. 27, between p. 97 and 111.

G. H. Pringle, 1937, Michigan Dept. Conserv., Geol. Survey Div. Prog. Rept. 3, p. 14. At Point au Gres, 6 feet of Bayport limestone occur along lakeshore on west side of the point. This is limestone named Pointe aux Gres by Douglass.

G. M. Ehlers and W. E. Humphrey, 1944, Michigan Univ. Contr. Mus. Paleontology, v. 6, no. 6, p. 114–117. Description of fauna from Point au

Gres limestone at Grand Rapids. Thickness in Grand Rapids area 50 to 70 feet. History of nomenclature reviewed and reference made to work of Lane (1893, 1895, 1899, 1900, 1909). Concluded that Point au Gres instead of "Grand Rapids" or "Bayport" should be used. Usage is based on definition by Douglass (1841 [1849]). Continued reference to limestone as "Bayport" would be unfortunate since this name and also "Grand Rapids" were used only in casual manner by Lane.

Typically exposed at Point au Gres on western side of Saginaw Bay, Lake Huron.

Point aux Barques Lighthouse[1] (Sandstone)

Mississippian: Michigan.

Original reference: A. C. Lane, 1899, U.S. Geol. Survey Water-Supply Paper 30, p. 85.

In Huron County.

Point aux Barques Sandstone[1]

Mississippian: Michigan.

Original reference: A. Winchell, 1871, Am. Philos. Soc. Proc., v. 11, p. 60–66.

Saginaw Bay region.

Pointe aux Chenes Formation or Shale (in Salina Group)

Upper Silurian (Cayugan): Northern 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. 26, 27, 33, 35–52 Proposed for strata which in recent reports have been designated by group term Salina. Consists of green and red shale with thin beds of dolomite of varied lithologic character and small irregular masses and thin beds of gypsum. Thickness varies from 8 to as much as 35 feet in outcrop sections; well records show between 500 and 600 feet on St. Ignace Peninsula. Occupies position between Middle Silurian Engadine dolomite and Upper Silurian St. Ignace formation (new). Further study may show that Salina group of Mackinac Straits area contains several formations and that the Pointe aux Chenes is its uppermost division. Pointe aux Chenes formation includes strata referred to Onondaga salt group by Hall (1851, Geological Reports pub. *in* pt. V. *of* Foster and Whitney report on Geology of Lake Superior Land District, U.S. Senate, Spec. Sess., March, 1851, Ex. Doc. no. 4) and Rominger (1873, Geology of the Upper Peninsula: Michigan Geol. Survey, v 1, pt. 3).

G. M. Ehlers and R. V. Kesling, 1957, Michigan Geol. Soc. [Guidebook] Ann. Geol. Excursion, p. 2 (table), 23–24. Most of strata are shales; hence, unit termed Pointe aux Chenes shale.

Named for exposures in area near Pointe aux Chenes, a headland on Lake Michigan about 9 miles northwest of city of St. Ignace.

Point Farfan diorite.

Miocene: Panamá.

[T. F. Thompson], 1943, Panama Canal, Spec. Eng. Div., 3d Locks Proj., pt. 2, chap. 3, p. 26. Grades regularly from coarse texture to fine grained and andesitic. Probably a small neck or intrusive plug. Pre-Pliocene.

W. P. Woodring *in* R. Hoffstetter and others, 1960, Lexique Strat. Internat., v. 5, Amérique Latine, fasc. 2a, p. 343–344. Augite-quartz diorite and presumably intrudes Panamá formation. Miocene.

Quarried at Point Farfan, near southern terminus of Thatcher Ferry, Point Farfan in on west side of Pacific entrance to Panamá Canal.

**Point Hey Member** (of Katalla Formation)

Point Hey Sandstone Member (of Redwood Formation)[1]

Oligocene: Southeastern Alaska.

Original reference: N. L. Taliaferro, 1932, Geol. Soc. America Bull., v. 43, no. 3, p. 773.

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. 7 (table), 12–13; 1945, Geologic and topographic map and sections of the Katalla area, Alaska: U.S. Geol. Survey War-Minerals Inv. Prelim. Map. Member of Katalla formation. East of long 144°19′ W. member consists of at least several hundred feet of gray to nearly black partly sandy shale and fine- to medium-grained gray sandstone. Sandstone beds range in thickness from 1 to 100 feet. Near long 144°19′ W., member is about 850 feet thick. West of long 144°19′ W., member includes a lower division mostly of shale which thickens westward to more than 2,000 feet and an upper division of thick sandstone beds and thin shale beds. Lies conformably between unnamed organic shale member below and Puffy member above. In unpublished manuscript by oil-company geologists, Point Hey shale and Point Hey sandstone are treated as two distinct units in Redwood formation.

Named for excellent outcrops in vicinity of Point Hey, Katalla district, Controller Bay region.

Point Lookout Granite[1]

Precambrian(?): Southwestern Virginia.

Original reference: A. I. Jonas, 1935, Geol. Soc. America Bull., v. 46, p. 49.

A. J. Stose and G. W. Stose, 1946, Maryland Dept. Geology, Mines and Water Resources Carroll and Frederick Counties Rept., p. 17. Described as biotite quartz monzonite. Intrudes a biotite gneiss injection complex, the oldest rock of which is the newly named Saddle gneiss. Cut by pink pegmatite.

Named from occurrence in Point Lookout Mountain, Grayson County.

**Point Lookout Sandstone** (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. 90, 94, pl. 1. Described in Fort Defiance-Tohatchi quadrangle where it overlies Crevasse Canyon formation (new) and underlies Menefee formation. Made up of one thin and two thick units, totaling 320 feet. Northward, the thick units are separated by tongue of finer-grained material (Satan tongue of Mancos shale) so that combined thickness is about 400 feet; south of Crevasse Canyon, within 1 mile they thin abruptly and completely disappear within 2 miles. Lower cliff-making unit is here called Hosta sandstone tongue.

P. T. Hayes and A. D. Zapp, 1955, U.S. Geol. Survey Oil and Gas Inv. Map OM–144. Described in Barker dome-Fruitland area, San Juan County, N. Mex., where it includes North Hogback tongue (new). Intertonguing relationships with Menefee discussed.

E. C. Beaumont, C. H. Dane, and J. D. Sears, 1956, Am. Assoc. Petroleum Geologists Bull., v. 40, no. 9, p. 2156. Discussion of revised nomenclature of Mesaverde in San Juan basin, and term Point Lookout sandstone is extended throughout area. Point Lookout as a formation 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. Hosta tongue of Point Lookout sandstone replaces lower part of Hosta sandstone member where that is present.

Well exposed in cliffs at Point Lookout, about 7½ miles southwest of Mancos, Montezuma County, Colo.

†Point of Rocks Group[1]

Upper Cretaceous (Montana): Southwestern Wyoming, northwestern Colorado, and northeastern Utah.

Original reference: J. W. Powell, 1876, Geology of eastern portion of Uinta Mountains, p. 40, 47, 155.

Point of Rocks Station, Sweetwater County, Wyo.

Point of Rocks Sandstone

Point of Rocks Sandstone Member (of Tejon Formation)

Eocene, upper: Southern California.

R. D. Reed and J. S. Hollister, 1936, Am. Assoc. Petroleum Geologists Bull., v. 20, no. 12, p. 1566 (fig. 9). Named on columnar section of upper Eocene strata in Devils Den area. Underlies Kreyenhagen and overlies "Tejon" shale.

Martin Van Couvering and H. B. Allen, 1943, California Div. Mines Bull. 118, pt. 3, p. 496, 497 (fig. 211). Described as tawny massive cavernous crossbedded medium to coarse quartzose sandstone; contains large chocolate-brown concretions in lower part; includes two thin silty claystone beds. Thickness 3,005 feet. Underlies Welcome formation; overlies Gredal formation (new).

H. H. Heikkila and G. M. MacLeod, 1951, California Div. Mines Spec. Rept. 6, p. 4 (table 1), 5 (table 2), 7, pl. 1. Described in Bitterwater Creek area, Kern County, as coarse- to medium-grained sandstone characterized by red-brown "cannonball" concretions of calcarinate sandstone up to 4 or 5 feet in diameter. Maximum thickness 600 feet; southeastward along strike there is a gradual decrease in apparent thickness due to progressive overlap by younger Santos shale member of Monterey formation and at one locality Twisselmann sandstone member (new) of the Monterey. In Antelope Valley, sandstone wedges out or is truncated by either the McDonald shale or Tulare sediments.

V. S. Mallory, 1959, Lower Tertiary biostratigraphy of the California Coast Ranges: Tulsa, Okla., Am. Assoc. Petroleum Geologists, p. 10, 11, 19, 70, 101, 282. Report makes several references to Point of Rocks sandstone member of Tejon formation. At Media Agua Creek, bulk of Point of Rocks member was deposited during early Narizian, *Uvigerina churchi* time.

L. B. McMichael, chm., 1959, San Joaquin Geol. Soc. Guidebook Field Trip, May 9, p. 13, 14. Chart and columnar section of Chico-Martinez Creek area show Point of Rocks sandstone and shale member of Tejon formation unconformable below Salt Creek shale member of Tejon formation.

O. T. Marsh, 1960, California Div. Mines Spec. Rept. 62, p. 28. Conspicuous craggy sandstone at Red Man Rocks, Orchard Peak area, has been mapped as Eocene, usually as Point of Rocks whose type locality lies 4 miles southeast of Devils Den. Craggy sandstone in northeast corner of area has been regarded as Cretaceous. In present report, both exposures are mapped as Upper Cretaceous Red Man sandstone (new).

Type locality: T. 26 S., R. 18 E., Devils Den district, Kern County.

**Point Peak Shale 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). Greenish shale underlying San Saba limestone member and overlying Morgan Creek limestone 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 v. 58, no. 1, p. 115–116, pls. 1, 2. Consists of well-bedded soft greenish calcareous shales with subordinate amounts of fine-grained compact dolomite; medium- to fine-grained glauconitic limestone; intraformational conglomerates; and near top, occasional beds of oolitic limestone and commonly extensive to scattered stromatolitic bioherms that locally coalesce to form biostromes. Average thickness 160 feet; at type section 270 feet; thins to 25 feet along Pedernales River in Blanco County. At type locality, underlies San Saba limestone member and overlies full but thin section of Morgan Creek limestone member. Locally in contact with Pedernales dolomite member. Top of the Point Peak drops abruptly southward in Sudduth area of Burnet County; bottom boundary likewise is not at a constant stratigraphic horizon, it ranges from 90 feet above base of formation on Point Peak to about 170 feet in Salt Branch section; difference in position of boundary probably due chiefly to facies change from shale to limestone.

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 south slope of Point Peak, an isolated hill about 4 miles northeast of Lone Grove, Llano County.

**Point Pleasant Formation**

Point Pleasant Limestone[1]

Middle Ordovician: Southwestern Ohio and northern Kentucky.

Original reference: J. S. Newberry, 1873, Ohio Geol. Survey, v. 1, p. 89 (table), 119–121.

M. P. Weiss and C. E. Norman, 1960, Ohio Geol. Survey Inf. Circ. 26, pl. 1. Chart shows development of stratigraphic classification of Ordovician rocks in Cincinnati region. Point Pleasant (Cynthiana) formation is below the Eden which is basal formation of Covington group, Cincinnatian series.

Named for exposures at Point Pleasant, Clermont County, Ohio.

Point Reyes Granodiorite

[Cretaceous]: Northern California.

G. H. Curtis, J. F. Evernden, and J. Lipson, 1958, California Div. Mines Spec. Rept. 54, p. 9. Discussed in report dealing with potassium-argon determinations. Age given as 83.9 million years.

Crops out in vicinity of Point Reyes lighthouse and along northern shores of Point Reyes Peninsula toward Tomales Point at head of Tomales Bay. Dated specimen collected from quarry near old Government Landings.

Point Rock Shale Member (of Wilberns Formation)

Upper Cambrian: Central Texas.

B. F. Howell and others, 1944, Geol. Soc. America Bull., v. 55, no. 8, chart 1. Shown on correlation chart above Morgan Creek limestone member and below San Saba limestone and Pedernales dolomite members. [This may be lapsus for Point Peak shale member of Wilberns formation (Romberg and Barnes, 1944).]

Central mineral region.

**Point Sal Formation**

Miocene, lower and middle: Southern California.

C. R. Canfield, 1939, Am. Assoc. Petroleum Geologists Bull., v. 23, no. 1, 66 (footnote). Name provisionally proposed for the Siltstone and Shell zone in Monterey formation.

W. P. Woodring, M. W. Bramlette, and K. E. Lohman, 1943, Am. Assoc. Petroleum Geologists Bull., v. 27, no. 10, p. 1341 (table 1), 1344–1345; W. P. Woodring and M. N. Bramlette, 1950, U.S. Geol. Survey Prof. Paper 222, p. 11 (chart), 16–17, pls. 1, 3. Consists chiefly of dark-gray brown-weathering mudstone and siltstone. Includes thin beds of sandstone, limestone concretions, and diabase sills. Thickness ranges from 150 to 1,500 feet, thickest section being on south slope of Mount Lospe. In Point Sal area, appears to overlap the Lospe and to rest on Knoxville or Franciscan. On Mount Lospe, conformably overlies Lospe formation. Underlies Monterey formation. Type locality redesignated.

Type locality: As redesignated, on south slope of Mount Lospe, Santa Maria district. As designated by Canfield, on Point Sal Grade, approximately one-half mile east of old Point Sal Landing (Guadalupe quadrangle).

**Poison Canyon Formation**[1]

Paleocene: Southeastern Colorado.

Original reference: R. C. Hills, 1888, Colorado Sci. Soc. Proc., v. 3, pt. 1, p. 148–164.

G. H. Wood and others, 1951, U.S. Geol. Survey Coal Inv. Map C–4 Described in Stonewall-Tercio area, Las Animas County, where several hundred feet of basal part of formation are exposed. Intertongues with underlying Raton formation. Paleocene.

R. B. Johnson and J. G. Stephens, 1954, U.S. Geol. Survey Oil and Gas Inv. Map OM–146. Exposed over much of La Veta area where it is composed of approximately 2,500 feet of alternating beds of buff to red massive arkosic sandstone and conglomerate and thin beds of yellow shale. Overlies Vermejo formation (Raton formation not present in this area). Underlies Cuchara formation.

Well exposed in beds extending down Poison Canyon, west of Gardner, and across Muddy Creek to Promontory Bluffs, Huerfano County.

Poison Canyon Sandstone (in Westwater Canyon Sandstone Member of Morrison Formation)

Jurassic: Northwestern New Mexico.

R. T. Zitting and others, 1957, The Mines Magazine, v. 47, no. 3, p. 55, 57; L. S. Hilbert and A. F. Corey, 1957, U.S. Geol. Survey Trace Elements Inv. Rept. TEI-690, book 2, p. 370 (fig. 86), 371. Upper Westwater sandstone lens which intertongues with overlying Brushy Basin shale member of Morrison formation. Generally separated from main body of Westwater by a shale. Practically absent in parts of area and up to 100 feet thick in other places. Base of Poison Canyon consistently 160 feet below base of Dakota formation.

In Ambrosia Lake area, McKinley County.

†Poison Canyon Series[1]

Eocene: Southeastern Colorado.

Original reference: R. C. Hills, 1888, Colorado Sci. Soc. Proc., v. 3, pt. 1, p. 148–164.

In Huerfano Basin, Huerfano County.

**Poison Creek Formation**[1] (in Idaho Group)

Pliocene: Southwestern Idaho.

Original reference: J. P. Buwalda, 1923, Idaho Bur. Mines and Geology Pamph. 5, p. 3.

U.S. Geological Survey currently classifies the Poison Creek as a formation in Idaho Group on basis of a study now in progress.

Type locality: At north end of Silver City Range at Poison Creek grade, Snake River valley.

Pokeberry cyclothem (in Carbondale Group)

Pennsylvanian: Western Illinois.

H. R. Wanless, 1957, Illinois Geol. Survey Bull. 82 (fig. 22), 60, 113, 189, 190. Thickness 11 to 17 feet. Includes Pokeberry limestone. In sequence, occurs above Brereton cyclothem and below Sparland cyclothem. May be equivalent to Jamestown cyclothem.

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 56 (table 3). Replaced by Jamestown cyclothem.

Named from outcrops about 1 mile east of Pokeberry school in sec. 26, T. 2 N., R. 1 W., Beardstown quadrangle, Schuyler County.

Pokeberry Limestone Member (of Carbondale Formation)

Pokeberry Limestone (in McLeansboro Formation)

Pennsylvanian: Western Illinois.

H. R. Wanless, 1939, Geol. Soc. America Spec. Paper 17, p. 17, 98. Marine limestone in lower McLeansboro, between Danville (No. 7) coal above and Brereton limestone.

H. R. Wanless and Raymond Siever, 1956, Illinois Geol. Survey Circ. 217, p. 11. Included in Jamestown cyclothem. Type locality designated.

H. R. Wanless, 1957, Illinois Geol. Survey Bull. 82, p. 50 (fig. 22), 113. Blue-gray to greenish-gray limestone commonly 1½ to 2 feet thick. Columnar section shows Pokeberry limestone stratigraphically below Copperas Creek sandstone and above Sheffield shale. Included in Pokeberry cyclothem (new), Carbondale group.

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 35, 48 (table), pl. 1. Rank reduced to member status in Carbondale formation (redefined). Occurs above Lawson shale member (new) and below

Copperas Creek sandstone member. Presentation of new rock-stratigraphic classification of Pennsylvanian strata in Illinois. Cyclical classification retained but is entirely independent of rock-stratigraphic classification.

Type locality: NW¼ sec. 26, T. 2 N., R. 1 W., Schuyler County.

**Pokegama Quartzite**[1] (in Animikie Group)

Precambrian: Northeastern Minnesota.

Original reference: H. V. Winchell, 1893, Minnesota Geol. Survey 20th Ann. Rept., p. 123.

F. F. Grout and others, 1951, Geol. Soc. America Bull., v. 62, no. 9, p. 1021 (table 3), 1042–1044. Base of Animikie group; lies on truncated pre-Animikie rocks—Archean greenstone, pre-Knife Lake granite, Knife Lake group, and Giants Range granite; overlain conformably, or nearly so, by Biwabik iron-bearing formation. Quartzite changes across strike from conglomerate at base through thin-bedded micaceous quartzite to very massive coarse-grained quartzite at top; succession fairly persistent where quartzite is thick; strike parallels Mesabi Range. Total thickness not more than 200 feet; commonly not over 75 feet.

Named for outcrops at Pokegama Falls on Mississippi River north of Grand Rapids, Itasca County.

Poland Limestone Member (of Denmark Formation)

Middle Ordovician (Mohawkian): East-central New York.

G. M. Kay, 1943, Am. Jour. Sci., v. 241, no. 10, p. 598, 599, 600–601, 603, 605; 1953, New York State Mus. Bull. 347, p. 45, 53–55. Name proposed for middle member of formation. Consists principally of dense fossiliferous limestone with intercalated calcareous shale southeastward to Newport, passing wholly into sparsely fossiliferous argillaceous calcilutite and shale of the "Dolgeville" facies at East Canada Creek, and ultimately into black shale at Canajoharie. Includes black dense resistant limestone at its base; not exposed at Trenton Falls. In various section contains a metabentonite near the base, two higher in unit, and a fourth at contact with overlying Russia limestone member (new). Contrasts with underlying Rathbun limestone member (newly defined) by lack of coquinal beds. Thickness about 60 feet.

Type section: At Trenton Falls on West Canada Creek near Oneida-Herkimer County line. Named for Poland, Herkimer County, southeast of Trenton Falls.

**Pole Canyon Limestone**

Middle Cambrian: East-central Nevada.

Harald Drewes and A. R. Palmer, 1957, Am. Assoc. Petroleum Geologists Bull., v. 41, no. 1, p. 106 (fig. 2), 109 (fig. 4), 110–113, 118–119; Harald Drewes, 1958, Geol. Soc. America Bull., v. 69, no. 2, p. 224 (fig. 2), 225–226, pl. 1. Gray and white limestone, commonly massive. Total thickness about 2,000 feet. On west side of Snake Range, five alternating gray and white members are recognized (ascending): A, 415 feet thick; B, 630 feet; C, 160 to 320 feet; D, 220 to 380 feet; E, 340 feet. Conformably overlies Pioche shale; underlies Lincoln Peak formation (new). No complete type section available.

Named for Pole Canyon on west side of Mount Washington, on which most of formation is well exposed. Forms cliffs extending in broad, continuous outcrop band from Minerva district on west flank of Snake Range to Mount Washington and eastward into Big Wash drainage.

Pole Canyon Member (of Oquirrh Formation)

Pennsylvanian (Virgilian) : Northwestern Utah.

H. J. Bissell, 1959, Utah Geol. Soc. Guidebook 14, p. 121–126, pls. 1, 2. Interbedded and intercalated orthoquartzites, calcareous orthoquartzites, calcareous sandstones, crystalline limestones, cherty fossiliferous-fragmental limestones, and argillaceous to silty limestones, some of which contain chert nodules. Thickness 1,526 feet. Overlies Lewiston Peak member (new) ; underlies strata referred to as Wolfcampian(?).

Type locality: On east-trending spur in west side of Pole Canyon in secs. 2 and 11, T. 6 S., R. 3 W., Utah County. This is on west limb of Pole Canyon syncline (east limb of Ophir anticline).

Polecat Bench Formation

Paleocene: Northwestern Wyoming.

G. L. Jepsen, 1940, Am. Philos. Soc. Proc., v. 83, no. 2, p. 231–238. Proposed to replace name Fort Union for sediments in vicinity of Polecat Bench. Thickness about 3,500 feet. Bounded below by *Triceratops*-bearing (Lance?) beds and above by *Homogalax*-bearing (Gray Bull) beds. Composed of rocks, at Polecat Bench, mapped and described as Lebo and Tongue River by Stow (1938, Geol. Soc. America Bull., v. 49, no. 5, p. 731–762) and as Paleocene and Fort Union by Jepsen (1930, Am. Philos. Soc. Proc., v. 69, no. 7). Includes (ascending) Mantua lentil, Rock Bench quarry beds, Silver Coulee beds, and Clark Fork beds.

F. B. Van Houten, 1944, Geol. Soc. America Bull., v. 55, no. 2, p. 178. Underlies Willwood formation (new) ; in middle of Big Horn Basin, contacts are conformable; near basin's margin Willwood dips basinward and is locally nonconformable or overlaps Polecat Bench.

Well exposed at Polecat Bench, in Bighorn near Powell, Park County.

**Pole Creek Dacite**

Pliocene(?) : Northeastern Nevada.

R. R. Coats, 1957, U.S. Geol. Survey Trace Elements Inv. Rept. TEI–690, book 2, p. 304, 306–307. Medium-gray to black vitrophyre in form of small domical protrusions. Maximum thickness as much as 900 feet and maximum exposed length about 1½ miles; parts of masses concealed by gravels. Older than Gods Pocket dacite (new) ; younger than Robinson Creek vitrophyre.

Near eastern border of Jarbidge quadrangle.

**Poleo Sandstone Lentil** (in Chinle Formation)

Poleo Sandstone[1]

Upper Triassic: Central northern New Mexico.

Original reference: F. V. Huene, 1911, Neues Jahrb., Beilage-Bd. 32, p. 730–739, pl. 32.

G. H. Wood and S. A. Northrop, 1946, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 57. Rank reduced to lentil in lower part of Chinle; overlies Salitral shale tongue (new). Prior to this survey, unit had been mapped as Senorito sandstone lentil of Chinle(?) in vicinity of Senorito Canyon and as Poleo sandstone in Mesa Poleo region.

Forms crest of Mesa Poleo.

Poleslide Member (of Brule Formation)

Oligocene: Southwestern South Dakota.

J. D. Bump, 1956, Am. Jour. Sci., v. 254, no. 7, p. 431–432. Unit formerly known as *Proteceras* beds (*Leptauchenia* beds) here designated Poleslide member. Subdivided into three units: lower zone includes approximately 100 feet of rather barren clays capped with light-gray clay band; middle zone, about 110 feet thick, is buff and gray clays where *Leptauchenia* nodules are developed and channel sandstones occur; upper unit, about 85 feet thick, is vertically weathered gray silty ash. Overlies Scenic member (new); underlies Arikaree white ash.

Standard section: NW¼ sec. 23, T. 43 N., R. 44 W., 8½ miles south of Scenic, and on south rim of Sheep Mountain Table, Shannon County.

†Polk Bayou Limestone[1]

Middle and Upper Ordovician: Northern Arkansas.

Original reference: H. S. Williams, 1899, Am. Jour. Sci., 4th, v. 8, p. 139–152.

Named for Polk Bayou, near Batesville, Independence County.

†Polk County Ash Bed (in Stanley Shale)[1]

Pennsylvanian: Southwestern Arkansas.

Original reference: J. F. Williams, 1891, Arkansas Geol. Survey Ann. Rept. 1888, v. 2, p. 375–376.

Named for exposures in Polk County.

**Polk Creek Shale[1]**

Upper Ordovician: Southwestern Arkansas and southeastern Oklahoma.

Original references: A. H. Purdue, 1909, Geol. Soc. America Bull., v. 19, p. 557; 1909, Slates of Arkansas, Arkansas Geol. Survey, p. 30, 36.

B. H. Harlton, 1953, Am. Assoc. Petroleum Geologists Bull., v. 37, no. 4, p. 781 (fig. 2), 787. Described in Ouachita Mountains of southeastern Oklahoma where it is well developed at Black Knob Ridge and in the Potato Hills. In most exposures, shale is somewhat altered, hard, siliceous, and darker than the normal Sylvan; lower part is dark gray to black, dolomitic, and resembles "Normal Sylvan" of the Arbuckles; it includes the black bituminous type at its base, everywhre along south front of mountains east of Ardmore on Highway 77 and at Apache; the remainder, approximately 60 feet, consists of rather soft dark-greenish to greenish-gray platy shale, which is indistinguishable from the Sylvan of the Arbuckles. Unconformably overlies Big Fork chert; unconformably underlies Missouri Mountain shale. Silurian.

Named for Polk Creek, Montgomery County, Ark.

Pollack Quartz Latite

Tertiary, upper: Southwestern New Mexico.

H. L. Jicha, Jr., 1954, New Mexico Bur. Mines Mineral Resources Bull. 37, p. 39 (table 3), 47, pl. 1. Quartz latite ranges in color from a dominant pinkish brown to light red and purple. Attains maximum thickness of about 300 feet. Disconformable contacts with overlying Razorback formation and underlying Mimbres Peak formation. Late Tertiary.

W. E. Elston, 1957, New Mexico Bur. Mines Mineral Resources Bull. 38, p. 17 (table 1), 37. Described as purplish-gray rhyolite in Dwyer quadrangle. Underlies Santa Fe fanglomerates. Tertiary(?).

Type area: Along Taylor Creek which branches off to north of Pollack Creek. Named for exposures on Pollack Creek, Lake Valley quadrangle.

**Pololu Volcanic Series**

Pliocene(?) : Hawaii Island, Hawaii.

H. T. Stearns, and G. A. Macdonald, 1946, Hawaii Div. Hydrography Bull. 9, p. 171, 176, 197; D. A. Davis and G. A. Macdonald *in* Jacques Avias and others, 1956, Lexique Strat. Internat., v. 6, Océanie, fasc. 2, p. 127. Predominantly olivine basalt with minor amounts of picrite-basalt and a few intercalated vitric tuff beds. At type section, consists of 450 feet of thin-bedded highly vesicular aa and pahoehoe primitive-type basalts dipping about 5° NE.; they extend an unknown distance below sea level; section is capped by flow of andesite of Hawi volcanic series (new). Maximum exposed thickness about 3,500 feet; 891 feet on southeast wall of Waipio Valley. Separated from overlying Hawi volcanic series by erosional unconformity.

Type section :Exposures on trail down northwestern wall of Poholu Valley. Composes lower slopes of much of Kohala Mountains at north end of island.

Polonio Sandstone Tongue (in McLure Shale)

Miocene, upper: Southern California.

O. T. Marsh, 1960, California Div. Mines Spec. Rept. 62, p. 7 (fig. 3), 32–33, pls. 1–2. Comprises alternating beds of siliceous quartz sandstone and interbeds of siliceous shale in approximately equal amounts. The massive sandstones crop out at prominent ledges and range in thickness from 1 foot to 36 feet; 10-foot-thick beds are common. Beds much broken by vertical closely spaced joints. Characteristic feature is intricate criss-crossing of thin siliceous veinlets which weather into sharp relief as ledges. Approximately every 20 feet along bedding are light-gray-brown lenticular concretions up to 3 by 5 feet which weather to brown.

Named for Polonio Pass at head of Antelope Valley [Kern County]. Tongue enters Orchard Peak area from northwest, thins southeastward and pinches out northwest of Hughes Ranch, near head of valley.

**Pomeroy Member** (of Naknek Formation)

Upper Jurassic: Central southern Alaska.

C. E. Kirschner and D. L. Minard, 1948, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 95 [1949]. Comprises two facies. Sandstone facies approximately 400 feet thick on Oil Bay and 1,300 feet on south shore of Chinitna Bay. Sandstone beds on Oil Bay averaging 10 feet in thickness are interbedded with arenaceous siltstone beds averaging 1 foot in thickness. Sandstone is gray coarse grained arkosic grit. Conglomerate facies approximately 500 feet thick on east shore of Iniskin Bay. Lithology of conglomerate similar to that of conglomerate facies of Chisik member. Total thickness of member ranges from 600 to 1,300 feet. Conformable contacts with unnamed underlying siltstone member and overlying upper sandstone member.

Conglomerate facies forms northwest-facing cliff and hogback ridge extending from Iniskin Bay to Mount Pomeroy and eastward; on Iniskin Peninsula.

Pomeroy Quartz Monzonite[1]

Tertiary(?): Central Colorado.

Original reference: R. D. Crawford, 1913, Colorado Geol. Survey Bull. 4, p. 79.

J. W. Adams, 1953, U.S. Geol. Survey Bull. 982–D, p. 98, 103–104. Probably of Tertiary age.

M. G. Dings and C. S. Robinson, 1957, U.S. Geol. Survey Prof. Paper 289, p. 23. Name changed to Mount Pomeroy quartz monzonite because name Pomeroy was preempted.

Named for Pomeroy Mountain, Monarch district, Garfield quadrangle, Chaffee County.

Pomeroy Sandstone (in Monongahela Formation)[1]

Pomeroy sandstone member

Pennsylvanian (Monongahela Series): Southeastern Ohio and West Virginia.

Original reference: E. Lovejoy, 1888, Ohio Geol. Survey, v. 6, p. 630, 631, 635.

A. T. Cross and M. P. Schemel, 1956, West Virginia Geol. Survey, v. 22, pt. 1, p. 76 (figs. 1–70). Geologic section shows Pomeroy sandstone present in Guyandot quadrangle, Wayne County, W. Va. Thickness about 8 feet. Occurs above Redstone (Pomeroy) coal zone.

D. L. Norling, 1958, Ohio Geol. Survey Bull. 56, p. 10 (fig. 3), 71, geol. map. Pomeroy sandstone member (Monongahela series) underlies Fishpot limestone and shale member and overlies Redstone-Pomeroy (No. 8–A) coal. In early reports, Pomeroy coal was considered correlative of Pittsburgh (No. 8) coal, and term Pomeroy was applied to the overlying sandstone, which is the Upper Pittsburgh sandstone. With the recognition of the equivalency of the Pomeroy coal and the Redstone (No. 8–A) coal, term Pomeroy was applied in its present meaning. Ohio Geological Survey no longer considers the Fishpot sandstone correlative with the Pomeroy and has abandoned term Fishpot sandstone. In Morgan County, the Pomeroy member is a well-developed sandstone unit in many areas and a sequence of sandstones and shales in other areas. The massive phase locally extends upward to coalesce with the stratigraphically higher Lower Sewickley sandstone in areas where the Fishpot limestone, clay, and coal members are not present. The Pomeroy coalesces with the Upper Pittsburgh sandstone where Redstone coal and limestone members are absent. Where underlying Redstone (No. 8–A) coal and overlying Fishpot limestone members are present, the Pomeroy sandstone interval is 11 to 30 feet thick and averages 18 feet.

M. T. Sturgeon and others, 1958, Ohio Geol. Survey Bull. 57, p. 159 (table 13), 170. Member of Fishpot cyclothem in report on Athens County. Term Pomeroy sandstone first used by Lovejoy (1888) for sandstone overlying Pomeroy or Redstone coal bed near Pomeroy, Ohio. Since that date, other names applied to this member include Redstone sandstone (Swartz and others, 1919) and Cedarville sandstone (Reger, 1916). Name Pomeroy has priority and is retained in this report. Thickness 0 to 30 feet; average thickness 12 feet. Underlies Fishpot redbed member; overlies roof shale at top of Redstone cyclothem. Monongahela series.

Named for Pomeroy, Meigs County, Ohio.

Pomfret Granite[1]

Devonian: Southeastern Vermont.

Original reference: E. J. Foyles and C. H. Richardson, 1929, Vermont State Geologist 16th Rept., table opposite p. 288.

Probably named for Pomfret Township, Windsor County.

Pomfret Phyllite[1]

Pomfret phyllite phase (of Hebron Gneiss)

Pre-Triassic: Northeastern Connecticut.

Original reference: H. E. Gregory, 1906, Connecticut Geol. Nat. History Survey Bull. 6, p. 129.

John Rodgers and others, 1956, Preliminary geological map of Connecticut (1:253,440): Connecticut Geol. Nat. History Survey [Bull. 84]. Refers to Pomfret (Worcester) phyllite phase of the Hebron gneiss. Occurs at the eastern margin of the Hebron outcrop area. Pre-Triassic.

Typically developed in northeastern part of Pomfret [Township], Windham County.

Pompey Member (of Skaneateles Shale)[1]

Middle Devonian: Central New York.

Original reference: G. A. Cooper, 1930, Am. Jour. Sci., 5th, v. 19, p. 219, 220.

G. A. Cooper and others, 1942, Geol. Soc. America Bull., v. 53, no. 12, pt. 1, chart 4. Overlies Delphi Station member (name replaces Delphi of Cooper, 1930); underlies Butternut shale member (name replaces Berwyn member of Cooper, 1930). Middle Devonian.

Type section: Upper 60 feet of section at top of Pratt Falls. Name is probably from village of Pompey, Onondaga County.

Pomponio Member (of Purisima Formation)

Pliocene: Northern California.

R. M. Touring, 1959, Dissert. Abs., v. 20, no. 4, p. 1325. Consists of about 2,300 feet of rhythmically interbedded siliceous mudstones and siltstones with a sandstone, siltstone, and mudstone facies locally developed. Overlies Tahana member (new); underlies San Gregorio member (new).

Area of report is in Santa Cruz Mountains, 30 to 40 miles south of San Francisco.

Ponca sandstone[1]

Upper Cretaceous: Northeastern Nebraska and northwestern Iowa.

Original reference: C. R. Keyes, 1912, Iowa Acad. Sci. Proc., v. 19, p. 148, 150.

Named for Ponca, Dixon County, Nebr.

**Ponce Limestone**

Ponce Chalky Limestones[1]

Oligocene, upper, and Miocene, lower: 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, 2 sheets. Ponce limestone, in this report, comprises entire sequence of limestones overlying Juana Díaz formation; as mapped, is divided into a lower buff chalky limestone member and an upper hard white limestone member. Maximum thickness about 1,300 meters—between river valleys south of Peñuelas and west and southwest of Ponce. Uncomformable below undifferentiated Quaternary deposits.

R. C. Mitchell-Thome, 1960, Caribbean 2d Geol. Conf. Trans., Mayagüez, Puerto Rico, p. 138. Includes Mercedita lentil (new) in lower part.

On south coastal plain, main outcrop of formation extends 55 kilometers, from hills 5 kilometers southeast of Juana Díaz to Ponce and westward from there to Bahia Montalva.

Poncho Rico Formation[1]

Miocene(?) and Pliocene: Southern California.

Original reference: R. D. Reed, 1925, Jour. Geology, v. 33, p. 591, 592, 605–607.

B. L. Clark, 1940, (abs.) Geol. Soc. America Bull., v. 51, no. 12, pt. 2, p. 1956–1957. Underlies King City formation (new).

J. E. Kilkenny, 1948, Am. Assoc. Petroleum Geologists Bull., v. 32, no. 12, p. 2260–2261. Described in Salinas Valley where it consists of sands, silts, shales, and conglomerates, and contains Pliocene megafossil assemblage. Both conformable and unconformable on underlying Santa Margarita sand on Central fault block where it is generally less than 500 feet thick. Reaches maximum thickness of 900 feet in Cholame Hills where unconformable with underlying McLure shale. Unconformably underlies Paso Robles formation. Term Poncho Rico preferred here to Etchegoin because type section of former is in Salinas Valley, and type section of latter is in San Joaquin Valley. King City formation is limited in extent and for convenience is included in uppermost part of Santa Margarita formation.

Probably named for exposures along or near Poncho Rico Creek, Monterey County. [Now spelled on topographic map as Pancho Rico.]

Pond Limestone[1]

Mississippian (Chester): Northeastern Mississippi.

Original reference: W. C. Morse, 1928, Jour. Geology, v. 36, p. 31–43.

Tishomingo County.

Pond 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. Proposed for coal member reported at depth of 125 feet in drill hole. Occurs above DeGraff coal member (new) and below Lake Creek coal member (new). Coal has been referred to informally as 2d Cutler Rider coal. Piasa limestone and DeGraff, Pond Creek, and Lake Creek coals may be included in the complex West Franklin limestone member 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 Creek that flows through northern part of township.

**Pondera Till**

Pleistocene: Central northern Montana.

J. F. Smith, Jr., I. J. Witkind, and D. E. Trimble, 1959, U.S. Geol. Survey Bull. 1071–I, p. 142, 153, pl. 10. Till is light brown but weathers chocolate brown to contrast markedly with light buff of underlying Lothair till (new) or the yellow of the intertill silt. Semiplastic and consists of clay that contains small amounts of unsorted pebbles, cobbles, and boulders of quartzite, limestone, dolomite, granite, and foliated metamorphic rocks. Rocks are rounded and average about half an inch in diameter. Thickness in most places about 30 feet; in a few exposures as much as 60 feet.

Named for exposures along north valley wall of Pondera Coulee in T. 29 N., Rs. 4 and 5 E., Liberty County. Best exposed on both sides of Marias River valley, in secs. 2, 10, and 11, T. 29 N., R. 5 E., and along north valley wall of Pondera Coulee in T. 29 N., Rs. 4 and 5 E.

Pond Hill 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: Concord, New Hampshire State Plan. Devel. Comm., p. 28, map.

M. P. Billings, 1937, Geol. Soc. America Bull., v. 48, no. 4, p. 510, pl. 12. Discussed under New Hampshire magma series. Medium-fine gray granite. On map legend, Pond Hill granite is above Sugar Hill quartz monzonite and below Moody Ledge granite. However, relative ages of units of series have not been determined with complete satisfaction for in few places are they in contact.

Mapped on Pond Hill in northern part of Moosilauke quadrangle.

**Pondville Conglomerate[1]**

Pennsylvanian: Southeastern Massachusetts and eastern Rhode Island.

Original reference: J. B. Woodworth, 1899, U.S. Geol. Survey Mon. 33, p. 134–141.

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]. Interfingers with Wamsutta formation in southern part of quadrangle; partly older than "red beds" of Wamsutta and partly equivalent to them. Pennsylvanian.

A. W. Quinn, 1952, Bedrock geology of the East Greenwich quadrangle, Rhode Island: U.S. Geol. Survey Geol. Quad. Map [GQ–17]. Basal beds are chiefly white to buff coarse conglomerate with pebbles and boulders mostly of quartzite. These are interbedded with layers of gray to dark-gray sandstone. Bedding variable; crossbedded in part. Thickness generally 100 to 160 feet in Natick area. Underlies Rhode Island formation with gradational contact. Not recognized south of Greenwich Bay, R. I., where unit as mapped by Emerson (1917) is assigned to the Rhode Island formation.

Basal beds well exposed near Pondville Station on Walpole and Wrentham Railroad, Norfolk County, Mass.

Ponia (Poniya) Limestone

Pleistocene: Mariana Islands (Rota).

Risaburo Tayama, 1939, Correlation of the strata of the South Sea Islands: Geol. Soc. Japan Jour., v. 46, no. 345, 346 (correlation table) [English translation in library of U.S. Geol. Survey, p. 2, correlation table.] Poniya limestone shown on correlation chart below Mariana limestone and above Hirippo limestone. Pliocene(?).

S. Hanzawa, 1956, *in* Jacques Avias and others, Lexique Strat. Internat., v. 6, Océanie, fasc. 2, p. 53. Limestone complex. Forms foundations of successive terraces; consists of Foraminifera, calcareous algae, and fragmental reef-building corals; commonly thinly stratified. Dips toward sea at angle of 20°. Present in altitude less than 200 meters while Mariana limestone is found even in highest terrace of island, 470 meters in height. Sometimes unconformably overlain by Mariana limestone. In this case, it may be contemporaneous with one of Mariana limestone of higher terraces. Also considered forereef detrital facies of Mariana.

Type locality: Ponia, south coast of Rota Island.

Pontchartrain Clay[1]

Pleistocene: Southeastern Louisiana and southwestern Mississippi.

Original reference: L. C. Johnson, 1891, Geol. Soc. America Bull., v. 2, p. 24–25.

In region north of Lake Pontchartrain, La.

Pontiac Limestone (in McLeansboro Formation)[1]

Pontiac Limestone (in McLeansboro Group)

Pennsylvanian: Central eastern Illinois.

Original reference: J. E. Lamar, 1929, Illinois Geol. Survey Rept. Inv. 17, passim.

M. E. Ostrom, 1957, Illinois Geol. Survey Circ. 243, p. 4 (fig. 2), 7. Rank raised to formation in McLeansboro group. Lies approximately 150 to 200 feet above Lonsdale limestone and 250 to 300 feet below Millersville, LaSalle, and Livingston limestones.

Crops out southeast, northeast, and northwest of Pontiac, Livingston County.

**Pontotoc Group**[1]

Pennsylvanian and Permian: Central southern Oklahoma.

Original reference: G. D. Morgan, 1922, Oklahoma Geol. Survey Circ. 11.

H. D. Miser and others, 1954, Geologic map of Oklahoma (1:500,000): U.S. Geol. Survey. Upper part of group mapped. Hart limestone member of Stratford formation of Pontotoc group at base in Pontotoc, Garvin, and Murray Counties. Permian.

W. F. Tanner, 1956, Oklahoma Geol. Survey Bull. 74, pl. 1. In Seminole County, comprises Vanoss formation below and Konawa formation above. Overlies Ada formation. Pennsylvanian (Virgil) and Permian.

Named for development in western part of Pontotoc County.

Pony Group, Metamorphics or Gneiss

Pony Series[1]

Precambrian (pre-Belt): Southwestern Montana.

Original reference: W. Tansley, P. A. Schafer, and L. H. Hart, 1933, Montana Bur. Mines and Geology Mem. 9, p. 8, map.

E. W. Heinrich, 1948, (abs.) Geol. Soc. America Bull., v. 59, no. 12, pt. 2, p. 1329. Cut by Blacktail granite gneiss (new).

A. M. Hanson, 1952, Montana Bur. Mines and Geology Mem. 33, p. 20. Locally underlies Flathead sandstone.

Robert Scholten, K. A. Keenmon, and W. O. Kupsch, 1955, Geol. Soc. America Bull., v. 66, no. 4, p. 350, pl. 1. Group mapped and described in Lima region, Montana. Intruded by Dillon granite gneiss (term replaces Blacktail granite gneiss, preoccupied). Stratigraphic relations between Pony group and Cherry Creek group not clear in this area.

R. R. Reid, 1957, Montana Bur. Mines and Geology Mem. 36, p. 3–4, 14, geol. map. Metamorphics mapped and described in Tobacco Root Mountains. Within map area, Pony metamorphics are separated from Cherry Creek metamorphics by seemingly continuous greenish quartzite layer with only small isoclinal folds present within it. Foliation in Cherry Creek metamorphics appears to be everywhere parallel to that in Pony in vicinity of contact. Discordance suggested by Tansley and Schafer (1933) not observed. Most significant structural fact is that Cherry Creek metamorphics dip beneath Pony metamorphics. Unless some kind of large scale structural overturning has occurrred, the Cherry Creek metamorphics in Tobacco Root Mountains are older than Pony metamorphics (in range in which their type locality has been defined). This is contrary to generally accepted opinion.

Named for exposures at and in vicinity of town of Pony, Madison County.

**Pony Creek Shale Member** (of Wood Siding Formation)

Pony Creek Shale (in Wabaunsee Group)[1]

Pennsylvanian (Virgil Series): Southeastern Nebraska, eastern Kansas, and northern Oklahoma.

Original reference: G. E. Condra, 1927, Nebraska Geol. Survey Bull. 1, 2d ser., p. 74, 81.

G. E. Condra and E. C. Reed, 1943, Nebraska Geol. Survey Bull. 14, p. 41. Pony Creek shale was named by Condra (1927) to include too much section; it was redefined to a thickness of about 6 feet, which, at places, does not represent a natural formation and probably not a good member. Rank reduced to member status in Wood Siding formation (new); Pony Creek as restricted by Moore is not a good formation in Nebraska. Overlies unnamed sandstone and shale units; underlies Brownville limestone.

G. E. Condra, 1949, Nebraska Geol. Survey Bull. 16, p. 13. New type locality selected.

R. C. Moore and M. R. Mudge, 1956, Am. Assoc. Petroleum Geologists Bull., v. 40, no. 9, p. 2273, 2274 (fig. 1). Included in Wood Siding formation (redefined). Underlies Brownville limestone member; overlies Grayhorse limestone member.

P. B. Greig, 1959, Okla. Geol. Survey Bull. 83, p. 65–67. Described in Pawnee County where it is 60 to 75 feet thick. Overlies Brownville limestone member; underlies "Grayhorse" limestone member. Further southward continuation of unit appears likely but its extent is not known.

Type locality (Selected by Nebraska Survey): On Towle Farm 2½ miles southwest of Falls City, Richardson County, Nebr. Named for exposures east of Pony Creek, between Kansas-Nebraska line and 2 miles south of Falls City.

**Pony Express Limestone Member** (of Wanakah Formation)

†Pony Express Beds (in Morrison Formation)[1]

Pony Express Limestone Member (of Morrison Formation)

Upper Jurassic: Southwestern Colorado, New Mexico, and Utah.

Original reference: J. D. Irving, 1905, U.S. Geol. Survey Bull. 260, p. 56.

M. I. Goldman and A. C. Spencer, 1941, Am. Assoc. Petroleum Geologists Bull., v. 25, no. 9, p. 1748 (fig. 2), 1750, 1752, (fig. 3), 1853 (table). Referred to as limestone member of Morrison. Underlies Bilk Creek sandstone member (new) ; overlies Entrada sandstone. [See La Plata sandstone.]

E. B. Eckel, 1949, U.S. Geol. Survey Prof. Paper 219, p. 27 (table), 28, 29. Described in La Plata district, Colorado, where it is reallocated to member status in Wanakah formation (redefined). In places, consists of single massive bed, and, in others, comprises three or more beds, each about a foot thick. In latter areas, upper beds are commonly massive and lower ones thinly laminated; most limestone bituminous. Thickness 6 inches to 30 feet; average 3 feet; variations in thickness probably due to irregularities in surface of Entrada upon which limestone was deposited. Underlies Bilk Creek sandstone member.

Named for occurrence in Pony Express mine, Ouray district, Colorado.

Pony Spring Siltstone Member (of Maroon Formation)[1]

Pony Spring Siltstone Member (of Minturn Formation)

Pennsylvanian or Permian: Central Colorado.

Original reference: D. B. Gould, 1935, Am. Assoc. Petroleum Geologists Bull., v. 19, no. 7, p. 971–1009.

C. A. Arnold, 1941, Michigan Univ. Mus. Paleontology Contr., v. 6, no. 4, p. 59–70. Mentioned in discussion of some Paleozoic plants from central Colorado and their stratigraphic significance. Bath submember of Pony Spring has yielded *Walchia sp. Walchia* has been found in Pennsylvanian strata as well as in Permian and is, therefore, not a strict time marker, but rather a reflection of environment.

J. T. Stark and others, 1949, Geol. Soc. America Mem. 33, p. 43–44, 152–153, pls. 1, 8. Described in South Park area where, near Salt Creek, it is about 6,000 feet thick; conformably overlies Chubb siltstone member. At type locality, upper limit is Tertiary erosion surface formed before extrusion of Buffalo Peak flows; upper contact now concealed by lavas and talus. [Text states locality from which unit was named and refers to appendix for type section; however, sections in appendix are headed representative sections, but none agree exactly with locality from which unit was named. Most detailed section is on p. 152–153.].

K. G. Brill, Jr., 1952, Geol. Soc. America Bull., v. 63, no. 8, p. 820, 836–837. Pony Spring siltstone considered member of Minturn formation in this report [Permo-Pennsylvanian zeugogeosyncline, Colorado and New Mexico]. Overlies Chubb member and consists of 4,000 to 6,000 feet of greenish-gray and red siltstone and sandstone and was deposited in piedmont cyclothems. Contact of Minturn and Maroon formations lies in lower Pony Spring member at top of limy zone a few hundred feet above top of Bath sandstone (Gould, 1935) ; zone consists of gray shale and thin beds of limestone on Salt Creek and can be traced southward to Muleshoe Gulch where limestone is thinner. Zone lies about 2,700 feet above the gypsum [in Chubb member ] and about 4,300 feet above base of Pennsylvanian. Chubb siltstone assumed to be Desmoinesian because of position in section; on basis of correlations, basal Pony Creek is probably Desmoinesian.

Named for Pony Spring at west side of Pony Park, near NW cor. sec. 28, T. 12 S., R. 77 W., Park and Chaffee Counties. Representative section

(Stark and others, p. 152–153) is in secs. 20, 29, 32, and 33, T. 12 S., and sec. 16, T. 13 S., R. 77 W., [Park-Chaffee Counties].

Pooleville Member (of Bromide Formation)

Ordovician: Southern Oklahoma.

G. A. Cooper, 1956, Smithsonian Misc. Colln., v. 127, pt. 1, p. 120, 121. Name proposed for upper limy beds of formation. At type section, mostly a light-gray to nearly white limestone, thin-bedded except for top 15 feet which is massive. Thickness at type section about 250 feet. Overlies Mountain Lake member (new); unconformably underlies Viola formation.

R. W. Harris, 1957, Oklahoma Geol. Survey Bull. 75, p. 95, fig. 1. Pooleville apparently includes Ulrich's Criner and Webster (name preempted) formations. Corbin Ranch (new) of this report is the topmost lithographic limestone and calcareous shale section of Cooper's Pooleville.

Type section: On Spring Creek about on the line between secs. 8 and 17, T. 2 S., R. 1 W., Murray County. Name taken from Pooleville on west side of Arbuckle Mountains.

Pools Brook Limestone[1] (in Manlius Group)

Pools Brook Limestone Member (of Manlius Limestone)

Silurian(?): Central New York.

Original reference: Burnett Smith, 1929, New York State Mus. Bull. 281, p. 27, 31.

G. H. Davis 3d, 1953, New York State Mus. Circ. 35, p. 8, 10. Described as a member of Manlius limestone.

Named for exposure along southern rim of Pools Brook Valley, eastern Onondaga County.

Poorman Formation[1]

Precambrian: Southwestern South Dakota.

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

J. A. Noble and J. O. Harder, 1948, Geol. Soc. America Bull., v. 59, no. 9, p. 944 (fig. 1), 945–946. Thickness possibly 2,000 feet or more; base not exposed. Underlies Homestake formation. Includes unit formerly termed De Smet formation.

Named for exposed section at junction of Poorman and Deadwood Gulches, along railroad track, Lead district, Lawrence County.

Poor Mountain Limestone Series,[1] or zone[1]

Cambrian(?): Northwestern South Carolina.

Original references: E. Sloan, 1905, South Carolina Geol. Survey geognostic map of South Carolina; published in 1908, in South Carolina Geol. Survey, ser. 4, Bull. 2; 1907, Summary of mineral resources of South Carolina, p. 6, 10.

Exposed from a high point on Poor Mountain to a low point on a dale of Rich Mountain. Named for exposures along Poor Mountain, Oconee County.

**Poor Valley Ridge 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.

143–148, 188; R. L. Miller and W. P. Brosgé, 1954, U.S. Geol. Survey Bull. 990, p. 76–79, 122, 125–126, pl. 1. Fine- to medium-grained buff to greenish-white sandstone in beds a few inches to two feet thick, with partings and interbeds of green shale. Sandstone most massive in lower part; shale most abundant in upper part. Thickness 183 feet. Overlies Hagan member (new) ; underlies Clinton shale.

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 Valley Ridge near Hagan, Lee County, Va.

**Pope Chapel Sandstone Member** (of Atoka Formation)[1]

Pennsylvanian (Atoka Series) : 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. 28–29. Hard calcareous greenish-gray to buff sandstone. Thickness 10 to 20 feet. Overlies unnamed shale above Coody sandstone member; underlies unnamed shale below Georges Fork sandstone member.

Named for exposure at Pope Chapel, sec. 24, T. 12 N., R. 19 E., Muskogee County.

Pope Creek Coal Member (of Abbott Formation)

Pennsylvanian: Western Illinois.

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 31, 45 (table 1), pl. 1. Assigned to member status in Abbott formation (new). Occurs above Tarter coal member and below Bernadotte sandstone member. Name Pope Creek sandstone discontinued. Coal named by Wanless (1931, Illinois Geol. Survey Bull. 60). Presentation of new rock-stratigraphic classification of Pennsylvanian strata in Illinois. Cyclical classification retained but is independent of rock-stratigraphic classification.

Type locality: Center sec. 33, T. 14 N., R. 2 W., Mercer County.

Pope Creek cyclothem (in Abbott Formation)

Pope Creek cyclothem (in Tradewater Group)[1]

Pennsylvanian: Western, northern, and central Illinois.

Original reference: H. R. Wanless, 1931, Illinois Geol. Survey Bull. 60, p. 189, 192.

H. R. Wanless and Raymond Siever, 1956, Illinois Geol. Survey Circ. 217, pl. 1. Shown on correlation chart below Seville cyclothem and above Tarter cyclothem (new).

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

Named from exposures on south side of Pope Creek near center sec. 33, T. 14 N., R. 2 W., Alexis quadrangle, Mercer County.

Pope Creek Sandstone

Pennsylvanian: Western, northern, and central Illinois.

H. R. Wanless, 1957, Illinois Geol. Survey Bull. 82, p. 50 (fig. 22), 63–64, 67–70, 192, 201, 204, 205. Pope Creek sandstone is commonly light gray, fine grained, very slightly micaceous, not very massive, and not well laminated. Thickness a few inches to 5 feet; average about 1 foot. Thickness of cyclothem as much as 17 feet. Bernadotte sandstone, in basal part of Seville cyclothem, truncates Pope Creek shale at several localities, and locally cuts out entire Pope Creek cyclothem.

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 31. Name Pope Creek sandstone discontinued so that term Pope Creek may be retained for coal member.

Cyclothem named from exposures on south side of Pope Creek near center sec. 33, T. 14 N., R. 2 W., Alexis quadrangle, Mercer County.

†Pope Hollow Conglomerate[1]

Pope Hollow Conglomerate Member (of Venango Formation)

Upper Devonian: Southwestern New York and northwestern Pennsylvania.

Original reference: J. F. Carll, 1883, Pennsylvania 2d Geol. Survey Rept. $I_4$, p. 180–181.

Bradford Willard, 1939, Pennsylvania Geol. Survey, 4th ser., Bull. G–19, p. 14, 243, 253. Prominent conglomerate band in middle part of Venango formation. Underlies Saegerstown shale member; overlies North Warren shale member. Upper Devonian.

Probably named for occurrence at Pope Hollow, Chautauqua County, N.Y.

Pope Springs Sandstone

[Upper Paleozoic]: Southeastern Wyoming.

C. M. Boos, 1941, (abs.) Colorado-Wyoming Acad. Sci. Jour., v. 3, no. 1, p. 25–26. Sand stratum close to the Satanka-Casper contact. Referred to also as Pope Spring sandstone.

In foothills of Laramie Mountains, a few miles east and south of town of Laramie, Laramie County, where there are a number of large springs.

**Poplar Mountain Gneiss**

Middle Paleozoic: North-central Massachusetts.

M. E. Willard, 1951, Bedrock geology of the Mount Toby quadrangle, Massachusetts: U.S. Geol. Survey Geol. Quad. Map [GQ–8]. Described in Mount Toby quadrangle. Underlies Erving hornblende schist with gradational contact. Probably an eastern partially granitized facies of Amherst schist. Name credited to Robert Balk. Pre-Triassic.

Robert Balk, 1956, U.S. Geol. Survey Geol. Quad. Map GQ–93. Described in type area as dark-gray well-foliated micaceous gneiss consisting of thin parallel black layers of biotite intercalated with fine-grained gray layers containing quartz and biotite in equal amounts. Lenses and beds of brittle light-gray well-stratified quartzite widespread; some actinolitic. Thickness of quartzite layers varies from less than 1 inch to 400 feet. Thin layers of typically dark-green to nearly black amphibolite common. Intermixed with Dry Hill granite gneiss. Represents sedimentary facies of the domelike gneissic complex termed Pelham granite by Emerson (1917, U.S. Geol. Survey Bull. 597). Middle Paleozoic.

Named for excellent exposures on Poplar Mountain 1 mile northeast of Millers Falls, Millers Falls quadrangle.

**Popo Agie Member** (of Chugwater Formation)

Popo Agie Beds[1]

Popo Agie Formation (in Chugwater Group)

Upper Triassic: Western Wyoming.

Original reference: W. C. Knight, 1901, Eng. and Min. Jour., v. 72, p. 359.

J. D. Love, 1939, Geol. Soc. America Spec. Paper 20, p. 43, 45. Allocated to member status in Chugwater formation. Underlies Gypsum Spring member; overlies Crow Mountain member (new). Thickness 297 feet. Area of report is southern margin of Absaroka Range.

E. B. Branson and C. C. Branson, 1941, Am. Assoc. Petroleum Geologists Bull., v. 25, no. 1, p. 135–136. Rank raised to formation in Chugwater group. In Wind River Mountains, overlies Crow Mountain formation; underlies Wyopo formation (new). Thickness as much as 125 feet.

J. D. Love and others, 1945, U.S. Geol. Survey Oil and Gas Inv. Prelim. Chart 17. Popo Agie, as used in this report [central Wyoming], is youngest member of Chugwater and is characterized by 100 to 200 feet of ocher-colored oolitic, siliceous, dolomitic claystones, limestone pellet conglomerates, purple and red shales, and red silty sandstones. Overlies Alcova limestone member. No consistent base for member has been found, either on surface or in subsurface. Underlies Nugget sandstone. Name Popo Agie used in this area in preference to Jelm.

Named from exposures on Popo Agie River, near Lander.

**Popotosa Formation**

Miocene, upper: Central New Mexico.

C. S. Denney, 1940, Jour. Geology, v. 48, no. 1, p. 77–84. Consists of debris eroded from volcanic rocks, plus small amount of tuff which was contributed by relatively small contemporaneous eruptions. Highly faulted. Estimated minimum thickness 3,000 feet; possible maximum 5,000 feet. Unconformably overlies volcanic rocks of Miocene(?) age to east of Silver Creek; underlies Santa Fe formation.

Well exposed in Silver Creek valley, T. 1 N., R. 2 W., San Acacia area, Socorro County. Named for Arroyo Popotosa.

Porcupine Beds[1]

Tertiary: Southwestern Alaska.

Original reference: J. E. Spurr, 1898, U.S. Geol. Survey 18th Ann. Rept., pt. 3, p. 197, 253.

Exposed on Porcupine River, between mouth of Driftwood River and head of the Ramparts, Yukon gold district.

Porcupine Group[1]

Ordovician and Silurian: Eastern Alaska, and northwestern Yukon, Canada.

Original reference: D. D. Cairnes, 1912, Canada Geol. Survey Summ. Rept. 1911, p. 26–32.

Yukon-Alaska boundary between Porcupine and Yukon Rivers.

Porcupine Ranch Substage

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. Substage of Bull Lake stage. Occupies Iowan-Tazewell interval between Iowan subage and Tazewell sub-age.

Twin Lakes area.

**Porphyry Peak Rhyolite**[1]

Tertiary: Central southern Colorado.

Original reference: W. S. Burbank, 1932, U.S. Geol. Survey Prof. Paper 169.

J. W. Gabelman, 1953, Econ. Geology, v. 48, no. 3, p. 195, 196. In Greater Bonanza district, 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 the Bonanza latite is replaced by Hayden Peak latite.

Exposed on slopes of Porphyry Peak, Bonanza district, Saguache County.

Porphyry Peaks Conglomerate

Pleistocene (?) : North-central Colorado.

R. L. Ives, 1938, Geol. Soc. America Bull., v. 49, no. 7, p. 1049–1050. Poorly consolidated conglomeratic material. In two layers, separated in places by crossbedded sand. Most of the larger boulders are gray porphyry derived from the erosion of a steep-walled canyon through a porphyry dike near Pony Park. Top of conglomerate veneered with injection gneiss fragments which probably were washed from nearby moraines. Fills valley of Stillwater Creek to maximum depth of about 100 feet.

In valley of Stillwater Creek from Sleepy Hollow School to Pony Park in Monarch Valley, Grand County. In places nearly 1 mile wide.

Porphyry Peaks Rhyolite[1]

Tertiary : Central northern Colorado.

Original reference: L. E. Spock, Jr., 1928, New York Acad. Sci. Annals, v. 30.

Caps Porphyry Peaks and occurs on mountain tops on either side of Stillwater Creek farther south, in northeastern part of Grand County.

†Portage Group,[1] Formation,[1] or Shale[1]

Upper Devonian: New York, Maryland, Pennsylvania, and western Virginia.

Original references: J. Hall, 1840, New York Geol. Survey 4th Rept., p. 391–392, 452–455; L. Vanuxem, 1842, Geology of New York, pt. 3, p. 171, 172; J. Hall, 1843, Geology of New York, 4th dist., p. 224–249.

H. S. Williams, R. S. Tarr, and E. M. Kindle, 1909, U.S. Geol. Survey Geol. Atlas, Folio 169. Following the Genesee, and conformable with it, are beds of Portage formation. In this are included those beds which have been generally referred to by term Portage, or Portage group. Portage group was originally defined by Hall (1840) and applied to sandstones lying above Gardeau flagstone of Genesee Valley and distinct from the Gardeau, Ithaca, and Cashaqua groups which were named in same report. In this folio [Watkins Glen-Catatonk], rocks between the Genesee and Chemung are called Portage formation. Portage formation, which in typical region of Genesee Valley is composed of the Cashaqua, Gardeau, and "Portage" members, consists in Watkins Glen quadrangle of (ascending) Sherburne, Ithaca, and Enfield members.

Bradford Willard and A. B. Cleaves, 1938, Pennsylvania Geol. Survey, 4th ser., Bull. G–8, p. 13–16. Upper Devonian begins with lowest beds of Portage group which in Juniata Valley are represented by remnant of Tully. This rests disconformably upon highest Hamilton, the Moscow shale, with its *Vitulina* zone. Top of Portage group lies approximately at base of Catskill red beds, of early Chemung age. Divisions of Portage recognized in Pennsylvania are (ascending) Rush formation (with Tully shale and limestone and Burket black shale) and Fort Littleton formation (with Harrell gray shale, Brallier sandstone and shale, Losh Run shale, Trimmers Rock sandstone, and Parkhead sandstone). Changes among members of group occur from Allegheny Front into eastern Pennsylvania. In the west, members are all shale except Tully and group is dominated by Brallier shale. From Susquehanna Valley east, dominant element of group is Trimmers Rock sandstone which has largely displaced Brallier shale. Tully is little known east of Susquehanna and is presumably displaced by Burket black shale.

G. A. Cooper and others, 1942, Geol. Soc. America Bull., v. 53, no. 12, pt. 1, chart 4. On Devonian correlation chart term "Portage" formation is used in column for east-central West Virginia. Portage shale is used in column for Genesee Valley, Portage is shown above the Letchworth and below the Wiscoy.

H. P. Woodward, 1943, West Virginia Geol. Survey, v. 15, p. 385. Term Brallier shale replaces "Portage" shale as formerly used in West Virginia.

R. G. Sutton, 1951, Rochester Acad. Sci. Proc., v. 9, nos. 5–6, p. 392–396. Four formations, Grimes sandstone, Gardeau flags and shales, Nunda sandstone, and Wiscoy shale, overlie Naples group in Batavia quadrangle. No group name is applied to them, although they belong to Chemung stage. They had previously been included in Portage group but Chadwick (1933, Pan-Am. Geologist, v. 60) returned name Portage to formational status.

Wallace de Witt, Jr., and G. W. Colton, 1959, Am. Assoc. Petroleum Geologists Bull., v. 43, no. 12, p. 2821, 2826. Report presents revised correlations of lower Upper Devonian rocks in western and central New York. Sherburne flagstone member is excluded from Portage formation of Williams (1906, Science, new ser., v. 24) and Williams and others (1909) and assigned to Genesee formation. Ithaca shale member of Portage is redefined as Ithaca member of Genesee. In area south of Cayuga Lake, the Sonyea formation occupies the upper four-fifths of rock sequence that was designated Enfield shale member of Portage by Williams and others (1909).

Carlyle Gray and others, 1960, Geologic map of Pennsylvania (1:250,000): Pennsylvania Geol. Survey, 4th ser. Unit mapped as marine beds (Dm) consists of gray to olive-brown shales, graywackes, and sandstones; contains "Chemung" beds and "Portage" beds including Burket, Brallier, Harrell, and Trimmers Rock; Tully limestone at base.

In 1843, Hall redefined "Portage or Nunda" Group to include older rocks, specifically Sherburne Flagstones, Cashaqua Shale, the Gardeau and Portage Groups of the annual reports. As redefined, Hall's Portage comprises all of the West Falls Formation, all of the Sonyea Formation, and upper two-thirds of Genesee Formation of de Witt and Colton (1959).

Named for exposures along banks of Genesee River in district formerly included in town of Nunda now Portage, Livingston County, N.Y.

†Portage Sandstone[1]

Upper Devonian: New York.

Original reference: J. Hall, 1843, Geology New York, div. 4, 4th dist., p. 226, 228–229, 248.

Well exposed in deep gorge below Portageville, Wyoming County.

**Portage Lake Lava Series**

Precambrian (Keweenawan): Northern Michigan.

W. S. White, 1952, Jour. Sed. Petrology, v. 22, no. 4, p. 190. First appearance of name. Credited to White, Cornwall, and Swanson, 1952 [1953].

W. S. White, H. R. Cornwall, and R. W. Swanson, 1953, U.S. Geol. Survey Geol. Quad. Map GQ–27. Name proposed to include the Eagle River, Ashbed, Central Mine, and Bohemian Range groups of old reports; these older subdivisions are quite arbitrary and depend on the continuity of individual flows or conglomerate beds for validity and are not useful for purpose of this report. A thick sequence of basalt and andesite flows with a few thin interbedded rhyolite conglomerates. Some flows are uniformly fine grained, but most increase in grain size from both the top and the bottom toward the center. Capping the massive lava that forms the bulk of each flow is a layer of amygdaloidal lava 1 to 75 feet thick (5 to 10 feet thick on most flows). Conglomerate and sandstone beds within the lava series composed primarily of rhyolitic material. The bulk of the clastic particles range in diameter from a small fraction of an inch to about 6 inches; pebbles and cobbles are generally well rounded. Most conglomerate beds or their equivalent horizons can be recognized for tens of miles northeast and southwest of this quadrangle. Tops of conglomerate beds, therefore, form excellent reference horizons for stratigraphic subdivisions of the series, and most of these beds, in consequence, have acquired names in local usage. Designated in ascending order these names are St. Louis conglomerate, the Old Colony and Wolverine sandstones, and the Kingston, Calumet and Hecla, Houghton, Allouez, Pewabic West, and Hancock conglomerates. Because of their exceptional thickness or economic interest, a few of the more persistent lava flows have acquired names in local usage, but most of the flows are nameless. Seven of the flows shown here are designated: the Greenstone, Kearsarge, Scales Creek (new), and Copper City (new) are noteworthy for their thickness; and the Ashbed, Iroquois (new), and Osceola flows, together with the Kearsarge, are of economic interest. Series represents oldest rocks in Ahmeek quadrangle; conformably underlies Copper Harbor conglomerate. Locally intruded by small body of rhyolite.

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]. Total thickness of 17,000 feet in Bruneau Creek quadrangle, including about 350 separate lava flows and approximately 20 thin beds of sedimentary rocks. Includes Bohemia conglomerate and Gratiot flow.

Other named units that have been assigned to the series are: the Ashbed, Calumet, Kearsarge, Medora, and Osceola amygdaloids and Lac la Belle conglomerate.

Named from Portage Lake, 10 miles southwest of the Ahmeek quadrangle, which was the site of one of Marvine's classic stratigraphic sections of the unit (Pumpelly, 1873, p. 47–89).

Portal Formation

Upper Devonian: Southeastern Arizona.

F. S. Sabins, Jr., 1957, Am. Assoc. Petroleum Geologists Bull., v. 47, no. 3, p. 475–480. Consists of four members (ascending): alternating very thin beds of calcareous olive-colored shale and shaly aphanitic dark olive-gray limestone—93 feet thick at type section; hard fissile siliceous black shale—37 feet; alternating very thin beds of shale and limestone—153 feet; and alternating thick and very thick beds of bioclastic limestone—

59 feet. Total thickness ranges from 200 to 342 feet; 342 feet at type section. Overlies El Paso formation with disconformable contact; underlies Escabrosa limestone.

Type section: About 2½ miles northwest of village of Portal, from which name is derived. Exposed in SW¼ sec. 14, T. 17 S., R. 31 E., where formation forms ridge between Round Valley on north and Silver Creek on south.

Port Austin Sandstone[1]

Mississippian: Michigan.

Original reference: A. C. Lane, 1899, U.S. Geol. Survey Water-Supply Paper 30, p. 85.

Named for exposures at Port Austin, Huron County.

Port Byron Formation (in Coe Group)

Port Byron Limestone[1] or Dolomite

Port Byron Stage

Middle Silurian: Northwestern Illinois.

Original reference: T. E. Savage, 1926, Geol. Soc. America Bull., v. 37, p. 525–526, 531–533.

J. N. Payne, 1942, Illinois Geol. Survey Bull. 66, p. 191 (table 8). Shown on table of general classification of geologic time as Port Byron stage of Niagaran epoch.

C. K. Swartz and others, 1942, Geol. Soc. America Bull., v. 53, no. 4, chart 3. Shown on correlation chart as Port Byron dolomite; overlies Cordova dolomite (new). Niagaran and questionably Cayugan.

H. A. Lowenstam, 1949, Illinois Geol. Survey Rept. Inv. 145, p. 18. Uppermost formation in Coe group (new).

Exposed in quarry at Port Byron, Rock Island County.

**Port Clarence Limestone**[1] (in Nome Group)

Lower and Upper Ordovician, Silurian, and Devonian: Northwestern Alaska.

Original reference: A. J. Collier, 1902, U.S. Geol. Survey Prof. Paper 2, p. 18, map.

R. M. Moxham and W. S. West, 1953, U.S. Geol. Survey Circ. 265, p. 2, 3. Probably mostly Silurian in age in Serpentine-Kougarok area.

Type locality: York Mountains, north of Port Clarence, Seward Peninsula.

**Port Deposit Gneiss**[1] or **Granite**

Lower Paleozoic(?) (Post-Glenarm): Northeastern Maryland, Delaware, and southeastern Pennsylvania.

Original reference: G. P. Grimsley, 1894, Cincinnati Soc. Nat. History Jour., v. 17, p. 112.

Ernst Cloos and H. G. Hershey, 1936, Acad. Nat. Sci., Philadelphia, Proc., v. 22, no. 1, p. 71–80. Port Deposit granite and Baltimore gabbro are intrusive into Glenarm series. Port Deposit granite and its associates, and Baltimore gabbro are not Precambrian, but Paleozoic (post-Conestoga).

Ernst Cloos, 1937, Maryland Geol. Survey [Rept.], v. 13, p. 33 (table 1). Included in Port Deposit granodiorite complex. Post-Lower Ordovician.

Norman Herz, 1951, Geol. Soc. America Bull., v. 62, no. 9, p. 980. Cuts Baltimore gabbro complex.

Port Deposit Granite or Gneiss cuts the Glenarm Series. U.S. Geological Survey currently designates age of the Glenarm Series as Lower Paleozoic(?).

Named for occurrences at Port Deposit, Cecil County, Md.

Port Deposit Granodiorite Complex

Post-Lower Ordovician: Northeastern Maryland, Delaware, and southeastern Pennsylvania.

Ernst Cloos, 1937, Maryland Geol. Survey [Rept.], v. 13, pt. 1, p. 13 (table 1). Includes, in addition to Port Deposit granodiorite, hornblende granodiorite, hornblende granodiorite with quartz diorite, pegmatite and aplite dikes, granite porphyry, and hornblende lamprophyre dikes. Post-Lower Ordovician.

H. G. Hershey, 1937, Maryland Geol. Survey [Rept.], v. 13, pt. 2, p. 109–148. Port Deposit granodiorite is part of Appalachian Piedmont complex in northeastern Maryland and northwestern Delaware. The Piedmont in these States, as elsewhere, is composed of metamorphosed sedimentary formations and intrusive igneous materials. In Maryland and Pennsylvania, metamorphism in this belt increases from northwest to southeast. Most of the igneous rocks are found in southeastern part, and of these the Port Deposit granodiorite complex is the largest. It is composed of three large and several small rock bodies, separated by schists, and extends over area about 30 miles long and 9 miles wide. Gabbro makes up parts of the north, west, and south boundaries of the complex. Rest of north boundary is composed of schists, probably of Glenarm series, and serpentine. A belt of metamorphic sedimentary rocks occurs north of the gabbro and south of the Paleozoic rocks. It is interrupted by a narrow, northeast-striking syncline of slate and conglomerates just north of Peach Bottom. Rest of south boundary is marked by overlap of unconsolidated Coastal Plain sediments and "Baltimore gneiss".

Porter Shale[1] or Formation

Oligocene, middle: Western Washington.

Original reference: C. E. Weaver, 1912, Washington Geol. Survey Bull. 15, p. 10–22.

C. E. Weaver, 1937, Washington [State] Pubs. in Geology, v. 4, p. 110. Suggests abandoning name and retaining Lincoln formation for the middle Oligocene of Washington.

Exposed in cliffs on east and west sides of town of Porter along north side of Chehalis River near junction with Porter Creek [Thurston County].

Porterfield 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. Sequence of formations in type area of Porterfield is (ascending) Arline (new), Effna, Rich Valley (new), and Chatham Hill (new). Name credited to G. A. Cooper and B. N. Cooper.

Marshall Kay, 1958, Am. Jour. Sci., v. 256, no. 2, p. 94, 95. Constitutes lower part of type Bolarian series and therefore lower part of stage is equivalent to upper Chazyan.

Named from Porterfield quarry 5 miles east of Saltville, Maccrady quadrangle, Virginia, and its environs where it is well represented.

**Porters Creek Clay**[1] or **Formation** (in Midway Group)

Paleocene: Western Tennessee, southwestern Alabama, southwestern Illinois, western Kentucky, eastern Mississippi, and southeastern Missouri.

Original reference: J. M. Safford, 1864, Am. Jour. Sci., 2d, v. 37, p. 361, 368.

F. S. MacNeil, 1946, U.S. Geol. Survey Mineral Inv. Prelim. Rept. 3–195, p. 10–12. In addition to typical clay facies, the Porters Creek includes Tippah sand lentil in lower part, in northern part of Tippah County, Miss., and Matthews Landing marl member at top, from Winston County, Miss., to Butler County, Ala. At outcrop in northern Mississippi, the Porters Creek is about 200 feet thick but thickens southward in subsurface to about 600 feet. Typical clay facies extends from southern Illinois and southeastern Missouri to Tombigbee River in western Alabama. Underlies Naheola formation; overlies Chalybeate member (new) of Clayton formation. Midway group. Paleocene. Name Sucarnooche clay, formerly used for entire Porters Creek in Alabama as well as for the calcareous clay east of Tombigbee River, has been abandoned.

L. D. Toulmin, P. E. LaMoreaux, and C. R. Lanphere, 1951, Alabama Geol. Survey Spec. Rept. 21, p. 36–41. Described in Choctaw County, Ala., where it is about 350 feet thick and represents lowermost deposits of Midway group exposed in county. Includes Chalybeate limestone member (at base) and Matthews Landing marl member at top. Underlies Naheola formation.

T. W. Lusk, 1956, Mississippi Geol. Survey Bull. 80, p. 11–15. Described in Benton County where it is oldest outcropping formation. Only upper 70 to 80 feet exposed. Underlies Betheden formation.

R. J. Hughes, Jr., 1958, Mississippi Geol. Survey Bull. 84, p. 94–117. Described in Kemper County where it is about 500 feet thick. Consists of the typical clay facies, somewhat sandy and laminated at top. Includes Matthews Landing marl member at top. Conformably overlies Clayton formation (Chalybeate member at top); unconformably underlies Naheola formation. Midway group.

Named for exposures on Porters Creek, Hardeman County, Tenn., about 1½ miles west of railroad station at Middleton.

Portersville Limestone or fossiliferous horizon (in Conemaugh Formation)[1]

Portersville shale and limestone member

Pennsylvanian: Southeastern Ohio.

Original reference: D. D. Condit, 1912, Ohio Geol. Survey, 4th ser., Bull. 17, p. 20, 41.

N. K. Flint, 1951, Ohio Geol. Survey, 4th ser., Bull. 48, p. 68, table 1. Portersville shale and limestone member listed as member of Anderson cyclothem in report on Perry County. Greater part of member is shale, but embedded fossiliferous limestone nodules are very conspicuous. Thickness 3 to 8 feet. Conemaugh series.

M. T. Sturgeon and others, 1957, Ohio Geol. Survey Bull. 58, p. 95 (table 11), 122–123. Shale and limestone member of Anderson cyclothem in report on Athens County. Average thickness 2⅓ feet. Occurs above Anderson coal and Cow Run sandstone member of Upper Bakerstown cyclothem. Conemaugh series.

Named for village in eastern part of Perry County.

**Port Ewen Limestone** (in Helderberg Group)

Port Ewen Limestone (in Oriskany Group)[1]

Lower Devonian: Eastern New York, New Jersey, Pennsylvania, Virginia, and West Virginia.

Original reference: J. M. Clarke, 1903, New York State Mus. Handb. 19, p. 21.

F. M. Swartz, 1939, Pennsylvania Geol. Survey, 4th ser., Bull. G–19, p. 50, 62–65, tables 13, 14. Becraft and Port Ewen shale occur as units to which these names can be applied only in eastern part of Monroe County. Table 13 shows Port Ewen shale in Nearpass quarries, New Jersey. Overlies Becraft limestone. Helderberg group.

C. K. Swartz and F. M. Swartz, 1941, Geol. Soc. America Bull., v. 52, no. 8, p. 1162, 1168, 1181. Thickness at Delaware Water Gap 136 feet; underlies Oriskany shale; overlies Becraft(?) limestone. Thickness 174 feet on Bushkill Road; overlies Becraft limestone; underlies Oriskany shale.

H. P. Woodward, 1943, West Virginia Geol. Survey, v. 15, p. 97–110. Thickness in West Virginia 30 to 105 feet. Underlies Port Jervis limestone; overlies New Scotland limestone. Believed to comprise main part of "Shriver chert" of previous reports.

Winifred Goldring, 1943, New York State Mus. Bull. 332, p. 190–195. Port Ewen beds consist of series of shaly limestones, above Alsen limestone and below Oriskany sandstone. Maximum thickness 6 to 8 feet in Coxsackie quadrangle [this report]. Maximum thickness in New York about 200 feet (Port Jervis area).

Carlyle Gray, 1960, Geologic map of Pennsylvania (1:250,000): Pennsylvania Geol. Survey, 4th ser. As mapped, Helderberg formation consists of dark-gray calcareous thin-bedded shale (Mandata) at top, equivalent to Port Ewen shale and Becraft limestone in the east; dark-gray cherty thin-bedded fossiliferous limestone (New Scotland) with some local sandstones in the middle; and, at base, dark-gray medium- to thick-bedded crystalline limestone (Coeymans), sandy and shaly in places with some chert nodules.

W. B. Brent, 1960, Virginia Div. Mineral Resources Bull. 76, p. 50. Thickness about 95 feet in Rockingham County. Overlies New Scotland limestone; underlies Port Jervis limestone.

Named for exposures in vicinity of Port Ewen, Ulster County, N.Y.

**Port Hudson Formation**[1]

Pleistocene: Southeastern Louisiana, southern Mississippi, and eastern Texas.

Original references: E. W. Hilgard, 1869, Am. Jour. Sci., 2d, v. 47, p. 77–88; v. 48, p. 332; Preliminary Report of a Geological Reconnaissance of Louisiana, 1869.

C. W. Cooke, Julia Gardner, and W. P. Woodring, 1943, Geol. Soc. America Bull., v. 54, no. 11, p. 1714, chart 12. Shown on correlation chart as underlying Hammond terrace deposits and overlying Prairie member (Fisk, 1938).

Named for prominent development at Port Hudson, East Baton Rouge Parish, La.

Port Jervis Limestone (in Oriskany Group)[1]

Port Jervis Limestone and Chert (in Helderberg Group)

Lower Devonian: Southeastern New York, Maryland, Pennsylvania, Virginia, and West Virginia.

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

H. P. Woodward, 1943, West Virginia Geol. Survey, v. 15, p. 110–127, measured sections. Referred to as Port Jervis limestone and chert in Helderberg group. Geographically extended into West Virginia. At type locality, limestone is about 30 feet thick and consists of blue-gray partly siliceous or finely arenaceous limestone with specimens of *Dalmanites*, *Rensselaracria*, and *Homalonotus*. In central eastern Pennsylvania, formation disappears in an erosional unconformity between Oriskany sandstone and early members of Helderberg group. It is believed to reappear in Franklin County, southern Pennsylvania, and continues southward across Maryland, into West Virginia. In this belt, it occupies more of the Licking Creek limestone of Swartz (1938). Formation thins and is absent in Massanutten syncline of northern Virginia. Overlies Port Ewen limestone; underlies Ridgeley sandstone. Equivalent to part of Shriver chert or "Becraft limestone" of previous reports. Thickness as much as 90 feet.

W. B. Brent, 1960, Virginia Div. Mineral Resources Bull. 76, p. 49, 50. Thickness about 10 feet in Rockingham County. Overlies Port Ewen limestone. Helderberg group.

Named for Port Jervis, Orange County, N.Y.

**Portland Arkose** (in Newark Group)

Portland Formation

Upper Triassic: Central Connecticut.

P. D. Krynine, 1941, (abs.) Geol. Soc. America Bull., v. 52, no. 12, pt. 2, p. 1919. Named as formation. Maximum thickness 4,000 feet. Overlies Meriden formation. A fluvial deposit similar to New Haven arkose.

P. D. Krynine, 1950, Connecticut Geol. Nat. History Survey Bull. 73, p. 30–31, 32, 69–70. Described as arkose. Consists of conglomerates, reddish-brown, purple, and grayish arkoses, fine-grained micaceous siltstones, and subordinate red and dark shales; these compose the normal sedimentary facies. Material becomes coarser from west to east; at the eastern margin in the vicinity of the Great Fault are coarse conglomerates and fanglomerates. Included in Newark group. Outcrop areas described.

E. P. Lehmann, 1959, Connecticut Geol. and Nat. History Survey Quad. Rept. 8, p. 8 (table 1), 25–30. In this report [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. Except for small area in extreme southeast corner of quadrangle where pre-Triassic Bolton schist crops out, Portland arkose underlies entire eastern half of quadrangle; appears in northwest quarter as result of faulting. Estimated thickness 3,000 to 3,500 feet.

Best exposures in the Portland "brownstone" quarries near Middletown, Middlesex County.

Portland Clays[1]

Age(?) : Maine.

Original reference: C. H. Hitchcock, 1861, Rept. Geology Maine, p. 275–282.

At and around Portland, Cumberland County.

†Portland division (of Selma Chalk)[1]

Upper Cretaceous: Alabama.

Original reference: E. A. Smith, 1903, 58th Cong., 1st sess., S. Ex. Doc. 19, p. 12–20, map.

Along Tombigbee River from Pace's Landing nearly to Moscow, and along Alabama River from Elm Bluff to Old Lexington Landing. Named for exposures at Portland, Dallas County.

Portland (delta) Gravels[1]

Portland Sands and Gravels

Pleistocene: Western Oregon.

Original reference: J. P. Buwalda and B. N. Moore, 1930, Carnegie Inst. Washington Pub. 404, p. 21–22.

R. C. Treasher, 1942, Geologic map of the Portland area, Oregon (1:96,000): Oregon Dept. Geology and Mineral Resources. Referred to on map legend as Portland terrace gravels. Correlates with Clackamas, Tualatin, and Willamette terrace deposits and glacial outwash.

W. D. Lowry and E. M. Baldwin, 1952, Geol. Soc. America Bull., v. 63, no. 1, p. 17–19. Portland gravels, sometimes referred to as Portland delta gravels, were deposited mainly by Columbia River during the Pleistocene. Base of gravels not known with certainty. Maximum thickness may be nearly 600 feet.

E. M. Baldwin, 1957, Northwest Sci., v. 31, no. 3, p. 114–115. Term Portland sands considered more appropriate than gravels.

Present in Willamette Valley in vicinity of Portland.

†Portland Quartzite[1]

Precambrian (Middle? Huronian): Central southern Wisconsin.

Original reference: T. C. Chamberlin, 1877, Geology Wisconsin, v. 2, p. 252–256.

Crops out in several places in town of Portland, Dodge County.

†Portland Shale[1]

Upper Devonian: Western New York.

Original reference: J. M. Clarke, 1903, New York State Mus. Handb. 19, p. 24, chart.

Probably named for exposures at Portland, Chautauqua County.

Portland Hills Silt Member (of Troutdale Formation)

Pliocene, upper, or Pleistocene, lower: Northern Oregon and southwestern Washington.

W. D. Lowry and E. M. Baldwin, 1952, Geol. Soc. America Bull., v. 63, no. 1, p. 10–13, pl. 2. In most roadcuts where silt has been exposed, it is structureless light-brown or yellowish-brown mass which in upper part may be mottled with gray streaks. In deep cuts, light-brown silt grades down into a reddish-brown, clayey silt. Surprisingly uniform in grain size, and suggestion of stratification noted in only few places. Scattered well-rounded quartzite pebbles occur in silt at elevation of 1,100 feet along crest of Portland Hills and attest to water-laid origin there. Thickness 300 to more than 700 feet. Uppermost member of formation.

E. M. Baldwin, 1957, Northwest Sci., v. 31, no. 3, p. 112–113. Rhinoceros tooth from the Portland Hills identified as form not known in North America beyond the Hemphillian. This strengthens Pliocene age for unit.

Forms thick cover over much of the Portland Hills in Oregon. Observed in clay pit west of West Pioneer, Wash. Traced eastward to Underwood Mountain on north side of Columbia River in Washington near Hood River, Oreg.

Portland Point Member (of Moscow Shale)[1]

Middle Devonian: Central New York.

Original reference: G. A. Cooper, 1930, Am. Jour. Sci., 5th, v. 19, p. 21, 229.

G. A. Cooper, 1933, Am. Jour. Sci., 5th, v. 26, p. 544, 550. In Schoharie Valley, overlies Panther Mountain shale and sandstone member (new).

R. S. Boardman, 1960, U.S. Geol. Survey Prof. Paper 340, p. 4 (fig. 2), 7. Basal limestone of Portland Point member extends westward [from type locality] and is considered equivalent of Menteth limestone member. Thickness 8½ feet at type locality.

Named for exposures at Portland Point (formerly Shurger Point), Cayuga Lake area.

**Portneuf Limestone Member** (of Thaynes Formation)

Portneuf Limestone (in Thaynes Group)[1]

Lower Triassic: Southeastern Idaho.

Original reference: G. R. Mansfield, 1915, Washington Acad. Sci. Jour., v. 5, p. 492.

G. R. Mansfield, 1952, U.S. Geol. Survey Prof. Paper 238, p. 17, 31–33, pl. 1. Limestone unconformably underlies Timothy formation where mapped in Ammon and Paradise Valley quadrangles. In Lanes Creek, Freedom, and Montpelier quadrangles farther east and southeast, the limestone contains a well-developed red-bed unit, which consists of interbedded red sandstones and shales and ranges from 200 to 1,000 feet in thickness.

Bernhard Kummel, 1954, U.S. Geol. Survey Prof. Paper 254–H, p. 173, fig. 18. Described as member of Thaynes formation. Underlies Timothy sandstone member.

Named for Portneuf River, in Fort Hall Indian Reservation, at head of which the limestone is well exposed.

Port Orford Formation

Pliocene, middle: Southwestern Oregon.

E. M. Baldwin, 1945, Jour. Geology, v. 53, no. 1, p. 37–39. Name proposed for beds lying unconformably between Empire formation and overlying terrace deposits. Formation has been included with terrace deposits under name of Elk River beds, which are here restricted to exclude newly named unit. Formation consists of a basal bed of buff sand overlain by conglomerate and separated from it by a local unconformity; above the conglomerate is rusty sand that grades upward into blue-gray argillaceous sand which bears fossiliferous concretions; top of argillaceous sand has been truncated by the sea and Elk River beds have been deposited on this truncated surface; locally the sand pinches out and Port Orford conglomerate is difficult to distinguish from the gravels of the terrace deposits.

J. H. Van Voorthuysen, 1953, Jour. Paleontology, v. 27, no. 4, p. 604. Foraminiferal studies indicate an Amstelian age—oldest Pleistocene.

Exposed south of Cape Blanco within the Port Orford quadrangle, Curry County.

Portsmouth Conglomerate[1]

Carboniferous: Southeastern Rhode Island.

Original reference: A. F. Foerste, 1899, U.S. Geol. Survey Mon. 33, p. 328–329.

Exposed near Portsmouth Grove Station, in Portsmouth camp-meeting grounds, and elsewhere in that region of Newport County.

Portsmouth Member (of Black Hand Formation)[1]

Portsmouth Member (of Logan Formation)

Portsmouth Shale Member (of Cuyahoga Formation)

Lower Mississippian: Southern Ohio.

Original reference: J. E. Hyde, 1915, Jour. Geology, v. 23, p. 656, 657, 758.

F. T. Holden, 1941, Illinois Acad. Sci. Trans., v. 34, no. 2, p. 173; 1942, Jour. Geology, v. 50, no. 1, p. 41 (table 1), 61. Included in Scioto shale facies (new) of Logan formation. Underlies Vinton sandstone member; overlies Buena Vista sandstone member; both contacts poorly exposed. In eastern Pike and Ross Counties, Portsmouth grades eastwardly into Byer sandstone member; along Ohio River, it is probable that upper part of Portsmouth is westward equivalent of the lower Vinton sandstone member of the adjacent Pretty Run facies. Maximum thickness 253 feet.

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 middle member of Cuyahoga formation. Underlies Black Hand member; overlies Buena Vista member.

Named for Portsmouth, Scioto County.

**Portuguese 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. 131.

W. P. Woodring, M. N. Bramlette, and W. S. W. Kew, 1946, U.S. Geol. Survey Prof. Paper 207, p. 16–19. Basal part of Altamira. Thickness at least 280 feet. Below Miraleste tuff bed of Altamira. Type region redesignated.

Type region: Along Klondike Canyon, near Portuguese Bend, Palos Verdes Hills, Los Angeles County.

†Portville Conglomerate[1]

Devonian or Carboniferous: Southwesern New York.

Original reference: K. E. Caster, 1934, Bulls. Am. Paleontology, v. 21, no. 71, p. 83.

On hills about Portville, Cattaraugus County.

Port Washington Stage[1]

Pleistocene: Southeastern New York.

Original reference: J. B. Woodworth, 1901, New York State Mus. Bull. 48, p. 621–663, pl. 1, map.

On northern and western extremity of Manhasset Neck, near Port Washington, Long Island.

Port Wing Brownstone Member (of Orienta Formation)

Cambrian: Northwestern Wisconsin.

G. O. Raasch, 1950, Illinois Acad. Sci. Trans., v. 43, p. 145 (fig. 8), 147. Critical examination of evidence on which Thwaites (1912) established his Chequamegon formation reveals that his Chequamegon brownstone formation is none other than the Port Wing brownstone member of the Orienta formation, repeated by faulting. [Thwaites' (1912 general section referred to Upper brownstone (of Port Wing); thickness 500 to 700 feet.].

Type locality not given. Thwaites referred to quarries at Port Wing, Bayfield County.

Portwood Formation (in New Albany Shale)

Upper Devonian: Eastern Kentucky.

Guy Campbell, 1946, Geol. Soc. America Bull., v. 57, no. 9, p. 860 (fig. 4), 861, 862–866. Portwood formation *Hypothyridina* zone is basal stratum of the New Albany in eastern Kentucky and includes all beds between Middle Devonian limestone and Trousdale shale. Consists of Duffin dolomite, Harg calcareous shale (new), and Ravenna carbonaceous shale as members, which are regarded as coeval facies within the *Hypothyridina* zone. Generalized section of Estill County shows maximum thickness 22 feet; all three facies present.

Type locality and derivation of name not given.

Posey Formation

Quaternary, late: Western California.

P. D. Trask and J. W. Rolston, 1951, Geol. Soc. America Bull., v. 62, no. 9, p. 1082. Firm sandy clay and sand as much as 50 feet thick. Underlies Merritt sand; overlies San Antonio formation.

Occurs in area around San Francisco-Oakland Bay Bridge. Named for the fact that it is well developed near Posey Tube between Alameda and Oakland.

Posideon Shale Member (of Graford Formation)[1]

Posideon Shale Member (of Palo Pinto Formation)

Pennsylvanian (Canyon Series): North-central Texas.

Original reference: F. B. Plummer and J. Hornberger, Jr., 1936, Texas Univ. Bull. 3534, p. 48–50, map.

M. G. Cheney, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 1, p. 66 (fig. 1). Reallocated to member status in redefined Palo Pinto formation. Overlies Wynn limestone member (new).

Typically exposed in vicinity of Posideon, Palo Pinto County.

**Possum Sandstone Tongue** (of Revard Sandstone Member of Tallant Formation)

Possum 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, 332.

W. F. Tanner, 1956, Oklahoma Geol. Survey Circ. 40, p. 32, 38, pl. 1. Rank reduced to bed in Tallant formation. More or less massive sandstone about 10 feet thick. Goldman (1920) identified it correctly as probably a tongue of the Revard sandstone.

Named for occurrence as a prominent ledge along sides of Opossum Creek in SE cor. T. 29 N., R. 11 E., Osage County.

Possumtrot 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. 300, 414.

Type locality: On west side of Indian Creek 1.6 miles northeast of Raines Corner and slightly north of Possumtrot Branch, Monroe County.

**Post Oak Conglomerate Member** (of Wichita Formation)

Permian : Southwestern Oklahoma.

G. W. Chase, 1954, Am. Assoc. Petroleum Geologists Bull., v. 38, no. 9, p. 2028–2035. Proposed for conglomerate and arkose beds surrounding Wichita Mountains as a near-shore facies of lower part of Wichita formation. Composed of four distinct conglomerate facies: granite boulder conglomerate, rhyolite porphyry conglomerate, limestone boulder conglomerate, and conglomerate with zeolite-opal cement. This latter facies was named Tepee Creek (Merritt and Ham, 1941,). Tongues into Wellington formation.

W. E. Ham, C. A. Merritt, and E. A. Frederickson, 1957, Panhandle Geol. Soc. [Guidebook] May 2, 3, 4, p. 28. As now used, term Tepee Creek is applied to zeolite-opal sediments that were deposited as anorthosite conglomerates and sandstones unconformably on basic igneous rocks in central part of Wichita Mountain region. These sediments probably are coarse-clastic shoreward facies of shales in Wichita formation of Lower Permian age. Also included in this general classification are the limestone conglomerates, granite conglomerates, and arkoses which in eastern part of Wichita Mountains are called Post Oak conglomerate member of Wichita formation. General concept of Post Oak member must be revised to take into consideration rather extensive granite conglomerates and arkoses in overlying Hennessey formation that border granite hills in Quartz Mountain area near Lugert.

Name taken from Post Oak Creek in sec. 12, T. 2 N., R. 15 W., and from Post Oak Mission in NE cor. sec. 7, T. 2 N., R. 14 W., where the conglomerate is thick and well developed.

**Post Pond Volcanic Member** (of Orfordville Formation)

Post Pond Volcanics

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, (1:62,000) ; C. A. Chapman and others, 1938. Geologic map and structure sections of the

Mascoma quadrangle, New Hampshire (1:62,500): New Hampshire Highway Dept. Member consists of green chlorite-sericite schist in low grade metamorphic zone of Orfordville formation and amphibolite, amphibole gneiss, calcareous amphibole gneiss, fine-grained biotite gneiss, and gray quartz-mica schist in middle grade zone. Occurs near base of formation below Hardy Hill quartzite member (new). Middle Ordovician(?).

J. B. Hadley, 1942, Geol. Soc. America Bull., v. 53, no. 1, p. 119–121, 123–124. Thickness 2,000 to 4,000 feet.

R. J. Bean, 1953, Geol. Soc. America Bull., v. 64, no. 5, pls. 1, 2. Volcanics are mapped as separate unit underlying the Albee formation and overlying the Orfordville formation. Map legends show Upper(?) Ordovician age.

J. B. Lyons, 1955, Geol. Soc. America Bull., v. 66, no. 1, p. 113, 114–116, pl. 1. Stratigraphic revision of the Orfordville formation implies that the Post Pond and Sunday Mountain volcanic members are essentially equivalent; latter is not mapped separately. Assigned higher stratigraphic position; occurs above the Hardy Hill quartzite member.

Named for outcrops in vicinity of Post Pond, Lyme Township Grafton County, N. H. Outcrop belt extends southwestward into Vermont.

**Potapaco 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. 58, 65–66.

D. J. Cederstrom, 1957, U.S. Geol. Survey Water-Supply Paper 1361, p. 2, 24. In York-James Peninsula, Va., the lower Eocene (Wilcox) part of Nanjemoy formation, Potapaco clay member, truncates Aquia formation. Downdip from the Fall Line the Aquia formation and Potapaco member, as well as basal pink Marlboro clay member of Nanjemoy, have been truncated by transgressive sea of middle Eocene time.

Potapaco is early name for Port Tobacco Creek, eastern Maryland.

Potato Sandstone[1]

Miocene(?): Southern California.

Original reference: F. E. Vaughan, 1922, California Univ. Pub., Dept. Geol. Sci. Bull., v. 13, no. 9, p. 344, 374–375, map.

A. O. Woodford, T. G. Moran, and J. S. Shelton, 1946, Am. Assoc. Petroleum Geologists Bull., v. 30, no. 4, p. 557. Conglomeratic Potato sandstone, which occupies several square miles in San Bernardino Mountains, was tentatively correlated with Puente formation by Vaughan (1922). Potato sandstone is arkosic, nonfossiliferous, and well indurated. Many of its pebbles are slabs of dark lustrous Pelona schist. Absence of Pelona shist fragments from conglomerates of Puente, indicates that the two formations, if contemporaneous, obtained their detritus from different and restricted areas.

Named for Potato Canyon, San Bernardino County. Forms the part of the ridge between Potato Canyon and Mill Creek east of Wilson Creek.

Potato Hill Andesite (in Buck Hill Volcanic Series)

Potato Hill Andesite (in Pruett Tuff or Formation)

Oligocene and younger(?): Southwestern Texas.

S. S. Goldich and M. A. Elms, 1946, (abs.) Geol. Soc. America Bull., v. 57, no. 12, pt. 2, p. 1197. Lavas intercalated with Pruett tuff (new) are (ascending) Crossen trachyte, Sheep Canyon basalts, and Potato Hill andesite (all new).

S. S. Goldich and M. A. Elms, 1949, Geol. Soc. America Bull., v. 60, no. 7, p. 1138 (table 1), 1144 (fig. 3), 1155–1156, pl. 1. Dark-reddish-brown porphyritic flow and flow breccia in upper part of Pruett tuff. At Potato Hill, the andesite is 31 feet thick. It lies on about 50 feet of tuff which rests on Crossen trachyte. Andesite overlain by 25 feet of hard, dense, red tuff. North of Potato Hill, the andesite is 18 feet thick and is overlain by 29 feet of well-stratified tuff below Cottonwood Spring basalt. Eocene(?).

W. N. McAnulty, 1955, Geol. Soc. America Bull., v. 66, no. 5, p. 536 (table 1), 549–550, pl. 1. Described in Cathedral Mountain quadrangle where it is given rank of formation in Buck Hill volcanic series. Thickness 35 to 190 feet. Overlies Sheep Canyon basalt; underlies Cottonwood Spring basalt. Oligocene and younger(?).

Named for Potato Hill on Crossen Mesa, Buck Hill quadrangle, Brewster County.

Poteau Stage[1]

Pennsylvanian: Western Arkansas and central eastern Oklahoma.

Original reference: A. Winslow, 1896, New York Acad. Sci. Trans., v. 15, p. 51.

C. C. Branson, 1957, Oklahoma Geology Notes, v. 17, no. 11, p. 102. Abandoned by Oklahoma Geological Survey. Unit is essentially the Boggy formation.

Name is from Poteau Mountains, Le Flore County, Oklahoma, and Segastian County, Arkansas.

**Poteet 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). Gray, brown, and tan, dense fine-grained limestone with abundant chert nodules; darker colored limestone predominant in lower part, and lighter colored limestone predominant in upper part; locally has zone of coarsely crystalline fragmental limestone at or near base, and one or more beds of dolomitic limestone higher up. Thickness 45 to 97 feet. Underlies Rob Camp limestone (new); unconformably overlies Dot limestone (new). Poteet limestone and Dot limestone shown as Murfreesboro limestone (after Butts) 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, 37–39, pl. 1. Unconformably underlies Martin Creek limestone in areas where Rob Camp limestone is absent. Derivation of name given. Discussion of problems of correlation and summary of nomenclature of Middle Ordovician formations in Lee and Tazewell Counties.

Named from Poteet Ford, an old crossing of the Powell River in central part of Jonesville district, Lee County. Well exposed along a woods lane at base of bluff overlooking Powell River 0.2 miles north of suspension footbridge at Poteet Ford.

**Potem Formation[1]**

Lower and Middle Jurassic: Northern California.

Original reference: J. S. Diller, 1906, U.S. Geol. Survey Geol. Atlas, Folio 138.

A. F. Sanborn, 1960, California Div. Mines Spec. Rept. 63, p. 6 (figs. 3, 4), 14–16, pl. 1. In southwest quarter of Big Bend quadrangle, consists of argillites and fine-grained tuffaceous sandstone with small amounts of conglomerate, tuff, medium to coarse tuffaceous sandstone and a few beds of limestone and coarse pyroclastic material. Thickness about 1,000 feet. Intercalated with Bagley andesite. Underlies Montgomery Creek formation. Middle and Upper Jurassic (text) ; Middle Jurassic (map bracket).

Named for exposures on Potem Creek, Shasta County.

**Potlatch Anhydrite**[1]

**Potlatch Member** (of Three Forks Formation)

Upper Devonian: Subsurface in Montana, North Dakota, and South Dakota.

Original reference: E. S. Perry, 1928, Montana Bur. Mines and Geology Mem. 1, p. 4–6.

C. A. Sandberg and C. R. Hammond, 1958, Am. Assoc. Petroleum Geologists Bull., v. 42, no. 10, p. 2322–2323, 2326. Designated member of Three Forks formation in area east of 110° meridian in Montana. In current informal subsurface usage, this unit is called "Potlatch". Wilson (1955, Billings Geol. Soc. Guidebook 6th Ann. Field Conf.) recognized that "Potlatch" represented only a small part of type Potlatch and used term Potlatch anhydrite (restricted). Used as member (as herein recommended), unit does not imply any redefinition or restriction of Perry's Potlatch anhydrite formation which is valid subsurface unit in its type area. From Little Rocky Mountains westward, upper part of Three Forks consists predominantly of green fossiliferous calcareous shale interbedded with thin beds of limestone and siltstone, and Potlatch member consists of anhydrite, dolomite, and dolomitic siltstone interbedded with calcareous and dolomitc shale.

Named for the fact that complete section is shown in cuttings of Potlatch-Adams No. 1 well on sec. 21, T. 34 N., R. 1 W., Toole County, Mont.

**Potomac Group**[1]

Lower and Upper Cretaceous : Virginia, Delaware, and Maryland.

Original references: W. J. McGee, 1886, Rept. Health Office, D.C., 1885, p. 19–21 ; Am. Jour. Sci, 3d., v. 31, p. 473–474.

N. H. Darton, 1951, Geol. Soc. America Bull., v. 62, p. 747, 752. Consists of (ascending) Patuxent, Arundel, and Patapsco formations. Group does not represent a large part of Lower Cretaceous. Structurally, a wedge-shaped mass lying on east-sloping floor of crystalline rocks; well records show that it thickens eastward to more than 1,000 feet. South of Fredericksburg, Aquia formation overlaps edge of Potomac group slightly, onto crystalline rock, and the Potomac in turn is overlapped by Miocene Calvert formation, Nanjemoy formation with its Marlboro clay member having thinned out or been eroded. In some areas, unconformably underlies Raritan formation.

Erling Dorf, 1952, Am. Assoc. Petroleum Geologists Bull., v. 36, no. 11, p. 2169 (fig. 1), 2173–2177. Lower Cretaceous. This assignment is made on basis of both floral and faunal evidence. Detailed discussion of probelm.

D. J. Cederstrom, 1957, U.S. Geol. Survey Water-Supply Paper 1361, p. 16, pl. 1. Early and late Cretaceous. In subsurface (in York-James Peninsula, Va.), underlies Mattaponi formation (new).

Type locality and derivation of name not stated. Unit crosses Potomac River near Chain Bridge, Virginia and District of Columbia.

**Potosi Dolomite**[1]

Upper Cambrian : Eastern and central Missouri.

Original reference: A. Winslow, 1894, Missouri Geol. Survey, v. 6, p. 331, 351, 355.

E. B. Branson, 1944, Missouri Univ. Studies, v. 19, no. 3, p. 30–32. Thick-bedded crystalline bluish-gray dolomite. Contains few fossils. Maximum thickness about 400 feet. Overlies Derby formation [compound term Derby-Doe Run not used in this report]; underlies Eminence dolomite. Upper Cambrian.

V. E. Kurtz, 1960, Dissert. Abs., v. 21, no. 3, p. 595. Overlies Doerun member of Elvins formation.

Named for Potosi, Washington County.

†Potosi Group[1]

Upper Cambrian and Lower Ordovician: Southeastern Missouri.

Original reference: A. Winslow, 1894, Missouri Geol. Survey, v. 6, p. 331, 351, 355.

Probably named for Potosi, Washington County.

†Potosi Slates and Conglomerates[1]

Upper Cambrian : Eastern Missouri.

Original reference: F. L. Nason, 1901, Am. Jour. Sci., 4th, v. 12, p. 358–361.

Typically exposed near Elvins, St. Francois County.

**Potosi Volcanic Group**

Potosi Volcanic Series[1]

Tertiary, middle or upper : Southwestern Colorado.

Original reference : W. Cross, 1899, U.S. Geol. Survey Geol. Atlas, Folio 57.

E. S. Larsen, Jr., 1949, Am. Geophys. Union Trans., v. 30, no. 6, p. 863. Includes (ascending) Conejos andesite (quartz latite), Treasure Mountain rhyolite, Sheep Mountain quartz latite, Alboroto quartz latite (rhyolite), Huerto andesite (quartz latite), and Piedra rhyolite. Lavas of Potosi volcanic series followed those of Silverton volcanic series and were in turn followed by eruption of Fisher quartz latite.

E. S. Larsen, Jr., and Whitman Cross, 1956, U.S. Geol. Survey Prof. Paper 258, p. 90–166, pl. 1. Series and units described in detail. Miocene.

T. A. Steven and J. C. Ratte, 1960, U.S. Geol. Sruvey Prof. Paper 343, p. 9–10, pl. 1. Middle or late Tertiary.

Named for exposures on Potosi Peak, Silverton quadrangle.

†Potsdam Limestone[1]

Upper Cambrian : New York.

Original reference: W. B. Dwight, 1886, Am. Jour. Sci., 3d, v. 31, p. 125–133.

In Dutchess County.

**Potsdam Sandstone**[1]

Upper Cambrian : Central and eastern New York and Vermont.

Original references: E. Emmons, 1838, New York Geol. Survey 2d Rept., p. 214–217, 230; 1840, New York Geol. Survey 4th Ann. Rept., p. 347.

John Rodgers, 1937, Geol. Soc. America Bull., v. 48, no. 11, p. 1575. Potsdam forms lowest unit of New York Paleozoic section except for beds in thrust plates of Taconic orogeny. Base of Potsdam in this area is coarse sandstone approaching a conglomerate; it grades upward into fairly massive, clean sandstone. In Vermont, rock has been metamorphosed and is more properly quartzite. Thickness about 400 feet. At Whitehall, upper beds show transition into Little Falls through interbedded dolomite and sandstone. This transition facies has been called Theresa formation. At Shoreham, in Ticonderoga quadrangle, Little Falls is immediately underlain by 50 feet of massive quartzite without transition; beneath this is 50 feet of interbedded dolomite and sandstone, and then body of Potsdam. If these beds are equivalent to "Theresa" at Whitehall, they bear out suggestion by Emmons that upper Potsdam graded from sandstone in Champlain region to calcareous sediments in Saratoga region. Upper Potsdam as here used is Franconia; remainder is presumably Dresbach.

D. W. Fisher and G. F. Hanson, 1951, Am. Jour. Sci., v. 249, no. 11, p. 795–814. Evidence presented to substantiate radical change in interpretation of Paleozoic stratigraphy of Saratoga Springs region. Previously accepted sequence (Potsdam sandstone, Theresa formation, Hoyt limestone, Little Falls dolomite, Amsterdam limestone, Trenton limestone, Canjoharie 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, and Canajoharie shale. Name Galway is reintroduced for strata younger than Potsdam and older than Hoyt. Term "Theresa" not applicable in area.

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. 36 (table 2), 53. At Skene Mountain, the Potsdam underlies Dewey Bridge formation (new).

A. W. Postel, A. E. Nelson, and D. R. Wiesnet, 1959, U.S. Geol. Survey Geol. Quad. Map GQ–123. In Nicholville quadrangle, New York, Potsdam is divided into Nicholville conglomerate member (new) and upper unnamed orthoquartzite member. Unnamed member corresponds to Keeseville sandstone of Emmons (1842, Geology of New York, pt. 2). Upper member crops out in Hopkinton Brook, three-fourths mile north of Hopkinton. Upper and lower members may interfinger and may be locally unconformable.

C. W. Welby, 1959, New England Intercollegiate Geol. Assoc. Guidebook 51st Ann. Mtg., p. 23. Underlies Ticonderoga formation (new).

Named for occurrence at Potsdam County, St. Lawrence County, N.Y.

†Pottawatomie Formation[1]

Pennsylvanina: Eastern Kansas.

Original reference: E. Haworth, 1898, Kansas Univ. Geol. Survey, v. 3, p. 92–94.

Named for Pottawatomie River.

†Pottawatomie Series[1]

Pennsylvanian: Iowa, Kansas, Missouri, Nebraska, and Oklahoma.

Original reference: R. C. Moore, 1931, Kansas Geol. Soc. Guidebook 5th Ann. Field Conf., correlation chart.

Potter Formation[1]

Pliocene: Texas.

Original reference: L. T. Patton, 1923, Texas Univ. Bull. 2330, p. 78–80.

In Panhandle

Potter parvafacies[1]

Upper Devonian: Southern New York and northern Pennsylvania.

Original reference: K. E. Caster, 1934, Bulls. Am. Paleontology, v. 21, no. 71, p. 31.

L. V. Rickard, 1957, New York Geol. Soc. Guidebook 29th Ann. Mtg., fig. 2. Figure 2 shows Potter as part of Upper Devonian depositional facies in southern New York. Interfingers with Cattaraugus and Oswayo to southwest and Elkland to northeast.

Named for occurrence in Potter County, Pa.

**Potterchitto Member** (of Cook Mountain Formation)

Potterchitto Member (of Wautubbee Formation)

Eocene: Eastern Mississippi.

E. P. Thomas, 1942, Mississippi Geol. Survey Bull. 48, p. 53–57, profile C. Defined as middle member of Wautubbee formation eastern Mississippi. Lithology varies; all gradations from greensand to nonglauconitic sand are present; sands range from calcareous and marly to noncalcareous and from highly fossiliferous to nonfossiliferous and contain pellets, partings, interbeds, and lenses of carbonaceous clay and shale; bentonite and bentonic clay locally present; earthy siderite common. Thickness varies; 36 feet at type section. Overlies Archusa member (new) with contact conformable and gradational; underlies Gordon Creek shale member (new) with contact conformable and sharply defined.

F. S. MacNeil, 1947, U.S. Geol. Survey Oil and Gas Inv. Prelim. Chart 29. Assigned to Cook Mountain formation.

Type locality: A series of roadcuts along the Newton-Decatur Highway (State Highway 15) on south side of valley wall of creek about 2 miles northeast of town of Newton, NE¼ sec. 26 and SE¼SE¼ sec. 23, T. 6 N., R. 11 E., Newton County. Named for outcrop near Potterchitto Creek.

**Potter Farm Formation**[1] (in Traverse Group)

Middle and Upper (?) 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), 590–593. Described in Thunder Bay region where composite section is about 65 feet thick. Overlies Norway Point formation. Separated from overlying Thunder Bay limestone by covered interval about 27 feet thick that includes two resistant members which are probably limestones. Included in Traverse group.

Type locality: Fred Potter Farm, E½ secs. 18 and 19, sec. 20, T. 31 N., R. 8 E., Alpena County.

†Pottsboro Subgroup[1]

Lower Cretaceous (Comanche Series): Northeastern Texas.

Original reference: R. T. Hill, 1901, U.S. Geol. Survey 21st Ann. Rept., pt. 7, p. 121, 247, 270, 280–288.

Named for Pottsboro, Grayson County.

Pottstown 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 Pottstown, Montgomery County.

**Pottsville Formation[1] or Group[1]**

Pottsville Series

Lower and Middle Pennsylvanian: Pennsylvania, Alabama, Georgia, Indiana, Kentucky, Maryland, Mississippi, Ohio, Tennessee, Virginia, and West Virginia.

Original references: J. P. Lesley, 1876, Pennsylvania 2d Geol. Survey Rept. L, app. E, p. 221–227; 1877, Pennsylvania 2d Geol. Survey Rept. $H_3$, p. xxiii; C. A. Ashburner, 1877, Am. Philos. Soc. Proc., v. 16, p. 520, 535; David White, 1900, U.S. Geol. Survey 20th Ann. Rept., p. 749–953.

P. H. Price and E. T. Heck, 1939, West Virginia Geol. Survey [Rept.] Greenbrier County, p. 212–251. Pottsville series divided into (ascending) Pocahontas, New River, and Kanawha groups. Only basal members of Kanawha present in area of this report. Overlies Mauch Chunk series of Mississippian age.

Charles Butts, 1940, Virginia Geol. Survey Bull. 52, pt. 1, p. 408–435. Pottsville group includes (ascending) Lee formation, Norton formation, Gladeville sandstone, Wise formation, and Harlan sandstone (possibly of Allegheny age). Overlies Bluestone formation, as in Tazewell County, or Pennington formation as in Lee and Wise Counties.

Charles Butts and Benjamin Gildersleeve, 1948, Georgia Geol. Survey Bull. 54, p. 54–56. Formation in northwest Georgia contains Lookout sandstone and Walden sandstone. Thickness about 1,430 to 1,500 feet. Stratigraphically above Rockmart slate.

N. K. Flint, 1951, Ohio Geol. Survey, 4th ser., Bull. 48, p. 20–39, table 1. Pottsville series in Ohio includes basal Harrison formation and cyclothems from the Sharon up through the Tionesta. Base of Homewood member of Brookville cyclothem of Allegheny series is considered boundary between Pottsville and Allegheny series. In this report [Perry County], the Pottsville is subdivided into 10 cyclothems. [For sequence see Anthony cyclothem].

G. H. Wood, Jr., and others, 1956, Am. Assoc. Petroleum Geologists Bull., v. 40, no. 11, p. 2669–2688. At type section and reference section, formation subdivided into (ascending) Tumbling Run, Schuykill, and Sharp Mountain members. Thickness 1,116 feet at reference section; 1,195 feet at type section (White, 1900). Overlies Mauch Chunk formation; underlies post-Pottsville rocks (Buck Mountain coal bed). Members crop out throughout Southern anthracite field and have been tentatively correlated with strata in parts of other anthracite fields.

C. W. Wilson, Jr., J. W. Jewell, and E. T. Luther, 1956, Pennsylvanina geology of the Cumberland Plateau: Tennessee Div. Geology [folio], p. 1. Pennsylvania strata, Pottsville series, subdivided into nine groups (ascending): Gizzard, Crab Orchard Mountains, Crooked Fork, Slatestone, Indian Bluff, Graves Gap, Redoak Mountain, Vowell Mountain, and Cross Mountain.

G. T. Malmberg and H. T. Downing, 1957, Alabama Geol. Survey County Rept. 3, p. 68–71. Pottsville formation is uppermost Paleozoic unit cropping out in Madison County. Only lower part of formation present in county. Consists of about 85 feet of sandstone, shale, and coals. Unconformably overlies Pennington shale of Mississippian age.

M. T. Sturgeon and others, 1958, Ohio Geol. Survey Bull. 57, p. 43–46, 49 (table 7). In northern Appalachian region, including Ohio, the Pottsville series has commonly been defined to include all Pennsylvanian strata from base of Brookville coal downward to underlying Mississippian formations. Flint (1951) and Merrill (1950, unpub. thesis) have included Brookville underclay and Homewood sandstone in Brookville cyclothem. If accepted, decision logically extends base of overlying Allegheny series to base of Homewood shale and sandstone. In Athens County [this report] only Tionesta cyclothem of Pottsville series is exposed for total thickness of about 15 feet.

R. R. Dutcher and others, 1959, Geol. Soc. America Guidebook Pittsburgh Mtg., p. 68–71. Pennsylvanian section subdivided into (ascending) Pottsville, Allegheny, Conemaugh, and Monongahela groups. Average thickness of Pottsville in western Pennsylvania about 240 feet. Only rocks of upper Pottsville age are represented, and, as in most areas of Pennsylvania, unconformably overlie Mississippian Mauch Chunk or Pocono formations. Throughout western Pennsylvania, the lower two-thirds of Pottsville rocks consists of relatively thick sandstones and a few thin coal beds, and the upper one-third consists of highly variable sequence of clays, shales, and sandstones. Sandstones comprise Connoquenessing formation; overlying beds are assigned to Mercer formation (contains Mercer coals, Mercer clay, and Homewood sandstone). In extreme western and northwestern Pennsylvania and in southwestern Pennsylvania, the Sharon conglomerate forms basal Pottsville but is thought to be absent in others.

Carlyle Gray and others, 1960, Geologic map of Pennsylvania (1:250,000): Pennsylvania Geol. Survey, 4th ser. Mapped as group with Tumbling Run, Schuylkill, and Sharp Mountain formations.

Type section: South of city of Pottsville along Pennsylvania Railroad cut on east side of water gap through Sharp Mountain, Schuylkill County, Pa. Reference section: About 150 feet east of type section, along east side of roadcut for U.S. Highway 122.

Potwisha Quartz Diorite

Jurassic-Cretaceous: Central California.

D. C. Ross, 1958, California Div. Mines Spec. Rept. 53, p. 11, pl. 1. Dark gray in color with abundance of dark inclusions and schlieren. In gradational contact with Giant Forest pluton but mapped separately because of its distinctive color and mineral content.

Underlies about a square mile in vicinity of Potwisha Camp, Sequoia National Park.

Poudre Limestone Member (of Lykins Formation)

Permo-Triassic: Northern Colorado and eastern Wyoming.

T. L. Broin, 1958, Dissert. Abs., v. 19, no. 1, p. 114. Underlies Stonewall Creek shale member (new); overlies Livermore shale member (new).

Extends northward beyond Horse Creek, Wyo., and as far south as Loveland, Colo.

†Poughquag Limestone[1]

Cambrian and Ordovician : Southeastern New York.

Original reference: J. D. Dana, 1872, Am. Jour. Sci., 3d, v. 3, p. 179–186, 250–256.

Exposed at or near Poughquag, Dutchess County.

**Poughquag Quartzite[1]**

Lower Cambrian : Southeastern New York and western Connecticut.

Original reference: J. D. Dana, 1872, Am. Jour. Sci., 3d, v. 3, p. 179–186, 250–256.

E. B. Knopf, 1946, (abs.) Geol. Soc. America Bull., v. 57, no. 12, pt. 2, p. 1212. Thickness about 250 feet in vicinity of Stissing Mountain, N.Y. Basal Cambrian carrying *Olenellus* and probably *Obolella* near Beacon, N.Y. Underlies Stissing dolomite; overlies Precambrian gneisses.

John Rodgers and others, 1956, Preliminary geologic map of Connecticut (1:253,400): Connecticut Geol. Nat. History Survey. Mapped as pre-Triassic. Massive or bedded vitreous quartzite, gray, white, or buff; locally small amounts of muscovite along bedding planes, or thin layers of muscovite schist between beds; most micaceous near top. In places, grades into feldspathic biotite gneiss, probably only near base of formation.

Named for exposures at Poughquag, Dutchess County, N.Y.

**Poul Creek Formation[1]**

Oligocene and Miocene: Southeastern Alaska.

Original reference: N. L. Taliaferro, 1932, Geol. Soc. America Bull., v. 43, no. 3, p. 753.

D. J. Miller, 1957, U.S. Geol. Survey Oil and Gas Inv. Map OM–187, sheets 1, 2. Redefined to consist of approximately 6,100 feet of marine interbedded siltstone and sandstone strata that lie with apparent conformity on Kulthieth formation. As defined, formation includes in upper part most of the strata originally assigned to it at type locality on Poul Creek; also includes lower part of Yakataga Reef section, which was originally assigned to overlying Yakataga formation, and excludes beds described by Taliaferro as "glacio-fluvial conglomerates," here assigned to Yakataga formation. Age given in text as late Oligocene and early Miocene; mapped as Oligocene and Miocene.

Type locality: On Poul Creek, Yakataga district, Controller Bay region.

**Poultney Slate[1]**

Poultney Formation (in Poultney River Group)

Poultney Group

Lower Ordovician: Southwestern Vermont and New York.

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. Name Poultney slate was applied by Keith (1932) to lowest Ordovician formation after "good exposures in town of Poultney at the boundary of New York, 7 miles southwest of Castleton." Poultney formation as used herein, includes beds of Ordovician section up to overlying red and bluish-green slates named Indian River. Formation is variable unit consisting typically of bluish-gray waxy-looking banded argillites, locally with indigo-colored patches replacing banding. Near base are local developments of finger-thick green and greenish-weathering black argillite and brown sandstones, and also black slates with limestone conglomerates and thin ribbon limestones. Overlies Hatch Hill formation. In Poultney River group.

J. G. Elam, 1960, Dissert. Abs., v. 21, no. 6, p. 1523–1524. Discussion of geology of Troy South and East Greenbush quadrangles, New York. Stratigraphic section has been subdivided into four groups, and the previously described dominant formational names have been elevated to group status. The groups are Bull (Lower Cambrian), Poultney (Lower Ordovician), and Normanskill (Middle Ordovician).

Named for exposures in town of Poultney, Rutland County, Vt., at boundary of New York, 7 miles southwest of Castleton.

Poultney River Group

Upper Cambrian to Middle Ordovician : Western Vermont.

E-an Zen, 1959, New England Intercollegiate Geol. Conf. Guidebook 51st Ann. Mtg., p. 2. Six rock types recognized (ascending) : white-weathering black argillite with ribbon limestone and cherty beds; limestone-matrix limestone conglomerate; white-weathering green, gray, black, and rarely red argillite, with interbedded thin buff-weathering quartzite ("Poultney slate") ; black slate with interbedded brown-weathering ankeritic massive black quartzite with edgewise conglomerate, graded bedding, and channel filling abundant; soft red slate with thin dolomitic and quartzose beds ("Indian River") ; and black slate with massive black graywacke beds, commonly showing graded bedding and containing angular rock fragments. Units 1 and 3 are Dale's (1898, U.S. Geol. Survey Ann. Rept. 19, pt. 3, p. 188) Hudson white beds; unit 4 is Larrabee's (1939) Zion Hill quartzite; unit 5 is Keith's (1932) Indian River formation; unit 6 is Dale's (1898) Hudson grits. Thickness not more than 1,000 feet. Major unconformity probably separates group from West Castleton formation (new) ; this conclusion is based on overlap relations as well as gaps in stratigraphy ; an unconformity is present within group below unit 6.

Probably named for Poultney River.

Poundridge Granite[1]

Age (?) : Southeastern New York.

Original reference: G. K. Bell, Jr., 1936, Geol. Soc. America Proc. 1935, p. 65.

Occupies most of Poundridge (New York State Park) Reservation in northeast Westchester County.

Pounds cyclothem (in Caseyville-Abbott Formations)

Pounds 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. 5, 9, pl. 1. Includes (ascending) : Pounds sandstone (Makanda sandstone in restricted sense) and Reynoldsburg coal. Type locality designated.

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 53 (table 3), pl. 1. In Caseyville formation (redefined) and Abbott formation (new). Above Battery Rock cyclothem and below Grindstaff cyclothem. Presentation of new rock-stratigraphic classification of Pennsylvanian strata in Illinois; cyclical classification is independent of rock-stratigraphic classification.

Type locality: Secs. 35 and 36, T. 10 S., R. 8 E., Gallatin County.

**Pounds Sandstone Member** (of Caseyville Formation)

Pounds Formation (in Caseyville Group)

Lower Pennsylvanian: Southeastern and southwestern Illinois and western Kentucky.

J. M. Weller, 1940, Illinois Geol. Survey Rept. Inv. 71, p. 36, 38–39. Uppermost formation of group. Consists of a prominent sandstone below and a series of shaly beds above; sandstone has maximum thickness of more than 100 feet; shaly strata are poorly exposed and determination of their thickness depends upon recognition of overlying Grindstaff sandstone; the Grindstaff appears to lie from 40 to 60 feet above top of Pounds sandstone at most places, but locally the shaly beds have probably been cut out completely so that the Grindstaff or some younger sandstone is in direct contact with Pounds sandstone. Maximum thickness of formation 150 feet or more in eastern part of area; thins irregularly to west, and in places is not more than 50 feet thick. Probably unconformably overlies Battery Rock formation.

H. R. Wanless and Raymond Siever, 1956, Illinois Geol. Survey Circ. 217, pl. 1. Included in Pounds cyclothem.

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 29, 30, 44 (table 1), 61, pl. 1. Rank reduced to member status in Caseyville formation (redefined). Uppermost member of formation. In southeastern area, occurs above Gentry coal member (new); in southwestern area, occurs above Drury shale member. Thickness 80 feet at type section of Caseyville and about 100 feet at reference section of formation. In southwestern area, includes strata formerly considered to be lower part of Makando sandstone, which name is herein discontinued. 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: Along Pounds Hollow, sec. 35 and 36, T. 10 S., R. 8 E., Gallatin County.

Poverty Run Limestone (in Pottsville Formation)[1]

Pennsylvanian: Eastern Ohio.

Original reference: Wilber Stout, 1918, Ohio Geol. Survey, 4th ser., Bull. 21, p. 65.

R. E. Lamborn, 1951, Ohio Geol. Survey, 4th ser., Bull. 49, p. 22. On basis of fossil content, Morningstar (1922, Ohio Geol. Survey, 4th ser., Bull. 25) correlated Poverty Run limestone with Lowellville limestone as defined by Lamb (1910).

Exposed on Poverty Run, Muskingum County.

**Poway Conglomerate**[1]

Eocene, upper: Southern California.

Original reference: A. J. Ellis, 1919, U.S. Geol. Survey Water-Supply Paper 446.

G. J. Bellemin and Richard Merriam, 1958, Geol. Soc. America Bull., v. 69 no. 2, p. 199–220. Massive conglomerate of well-rounded pebbles and some boulders, consisting largely of rhyolitic tuff and porphyry; interbedded and crossbedded with sand lenses of coarse sand and fine silty clay; upper zones contain caliche. Ranges in thickness up to about 1,000 feet. Nearly horizontal, and in most places lies unconformably on Cretaceous Peninsular Range batholith and accompanying metamorphic rocks. Where Poway rests on La Jolla formation, contact is in most places conformable. Locally covered unconformably by more than 1,000 feet of soft-gray to yellow marine sands of Pliocene age termed San Diego formation. Upper Eocene; equivalent to Tejon formation.

Forms Poway Mesa and occurs in narrow belt extending from that mesa east of Witch Creek. Well exposed near town of Poway, and forms south wall of Poway Valley, San Diego County.

**Powderhorn Granite**[1]

Precambrian: Central western Colorado.

Original reference: J. F. Hunter, 1925, U.S. Geol. Survey Bull. 777.

Occurs in divide between Cebolla and Goose Creeks, north of Powderhorn, Gunnison County.

**Powell Limestone or Dolomite**[1]

Lower Ordovician: Northern Arkansas and southeastern Missouri.

Original reference: A. H. Purdue and H. D. Miser, 1916, U.S. Geol. Survey Geol. Atlas, Folio 202.

J. S. Cullison, 1944, Missouri Univ. School Mines and Metallurgy Bull., Tech. Ser., v. 15, no. 2, p. 39. Includes Bull Shoals Mountain chert bed (new) at base. Notes on derivation of name.

Arkansas Geological and Conservation Commission, 1956, *in* Kansas Geol. Soc. Guidebook 20th Field Conf., columnar sections. Fine-grained gray argillaceous dolomite with thin beds of shale, sandstone and sandy dolomite at places. Thickness as much as 215 feet. Overlies Cotter dolomite; underlies Everton formation.

Josiah Bridge, 1956, U.S. Geol. Survey Prof. Paper 277, p. 23. Name Powell of Missouri-Arkansas area should not be extended into Appalachian Valley. At present there is no evidence to indicate that any beds in the Appalachian Valley of Tennessee are equivalent to the Powell formation of Ozark region.

Name derived from Powell Station, now abandoned, on Missouri-Pacific Railroad about 2 miles down Crooked Creek from present village of Pyatt, Marion County, Ark.

Powelton Shale (in Allegheny Formation)[1]

Pennsylvanian: Central southern Pennsylvania.

Original reference: I. C. White, 1885, Pennsylvania 2d Geol. Survey Rept. $T_3$, p. 61–62.

Named for village in Huntingdon County.

Powers Bluff Quartzite[1]

Precambrian (middle Huronian): Central northern Wisconsin.

Original reference: S. Weidman, 1907, Wisconsin Geol. Nat. History Survey Bull. 16, p. 82.

Forms main part of Powers Bluff, near Arpin, Wood County.

**Powwow Conglomerate Member** (of Hueco Limestone)[1]

Powwow Conglomerate

Permian (Wolfcamp Series): Western Texas and southeastern New Mexico.

Original reference: P. B. King and R. E. King, 1929, Am. Assoc. Petroleum Geologists Bull., v. 13, p. 909, 911.

M. L. Thompson, 1954, Kansas Univ. Paleont. Contr. 14, Protozoa, art. 5, p. 17. In central New Mexico, Bursum formation is unconformably overlain by conglomerates and conglomeratic sandstones which commonly are referred to Abo formation but here are classed as belonging to Powwow conglomerate member of Abo.

Hugh Hay-Roe, 1957, Texas Univ. Bur. Econ. Geology Geol. Quad. Map 21. Described in Wylie Mountains and vicinity. Consists of sequence of poorly consolidated conglomerate, sandstone, siltstone, and shale; marl and limestone beds present near top. Typically dark reddish brown. Thickness more than 200 feet where it fills former valleys; thins to about 20 feet over buried hills. Underlies Hueco limestone; unconformably overlies Precambrian Carrizo Mountain group.

Well exposed from 2 to 5 miles south of Hueco Canyon along main escarpment of Hueco Mountains, Tex. Name derived from Powwow Canyon 3½ miles south of Hueco Canyon; which is followed by El Paso-Carlsbad Highway.

Poxino [Poxono] Island Limestone (in Wills Creek Shale)[1]

Silurian: Northeastern Pennsylvania.

Original reference: I. C. White, 1882, Pennsylvania 2d Geol. Survey Rept. $G_6$, p. 146–147, 223–224.

Exposed only in steep bluff on Delaware River opposite Poxino Island.

Poxino Island Shale[1]

*See* Poxono Island Shale, correct spelling.

Poxono Island Shale[1]

Silurian (Cayugan Series): Northeastern Pennsylvania.

Original reference: I. C. White, 1882, Pennsylvania 2d Geol. Survey Rept. $G_6$, p. 77, 145–146.

C. K. Swartz and F. M. Swartz, 1941, Geol. Soc. America Bull., v. 52, no. 8, p. 1184–1187, measured sections. Consists of calcareous shale weathering light colored, greenish to buff. Interbedded with shale are local bands of Bloomsburg type. Near base of shale, at type locality, is bed of blue-gray limestone, about 5 feet thick—White's (1882) Poxono Island limestone—containing great numbers of Ostracoda. Thickness varies greatly; at Schuylkill River, absent or reduced to thickness of few feet. Gradually thickens northeastward; about 150 feet at Snyders; about 200 feet at Delaware Water Gap and type locality. Underlies Bossardville limestone; overlies and intertongues with Bloomsburg red sandstone. Poxono Island shale and Bossardville limestone are similar to, and homotoxial with, Wills Creek shale and Tonoloway limestone, respectively, of central

Pennsylvania and Maryland but lie in different province and the corresponding formations differ in their time limits. Both are believed to be later than Wills Creek shale.

C. K. Swartz and others, 1942, Geol. Soc. America Bull., v. 53, no. 4, chart 3. Shown on correlation chart in Cayugan series.

Named for exposures in bluff of Delaware River in Middle Smithfield Township opposite Poxono Island.

**Pozo Formation**[1]

Pliocene (?) : Southwestern Nevada.

Original reference: F. L. Ransome, 1909, U.S. Geol. Survey Prof. Paper 66, p. 28, 70.

Named for exposures in Pozo Canyon, Goldfield district.

**Prairie Formation**

Prairie member

Pleistocene: Central and southwestern Louisiana.

H. N. Fisk, 1938, Louisiana Dept. Conserv. Geol. Bull. 10, p. 78 (fig. 6), 163–166. 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. Prairie deposits, which in many areas are identical in appearance to those of the present flood plain, border the alluvial valley of the Mississippi and occur to greater distances flanking tributary streams than any of the older flood-plain materials. A typical section consists of an alternation of silty sands and silty clays, loamy material with some coarse sand lenses. Thickness 20 to 52 feet.

H. N. Fisk, 1940, Louisiana Dept. Conserv. Geol. Bull. 18, p. 182–183, pl. 1. Rank raised to formation. Described in Rapides and Avoyelles Parishes where it consists entirely of fresh-water clays, silts, sands, and basal graveliferous deposits; all but upper 20 feet of sequence is covered by Recent alluvium.

Named for Prairie Terrace typically developed near Aloha, sec. 16, T. 7 N., R. 4 W., Grant Parish, and at Nebo School, sec. 40, T. 7 N., R. 3 E., La Salle Parish.

**Prairie Formation** (in Elk Point Group)

Middle Devonian: Subsurface in Saskatchewan, Alberta, and Manitoba, Canada, and northeastern Montana and northwestern North Dakota.

A. D. Baillie, 1953, Am. Assoc. Petroleum Geologists Bull., v. 37, no. 2, p. 444, 445 (fig. 1), 446 (fig. 2); 1953, Manitoba Dept. Mines and Nat. Resources Mines Br. Pub. 52–5, p. 11 (fig. 2), 12 (table 2), 24–25. Prairie evaporite formation proposed for salt and anhydrite beds that form upper unit of Elk Point group throughout most of Elk Point basin area. Beds range in thickness from more than 600 feet near center of basin to less than 50 feet around basin margins except on west side of map area where evaporite, as much as 450 feet thick, extend into Alberta. Thickness in type well 640 feet. Uppermost formation of group; overlies Winnipegosis formation; underlies Dawson Bay formation of Manitoba group.

C. A. Sandberg and C. R. Hammond, 1958, Am. Assoc. Petroleum Geologists Bull., v. 42, no. 10, p. 2306–2307. Formation underlies deepest part of Williston basin northwestern North Dakota and northeastern Montana.

Thickness fraction of a foot to almost 500 feet. In center of basin, divided into two members: lower contains mostly anhydrite and dolomite interbedded with shale and thin beds of halite; upper is largely halite and is designated as salt member.

Type section: Interval between depths of 4,350 and 4,990 feet in Imperial Oil Co.'s Davidson well 1, in Lsd. 16, sec. 8, T. 27, R. 1 W. 3d Meridian, Saskatchewan, Canada.

**Prairie Bluff Chalk**[1] (in Selma Group)

Upper Cretaceous: Southwestern Alabama and Mississippi.

Original reference: A. Winchell, 1857, Am. Assoc. Adv. Sci. Proc., v. 2, p. 83, 84, 90.

W. E. Belt and others, 1945, Geologic map of Mississippi (1:500,000): Mississippi Geol. Survey. Assigned to Selma group.

R. J. Hughes, Jr., 1958, Mississippi Geol. Survey Bull. 84, p. 68–78, pls. 1, 5, 6, 10. Described in Kemper County where it consists of massive hard brittle glaring white to blue-gray chalk. Thickness about 30 feet. Disconformably overlies Ripley formation; unconformably overlain by Chalybeate limestone member of Clayton formation.

N. F. Sohl, 1960, U.S. Geol. Survey Prof. Paper 331–A, p. 25–27. Consists dominantly of impure sandy chalk with subordinate amounts of clay, sand, and chalky limestone. Maximum thickness about 70 feet. Thickness 15 feet at type locality. Recognizable from southernmost Tippah County, Miss., to Bullock County, Ala., where it interfingers with Providence sand. In northeastern Mississippi, interfingers with Owl Creek formation; in northern Mississippi, overlain by Clayton formation. Overlies Ripley formation.

Named for exposures in Prairie Bluff, Wilcox County, Ala.

Prairie Creek Limestone Lentil (in Geuda Springs Shale Member of Wellington Formation)

Permian: Central Kansas.

W. A. Ver Wiebe, 1937, Wichita Municipal Univ. Bull., v. 12, no. 5, p. 13. Uppermost 40 feet of the Geuda Springs consists of drab clays which weather greenish. They are delimited by 2 thin limestones separated by about 5 feet of shale. The limestones are rarely much more than 1 foot thick, but are almost invariably accompanied by prominent veins of secondary calcite which produce a honeycomb rock. Name Prairie Creek limestone lentil is proposed for these beds.

Named for occurrence along Prairie Creek, southeast of Furley, Sedgwick County. Have been traced from Gore Township (T. 30 S., R. 2 E.) northward to a point east of Furley in Lincoln Township (T. 25 S., R. 2 E.).

Prairie d'Ane Clay[1]

Pleistocene: Southwestern Arkansas.

Original reference: R. T. Hill, 1888, Arkansas Geol. Survey Ann. Rept. 1888, v. 2, p. 32–33, 46–47, 188.

Forms Prairie d'Ane at Prescott, Prairie de Roan at Hope, and Bois d'Arc Prairie, 10 miles south of Washington. Named for exposures in Prairie d'Ane at Prescott, Nevada County.

Prairie de Roan division[1]

Pleistocene: Southwestern Arkansas.

Original reference: R. T. Hill, 1888, Arkansas Geol. Survey Ann. Rept. 1888, v. 2, p. 29, 33.

Named for Prairie de Roan at Hope, Hempstead County.

Prairie Divide Glacial Stage

Pleistocene (pre-Wisconsin) : Northeastern Colorado.

Kirk Bryan and L. L. Ray, 1940, Smithsonian Misc. Colln., v. 99, no. 2, p. 28–29; L. L. Ray, 1940, Geol. Soc. America Bull., v. 51, no. 12, p. 1856–1857. Till and gravel of Prairie Divide represent widespread glaciation to which name Prairie Divide stage is applied. Oldest glacial deposit in Cache la Poudre drainage area. Probably correlative with Cerro glaciation of San Juan Mountains.

Till and gravel form surface of Prairie Divide, a broad mountain flat, with altitude of approximately 7,900 feet in T. 10 N., R. 72 W., Livermore and Home quadrangles.

**Prairie du Chien Group**[1]

Prairie du Chien Formation

Lower Ordovician: Southwestern Wisconsin, Illinois, Iowa, and southern Minnesota.

Original reference: H. F. Bain, 1906, U.S. Geol. Survey Bull. 294, p. 18.

R. L. Heller, 1956, Geol. Soc. America Guidebook for Field Trips Minneapolis Mtg., Field Trip 2, p. 29–40. Prairie du Chien group of most authors is revised to formation status. As thus defined, formation consists of (ascending) Oneota dolomite, New Richmond sandstone, and Shakopee dolomite. Name Root Valley sandstone, employed by some for sandstone facies of middle member in southeastern Minnesota is suppressed. As thus defined, the Prairie du Chien consists of a thick sequence of predominantly dolomitic rocks that occurs between the Jordan sandstone of Croixan age and St. Peter sandstone of Chazy age. Ranges in thickness from less than 100 feet in shoreward areas north and west of Minneapolis to 260 feet near Lanesboro, Minn. Canadian.

A. F. Agnew and others, 1956, U.S. Geol. Survey Prof. Paper 274–K, p. 272–273. In some areas, group is divisible into Oneota dolomite, New Richmond sandstone, and Shakopee dolomite. In some areas, no recognizable sandstone is found and threefold division cannot be made. Maximum thickness 240 feet. Underlies St. Peter sandstone.

Named for exposures in vicinity of Prairie du Chien, Wis.

**Prairie Grove Member** (of Hale Formation)

Pennsylvanian (Morrow Series) : Northwestern Arkansas and northeastern Oklahoma.

L. G. Henbest, 1953, Am. Assoc. Petroleum Geologists Bull., v. 37, no. 8, p. 1935, 1940–1942. Name applied to upper member of formation. Described as a massive, variously sandy crossbedded, pock-marked limestone; lenses of relatively pure, crinoidal, highly fossiliferous limestone and oolitic limestone beds common. Thickness 60 to 200 feet. Overlies Cane Hill member (new) with angular discordance; underlies Bloyd shale.

Named for exposures in mountains east and south of Prairie Grove, Washington County, Ark. Member is distinguishable westward in Oklahoma to Arkansas River valley.

Prairie Hollow Member (of Prairie Mountain Formation)

Prairie Hollow Member (of Wildhorse Mountain Formation)

Mississippian: Southeastern Oklahoma.

B. H. Harlton, 1938, Am. Assoc. Petroleum Geologists Bull., v. 22, no. 7, p. 857, 880. Variegated maroon and green shale, about 450 feet above base of Prairie Mountain formation (new).

L. M. Cline, 1960, Oklahoma Geol. Survey Bull. 85, p. 49–51. Reallocated to Wildhorse Mountain formation. Thickness about 300 feet.

Type locality: In Prairie Hollow on west side of Round Prairie syncline at type locality of Prairie Mountain formation which is in sec. 25, T. 1 S., R. 12 E., Atoka County.

Prairie Mountain Formation (in Jackfork Group)

Mississippian: Southeastern Oklahoma.

B. H. Harlton, 1938, Am. Assoc. Petroleum Geologists Bull., v. 22, no. 7, p. 854 (fig. 1), 857, 880–884. Defined to include strata underlying Markham Mill formation (new) and overlying Wildhorse Mountain formation (new). Consists of siliceous shale, commonly dark gray to gray, followed by alternating sandstones and shales. Includes the maroon and green shale Prairie Hollow member (new) about 450 feet above base. Thickness varies; in Round Prairie syncline approximately 1,350 feet; in Tuskahoma syncline about 4,300 feet. Jackfork group. Pushmataha series.

L. M. Cline, 1956, Tulsa Geol. Soc. Digest, v. 24, p. 101, 102. Harlton's map units extended into central Ouachitas. Restudy of type section of the Jackfork formation reveals that upper part of type Wildhorse Mountain formation duplicates an equivalent interval in lower type Prairie Mountain formation. By definition, Harlton's type Prairie Mountain formation includes type locality of Prairie Hollow maroon shale member. It has been found that the Prairie Hollow also occurs in midst of Wildhorse Mountain type section; the stratigraphic overlap is about 3,600 feet.

L. M. Cline, 1960, Oklahoma Geol. Survey Bull. 85, p. 43 (table 3), 51–54, pls. Formation in Ouachita Mountains overlies Wildhorse Mountain formation and underlies Markham Mill formation. Restricted to exclude Prairie Hollow shale member which is reallocated to member status in Wildhorse Mountain formation. Harlton lists thickness of 1,350 feet for formation at type locality, but when allowance is made for his error in including upper part of Wildhorse Mountain with the Prairie Mountain, the Prairie Mountain cannot be more than 400 or 500 feet thick in type area. Harlton's thickness of 4,300 feet in Tuskahoma syncline is believed to be too great. Maximum thickness less than 2,000 feet in Kiamichi Range. Mississippian (Meramecian and Chesterian).

Type locality: In Prairie Mountain, located in center of sec. 25, T. 1 S., R. 12 E., Atoka County.

Prairie River Granite[1]

Precambrian: Northeastern Minnesota.

Original reference: G. E. Culver, 1894, Minnesota Geol. Nat. History Survey 22d Ann. Rept., p. 102–114.

Exposed in SE¼SE¼ sec. 32, sec. 33, and sec. 34, T. 56, R. 25, Itasca County.

Prairie Rock Limestone[1]

Upper Cretaceous: Mississippi.

Original references: E. C. Eckel, 1905, U.S. Geol. Survey Bull. 243, p. 206–219; A. F. Crider, 1905, U.S. Geol. Survey Bull. 260, p. 510–521.

Quarried on southwest side of Bogue Chitto Creek, Neshoba and Kemper Counties; one-half mile east of Prairie Rock.

Prallsville Member (of Stockton Formation)

[Upper] Triassic: West-central New Jersey.

M. E. Johnson and D. B. McLaughlin, 1957, Geol. Soc. America Guidebook Atlantic City Mtg., p. 53 (table). Shown on stratigraphic table as Lower Prallsville member and Upper Prallsville member, each consisting of thick-bedded medium to coarse arkose with red sandstone interbeds and separated one from the other by 136 feet of red and brown sandstone and red shale. Thickness of Lower Prallsville 474 feet, of Upper Prallsville 205 feet. Prallsville may or may not include overlying 373 feet of red and brown sandstone and underlying 447 feet of red sandstone [see Stockton formation]. Older than Cutalossa member (new); younger than Solebury member (new).

In area along Delaware River from Stockton northward to 3 miles west of Milford, Hunterdon County.

Pratt Ferry Formation

Middle Ordovician (Mohawkian): Central Alabama.

G. A. Cooper, 1956, Smithsonian Misc. Colln., v. 127, pt. 1, p. 75, 85–86, chart 1 (facing p. 130). Name proposed for somewhat bituminous calcarenite occurring in layers up to 4 inches or more in thickness. Total thickness about 8 feet. Underlies black shale of Columbiana formation (new); overlies limestone mapped as Lenoir but which had faunal similarities to Little Oak formation. Name attributed to B. N. Cooper and G. A. Cooper.

Occurs 0.2 mile southeast of Pratt Ferry.

**Pratt Point Member** (of Little Sitkin Dacite)

Quaternary: Southwestern Alaska.

G. L. Snyder, 1959, U.S. Geol. Survey Bull. 1028–H, p. 182, pl. 23. A body of obsidian (chemically a rhyodacite). Rhyodacite ranges from light-gray to white glass, has many plagioclase and few pyroxene and hornblende phenocrysts, ranges from slightly to very vesicular, and, locally, contains small pink devitrification spherulites. Contact with surrounding low-silica dacite of Little Sitkin dacite extremely complex—apparently they were extruded contemporaneously from same vent.

Type locality: On north side of Pratt Point along coast of Little Sitkin Island, in Rat Islands group of Aleutian Islands. A long narrow body from 200 to 700 feet wide and about 2 miles long that extends from rim of Little Sitkin crater to coast north of Pratt Point.

Prattsburg Sandstone and Shale[1]

Upper Devonian: Western New York.

Original reference: J. M. Clarke, 1903, New York State Mus. Handb. 19, p. 25 and chart.

G. A. Cooper and others, 1942, Geol. Soc. America Bull., v. 53, no. 12, pt. 1, chart 4. Table shows sandstone as youngest unit of Chemung stage in Canandaigua Lake area. Underlies Dunkirk shale; overlies Nunda sandstone.

Named for occurrence at Prattsburg, Steuben County.

**Praysville Porphyry**[1]

Precambrian (Keweenawan) : Northern Michigan.

Original reference: R. D. Irving, 1883, U.S. Geol. Survey Mon. 5, p. 81, 176, 177.

Occurs on Old Suffolk mining location, Praysville, Keweenaw Point.

**Preble Formation**

Middle or Upper 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]. Schist, slate, and hornfels with crystaline limestone lenses a few hundred feet to over a mile long in lower part, partly dolomitized. Thickness at type locality may exceed 15,000 feet. In Winnemucca quadrangle, Cambrian(?) Osgood Mountain quartzite (new) and Preble formation are in thrust contact with other Paleozoic formations; in Golconda quadrangle, the Preble is apparently in normal contact with Ordovician Comus formation and is overlain unconformably by formations of Pennsylvanian age.

Type locality: Emigrant Canyon, near Preble Station, Golconda quadrangle.

**Prescott Diorite**[1]

Upper Carboniferous or post-Carboniferous: Western central Massachusetts.

Original reference: B. K. Emerson, 1898, U.S. Geol. Survey Mon. 29, pl. 34.

Comprises Packard Mountain in Prescott, Hampshire County.

**Presidio Formation** (in Trinity Group)[1]

Lower Cretaceous (Comanche Series) : Western Texas.

Original reference: J. A. Udden, 1904, Texas Univ. Min. Survey Bull. 8, p. 10, 11, 25–30.

C. P. Ross, 1943, U.S. Geol. Survey Bull. 928–B, p. 66–78, pl. 7. Five subdivisions recognized (ascending) : basal unit, 50 to 90 feet thick, of soft marl, clay, thin-bedded arenaceous limestone, calcareous sandstone and shell breccia; a conglomerate unit, 90 to 120 feet; tripartite unit, about 95 feet thick, of medium-bedded to massive limestone, calcareous sandstone, thin-bedded limestone, in part arenaceous, thin beds of shell breccia composed mainly of *Ostrea* sp. and a fairly massive sandstone, in part arenaceous; shell-breccia unit 110 to 165 feet thick; and cap rock of arenaceous limestone 30 feet thick. Underlies Shafter limestone (restricted) ; overlies Permain (Cibolo formation). Trinity age.

Named for exposures west of shaft of Presidio Mining Co., Presidio County.

**Presque Isle Granite**[1]

Precambrian (pre-Animikie) : Northwestern Michigan.

Original reference: R. C. Allen and L. P. Barrett, 1915, Jour. Geology, v. 23, p. 697.

N. K. Huber, 1959, Econ. Geology, v. 59, no. 1, p. 85 (table 1). Considered to be pre-Animikie (pre-Huronian of older reports).

Named for Presque Isle River.

Presque Isle Series[1]

Middle Devonian: Northeastern Michigan.

Original reference: 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. Presque Isle series or stage and its synonym, Long Lake series, are abandoned.

Occurs in Presque Isle and Alpena Counties. Derivation of name not stated.

Presque Isle Volcanics

Precambrian: Michigan and Wisconsin.

T. E. Hendrix, 1960, Dissert. Abs., v. 21, no. 3, p. 594. Incidental mention in discussion of structural history of East Gogebic Iron Range.

†Preston Formation (in Washita Group)[1]

Lower Cretaceous (Comanche Series): Northeastern Texas.

Original reference: R. T. Hill, 1894, Geol. Soc. America Bull., v. 5, p. 302, 303, 326.

Named for Preston, Grayson County.

**Preston Gabbro**[1]

Carboniferous or post-Carboniferous: Southeastern Connecticut.

Original reference: H. E. Gregory, 1906, Connecticut Geol. Nat. History Survey Bull. 6, p. 74, 115, 153, map.

John Rodgers and others, 1956, Preliminary geological map of Connecticut (1:253,440): Connecticut Geol. Nat. History Survey. Mainly massive dark-green to purple or black medium- to coarse-grained gabbro, locally porphyritic. Dark speckled quartz-bearing gabbro at western border. Locally converted to coarse amphibolite by shearing; mylonite at contact. Pre-Triassic.

C. B. Sclar, 1958, Connecticut Geol. Nat. History Survey Bull. 88, p. 85–124, map. Preston gabbro is irregular plutonic mass approximately 18 square miles in area. Field evidence suggests that the gabbro is laccolithic mass whose floor is eastern contact and whose roof is western contact, respectively, of gabbro with Putnam gneiss. At least six distinct facies present.

Crops out in Preston Township, New London County.

Preston Hornblende Diorite[1]

Upper Paleozoic(?): Northwestern California.

Original reference: J. H. Maxson, 1933, California Jour. Mines and Geology, v. 29, nos. 1–2, p. 128, map.

J. C. O'Brien, 1952, California Jour. Mines and Geology, v. 48, no. 4, p. 265. Commonly a fine-grained gray rock closely cut by quartz veins. Green hornblende more characteristic than brown, though both are present. Intruded by Siskiyou granodiorite. Late Paleozoic(?).

Named for occurrence in Preston Peak, Siskiyou County.

Preston Limestone (in Wabaunsee Group)[1]

Pennsylvanian: Southeastern Nebraska.

Original reference: G. E. Condra and N. A. Bengston, 1915, Nebraska Acad. Sci. Pub., v. 9, no. 2, p. 16, 26, 28.

G. E. Condra and E. C. Reed, 1943, Nebraska Geol. Survey Bull. 14, p. 45. Preston limestone formation was named to include two limestones separated by a shale. This formation lies between the Willard and Auburn shales. When it was found that these beds represent the "Emporia" of older Kansas surveys, the Nebraska Survey accepted and used name Emporia for a few years, that is, until it was discarded by Moore (1936, Kansas Geol. Survey Bull. 22), when he revived names Elmont and Reading, gave the name Harveyville to shale located between these limestones, and ranked the three divisions each as formations. Although the authors [Condra and Reed] believe that these units represent only members of the Preston limestone their formational rank is accepted, and name Preston limestone is dropped.

Type locality: Near railroad bridge, west of Preston, Richardson County.

Presumpscot Formation

Pleistocene, upper: Southwestern Maine.

A. L. Bloom, 1959, Late Pleistocene changes of sea level in southwestern Maine: New Haven, Conn., Yale Univ., Dept. Geology, p. 55–80. Proposed for the late Pleistocene marine silty clay of southwestern Maine. Thickness 0 to more than 110 feet. Thickness changes rapidly within short distances as formation was deposited on surface of considerable relief. Overlies bedrock, till, or stratified drift.

Named from exposures in valley of Presumpscot River in cities of Portland and Westbrook and adjoining township of Falmouth; no single type section can be given.

Prettymarsh Diorite

Devonian: Southeastern Maine.

G. H. Chadwick, 1942, (abs.) Geol. Soc. America Bull., v. 53, no. 12, pt. 2, p. 1796, 1797. Referred to as diorite and coeval diabase in list of formations. Older than Cadillac granite; younger than Ireson felsite. Devonian (post-Lower Devonian).

G. H. Chadwick, 1944, New York Acad. Sci. Trans., ser. 2, v. 6, no. 6, p. 174, 176, 177. Described as trap or "black granite." Occurs in form of cupolas, chonoliths, laccoliths, and dikes. Texture variable; large masses very coarse grained.

Occurs on Mount Desert Island and nearby islands, Hancock County.

Pretty Meadow Glacial Stage

Pleistocene (Illinoian?): North-central Colorado.

R. L. Ives, 1953, Geog. Rev., v. 43, no. 2, p. 235–237, 238, 249 (table). Time covered by the deposition of the Pretty Meadow moraines. Glaciation also evidenced by a large abandoned melting basin, now known as Pretty Meadow, a smaller melting basin to the north, and several glacially smoothed surfaces at high levels near crest of main range. Older than Albion glacial stage (new).

In Silver Lake Valley near head of Boulder Creek in Boulder County.

Pretty Run sandstone facies (of Logan Formation)

Mississippian (Osage): Central Ohio.

F. T. Holden, 1941, Illinois Acad. Sci. Trans., v. 34, no. 2, p. 172–173; 1942, Jour. Geology, v. 50, no. 1, p. 54 (fig. 3), 55–60. One of three facies distinguished in the formation. Includes Rushville shale, Vinton sandstone, Allensville conglomerate, Byer sandstone, and Berne conglomerate members; only latter four present at type locality. Lies to east of Scioto Valley shale facies.

Type locality: SE sec. 22, NE sec. 26, and NW sec. 25, T. 10 N., R. 19 W., Vinton County. Facies extends from eastern Scioto County northward into Wayne and Medina Counties.

**Preuss Sandstone[1] or Redbeds**

Upper Jurassic: Southeastern Idaho, north-central Utah, and western Wyoming.

Original reference: G. R. Mansfield and P. V. Roundy, 1916, U.S. Geol. Survey Prof. Paper 98, p. 76, 81.

H. D. Thomas and M. L. Krueger, 1946, Am. Assoc. Petroleum Geologists Bull., v. 30, no. 8, p. 1276 (fig. 8), 1277–1278, 1280 (fig. 10), strat. sections. Preuss redbeds present in western Uinta Mountains where they underlie Stump sandstone and overlie Twin Creek limestone. Measured sections show thicknesses of 669, 858, and 1,196 feet. East of Lake Fork, replaced by crossbedded Entrada sandstone.

R. W. Imlay, 1952, Am. Assoc. Petroleum Geologists Bull., v. 36, no. 9, p. 1735–1753. Includes Wolverine Canyon limestone member (new), in Bingham County area, Idaho. Origin and distribution discussed.

Named for Preuss Creek in northeastern part of Montpelier quadrangle, about 12 miles northeast of Montpelier, Idaho. Occurs mainly in area of thrust faulting along Idaho-Wyoming border and in north-central Utah, extending from southern end of Teton Mountains west of Jackson, Wyo., southward to southern end of central Wasatch Mountains near Thistle, Utah.

Prewitt Sandstone Member (of Morrison Formation)

Upper Jurassic: Northwestern New Mexico.

C. T. Smith, 1951, *in* New Mexico Geol. Soc. Guidebook 2d Field Conf., p. 13 (chart), 38. Massive conglomeratic crossbedded sandstone. Overlies Chavez member (new); underlies Brushy Basin member.

C. T. Smith, 1954, New Mexico Bur. Mines Mineral Resources Bull. 31, p. 16–17, pl. 1. Brown-weathering massive coarse-grained light-pinkish-red conglomeratic sandstone; near base is 4-foot purplish siltstone similar to underlying Chavez member; a similar purplish siltstone with great range of thickness occupies central part of member for many miles. Thickness 185 to 190 feet in type section (herein designated). Stratigraphic interval of Westwater Canyon sandstone member of Morrison in southeastern Utah and northeastern Arizona is approximately equivalent to position of the Prewitt in Thoreau quadrangle; some investigators have extended Westwater Canyon sandstone member into Thoreau quadrangle and applied it to all of sandy facies in upper part of Morrison.

J. A. Momper and W. W. Tyrrell, Jr., 1957, Four Corners Geol. Soc. Guidebook 2d Field Conf., p. 23. Upper Jurassic.

Type section: South of Mount Powell in western part of Thoreau quadrangle in sec. 9. T. 14 N., R. 13 W. Named for exposures along cliffs north of U.S. Highway 66, north of Prewitt, McKinley County.

**Price Sandstone,[1] Formation, or Siltstone**

Mississippian: Southwestern Virginia.

Original reference: M. R. Campbell, 1894, Geol. Soc. America Bull., v. 5, p. 171, 177, pl. 4.

A. K. Miller, 1936, Jour. Paleontology, v. 10, no. 1, p. 69–72. At least lower part of Price formation is Kinderhook in age. Determination made on basis of goniatite specimen.

Charles Butts, 1940, Virginia Geol. Survey Bull. 52, pt. 1, p. 336–350. Names Price and Pocono are practically synonymous. Name Pocono is applied in northern Virginia as far south as Alleghany County. Name Price is applied throughout region from southern Alleghany and western Botetourt Counties to Tennessee. Thicknesses: about 300 feet at Cumberland Gap and Little Stone Gap, Wise County; about 1,000 feet, Pine Mountain; 1,700 feet in Brush and Price Mountains; about 600 feet in Bland and Smyth Counties. Includes Cloyd conglomerate member (new). Underlies Maccrady formation (restricted).

B. N. Cooper, 1948, Jour. Geology, v. 56, no. 4, p. 258, 259. Supposed Osagean age of all of Price formation can no longer be affirmed. Although Keokuk age of upper part of Price seems reliably indicated, the lower parts of formation which contain fossils of early New Providence and Cuyahoga are probably Kinderhookian.

L. D. Harris and R. L. Miller, 1958, U.S. Geol. Survey Geol. Quad. Map GQ–111. Price siltstone, in Duffield quadrangle, consists of about 400 feet of pale-olive to greenish-gray siltstone, which weathers to light olive gray; contains some interbedded shale. In other regions where Price is apparently coarser grained, it has been referred to as sandstone. Occurs above Big Gap siltstone and below Maccrady shale. Mississippian.

Named for Price Mountain, Montgomery County.

**Price River Formation** (in Mesaverde Group)[1]

Upper Cretaceous: Central and central eastern Utah and central western Colorado.

Original reference: E. M. Spieker and J. B. Reeside, Jr., 1925, Geol. Soc. America Bull., v. 36, p. 445.

D. J. Fisher, 1936, U.S. Geol. Survey Bull. 852, p. 8–9 (table), 14. Traced eastward from Price River Canyon above Castle Gate, formation thickens greatly, and beyond Price River is divisible into four members (ascending): Castlegate sandstone, Sego sandstone, Neslen coal-bearing member (new), and Farrer non-coal-bearing member (new).

S. C. Schoff, 1938, Ohio State Univ. Abs. Doctors' Dissert. 25, p. 379. Underlies North Horn formation (new) in central Utah.

E. M. Spieker, 1946, U.S. Geol. Survey Prof. Paper 205–D, p. 130–132, fig. 15. Age fixed as Montana and probably late Montana. Unconformably overlies progressively older rocks from east to west.

E. M. Spieker, 1949, Utah Geol. Soc. Guidebook 4, p. 23–26. On west side of Wasatch Plateau, formation almost entirely conglomerate ranging from few tens of feet to over 2,000 feet in thickness. Conglomerate mostly gray to buff, but in northern part of Plateau and in Cedar Hills it is locally red. Unconformably overlies Indianola group.

H. E. Wheeler and V. S. Mallory, 1953, Am. Assoc. Petroleum Geologists Bull., v. 37, no. 10, p. 2413 (fig. 2), 2417. Includes Buck shale member in Colorado and Utah.

R. E. Hunt, 1954, Am. Assoc. Petroleum Geologists Bull., v. 38, no. 1, p. 120. Overlies South Flat formation (new) in northern part of Gunnison Plateau. Thins and disappears westward in Chicken Creek Canyon and North Maple Canyon.

R. G. Young, 1955, Geol. Soc. America Bull., v. 66, no. 2, p. 186–188, figs. 2, 3, pl. 3. Comprises a western (Farrer) facies and an eastern (Neslen) facies. Members included in Neslen facies are (ascending) Castlegate, Sego, Corcoran (new), Cozzette (new), and Cameo (new). Geographically extended to Colorado. Thickness ranges from about 1,000 to 2,000 feet at western end of Book Cliffs in Utah and from 1,000 to 2,500 feet in western Colorado.

J. D. Fisher, C. E. Erdmann, and J. B. Reeside, Jr., 1960, U.S. Geol. Survey Prof. Paper 332. p. 11 (table), 13, 14, pls. Restricted at base by removal of Castlegate sandstone which is herein raised to formation rank. Price River (restricted) extends eastward from type locality. South of type locality, it is widespread; to the west, it extends beyond divide between Price River and Spanish Fork of Provo River to valley of Spanish Fork where it forms part of a series of coarse-grained conglomerate beds. In western Book Cliffs, formation is sequence of gray shale beds, about 530 feet thick at Horse Creek. In western Book Cliffs, includes Bluecastle sandstone member at top.

Named for exposures in Price River Canyon, northwest of town of Castlegate, Utah, in Book Cliffs.

**Prichard Slate[1] or Formation[1]**

Precambrian (Belt Series) : Northern Idaho and northwestern Montana.

Original reference: F. L. Ransome, 1905, U.S. Geol. Survey Bull. 260, p. 277–285.

F. L. Ransome and F. C. Calkins, 1908, U.S. Geol. Survey Prof. Paper 62, p. 29–32, pl. 11. Mostly argillite, blue-black to blue-gray, commonly showing distinct and regular banding. Considerable interbedded gray indurated sandstone. Upper part characterized by numerous alternations of argillaceous and arenaceous layers, and by shallow-water features. Thickness about 8,000 feet. Base not exposed. Underlies Burke formation.

C. P. Ross, 1949, (abs.) Washington Acad. Sci. Jour., v. 39, no. 3, p. 111, 112. Exposed at intervals from northwest corner of Montana to vicinity of Philipsburg, Mont.

R. E. Wallace and J. W. Hosterman, 1956, U.S. Geol. Survey Bull. 1027–M, p. 578–579, pl. 48. Described in western Mineral County, Mont. Contact with Burke and Revett formations undifferentiated is gradational. From junction of Clark Fork and Flathead Rivers southwest to Paradise Ferry across Clark Fork River, an airline distance of 5½ miles, an almost continuous section of the Prichard is exposed in Canyon walls of Clark Fork River and in railroadcuts and roadcuts along the canyons. Discounting unidentified faults, this section is nearly 17,000 feet thick. A few apparently minor faults were identified northeast of the ferry, and top of the section is truncated by a major fault.

J. W. Hosterman, 1956, U.S. Geol. Survey Bull. 1027–P, p. 728, pl. 57. In Murray area, Idaho, formation divided into two mappable units. Lower unit consists of about 75 to 80 percent dark-gray argillite and 20 to 25 percent light-brownish-gray fine-grained impure quartzites. Base of unit not exposed in area, but observed thickness in Bear Gulch about 9,000 feet. Upper unit forms transition zone between lower part and overlying Burke formation. Contains quartzite and argillite in roughly a 2 to 1 ratio. Quartzite ranges from thin bedded, impure, and greenish gray near base to thick bedded, pure, and light gray to white near top. Argillite is thinly laminated; dark-gray fine-grained material alternates with light-gray coarser grained material. Thickness of unit on ridge running northwest from Goose Peak about 1,800 feet.

Occupies almost entire drainage basin of Prichard Creek, Coeur d'Alene district, Idaho.

Prickly Pear Member (of Spokane Formation)

Precambrian (Belt Series) : Western Montana.

C. L. Fenton, and M. A. Fenton, 1937, Geol. Soc. America Bull., v. 48, no. 12, p. 1877, 1878, 1898. Occurs in typical Meagher facies (new) of Belt series. Contains argillites interbedded with sandstones and lenticular conglomerates. Mud cracks and ripple marks common. Thickness 3,000 to 4,500 feet. Underlies Empire member and overlies Greyson member.

Typical Meagher facies interpreted to be exposed along Prickly Pear Creek and in Belt Mountains, central western Montana.

**Prida Formation** (in Star Peak Group)

Middle 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]. Lithology variable; basal beds locally quartzitic sandstone, elsewhere conglomerate or coarse fanglomerate; above is 50 to 100 feet of interbedded clastics and brown dolomite and shale, then 100 to 200 feet of dark calcareous shale and thin-bedded limestone; at top thicker-bedded limestone. Average thickness about 250 feet. Unconformably overlies Koipato formation; conformably underlies Natchez Pass formation (new).

R. E. Wallace and others, 1959, U.S. Geol. Survey Mineral Inv. Field Studies Map MF–220. Lower formation in Star Peak group. In Buffalo Mountain quadrangle, overlies Weaver rhyolite of Koipato group, angular unconformity; underlies Natchez Pass formation. Middle Triassic.

Type locality: East Range west of Prida Ranch, Winnemucca quadrangle.

Pride Shale (in Bluestone Formation)[1]

Pride Shale Member (of Bluestone Formation)

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

Original reference: D. B. Reger, 1926, West Virginia Geol. Survey Rept. Mercer, Monroe, and Summers Counties, p. 294, 325.

B. N. Cooper, 1944, Virginia Geol. Survey Bull. 60, p. 182, pl. 15. Redefined and renamed as member of Bluestone formation. In Burkes Garden quadrangle, Virginia, is basal member of formation. Average thickness about 100 feet. Underlies Pipestem shale member; overlies Princeton sandstone.

Type locality: At base of Bent Mountain, just south of Pride, Mercer County, W. Va.

**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. At type locality, consists of relatively thick units of shale that alternate with thinner units of limestone, sandstone, and siltstone. Has maximum thickness of about 325 feet in Tishomingo County, Miss.; thins eastward to about 150 feet in eastern Lawrence County, Ala. In Colbert County, Ala., and Tishomingo County, Miss., formation is divisible into several members on basis of the alternation of sandy beds with beds of calcareous shale and limestone (ascending): Alsobrook, Tanyard Branch (new), Wagnon (new), Southward Spring sandstone, Sandfall (new), Mynot sandstone (new), and Green Hill (new). Southward Spring sandstone member not present at type locality. Underlies Hartselle sandstone; overlies Tuscumbia limestone.

Type locality: About 2 miles east of Pride, Ala., and ½ mile south of U.S. Highway 72 in SE¼ sec. 15, T. 4 S., R. 12 W. Named for exposure in roadcuts on northeastern slope of Pride Mountain in north-central Colbert County.

Priest Granite

Precambrian: Central New Mexico.

J. T. Stark and E. C. Dapples, 1946, Geol. Soc. America Bull., v. 57, no. 12, pt. 1, p. 1138–1139. Coarse-grained rock composed chiefly of pink feldspar, quartz, and biotite. There are numerous irregular areas of pegmatite with gradational borders into finer grained granite. Contains many xenoliths of schist. Xenoliths of quartzites less common.

Named for occurrence at Priest Peak in Manzano Mountain. Forms northern abutment of belts of Sais quartzite and Blue Springs schist 1 mile north of Abo Pass and continues northward into heart of Manzano Mountains.

Priest Canyon Member (of Fremont Formation)

Upper Ordovician (Richmond): Central Colorado.

W. C. Sweet, 1954, Am. Assoc. Petroleum Geologists Bull., v. 38, no. 2, p. 295–296, 302. Sequence of thin-bedded argillaceous fine-grained dolomite which overlies massive dolomite member throughout central part of outcrop area. In Canon City region, a persistent 4- to 8-foot bed of very finely laminated cherty dolomitic shale occurs at base of member, but not present in sections west of Canon City region. Thickness of 211 feet in Kerber Creek area near head of San Luis Valley, only 75 feet at type section, and becomes thinner on both north and south. Gradational contact with lower member; unconformably underlies Williams Canyon formation.

Type locality: In Priest Canyon, sec. 13, T. 18 S., R. 71 W., Fremont County.

Priest Hill Granite[1]

Upper Devonian: Northwestern New Hampshire.

Original reference: M. P. Billings and C. R. Williams, 1935, Geology of Franconia quadrangle, New Hampshire, p. 9.

C. R. Williams and M. P. Billings, 1938, Geol. Soc. America Bull., v. 49, no. 7, p. 1023. Considered to belong to New Hampshire magma series, which is probably late Devonian. Considered younger than Bethlehem gneiss and Kinsman quartz monzonite, but older than Bickford granite.

Exposed on Priest Hill, Franconia quadrangle.

**Priest Pass Leucomonzonite**

Priests Pass Leucomonzonite

Upper Cretaceous: Southwestern Montana.

Adolph Knopf, 1957, Am. Jour. Sci., v. 255, no. 2, p. 81, 94–95, map facing p. 88. Monzonitic composition, nearly devoid of quartz, has only moderate content of biotite and hornblende.

Occurs at Priests Pass [Priest Pass, correct spelling], just south of Mullan Pass, Lewis and Clark and Powell Counties.

**Priest River Group**

Priest River terrane[1]

Precambrian: Northwestern Idaho and northeastern Washington, and southern British Columbia, Canada.

Original reference: R. A. Daly, 1912, Canada Geol. Survey Dept. Mines Mem. 38, maps 6, 7, 116°30′ to 117°30′.

C. F. Park, Jr., and R. S. Cannon, Jr., 1943, U.S. Geol. Survey Prof. Paper 202, p. 6, pl. 1. Group is complex sequence of metamorphic rocks that includes phyllites and schists, limestones, dolomites, quartzites, and volcanics in Metaline quadrangle, Washington. Underlies Shedroof conglomerate (new).

Outcrops at and to east of headwaters of Priest River, Idaho.

†Prieta Sandstone[1]

Upper Cretaceous: Central northern New Mexico.

Original reference: C. L. Herrick and D. W. Johnson, 1900, New Mexico Univ. Bull., v. 2, pt. 1, p. 3–63.

In Albuquerque quadrangle. Derivation of name not stated.

Primrose Sandstone (in Springer Group)

Primrose Sandstone Member (of Golf Course Formation)

Primrose Sandstone Member (of Springer Formation)[1]

Pennsylvanian: Central southern Oklahoma.

Original reference: E. Roth, 1928, Econ. Geology, v. 23, p. 45.

B. H. Harlton, 1938, Am. Assoc. Petroleum Geologists Bull., v. 22, no. 7, p. 854 (fig. 1), 900–901. Harlton (1934, Am. Assoc. Petroleum Geologists Bull., v. 18, no. 8) proposed to subdivide Wapanucka into basal, middle, and upper units. It is now proposed to apply names Primrose and Limestone Gap (new) formations to unit designated as basal Wapanucka. Included by Taff (1902, U.S. Geol. Survey Geol. Atlas, Folio 79) in Chickachoc chert lentils. In frontal Ouachitas and north of Arbuckles, overlies Union Valley sandstone and underlies Limestone Gap shale. North of Arbuckles, Primrose has been known as Union Valley limestone. South of Arbuckles, overlies Lake Ardmore and underlies Limestone Gap shale. Springer group, Morrow series; Morrow is here included in the Bendian.

R. C. Moore and others, 1944, Geol. Soc. America Bull., v. 55, no. 6, chart 6 (column 37). Shown on correlation chart as Primrose sandstone in Springer group.

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), 97–99. In southern Arbuckles, underlies Gene Autry shale (new). Morrow series.

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. Reallocated to member status at base of Golf Course formation (new). In Dornick Hills group.

Named for Primrose Ridge, in sec. 7, T. 4 S., R. 2 E., on which stand buildings of Primrose dairy farm.

**Prince Creek Formation** (in Colville Group)

Upper Cretaceous: Northern Alaska.

George Gryc, W. W. Patton, Jr., and T. G. Payne, 1951, Washington Acad. Sci. Jour., v. 41, no. 5, p. 160 (table 1), 166–167, fig. 2. Includes all nonmarine beds above top of Niakogon tongue (new) of Chandler formation (new) and intertongues with marine Schrader Bluff formation (new). Like the Chandler, it is made up of sandstone, conglomerate, shale, and coal, but contains more bentonite and tuff than does the Chandler. Separated into Tuluvak tongue (new) below and Kogosukruk tongue (new) above. Underlies Sagavanirktok (new) and Gubik formations.

R. M. Chapman and E. G. Sable, 1960, U.S. Geol. Survey Prof. Paper 303–C, p. 69, 70, 126–127, pls. Exposures of formation in Utukok-Corwin region are restricted to cutbacks in Arctic coastal plain province and north edge of northern foothills section along Utukok and Kokolik Rivers, where they form dark-gray vertical cliffs. Formation includes sandstone, conglomerate, ironstone, coal, bentonitic clay, shale, and claystone. Total thickness not known. Maximum exposed thickness about 93 feet. Overlies Corwin formation; unconformably underlies unconsolidated deposits of Quaternary age.

Type locality: Prince Creek, a tributary to Colville River.

**Princes Anne Formation** (in Columbia Group)[1]

Pleistocene: Eastern Virginia, eastern Maryland, and eastern North Carolina.

Original reference: C. K. Wentworth, 1930, Virginia Geol. Survey Bull. 32, p. 81.

S. W. Lohman, 1936, U.S. Geol. Survey Water-Supply Paper 773, p. 13. Surface of Pasquotank and Camden Counties, in vicinity of Elizabeth City, N.C. is underlain by fine sands and sandy loams of the undifferentiated Pamlico and Princess Anne formations, which are lowermost terrace deposits along Atlantic coast and are youngest formations of Columbia group. Terrace deposits conceal marine beds of Pleistocene and Pliocene age or both.

Named for typical occurrence at village of Princess Anne, Princess Anne County, Va.

†Princeton Limestone[1]

Mississippian: Western Kentucky.

The original use of this name is said to be by Ulrich in Crittenden Press, Dec. 1890. This publication is not in U.S. Geological Survey Library nor in Library of Congress.

Probably named for Princeton, Caldwell County.

Princeton Quartz Monzonite[1]

Tertiary: Central Colorado.

Original reference: R. D. Crawford, 1913, Colorado Geol. Survey Bull. 4, p. 78.

M. G. Dings and C. S. Robinson, 1957, U.S. Geol. Survey Prof. Paper 289, p. 25. Now designated Mount Princeton quartz monzonite.

Named for Mount Princeton, north of Monarch-Tomichi district.

**Princeton Sandstone** (in Pennington Group)

Princeton Sandstone[1]

Upper Mississippian: Southern West Virginia and southwestern Virginia.

Original reference: M. R. Campbell and W. C. Mendenhall, 1896, U.S. Geol. Survey 17th Ann. Rept., pt. 2, p. 487, 489.

B. N. Cooper, 1944, Virginia Geol. Survey Bull. 60, p. 180–181, pl. 15. Described in Burkes Garden quadrangle where it is about 30 to 50 feet thick, overlies Pennington formation, and underlies Bluestone formation.

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 the Pennington herein raised to group rank. Overlies Hinton formation; underlies Bluestone formation. Thickness about 50 feet in Duffield quadrangle, Virginia.

Named for Princeton, Mercer County, W. Va.

Princeton Series[1]

Precambrian (upper Huronian): Northwestern Michigan.

Original reference: R. C. Allen, 1914, Jour. Geology, v. 22, p. 571.

Named for Princeton mine, Gwinn district, Marquette County.

**Pringle Andesite**[1]

Tertiary: Central southern Colorado.

Original reference: W. Cross, 1890, Colorado Sci. Soc. Proc., v. 3, pt. 3, p. 276.

J. W. Gabelman, 1953, Econ. Geology, v. 48, no. 3, p. 197. In Silver Cliff-Rosita region, the volcanics, in order of decreasing age, consist of Rosita fragmental andesite, Bunker massive andesite, Fairview diorite in dike cutting earlier andesite, Bald Mountain dacite flows, rhyolite in dikes, eruptive channels and flows, Pringle andesite, trachyte flows, and Bassick agglomerate.

Forms upper part of Pringle Hill, west of Rosita, Silver Cliff-Rosita region.

**Proctor Dolomite**[1]

Upper Cambrian: Central and eastern Missouri.

Original reference: A. Winslow, 1894, Missouri Geol. Survey, v. 6, p. 331, 366.

Josiah Bridge, 1937, U.S. Geol. Survey Prof. Paper 186–L, p. 236. Considered to be upper part of Eminence formation in certain areas.

Named for exposures on Proctor Creek, Morgan County.

Proctor Sandstone (in Greene Formation)[1]

Permian: Northern West Virginia.

Original reference: I. C. White, 1883, The Virginias, v. 4, p. 124.

R. L. Nace and P. P. Bieber, 1958, West Virginia Geol. Survey Bull. 14, p. 17 (table 2). Proctor sandstone in Greene formation listed in summary of stratigraphic sections of Dunkard group in Harrison County. Thickness 45 to 65 feet (full thickness not present). Overlies Windy Gap limestone.

Thomas Arkle, Jr., 1959, Geol. Soc. America Guidebook Pittsburgh Mtg., p. 118 (table 1). Lower, Middle, and Upper Proctor sandstone listed at top of Greene series.

Named for occurrence below mouth of Proctor Creek, just south of Marshall-Wetzel County line.

Prospect Formation

Pleistocene: South-central Indiana.

H. H. Gray, R. D. Jenkins, and R. M. Weidman, 1960, Indiana Geol. Survey Bull. 20, p. 19 (fig. 3), 20–21, pl. 1. Silts, sands, and fine gravels similar to Martinsville formation (new) but more deeply weathered. Occurs as eroded terraces 20 to 50 feet above flood plain of present streams. Exposed thickness about 30 feet. Thickness 18 feet at type section (east of area of this report). Overlies most of bedrock formations of area; underlies parts of Martinsville formation; probably underlies windblown sand facies of Atherton formation (new) and probably intertongues with sand and gravel facies of Atherton. Early Wisconsin, Sangamon, or perhaps Illinoian. Name credited to W. J. Wayne (in preparation).

Type section: Along U.S. Highway 150, just west of village of Prospect, Orange County.

**Prospect Gneiss**

Prospect Porphyritic Gneiss[1]

Ordovician or Devonian: Southwestern Connecticut.

Original reference: H. E. Gregory, 1906, Connecticut Geol. Nat. History Survey Bull. 6, p. 59, 102–104, map.

John Rodgers and others, 1956, Preliminary geological map of Connecticut (1:253,440): Connecticut Geol. Nat. History Survey; John Rodgers, R. M. Gates, and J. L. Rosenfeld, 1959, Connecticut Geol. Nat. History Survey Bull. 84, p. 16. Age of Prospect gneiss designated pre-Triassic.

M. H. Carr, 1960, Connecticut Geol. Nat. History Survey Quad. Rept. 9, p. 14–17, pl. 1. Restricted to the dark-gray biotite augen gneiss; the interbanded schists are considered part of undifferentiated Hartland formation. Prospect gneiss always found at same stratigraphic position, that is, between The Straits schist member and the quartzitic member of Hartland formation.

Crops out in eastern part of Prospect Township, New Haven County.

†Prospectan series[1]

Cambrian: Nevada.

Original reference: C. R. Keyes, 1923, Pan-Am. Geologist, v. 40, p. 51, 53, 80.

Prospect Hill Formation (in North Hill Group)

Prospect Hill Sandstone Member (of Hannibal Shale)[1]

Prospect Hill Siltstone Member (of Hannibal Formation)

Lower Mississippian: Southeastern Iowa and western Illinois.

Original reference: R. C. Moore, 1928, Missouri Bur. Geology and Mines, v. 21, 2d ser., p. 22, 23–24.

L. A. Thomas, 1949, Geol. Soc. America Bull., v. 60, no. 3, p. 408–409, 410. Referred to as siltstone member of Hannibal formation. Conodont assemblage indicates Lower Mississippian age.

L. E. Workman and Tracey [Tracy] Gillette, 1956, Illinois Geol. Survey Rept. Inv. 189, p. 8 (fig. 1), 30. Included in North Hill group. In this report, name Prospect Hill formation is used for the siltstone that, in Adams and Hancock Counties, occupies stratigraphic position in North Hill group between McCraney limestone (below) and Starrs Cave limestone. Essentially light-gray to buff calcareous pyritic massive siltstone. From eastern limit, thickens westward to maximum of 29 feet.

First described at Prospect Hill, near Burlington, Des Moines County, Iowa.

†Prospect Mountain Limestone[1]

Middle Cambrian: Eastern Nevada.

Original reference: A. Hague, 1883, U.S. Geol. Survey 3d Ann. Rept., p. 253, 254–259.

Named for exposures on Prospect Mountain, Eureka district.

**Prospect Mountain Quartzite**[1]

Lower Cambrian: Eastern Nevada, eastern California, and western Utah.

Original reference: A. Hague, 1883, U.S. Geol. Survey 3d. Ann. Rept., p. 253, 254–259.

Charles Deiss, 1938, Geol. Soc. America Bull., v. 49, no. 7, p. 1139–1140, 1141 (fig. 5), 1142, 1156–1158. In House Range area, Utah, underlies Pioche shale. Thickness about 1,000 feet. In Highland Range, Nev., underlies Pioche shale; thickness about 450 feet.

H. E. Wheeler and D. M. Lemmon, 1939, Nevada Univ. Bull., Geology and Mining Ser., no. 31, p. 17–18, 33, 34. In Eureka district, underlies Eldorado formation; thickness 1,660 feet; base not exposed. In Pioche district, underlies Pioche shale; thickness 2,000 feet; base not exposed.

H. E. Wheeler, 1943, Geol. Soc. America Bull., v. 54, no. 12, pt. 1, 1786, 1788, 1792–1793, 1796–1797, 1808–1811. Prospect Mountain quartzite (Eureka district, Nevada) is present throughout entire region [Great Basin], ranging from Upper Algonkian(?) and Lower Cambrian in eastern Nevada and western Utah to lower Middle Cambrian in northwestern Arizona (Granite Gorge), central Arizona, northwestern Utah, and southeastern Idaho. The quartzite had been locally designated as Tapeats sandstone, Tintic, and Brigham quartzites. In Granite Gorge area, name Prospect Mountain substituted for term Tapeats.

W. H. Easton and others, 1953, Am. Assoc. Petroleum Geologists Bull., v. 37, no. 1, p. 146–147 (fig. 2). On correlation chart of recommended revision of stratigraphic units in Great Basin region, Prospect Mountain quartzite is replaced by Stirling quartzite in Death Valley, Providence Mountains, and Nopah-Resting Springs Mountains, Calif.; by Tapeats sandstone in Grand Canyon; by Tintic quartzite in central Utah; and by Brigham quartzite in southeastern Idaho.

J. C. Hazzard, 1954, California Div. Mines Bull. 170, chap. 4, p. 30–31, pl. 2. In Providence Mountains, replaces preoccupied term Tough Nut quartzite (Hazzard, 1938). Underlies Latham shale (new) which replaces preoccupied term Kelso. Maximum thickness 1,085 feet. Unconformable above Precambrian granite, gneiss, and schist.

F. D. Hewett, 1956, U.S. Geol. Survey Prof. Paper 275, p. 28, 29–31, 36 (fig. 6), pl. 1. Described in Ivanpah quadrangle (California-Nevada) where, together with the Noonday dolomite and Pioche shale, it makes up what is termed western facies of the Cambrian. Well exposed and underlies large areas in broad belt that extends from Clark Mountain 30 miles northwest to hills that lie 10 miles north of Kingston Range. Thickness 3,000 to 5,000 feet.

T. B. Nolan, C. W. Merriam, and J. S. Williams, 1956, U.S. Geol. Survey Prof. Paper 276, p. 6–7. Described in vicinity of Eureka, Nev., where total area of outcrop is about half a square mile. Forms discontinuous hook-shaped band that extends northward from west slope of Prospect Peak to south side of Ruby Hill and then swings southward along east side of ridge nearly to Eureka Tunnel; discontinuity due in part to transgression of outcrop band by Spring Valley fault. Total thickness unknown as base not exposed. Conformable below Pioche shale.

K. F. Bick, 1959, Am. Assoc. Petroleum Geologists Bull., v. 43, no. 5, p. 1065–1066. In Deep Creek Mountains, Utah, stratigraphically restricted below to exclude 3,000-foot sequence of alternating quartzite and shale units here named Goshute Canyon formation. As restricted, Prospect Mountain is 3,000 feet thick and consists completely of quartzite. Underlies Pioche shale (Cabin shale).

J. C. Young, 1960, Intermountain Assoc. Petroleum Geologists Guidebook 11th Ann. Field Conf., p. 159. In Ely area, overlies Piermont group (new).

Named for occurrence in Prospect Peak, Eureka district, Nevada.

Prospect Peak Basalts[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. 682. Cenozoic.

Occur in Lassen National Park.

**Prosperity Limestone Member** (of Greene Formation)[1]

Permian: Southwestern Pennsylvania and southeastern Ohio.

Original references: F. G. Clapp, 1907, U.S. Geol. Survey Bull. 300, p. 13, 128; 1907, U.S. Geol. Survey Geol. Atlas, Folio 144; name suggested by M. J. Munn; 1907, U.S. Geol. Survey Bull. 318, p. 77.

Named for village of Prosperity, Washington County, Pa.

**Prosser Member** (of Galena Dolomite)

Prosser Limestone[1]

Middle Ordovician: Southeastern Minnesota, northwestern Illinois, and northeastern Iowa.

Original reference: E. O. Ulrich, 1911, Geol. Soc. America Bull., v. 22, p. 368, 369, 524, 525, pl. 27.

C. R. Stauffer and G. A. Thiel, 1941, Minnesota Geol. Survey Bull. 29. Member of Galena formation. Underlies Stewartville member; overlies Decorah shale member. Chiefly hard compact drab limestone with subordinate amount of shale; some beds fairly thick, especially in upper middle part; several cherty horizons. Thickness 115 to 120 feet at type section herein designated.

M. P. Weiss, 1955, Jour. Paleontology, v. 29, no. 5, p. 764, 765. In Minnesota, restricted at base to exclude interbedded limestones and shaly limestones here named Cummingsville member of Galena.

M. P. Weiss, 1957, Geol. Soc. America Bull., v. 68, no. 8, p. 1029 (fig. 1), 1037–1039, 1054–1058, pl. 3. Described in Fillmore County, Minn., where it is middle member of Galena formation; overlies Cummingsville member; underlies Stewartville member. First reference to term Prosser was by Winchell and Ulrich (1897, Minnesota Geol. Nat. History Survey Final Rept., v. 3. pt. 2) when they diagrammed and described a section in Galena limestone from Prosser's ravine near Wykoff, Fillmore County, Minn. This section now known to be in valley of Mahood's Creek, and the real Prosser's ravine exposes only 25 feet of uppermost Stewartville rock. Winchell and Ulrich's section is similar to Part F of Mahood's Creek section (pl. 3) of present report, except that lower 37 feet is no longer accessible above mouth of Mahood's Creek. Member name was given by Ulrich (1911) who intended Prosser to be a formational name for a faunal zone. Stauffer and Thiel (1941) described a new measured section from valley of Mahood's Creek at Wykoff, although they still referred to it as Prosser's ravine. From about 180 feet of limestone bounded by *Prasopora* below and upper *Receptaculites* zone above, the Prosser is restricted in this report to limestone lying between very argillaceous limestone below and dolomitic limestone above. Both these boundaries in Fillmore County are delineated arbitrarily. Type section includes good exposure of member but no longer exposes its base. Concept of type section here expanded to include all exposures listed as parts of Mahood's Creek measured section (F192), and these include exposures of entire member with distance of half a mile. Thickness 51 feet at type locality. Toward the southeast, where lower Galena cannot be recognized as Cummingsville, the middle Galena is also unrecognizable as Prosser. The Cummingsville is not a phase or facies of the Galena. Name Prosser, whether restricted or not, is applicable only over relatively small part of upper Mississippi Valley. To give new name to strata in restricted Prosser of Weiss (1955) and present report would require suppression of name Prosser.

Type section (Stauffer and Thiel): Prosser Creek, 2½ miles west of Wykoff, Fillmore County, Minn.

Type section (Weiss): Mahood's Creek section compiled from several exposures in valleys of Spring Valley and Mahood's Creeks from about center of south edge of SE¼ sec. 8 southward to head of Mahood's Ravine along south edge of SE¼ sec. 20, T. 103 N., R. 12 W., Fillmore County.

Prout Limestone[1]

Prout Limestone Member (of Olentangy Shale)

Middle Devonian: Northern Ohio.

Original reference: C. R. Stauffer, 1907, Jour. Geology, v. 15, p. 592.

E. C. Stumm, 1942, Jour. Paleontology, v. 16, no. 5, p. 549–553. Prout limestone and underlying Plum Brook shale form bedrock along an arcuate line running from northeast to southwest through Erie County from Slate Cut, just south of shore of Lake Erie and 4 miles east of Sandusky, to Strong's Ridge, just northeast of Bellevue. The Prout is a hard, siliceous limestone 3 to 9 feet thick. Underlies Ohio shale.

R. E. Metter, 1953, Ohio Geol. Survey Rept. Inv. 18, p. 14. Prout limestone member of Olentangy shale underlies Huron shale in exposure at Slate Cut on U.S. Route 6, three-fourths mile east of new Cedar Point entrance.

K. V. Hoover, 1960, Ohio Geol. Survey Inf. Circ. 27, p. 8–15. Stratigraphic position and correlation of Olentangy shale discussed in detail. It is here suggested that the Olentangy, Plum Brook shale, Prout limestone, Silica shale, and Ten Mile Creek dolomite are stratigraphically correlatable, with reservation that Olentangy is probably Upper Devonian. At various times and by different authors, Plum Brook shale has been correlated with the Olentangy, and the so-called Prout limestone has been regarded as member of Olentangy. Regional information regarding Plum Brook shale-Prout limestone has not been worked out. Thickness of 36 feet for Plum Brook shale and Prout limestone has been reported in its area of outcrop in Erie County.

Type locality: Cut on B. & O. Railroad, 6 miles south of Sandusky and 1 mile north of Prout, Erie County.

Prout Series[1]

Middle Devonian: Northern Ohio.

Original reference: A. W. Grabau, 1915, Geol. Soc. America Bull., v. 26, p. 112.

Probably named for Prout, Erie County.

**Providence Limestone Member** (of Lisman Formation)

Providence Limestone (in McLeansboro Formation)[1]

Providence Limestone Member (of Dugger Formation)

Middle Pennsylvanian: Western Kentucky and west-central Indiana.

Original reference: L. C. Glenn, 1922, Kentucky Geol. Survey, ser. 6, v. 5, p. 98.

E. J. Harvey, 1956, U.S. Geol. Survey Water-Supply Paper 1356, p. 47, 55 (fig. 9), 64, 65, 67. Reallocated to member status in Lisman formation. In Henderson area, consists of gray fossiliferous strata that vary from massive and compact to thin and shaly. Thickness varies—maximum 10 feet. Overlain by No. 12 coal or, in places, by Anvil Rock sandstone member; basal member of formation, overlies No. 11 coal in Carbondale formation.

H. H. Murray, 1955, Indiana Geol. Survey Directory 3, p. 8 (fig. 1). Shown on stratigraphic column as member of Dugger formation in Indiana.

Well exposed in and about Providence, Webster County, Ky.

**Providence Sand** (in Selma Group)

Providence Sand Member (of Ripley Formation)[1]

Upper Cretaceous: Western Georgia and southeastern Alabama.

Original reference: Otto Veatch. 1909, Georgia Geol. Survey Bull. 18, p. 86.

C. W. Cooke and C. A. Munyan, 1938, Am. Assoc. Petroleum Geologists Bull., v. 22, no. 7, p. 791; C. W Cooke, 1943, U.S. Geol. Survey Bull. 941, p. 34–39. Rank raised to formation. Unconformably overlies Ripley formation and transgresses across it in its extension to northeast in Georgia. Overlapped by Paleocene Clayton formation east of Flint River.

D. H. Eargle, 1948, Southeastern Geol. Soc. [Guidebook] 6th Field Trip, p. 44, 51–53; 1950, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 105; 1955, U.S. Geol. Survey Bull. 1014, p. 69–83, pls. 1, 2. Subdivided to include Perote member (new) in lower part. At type locality of Providence, the variegated coarse sand of upper unnamed member is about 144 feet thick and overlies about 40 feet of fossiliferous fine sand of Perote member. In Alabama grades laterally westward into Prairie Bluff chalk. In Alabama, Providence included in Selma group.

Named for exposures on deep gullies at Providence, 8 miles west of Lumpkin, Stewart County, Ga. In Georgia, occurs in broad belt from Chattahoochee River in Clay and Quitman Counties northeastward to Flint River valley in Peach and Macon Counties; farther east, present in outliers in deeper stream valleys as far as Ocmulgee River valley. East of Ocmulgee River cannot be distinguished from underlying Cretaceous formations.

Providence Island Limestone or Dolomite

Lower Ordovician (Canadian) : Northwestern Vermont.

E. O. Ulrich. 1938, *in* E. O. Ulrich and G. A. Cooper, Geol. Soc. America Spec. Paper 13, p. 26, pl. 58 (columns 24, 27). Limestone which underlies Chazyan beds and overlies Cassin formation

R. B. Erwin, 1957, Vermont Geol. Survey Bull. 9, p. 11, 63, 92–93, pls. 1 2. Described on Isle La Motte and South Hero Island as a dark-blue and gray fine-grained generally massive dolomite. At type locality, underlies Day Point limestone. Type locality cited and several exposures described.

Type section said to be on Providence Island in Lake Champlain. Other exposures at extreme end of Isle La Motte and at southwestern end of South Hero Island in Lake Champlain.

Providence Mountains Limestone

Pennsylvanian: Southern California.

J. C. Hazzard, 1938, (abs.) Geol. Soc. America Proc. 1937, p. 240. Listed as underlying Mount Edgar limestone (new), possible unconformity, and overlying Mississippian Monte Cristo limestone, possible unconformity. Thickness 825 feet.

Occurs near Kelso, in Providence Mountains, San Bernardino County.

†Provo Epoch[1]

†Provo Stage[1]

Provo Epoch is name applied to the time during which Lake Bonneville of Utah stood at the Provo Stage.

Terms have been abandoned by U.S. Geological Survey.

**Provo Formation** (in Lake Bonneville Group)

Pleistocene: West-central Utah.

K. C. Bullock, 1951, Utah Geol. and Mineralog. Survey Bull. 41, p. 21–22. Youngest of Lake Bonneville deposits—that is younger than Bonneville and Alpine formations. Divided into four units: gravel, sand, silt, and clay members; stratification and sorting well developed. Name credited to H. J. Bissell (unpub. thesis).

C. B. Hunt, H. D. Varnes, and H. E. Thomas, 1953, U.S. Geol. Survey Prof. Paper 257–A, p. 13, 21–25, pl. 1. Deposited during what Gilbert (1890, U.S. Geol. Survey Mon. 1) called Provo stage. In most of the valley, rests on Alpine formation; locally rests on glacial outwash or on pre-Lake Bonneville deposits. Thickness about 19 feet. Included in Lake Bonneville group.

Well developed at base of Wasatch Mountains in form of terraces, deltas, spits, bars, beaches, and deeper water deposits. Well developed on western side of Lake Mountain.

Pruett Formation (in Buck Hill Volcanic Series)

Pruett Formation (in Green Valley Volcanic Series)

Eocene(?) or Eocene, upper: Western Texas.

S. S. Goldich and M. A. Elms, 1946, (abs.) Geol. Soc. America Bull., v. 57, no. 12, pt. 2, p. 1197. Constitutes lower 900 feet of Green Valley volcanic series. Underlies Cottonwood Spring basalt (new). Includes intercalated lava flows (ascending): Crossen trachyte, Sheep Canyon basalts, and Potato Hill andesite. Overlies Boquillas limestone.

S. S. Goldich and C. L. Seward, 1948, West Texas Geol. Soc. [Guidebook] Oct. 29–31, p. 13, 14 (table 1), 17 (fig. 3), 18–19. Basal unit of Buck Hill volcanic series. [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), 1145–1151, pl. 1. Chiefly tuff, gray to bluish-gray, but variegated and banded in many colors generally well lithified; commonly calcareous grading into fresh-water limestone; upper breccia, 6 feet thick; basal conglomerate and arkosic sandstone; includes intercalated lava flows as noted above. Thickness 900 to 1,000 feet. Unconformable above Boquillas limestone. Eocene(?). Derivation of name given.

W. N. McAnulty, 1955, Geol. Soc. America Bull., v. 66, no. 5, p. 536 (table 1), 542–546, pl. 1. Described in Cathedral Mountain quadrangle. Intercalated lava flows are here treated as separate formations and name Pruett restricted to the tuff, sandstone, conglomerate, and limestone below Crossen trachyte. Thickness between 474 and 798 feet. Vertebrate fossils indicate late Eocene (Duchesne) age.

Named for Pruett Ranch, north-central Buck Hill quadrangle, Brewster County.

**Pryor Conglomerate Member** (of Cloverly Formation)[1]

Lower Cretaceous: Central southern Montana and central northern Wyoming.

Original reference: C. J. Hares; 1917, Washington Acad. Sci. Jour., v. 7, p. 429.

P. W. Richards, 1955, U.S. Geol. Survey Bull. 1026, p. 42–43, pl. 1. Described in Bighorn Canyon, Hardin area, where it is composed of resistant sandstones, commonly with chert-pebble-bearing conglomerates at base. Ranges in thickness from about 30 feet at Soap Creek dome, where it is not conglomeratic, to 150 feet south of mouth of Bighorn Canyon. Occurs at base of formation. Where Pryor is absent, it is difficult to differentiate Cloverly from underlying Morrison.

Ralph Moberly, Jr., 1960, Geol. Soc. America Bull., v. 71, no. 8, p. 1143, 1145, 1147–1148, pl. 1. In this report [northern Bighorn Basin], Cloverly formation is redefined on lithogenetic basis. Name Pryor conglomerate retained for well-defined basal chert-pebble-conglomerate in northern part of area. Unit is of limited extent; unconformably overlies Morrison formation in outcrops from Sykes Mountain northwestward to Red Dome and at some exposures on west side of basin. Locally underlies Little Sheep mudstone member (new).

First described at base of Pryor Mountains, Carbon County, Mont.

Pryor Creek Shale (in Cherokee Shale)[1]

Pennsylvanian: Northeastern Oklahoma.

Original reference: D. W. Ohern, 1910, Oklahoma State Univ. Research Bull. 4, p. 13.

Well exposed in vicinity of town of Pryor Creek, Mayes County.

**Puckett Sandstone Member** (of Mingo 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, 40.

H. R. Wanless, 1946, Geol. Soc. America Mem. 13, p. 99, 102, 104, 148. In Mingo formation between Wallins Creek coal (above) and Slater sandstone.

Named for Puckett Creek, Bell County, Ky.

**Puckmummie Schist**[1]

Post-Ordovician(?): Northwestern Alaska.

Original reference: P. S. Smith, 1910, U.S. Geol. Survey Bull. 433, p. 50, 62, map.

Well exposed on lower part of Puckmummie Creek and on rocky knob to east, in low hill northwest of Post Creek, and in a few scattered outcrops in Seward Peninsula.

Puckwunge Conglomerate[1]

Puckwunge Formation (in Keweenawan Group)

Precambrian: Northeastern Minnesota.

Original reference: N. H. Winchell, 1897, Am. Geologist, v. 20, p. 50–51.

G. M. Schwartz, 1942, Geol. Soc. America Bull., v. 53, no. 7, p. 1003, pl. 1. Formation underlies Keweenaw Point volcanics; overlies Thomson slate.

G. M. Schwartz, 1949, Minnesota Geol. Survey Bull. 33, p. 18, 36, In Duluth area, consists of some conglomerate at base that grades upward into gray sandstone. Overlies Thomson slate. Thickness 100 to 200 feet.

F. F. Grout, H. P. Sharp, and G. M. Schwartz, 1959, Minnesota Geol. Survey Bull. 39, p. 13 (table 1), 29–30. Formation at base of Keweenawan group. Exposures along bluffs south of Pigeon River indicate thickness of at least 100 feet and maximum of 200 feet seems reasonable. Structurally conformable to Rove below and lava flows above. Area of report, Cook County.

Name derived from Puckwunge (Stump) River, a tributary of Pigeon River in T. 64 N., Rs. 3 and 4 E., Cook County.

†Puckwunge Slate[1]

Precambrian (upper Huronian): Northeastern Minnesota.

Original reference: N. H. Winchell, 1897, Am. Geologist, v. 20, p. 50–51.

Extends across Puckwunge Valley. Probably named for stream that enters Pigeon River from west to north of Grand Portage village, Cook County.

Pucro Sandstone

Pucro Sandstone Member (of Gatún Formation)

Miocene, middle: Panamá.

Karl Sapper, 1937, Mittelamerika, Handbuch der regionalen Geologie: Heidelberg, v. 8, Abt. 4a, no. 29, p. 132, 134 (correlation chart). Overlies Tuira formation; underlies Chucunaque formation. Contains typical Gatun fauna. Middle Miocene.

R. A. Terry, 1956, California Acad. Sci. Occasional Paper 23, p. 50, 51, 55. Uppermost member of Gatún formation. Thickness 1,500 to 2,000 feet.

W. P. Woodring, 1960, *in* R. Hoffstetter and others, Lexique Strat. Internat., v. 5, Amérique Latine, fasc. 2a, p. 344. Miocene. Note on locality.

Río Pucro is southwestward flowing tributary of Río Tuira. American Geographical Society's sheet N. B–18 shows village of same name on Río Pucro.

Pueblan series

Cretaceous (Mid-Cretacic): New Mexico.

Charles Keyes, 1936, Pan-Am. Geologist, v. 66, no. 2, p. 119 (plate 12); 1940, v. 74, no. 3, p. 213. The Cordilleran geosynclinal. Cretacic sediments on the east side of the Rocky Mountains include (ascending) Graneros shales, Greenhorn limestones, Carlile shales, Timpas limestones, and Apashapa shales.

Pueblo Formation[1]

Mesozoic or older: Southeastern Oregon.

Original reference: W. D. Smith, 1926, Oregon Univ. Commonwealth Rev., v. 8, p. 207–214.

Type locality: Pueblo Mountains, southern part of Harney County.

**Pueblo Formation** (in Wichita Group)

Pueblo Formation (in Cisco Group)[1]

Pueblo Group

Permian (Wolfcamp): Central and central northern Texas.

Original reference: F. B. Plummer, 1919, Am. Assoc. Petroleum Geologists Bull., v. 3, p. 133–145.

C. O. Nickell, 1938, *in* Wallace Lee and others, Texas Univ. Bur. Econ. Geology Pub. 3801, p. 132–134. Formation includes (ascending) Camp Creek shale, Coon Mountain sandstone, Stockwether limestone, a series of shale beds with some sandstones and thin limestones, and Camp Colorado limestone members. Overlies Harpersville formation; underlies Moran formation of Wichita group. Pennsylvanian.

M. G. Cheney, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 1, p. 66 (fig. 1), 91, 93. Rank raised to group and expanded below to redefined Permian-Pennsylvanian boundary (Wolfcamp-Cisco) which is placed at disconformity in Harpersville formation above Waldrip-Newcastle coal zone about 40 to 150 feet below Saddle Creek limestone. As redefined. includes (ascending) Saddle Creek, Stockwether, and Camp Colorado formations. Underlies Moran group; overlies Thrifty group (redefined).

R. C. Moore, 1949, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 80, sheet 2. Formation includes beds lying between disconformity at base of Waldrip shale and top of Camp Colorado limestone. Average thickness in southern Coleman County 225 feet. Comprises (ascending) Waldrip shale, Saddle Creek limestone, Camp Creek shale, Stockwether limestone, Salt Creek Bend shale, and Camp Colorado limestone members. Underlies Moran formation; overlies Pennsylvanian Cisco group.

P. T. Stafford, 1960, U.S. Geol. Survey Bull. 1081–G, p. 267–270. Formation, in Brazos River valley, comprises (ascending) Waldrip shale, Saddle Creek limestone, Camp Creek shale, Stockwether limestone, Salt Creek Bend shale, and Camp Colorado shale members. Thickness 275 to 400 feet. Overlies Chaffin limestone member of Thrifty formation; underlies Watts Creek shale member of Moran formation. Locally, Chaffin and underlying shale members of Thrifty are absent and Pueblo rests on rocks as old as Breckenridge member of Thrifty. Boundary between Pueblo and Moran not mapped north of Elm Creek (east-central Throckmorton and west-central Young Counties); boundary difficult to discern because of probable absence of Camp Colorado limestone.

D. H. Eargle, 1960, U.S. Geol. Survey Prof. Paper 315–D, p. 75–76, pl. 27. Formation in Brown and Coleman Counties comprises (ascending) Waldrip shale, Saddle Creek limestone, Camp Creek shale, Coon Mountain sandstone, Stockwether limestone, Salt Creek Bend shale, and Camp Colorado limestone members. Overlies Chaffin limestone member of Thrifty formation. Permian. Only lower part of formation discussed in this report.

Named for exposures along valley of Battle Creek at Pueblo, Callahan County.

†Pueblo Limestone Member (of Pueblo Formation)[1]

Pennsylvanian: Central northern Texas.

Original reference: F. B. Plummer, 1919, Am. Assoc. Petroleum Geologists Bull., v. 3, p. 133–145.

Type locality of Pueblo formation: In Pueblo Mountains, southern part of Callahan County.

†Pueblo Quartzite[1]

Precambrian: Central northern New Mexico.

Original reference: J. W. Gruner, 1920, Jour. Geology, v. 28, p. 731–742.

Exposed at head of Pueblo Creek, Tps. 26 and 27 N., Rs. 14 and 15 E., Taos County.

Pueblo Mountain Series[1]

Tertiary, upper: Northwestern Nevada and southeastern Oregon.

Original reference: R. E. Fuller, 1931, Washington Univ. Pub. Geology, v. 3, no. 1, p. 14.

Occurs on Pueblo Mountain.

Pueblo Range Series[1]

Miocene, lower: Northwestern Nevada.

Original reference: J. C. Merriam, 1910, California Univ. Pub., Dept. Geol. Bull., v. 6, no. 2, p. 26–52, pl. 2.

On west side of Pueblo Range.

**Puente Formation**[1]

Miocene, upper: Southern California.

Original reference: G. H. Eldridge and R. Arnold, 1907, U.S. Geol. Survey Bull. 309.

M. L. Krueger, 1936, (abs.) Am. Assoc. Petroleum Geologists Bull., v. 20, no. 11, p. 1520. In Whittier Hills, underlies Sycamore Canyon formation (new).

M. L. Krueger, 1943, California Div. Mines Bull. 118, p. 363 (fig. 150). Upper part of Puente in Chino area divided into (ascending) Papel

Blanco shale, Blanco sandstone, Cubierto shale, Hunter sandstone and conglomerate, Peculiar shale, and Mahala sandstone and conglomerate (all new).

A. O. Woodford, T. G. Moran, and J. S. Shelton, 1946, Am. Assoc. Petroleum Geologists Bull., v. 30, no. 4, p. 515, 516–517 (fig. 2), 519–523. Described in Puente and San Jose Hills where it is divided into three unnamed members: lower of shale and sandstone, middle of sandstone, and upper of shale, conglomerate, and sandstone. Delimitation of middle sandstone is key to threefold division. Thickness possibly 9,000 feet in Puente Hills; thinner in San Jose Hills. Krueger's (1943) subdivisions of upper Puente recognized in Slaughter Canyon and thicknesses measured. Overlain by sediments assigned to Repetto formation. In some areas, overlies Buzzard Peak conglomerate member (new) of Topanga formation.

S. N. Daviess and A. O. Woodford, 1949, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 83. In this report [northwestern Puente Hills], four divisions of Puente are recognized: lower siltstone member made up chiefly of interbedded siltstone and sandstone; sandstone member; upper siltstone member; and conglomeratic unit, Sycamore Canyon member. Krueger called this conglomeratic part of upper Puente the Sycamore Canyon formation. For purposes of this report, the unit is treated as local member of Puente because lower beds of conglomerate lens out within map area and in places interfinger with beds of upper siltstone member. Maximum thickness 8,500 feet or more. Underlies Repetto formation. Suggested that different plan of nomenclature for rocks herein assigned to the Puente may be desirable.

J. E. Schoellhamer and others, 1954, U.S. Geol. Survey Oil and Gas Inv. Map OM–154. Subdivided into (ascending) La Vida, Soquel, and Yorba (all new), and Sycamore Canyon members. Overlies El Modeno volcanics (new). On Burruel Ridge, Sycamore Canyon member is unconformably overlain by Repetto(?) formation. Late Miocene; correlative with Modelo formation of Santa Monica Mountains and with parts of Monterey formation.

R. F. Yerkes, 1957, U.S. Geol. Survey Prof. Paper 274–L, p. 326, pl. 46. In El Modeno area, strata of Puente formation rest with apparent conformity upon El Modeno volcanics. North of Santiago Creek and elsewhere strata overlap El Modeno volcanics, and Topanga, Vaqueros, and Sespe formations. Average thickness about 1,800 feet. In type area, to northwest of El Modeno, formation reaches thickness of about 11,000 feet.

Named for occurrence in Puente Hills, in southern part of Los Angeles County.

Puercan Age

Paleocene: North America.

H. E. Wood 2d and others, 1941, Geol. Soc. America Bull., v. 52, no. 1, p. 8, pl. 1. Provincial time term, based on the Puerco formation of the San Juan Basin, northwestern New Mexico, type locality, Rio Puerco area. Covers the interval from Upper Cretaceous to Dragonian (Paleocene) time.

Above report defines 18 provincial time terms, based on mammal-bearing units, for the North American continental Tertiary. Paleocene: Puercan, Dragonian, Torrejonian, Tiffanian, and Clarkforkian; Eocene: Wasatchian, Bridgerian, Uintan, and Duchesnean; Oligocene: Chadronian, Orellan, and Whitneyan; Miocene: Arikareean, Hemingfordian, and Barstovian; Pliocene: Clarendonian, Hemphillian, and Blancan.

Most typical and only fossiliferous exposures, the escarpment running from northwest of Ojo Alamo about 25 miles to Arroyo Eduardo, east of Kimbetoh, [New Mexico].

Puercan series[1]

Upper Cretaceous: New Mexico.

Original reference: C. R. Keyes, 1932, Pan-Am. Geologist, v. 58, no. 4, p. 289.

**Puerco Formation** (in Nacimiento Group)[1]

Paleocene: Northwestern New Mexico.

Original reference: E. D. Cope, 1875, Ann. Rept. Chief Engrs. USA, Rept. Secy War to 44th Congress, v. 2, pt. 2, p. 1008–1017.

T. E. Reynolds, 1936, Jour. Paleontology, v. 10, no. 3, p. 202. Formation has limited exposure in New Mexico. Lower Paleocene.

H. E. Wood 2d and others. 1941, Geol. Soc. America Bull., v. 52, no. 1, p. 29, pl. 1. Overlies Ojo Alamo formation; underlies Torrejon formation. Paleocene (Puercan).

G. G. Simpson, 1948, Am. Jour. Sci., v. 246, no. 5, p. 272. Puerco and Torrejon are not recognizable except as faunal zones in San Juan basin; here this part of stratigraphic sequence is considered as single formation, the Nacimiento, containing Puerco and Torrejon faunas.

Named for occurrence in valley of upper Puerco River.

Puertecito Formation[1]

Lower Cretaceous(?) to base of Triassic: Northwestern New Mexico.

Original reference: E. H. Wells, 1919, New Mexico School Mines Bull. 3 [1920].

Christina Lochman-Balk, 1959, New Mexico Geol. Soc. Guidebook 10th Field Conf., p. 108. Sedimentary beds between Permian and Cretaceous. Purple-red and purple-gray sandstones, shales, and conglomerates. Thickness 1,150 to 1,250 feet. New Mexico Bureau Mines recommends abandoning term.

Puertecito district, Socorro and Valencia Counties.

**Puerto Ferro Limestone**[1]

Miocene: Puerto Rico.

Original reference: H A. Meyerhoff, 1933, Geology of Puerto Rico, p. 74.

J. D. Weaver *in* R. Hoffstetter and others, 1956, Lexique Strat. Internat., v. 5, Amérique Latine, fasc. 2b, p. 337. Name given to Miocene deposits of island of Vieques, consisting of well-stratified limestone with some noncalcareous impurities, and containing numerous foraminifera, mollusca, and corals. Thickness about 200 feet. Rests discordantly on Cretaceous rocks.

Occurs on Vieques Island.

**Puffy Member** (of Katalla Formation)

Puffy Shale Member (of Redwood Formation)[1]

Oligocene: Southeastern Alaska.

Original reference: N. L. Taliaferro, 1932, Geol. Soc. America Bull., v. 43, no. 3, p. 773.

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. 7 (table), 13; 1945, Geologic and topographic map and sections of the Katalla area, Alaska: U.S. Geol. Survey War-Minerals Inv. Prelim. Map. Redefined as member of Katalla formation. Extends from base of lowest bed of shale-matrix conglomerate through the highest exposed Tertiary beds in Katalla area. Consists of dark-gray massive partly sandy shale, many beds of coarse- to medium-grained sandstone, and several thick beds and lenses of conglomerate. More than 3,700 feet thick. In unpublished manuscript by oil company geologists, Puffy conglomerate and Puffy shale treated as two distinct units in Redwood formation.

W. Waloweek and W. L. Norem, 1957, Jour Paleontology, v. 31, no. 3, p. 674–675. Miocene.

Named from exposures along Puffy Creek, Katalla district, Controller Bay region.

**Puget Group**[1]

Eocene and Oligocene(?): Western Washington.

Original reference: C. A. White, 1888, Am. Jour. Sci., 3d, v. 36, p. 443–450.

C. E. Weaver. 1937, Washington [State] Univ. Pubs. in Geology, v. 4, p. 26, (table), 53-74. Thick series of massive sandstone, shales, interstratified sandstone, intercalated layers of carbonaceous shales, and coal seams; units vary in lithology from one locality to another, making it impossible to correlate details of any sequence at one locality with the stratigraphic columns at other adjacent places. The strata, which are all of continental origin, usually occur in shallow or closely compressed plunging anticlines synclines which in most localities have been displaced as the result of complex faulting. In Green River area, group includes (ascending) Bayne, Franklin, and Kummer formations; in Carbon River area includes (ascending) Carbonado, Wilkeson, and Burnett formations.

W. C. Warren and others, 1945, Preliminary map of the coal fields of King County, Washington: U.S. Geol. Survey. Described in King County where it overlies and interfingers with volcanic series of Eocene age; consists of sandstones, shale, and carbonaceous beds and is undifferentiated. In Newcastle-Issaquah area, group is 3,000 to 3,200 feet thick and is overlain by marine Oligocene beds. Southeast of Reton, group is overlain with slight angular discordance by marine beds of Oligocene and Miocene age. Farther east at Cedar Mountain, no Oligocene and Miocene sedimentary beds appear, but shales at top of group have increased in thickness from about 300 feet near Renton to about 1,200 feet at Cedar Mountain. Where well-exposed along Green River, group is at least 6,500 feet thick and base is not exposed. Top of group, as exposed in western part of Green River district, occurs in sec. 25, T. 21 N., R. 6 E., where Kummer syncline crosses river. In this syncline, the group is overlain by rocks of volcanic origin. Along east edge of Green River district, uppermost 500 feet of group includes tuffaceous sediments and tuff beds, which are not easily distinguished from tuffs in overlying Keechelus andesitic series. Relation of Puget group of Green River district to Puget group in northern coal fields of King County is uncertain. The two groups may be equivalent, or the Puget group in Green River district may be equivalent to the combined Cowlitz(?) formation, the overlying group of the northern area.

D. R. Crandell and L. M. Gard, Jr., 1960, U.S. Geol. Survey Geol. Quad. Map GQ–125. Oldest rocks exposed in Buckley quadrangle. Consists of light-gray to buff feldspathic and micaceous sandstone, siltstone, gray to black shale, and coal. Thin dark-brown bed of volcanic conglomerate in upper part of group. Group not differentiated. Underlies Keechelus andesitic series.

Occupies a large part of Puget Sound Basin and extends upon the west flank of the Cascade Range.

**Pugh Formation**[1]

Middle Pennsylvanian: Northeastern West Virginia.

Original reference: J. A. Taff and A. H. Brooks, 1896, U.S. Geol. Survey Geol. Atlas, Folio 34.

Named for exposures at Pugh post office, Webster County.

†Pulaski Formation (in Arago Group[1] or Series)

Eocene: Southwestern Oregon.

Original reference: J. D. Diller, 1899, U.S. Geol. Survey 19th Ann. Rept., pt. 3, p. 319–320.

W. H. Twenhofel, 1943, Oregon Dept. Geology and Mineral Industries Bull. 24, p. 4. Sandstones, siltstones, and claystones. Possibly of continental origin. Underlies Coaledo formation; unconformably overlies Myrtle formation. In Arago series.

Forms hills about head of Pulaski Creek and Pulaski Arch, which separates Beaver Slough and Coquille coal basins.

**Pulaski Shale**[1]

Upper Ordovician: New York.

Original reference: L. Vanuxem, 1840, New York Geol. Survey 4th Rept., p. 373–374.

Rudolf Ruedemann, 1925, New York State Mus. Bull. 258, p. 149 (fig. 7), 154 (fig. 9). Pulaski shale comprises (ascending) Tremaines Bridge, Worthville, Sandy Creek, and Bennett Bridge beds.

W. H. Twenhofel and others, 1954, Geol. Soc. America Bull., v. 65, no. 3, chart 2 (column 19). Shown on correlation chart as Pulaski shale in Lorraine group. Occurs above Whetstone Gulf shale and below Oswego sandstone.

Named for occurrence on Salmon River at Pulaski, Oswego County.

†Pulaski Shale[1]

Mississippian: Southwestern Virginia.

Original reference: M. R. Campbell, 1894, Geol. Soc. America Bull., v. 5, p. 171, 178, pl. 4.

In Pulaski, Wythe, and Montgomery Counties. Named for Pulaski, Pulaski County.

Pullen Formation (in Wildcat Group)

Miocene, upper, to Pliocene, lower: Northwestern California.

B. A. Ogle, 1953, California Div. Mines Bull. 164, p. 13 (fig. 3), 26–28, 102–105, pls. 1, 2. Diatomaceous mudstone with local basal sandstone. Thickness 600 to 1,100 feet. Thins from its southern outcrop northward and is overlapped by younger Tertiary beds; thins to south and east and is overlapped by Eel River formation (new). Overlies Yager formation (new) with angular unconformity.

Type section: Along west bank of Eel River, near Scotia, Humboldt County. Named for exposures at Pullen Ranch on Price Creek.

†Pulliam Formation[1]

Upper Cretaceous (Gulf Series) : Southern Texas.

Original reference: T. W. Vaughan, 1900, U.S. Geol. Survey Geol. Atlas, Folio 64, p. 2.

Named for Pulliam Ranch, on Nueces River, Zavalla [Zavala] County.

Pulpit Conglomerate (in Almy Conglomerate)

Paleocene: Northern Utah.

A. J. Eardley, 1944, Geol. Soc. America Bull., v. 55, no. 7, p. 824 (table 1), 842, 843, pl. 1. Coarse red cliff-making conglomerate. Thickness about 2,000 feet. Underlies Saw Mill conglomerate division (new); overlies Henefer formation (new).

L. A. Hale, 1960, Wyoming Geol. Assoc. Guidebook 15th Ann. Field Conf., p. 136 (chart), 142. Discussion of Frontier formation in Coalville area, Utah. Chart of nomenclature history of Cretaceous rocks of area shows column credited to Trexler (1955, unpub. thesis). On column, Pulpit conglomerate occurs above Henefer formation and below Knight formation. Text refers to Echo Canyon (formerly Pulpit) conglomerate. Echo Canyon conglomerate overlies Henefer.

Named for Pulpit Rock at mouth of Echo Canyon, Morgan County.

**Pulteney Shale Member** (of Sonyea Formation)

Upper Devonian: Western and west-central New York.

G. W. Colton and Wallace de Witt, Jr., 1958, U.S. Geol. Survey Oil and Gas Inv. Chart OC–54. Consists largely of silty dark-gray and dark-brownish-gray shale; much very dark gray shale, finely interlaminated with lighter gray shale, present in lower part of member; numerous discrete beds of very dark gray shale and a few beds of brownish-black or black shale from 1 inch to 3½ feet thick present throughout member; most of these very dark shales are gradational into lighter colored shale above; layers of siltstone ranging from laminae a few hundredths of an inch thick to discrete beds 1½ feet thick are interbedded in member. Thickness 2 feet in southwestern Genesee County; 9 feet at reference section of the Sonyea south of Mount Morris; 162 feet at type exposure; thickens southward to about 250 feet in southeastern Yates County. Grades downward into Middlesex member through transition zone that ranges in thickness from a few inches in Genesee County to approximately 40 feet in Yates County; lower boundary arbitrarily placed at point above which dark-gray and dark-brown shale predominates over very dark gray, grayish-black, and black shale; locally in Ontario and Yates Counties, a bed of siltstone 2 to 10 inches thick in base of Pulteney marks the contact. In southern Genesee County and most of Livingston County, underlies Cashaqua shale member with boundary gradational through an interval of several feet; from eastern Livingston County to east edge of mapped area, overlain by Rock Stream siltstone member, boundary sharply marked.

Type exposure in Wagner Glen, one-half mile north of center of Pulteney, Pulteney Township, Steuben County.

**Pumpernickel Formation**

Pennsylvanian (?) : 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]. Greenstone, dark chert, and dark argillite with interbedded limestone and clastic sediments. Greenstone varies from chlorite schist to recognizable andesitic lavas and breccias. Dark chert may be in part silicified ash or fine-grained tuff. Interbedded siliceous slate and phyllite, probably tuffaceous in part. May be identical with Leach formation. Thickness may exceed 6,000 feet. Underlies Havallah formation (new) with contact gradational Pennsylvanian(?).

R. J. Roberts and others, 1958, Am. Assoc. Petroleum Geologists Bull., v. 42, no. 12, p. 2847–2848. Probably Mississippian or older.

Named for Pumpernickel Valley on eastern border of Winnemucca quadrangle.

Pumpkin Creek Limestone Member (of Big Branch Formation)

Pumpkin Creek Limestone Member (of Dornick Hills Formation)[1]

Pennsylvanian (Des Moines Series): Central southern Oklahoma.

Original reference: C. W. Tomlinson, 1928, Oklahoma Geol. Survey Bull. 40–Z, p. 14.

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. A member at top of Big Branch formation (redefined).

Named from outcrops on Pumpkin Creek in SE¼ sec. 19, T. 6 S., R 2 E., Carter County.

**Pumpkin Valley Member** (of Conasauga Shale)

**Pumpkin Valley Shale** (in Conasauga Group)

Middle Cambrian: Eastern Tennessee and southwestern Virginia.

Josiah Bridge, 1945, Geologic map and structure sections of the Mascot-Jefferson City zinc mining district, Tennessee (1:31,690): Tennessee Div. Geology. Named on may legend and mapped with Rome formation.

John Rodgers and D. F. Kent, 1948, Tennessee Div. Geology Bull. 55, p. 7–9. Pumpkin Valley shale formally proposed for 360 feet of shale which lies between typical Rome and typical Rutledge. Unit has commonly been included in the Rome. Derivation of name given. Report gives stratigraphic section at Lee Valley, Hawkins County.

John Rodgers, 1952, Geology of the Niota quadrangle, Tennessee (1:24,000): U.S. Geol. Survey Geol. Quad. Map. Southeast of Kennedy Ridge, in northwestern part of quadrangle, lower part of Conasauga shale differs from overlying main part of formation in being more silty, more purple in color, and in containing more siltstone but no limestone layers; particularly characterized by dull shales of green and purple and by monotonous uniformity that contrasts with underlying heterogeneous and varicolored Rome formation. In Hayes' original description of Rome and Conasauga formations, he classed these beds with the Conasauga, but in most of his mapping in northwest Georgia and Tennessee he mapped them as upper part of Rome. In this report, they are classed as Pumpkin Valley member of Conasauga shale. Member is exposed only in belt of Conasauga southeast of Kennedy Ridge. In other belts, member apparently does not reach surface. Thickness about 600 feet. Middle Cambrian.

John Rodgers, 1953, Tennessee Div. Geology Bull. 58, pt. 1 (plates); pt. 2, p. 46 (fig. 3), 48, 49, 50 (table 4). In eastern Tennessee, the Conasauga varies in lithology and three phases are recognized; in northwestern phase, is termed Conasauga shale and the Pumpkin Valley is classed as a member; in central phase, Conasauga is termed a group and consists of six formations of which the Pumpkin Valley is the lowermost. Thickness 200 to 400 feet.

L. D. Harris and R. L. Miller, 1958, U.S. Geol. Survey Geol. Quad. Map GQ–111. Pumpkin Valley shale described in Duffield quadrangle, Virginia. Thickness about 350 feet. Overlies Rome formation; underlies Rutledge limestone.

Named from Pumpkin Valley which lies between Cooper Ridge and Pine Ridge, Hawkins County, Tenn. Crops out along northwest side of valley and is typically exposed along State Highway 66.

### Puna Volcanic Series

Pleistocene, upper(?), and Recent: Hawaii Island, Hawaii.

H. T. Stearns and G. A. Macdonald, 1946, Hawaii Div. Hydrography Bull. 9, p. 100 (table), 103–110. Series covers most of Kileauea volcano and was erupted in Recent and latest Pleistocene time. Rocks on western and southern slopes were mapped as Kamehame basalt, but this name includes lavas from both Mauna Loa and Kileau; hence, new name is used herein. Series includes a prehistoric member and an historic member. Prehistoric member ranges in thickness from a few feet in a flow on southern slope to more than 410 feet in Uwekahuna Bluff at western edge of Kilauea caldera where base is not exposed. Historic lava flows, erupted since 1750(?), differ only in degree of blackness from the late prehistoric flows. Historic flows are olivine basalts ranging from 1 to 20 feet in thickness on flanks of volcano; flows ponded in caldera are massive and columnar jointed. Correlative with Kau volcanic series on Mauna Loa as both series overlie Pahala ash. Wentworth's (1938) Keanakakoi formation is here treated as aa member of Puna volcanic series.

G. A. Macdonald, 1949, U.S. Geol. Survey Prof. Paper 214–D, p. 64–72. Includes Uwekahuna ash.

D. A. Davis and G. A. Macdonald *in* Jacques Avias and others, 1956, Lexique Strat. Internat. v. 6, Océanie, fasc. 2, p. 128. Late Pleistocene(?) and Recent.

Named for Puna district where rocks of series are most abundant.

### Punchbowl Formation

Miocene, upper: Southern California.

R. E. Wallace, 1949, Geol. Soc. America Bull., v. 60, no. 4, p. 790. Incidental mention as Punch Bowl formation.

L. F. Noble, 1953, Geology of the Pearland quadrangle, California: U.S. Geol. Survey Geol. Quad. Map [GQ–24]. Described in Pearland quadrangle as conglomeratic sandstone and siltstone with gypsiferous shale member in middle. Thickness about 1,600 feet. Deposit strongly faulted and folded. Unconformable on Vasquez formation and basement rocks; relationship to Pliocene Anaverde formation unknown. Present only south of San Andreas fault.

L. F. Noble, 1954, U.S. Geol. Survey Geol. Quad. Map GQ–50. Described in Valyermo quadrangle as consisting of two facies. The western, present

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only north of San Andreas fault, corresponds in lithology to lower and middle member of formation as described in Pearland quadrangle; the eastern is divided into two members (mapped separately); upper member about 3,000 feet thick; lower member about 1,000 feet thick.

Type locality: Devils Punchbowl, Valyermo quadrangle.

**Punchbowl Volcanics**[1] (in Honolulu Volcanic Series)

Pleistocene, upper: Oahu Island, Hawaii.

Original reference: C. K. Wentworth, 1926, Bernice P. Bishop Mus. Bull. 30, p. 55–60.

G. A. Macdonald and D. A. Davis *in* Jacques Avias and others, 1956, Lexique Strat. Internat., v. 6, Océanie, fasc. 2, p. 128–129. Prominent cone of brown palagonitized tuff containing fragments of reef limestone and basalt of Koolau volcanic series, with minor amounts of black cinder and spatter and lava flow of nepheline basalt. Maximum thickness of tuff about 550 feet. Unconformably overlain by black ash of Tantalus and Sugar Loaf eruptions. Underlies reef limestone of plus 25-foot (Waimanalo) stand of sea and displaced a stream valley graded to the minus 60-foot (Waipio) stand of sea.

Named after Punchbowl Hill, the cone built by it. Exposed over area of about 0.7 square mile in Honolulu, on south side of Koolau Range about 13 miles west of Makapuu Head.

Puncheon Creek Sandstone (in Pottsville Group)[1]

Pennsylvanian: Southeastern Kentucky.

Original reference: I. B. Browning and P. G. Russell, 1919, Kentucky Geol. Survey, 4th ser., v. 5, pt. 2, p. 13.

Well developed along, and named for Puncheon Creek of Licking River, Magoffin County.

Punta de la Mesa Sandstone Member (of Mesaverde Formation)[1]

Upper Cretaceous: Central northern New Mexico.

Original references: C. L. Herrick, 1900, Am. Geologist, v. 25, p. 331–346; 1900, New Mexico Univ. Bull., v. 2, pt. 1, p. 3–63; pt. 2, p. 1–17.

Named for Punta de la Mesa, north of San Ignacio, Guadalupe County.

**Purcell Basalt**[1] (in Missoula Group)

Purcell Lava

Precambrian (Belt Series): Southeastern British Columbia and southwestern Alberta, Canada, and northwestern Montana.

Original reference: R. A. Daly, 1913, Canada Dept. Int. Rept. Chief Ast., 1910, v. 2, p. 207.

C. P. Ross, D. A. Andrews, and I. J. Witkind, 1955, Geologic map of Montana (1:500,000): U.S. Geol. Survey. Dark-greenish-gray altered effusive basalt. In Glacier National Park, it is near base of Missoula group; but in other localities, mainly in Canada, it is reported in other stratigraphic positions.

C. P. Ross, 1959, U.S. Geol. Survey Prof. Paper 296, p. 19 (table), 51–52, pl. 1. Purcell basalt included in lower part of Missoula group. Consists of dark greenish and purplish lava, much altered but originally basaltic. In Glacier National Park, principal flows are at or somewhat above top of Siyeh limestone of Piegan group and below Shepard formation. Thickness about 200 feet.

So named because maximum known thickness is in McGillivray division of Purcell Mountain system, British Columbia.

Purcell facies (of Belt Series)

Precambrian: Northern Idaho and 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. Purcell facies marked by abundant clastics throughout, with reduction of carbonate rocks. Quartzites, thick in lower parts, reach the known base of the Belt.

In Purcell Range.

Purcell Sandstone Lenses (in Hennessey Shale)[1]

Permian: Northern central Oklahoma.

Original reference: D. A. Green, 1936, Am. Assoc. Petroleum Geologists Bull., v. 20, no. 11, p. 1465.

O. E. Brown, 1937, Am. Assoc. Petroleum Geologists Bull., v. 21, no. 12, p. 1546 (fig. 6). Sandstone lenses in Hennessey formation.

Present in vicinity of Purcell, Kingfisher County.

Purefoys Mill Series[1]

Precambrain or Lower Cambrian: Northern central North Carolina.

Original reference: W. H. Fry, 1911, Elisha Mitchell Sci. Soc. Jour., v. 27, p. 124.

L. R. Thiesmeyer and R. R. Storm, 1938, (abs.) Geol. Soc. America Bull., v. 49, no. 12, pt. 2, p. 1964. Series originated in fresh-water lakes. A stratigraphic position, similar to that of varved shales in the so-called Lower Cambrian of Virginia and of suspected varve horizons in the Hiwassee slates of Tennessee, implies that the Purefoys sediments may be approximately contemporaneous with either or both of these deposits. It is suggested that such sediments were formed from melt waters of valley glaciers near margins of Appalachia during general refrigerations which accompanied continental glaciation of northern hemisphere in latest Precambrian or early Cambrian time.

In Chapel Hill area. Derivation of name not given.

**Purgatoire Formation**[1]

Lower Cretaceous: Eastern Colorado, central northern and northeastern New Mexico, and western Oklahoma.

Original reference: G. W. Stose, 1912, U.S. Geol. Survey Geol. Atlas, Folio 186.

G. I. Finlay, 1916, U.S. Geol. Survey Geol. Atlas, Folio 203. In Colorado Springs area, includes Lytle sandstone and Glencairn shale members (both new).

S. L. Schoff, 1939, Oklahoma Geol. Survey Bull. 59, p. 54–57. In Texas County, includes Cheyenne sandstone member and shales tentatively identified as Kiowa member.

J. W. Stovall, 1942, (abs.) The Compass, v. 22, no. 4, p. 327. In Cimarron County, comprises Cheyenne sandstone member, 66 feet, and Kiowa shale member, about 50 feet.

Ernest Dobrovolny and C. H. Summerson, 1946, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 62. In Quay County, N. Mex., subdivided into (ascending) Tucumcari shale, Mesa Rica sandstone (new), and Pajarito shale (new) members. Overlies Morrison formation; underlies Graneros shale.

K. M. Waagé, 1952, Colorado Sci. Soc. Proc., v. 15, no. 9, p. 375 (fig. 1), 378 (fig. 3), 380–384. In Denver area, includes Lytle and Glencairn members. Overlies Morrison formation; underlies Dakota sandstone. Thickness 230 feet.

H. D. Miser and others, 1954, Geologic map of Oklahoma (1:500,000): U.S. Geol. Survey. Mapped in Cimarron County with Cheyenne sandstone and Kiowa shale members.

T. G. McLaughlin, 1954, U.S. Geol. Survey Water-Supply Paper 1256, p. 17 (table 3), 96–100. In Baca County, Colo., includes beds above Morrison formation and below Dakota sandstone. Subdivided into Cheyenne sandstone member below and Kiowa shale member above. Thickness 75 to 225 feet.

R. L. Griggs and C. B. Read, 1959, Am. Assoc. Petroleum Geologists Bull., v. 43, no. 8, p. 2007. Term Purgatoire abandoned in Tucumcari-Sabinoso area, New Mexico. Members of Purgatoire, as used by Dobrovolny and Summerson (1946) raised to formation rank.

Named for Purgatoire Canyon, in Mesa de Maya quadrangle, Colorado.

**Purgatory Conglomerate**[1]

Pennsylvanian: Southeastern Rhode Island.

Original reference: A. F. Foerste, 1899, U.S. Geol. Survey Mon. 33, p. 364–374.

Typically developed at Purgatory.

Purington Shale Member (of Carbondale Formation)

Purington Shale[1] (in Carbondale Group)

Pennsylvanian: Northern and western Illinois.

Original references: H. R. Wanless, 1931, Geol. Soc. America Bull., v. 42, p. 804; 1931, Illinois Geol. Survey Bull. 60, p. 179–193.

H. R. Wanless, 1957, Illinois Geol. Survey Bull. 82, p. 50 (fig. 22), 94, 192, 197, 198. Light to medium gray; contains flattened oval ironstone concretions, which are most common in middle and lower parts. [In about half of area, the shale is cut out by channel deposits of the Pleasantview sandstone; in those areas where there is little or no truncation by the sandstone, it attains maximum thickness of about 50 feet.] In areas where shale attains its maximum thickness, upper 5 or 6 feet are silty to very fine sand and appears to grade upward into the Pleasantview sandstone; contact is abrupt where the sandstone is in channels. Overlies Oak Grove beds. Derivation of name credited to R. S. Poor (unpub. ms.). Occurs at top of Liverpool cyclothem.

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 35, 47 (table 1), 66, pl. 1. Rank reduced to member status in Carbondale formation (redefined). Occurs above Oak Grove limestone member and below Pleasantview sandstone member. Thickness about 15 feet. Presentation of new rock-stratigraphic classification of Pennsylvanian strata in

Illinois. Cyclical classification retained but is entirely independent of rock-stratigraphic classification.

Type locality: SW¼ sec. 17, T. 11 N., R. 2 E., Knox County. Named for exposures at pits of Purington Paving Brick Co., East Galesburg.

**Purisima Formation**[1]

Pliocene: Western California.

Original reference: H. L. Haehl and R. Arnold, 1904, Am. Philos. Soc. Proc., v. 43, p. 16–53.

J. E. Allen, 1946, California Div. Mines Bull. 133, p. 18 (fig. 3), 38, pls. 1, 3. Described in San Bautista quadrangle as a conformable series of poorly consolidated clays, silts, sands, and gravels, predominantly marine towards base and continental in upper portion; highly variable in composition both vertically and laterally, fossiliferous in marine facies; folded, exhibits attitudes varying from horizontal to vertical. Thickness nearly 10,000 feet. Overlaps upon Santa Lucia granite, Franciscan, and Monterey; unconformably underlies Pleistocene Aromas red sands. Middle and upper Pliocene.

C. F. Tolman and J. F. Poland, 1940, Am. Geophys. Union Trans., v. 21, pt. 1, p. 26–27 (fig. 3). In Santa Clara County, underlies Santa Clara formation.

R. M. Touring, 1959, Dissert. Abs., v. 20, no. 4, p. 1325. Formation, in La Honda and San Gregorio quadrangles, subdivided into (ascending) Tahana, Pomponio, San Gregorio sandstone, Lobitos mudstone, and Tunitas sandstone members (all new). Maximum thickness 5,670 feet. Conformably overlies Monterey formation.

Named for exposures near Purisima and along Purisima Creek, San Mateo County.

**Purslane Sandstone** (in Pocono Group)[1]

Purslane Sandstone Member (of Pocono Formation)

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.

H. E. Vokes, 1957, Maryland Dept. Geology, Mines and Water Resources Bull. 19, p. 91–92. In PawPaw-Hancock area, the Pocono is considered to have group rank and is divided into five formations; in western Maryland where the five units cannot be differentiated, the Pocono is treated as a formation and the Purslane as a member. In West Virginia, member attains maximum thickness of 310 feet; in Maryland, uppermost beds have been eroded and thickest section is 144 feet. Consists of thick-bedded coarse white sandstone with interbedded conglomerate and with coal seams and red shales between the sandstones; contains a few plant remains. Overlies Rockwell member.

Purslane Mountain, Morgan County, W. Va., is formed of this sandstone. In Maryland, forms crest of Sideling Hill in Washington County and Town Hill in Allegany County.

Purvine Hills Basalt

Late Cenozoic: Northeastern New Mexico.

Brewster Baldwin and W. R. Muehlberger, 1959, New Mexico Bur. Mines Mineral Resources Bull. 63, p. 132, pl. 15. Mentioned in discussion of

Capulin basalts in Des Moines quadrangle. [Most of discussion refers to basalts from Purvine Hills.]

Purvine Hills, a group of four small volcanic cones, on Purvine Ranch, Union County.

Purvine Mesa 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, 136 (table 4), 146 (fig. 23), pl. 1-b, 15. 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 Purvine Mesa, Dunchee Hill, Sierra Grande, and Gaylord Mountain is not known.

Underlies several square miles of Purvine Ranch east of Folsom, Union County.

Pushmataha Series

Carboniferous (Bendian): Oklahoma.

B. H. Harlton, 1938, Am. Assoc. Petroleum Geologists Bull., v. 22, no. 7, p. 854 (fig. 1), 855–856. Bendian system (period) subdivided into two series, the older, the Pushmataha (new), and the younger, the Morrow. Series consists of Stanley group and most of Jackfork group. Comprises seven subdivisions (ascending): Tenmile Creek, Moyers, Chickasaw Creek, Wildhorse Mountain, Prairie Mountain, Markham Mill, and Wesley (all new). First three comprise what was formerly called the Stanley, and latter group are subdivisions of former Jackfork.

Name derived from Pushmataha County.

**Put-in-Bay Dolomite Member** (of Bass Islands Dolomite)[1]

Put-in-Bay Formation (in Bass Islands Group)

Upper Silurian: Southeastern Michigan and northern Ohio, and Ontario, Canada.

Original reference: W. H. Sherzer and A. W. Grabau, 1909, Geol. Soc. America Bull., v. 19, p. 546.

Wilber Stout, 1941, Ohio Geol. Survey, 4th ser., Bull. 42, p. 38, 40, chart facing p. 46. Put-in-Bay formation included in Bass Islands group in Ohio. Overlies Tymochtee formation; underlies Raisin River formation. Consists of fairly pure dolomite, thin to massive bedded, gray to drab to light brown in color. Thickness 50 to 250 feet.

C. K. Swartz, 1942, Geol. Soc. America Bull., v. 53, no. 4, chart 3. Correlation chart shows occurrence in Ontario, Canada.

Named for exposures on Put-in-Bay Island, Lake Erie.

**Putnam Formation** (in Wichita Group)[1]

Putnam Group

Permian (Wolfcamp Series): Central and central northern Texas.

Original reference: F. B. Plummer and R. C. Moore, 1922, Jour. Geology, v. 30, p. 24, 31, 40.

M. G. Cheney, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 1, p. 66 (fig. 1), 93. Rank raised to group. Includes Santa Anna Branch formation below and Coleman Junction formation above. Underlies Admiral group (redefined): overlies Moran group.

R. C. Moore, 1949, *in* M. G. Cheney, 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. Described in Colorado River valley as a formation about 140 feet thick. Includes Santa Anna Branch member below and Coleman Junction member above. Underlies the Admiral and overlies the Moran herein designated as formations.

P. T. Stafford, 1960, U.S. Geol. Survey Bull. 1081–G, p. 271. Formation, in Brazos River valley, is 140 to 210 feet thick and comprises Santa Anna Branch shale member and Coleman Junction limestone member. Overlies Moran formation; underlies Admiral formation. Wichita group.

Named for Putnam, Callahan County.

**Putnam Gneiss**[1]

Putnam Series

Pre-Pennsylvanian: Eastern Connecticut and southern Massachusetts.

Original reference: H. E. Gregory, 1906, Connecticut Geol. Nat. History Survey Bull. 6, p. 114, 129, 133, 134, 136, 140, map.

W. G. Foye, 1949, Connecticut Geol. Nat. History Survey Bull. 74, p. 67–73, pl. 1. Rank raised to series. Consists of five members: metamorphosed conglomerate, quartzite, quartz-biotite schist, hornblende schist and amphibolite, and limestone and dolomite. The quartzite is mapped as Plainfield quartz schist member. Probably Precambrian.

John Rodgers and others, 1956, Preliminary geological map of Connecticut (1:253,440): Connecticut Geol. Nat. History Survey; 1959, Connecticut Geol. Nat. History Survey Bull. 84, p. 55, 56. Age of gneiss designated pre-Triassic. Derivation of name given.

C. C. Sclar, 1958, Connecticut Geol. Nat. History Survey Bull. 88, p. 9–85. Bedrock in area of this report [New London County] consists of (1) a highly diverse group of metamorphic foliates known collectively as Putnam gneiss; (2) basic magmatic intrusive mass, the Preston gabbro; and (3) gneisses of granitic composition referred to as Sterling granitic gneisses. Plainfield quartzite not mapped as separate unit.

R. M. Perhac, 1958, Connecticut Geol. Nat. History Survey Bull. 89, p. 7–8. Putnam quartz-biotite schist underlies about 15 square miles in Voluntown and Oneco quadrangles. This rock constitutes a part of Putnam gneiss formation. Maximum possible thickness of schist about 2,000 feet. Plainfield quartzite not included in Putnam gneiss in present report.

Named for town of Putnam, Windham County, Conn.

Putnam Limestone (in Putnam Formation)[1]

Permian: Central northern Texas.

Original reference: O. F. Hedrick, E. Owens, and P. A. Meyers, 1929, Geologic map of Shackelford County, Texas (1:48,000): Texas Bur. Econ. Geology.

Shackelford County.

Putnam Sandstone (in Putnam Formation)[1]

Permian: Central northern Texas.

Original reference: O. F. Hedrick, E. Owens, and P. A. Meyers, 1929, Geologic map of Shackelford County, Texas (1:48,000): Texas Bur. Econ. Geology.

Probably named for town of Putnam, Callahan County.

**Putnam Hill Limestone Member** (of Allegheny Formation)[1]

Putnam Hill limestone member

Pennsylvanian: Eastern Ohio.

Original reference: E. B. Andrews, 1870, Ohio Geol. Survey Rept. Prog. 1869, p. 84–85.

N. K. Flint, 1951, Ohio Geol. Survey, 4th ser., Bull. 48, p. 41–42, table 1. Member of Brookville cyclothem in report on Perry County. Average thickness 1½ feet. The limestone lies an average distance of 7 inches above Brookville coal, but the shale between the limestone and coal is nearly everywhere fossiliferous and is considered a part of Putnam Hill member. At most exposures, Putnam Hill member is overlain by sandy shale or interbedded fine- to medium-grained sandstone and shale of Clarion cyclothem. Allegheny series.

M. T. Sturgeon and others, 1958, Ohio Geol. Survey Bull. 57, p. 49 (table 7), 52–53. Uppermost member of Brookville cyclothem in Athens County. Average thickness about 2 feet. Occurs above Brookville (No. 4) coal member of Brookville cyclothem and below sandstone of Ogan cyclothem.

Named for Putnam Hill, Muskingum County.

**Putnam Peak Basalt**

Pliocene: Northwestern California.

C. E. Weaver, 1949, Geol. Soc. America Mem. 35, p. 110 (table 24), 130–131, pl. 7. Dense black and vesicular basalt. Thickness 25 to 300 feet. Unconformably overlies Markley sandstone and San Pablo group; commonly has a low eastward dip.

Named from Putnam Peak in northeast Mount Vaca quadrangle, Solano County, where it covers slightly more than a square mile.

**Puyallup Formation, Interglaciation**

Puyallup Sand[1] or interglacial epoch[1]

Pleistocene, middle(?): Western Washington.

Original reference: Bailey Willis, 1898, Geol. Soc. America Bull., v. 9, p. 111.

J. E. Sceva, 1957, U.S. Geol. Survey Water-Supply Paper 1413, p. 19–20, pl. 1. In Kitsap County, conformably overlies Kitsap clay member (new) of Orting gravel. Maximum thickness about 300 feet.

D. R. Crandell, D. R. Mullineaux, and W. W. Waldron, 1958, Am. Jour. Sci., v. 256, no. 6, p. 390, 392–394. Puyallup sands of Willis redefined as Puyallup formation to include a thicker and laterally more extensive deposit characterized by coarse and fine alluvium, lacustrine sediments, and mudflows. Maximum thickness about 135 feet. Separated from older Alderton formation (new) by Stuck drift (new). [For Pleistocene sequence in area see 1958 entry under Orting glaciation.]

Typical occurrence on west side of Puyallup Valley, Pierce County.

**Puye Conglomerate** (in Santa Fe Group)

Puye Gravel (in Santa Fe Group)

Pliocene(?): North-central New Mexico.

H. T. U. Smith, 1937, (abs.) Geol. Soc. America Proc. 1936, p. 103; 1938, Jour. Geology, v. 46, no. 7, p. 937 (fig. 4), 959. Quaternary formations in Abiquiu quadrangle comprise Canjillon till, Canones andesite, Vallecito basalt (all new), and Black Mesa basalt, which were poured out on high-level erosion surfaces, and Puye gravel (new), which overlies an erosion surface of intermediate level and is overlain, locally, by Bandelier rhyolite and Santa Clara basalt (both new).

E. H. Baltz and others, 1952, New Mexico Geol. Soc. Guidebook 3d Field Conf., p. 12. Ancha formation (new) is eastward extension of Puye gravel.

Brewster Baldwin, 1956, New Mexico Geol. Soc. Guidebook 7th Field Conf., p. 118 (fig. 2), 119. Mentioned in discussion of upper unit of Santa Fe group. Puye gravel, Ancha formation, and Tuerto gravel all rest with angular unconformity on deformed beds of Tesuque formation. These units of gravel are 500, 300, and 150 feet in maximum thickness, respectively. In Buckman area, Ancha formation appears to intertongue with Puye gravel. Early Pleistocene.

Mapped in valley of Chama River, Rio Arriba County.

Puyer Formation[1]

Eocene: Central Washington.

Original reference: J. Daniels, 1915, Geol. Soc. America Bull., v. 26, no. 1, p. 132.

Pierce County coal field.

P. W. A. Quarry Limestone Member (of Drum Formation)

Pennsylvanian (Missouri Series): Eastern Nebraska and south-central Iowa.

G. E. Condra, 1949, Nebraska Geol. Survey Bull. 16, p. 37. Basal member of formation. Thickness about 1 foot in Sarpy County, Nebr., and about 2 feet in south-central Iowa; this is a "middle" limestone zone and may not extend very far southward. Underlies Richfield Quarry shale member (new); overlies Quivira formation.

Type locality: P. W. A. quarry in Missouri River bluffs, east of Richfield quarry, Sarpy County, Nebr.

**Pyburn Limestone Member** (of Oliver Hill Formation)[1]

Lower Devonian: Western and central Tennessee.

Original reference: A. F. Foerste, 1903, Jour. Geology, v. 11, p. 685.

C. W. Wilson, Jr., 1949, Tennessee Div. Geology Bull. 56, p. 288. Use of name, Pyburn limestone, is discontinued and all limestone formerly classed as Pyburn is included in Ross limestone member of Ross formation (new).

Named for exposures in Pyburn Bluff, Hardin County.

Pyramid conglomerate[1]

Upper Cretaceous: Southwestern (?) New Mexico.

Original reference: C. R. Keyes, 1922, Pan-Am. Geologist, v. 38, p. 338.

Crops out in Pyramid Butte.

Pyramid shale[1]

Cretaceous (?): Eastern New Mexico.

Original reference: C. R. Keyes, 1905, Am. Jour. Sci., 4th, v. 20, p. 424.

Derivation of name not stated.

Pyramid Rock Basalt (in Honolulu Volcanic Series)

Pleistocene: Oahu Island, Hawaii.

H. T. Stearns, 1940, Hawaii Div. Hydrography Bull. 5, p. 50–51. Lava flow and feeder dike of nepheline basalt.

G. A. Macdonald and D. A. Davis *in* Jacques Avias and others, 1956, Lexique Strat. Internat., v. 6, Océanie, fasc. 2, p. 129. Thickness unknown; Pyramid Rock has summit altitude of 100 feet, but lava extends below sea level. Overlain by reef of plus 25-foot (Waimanalo) stand of sea. Included in lower part of Honolulu volcanic series. Pleistocene.

Named for Pyramid Rock, a hill on Mokapu Peninsula that is composed of the lava and may mark vent from which it issued. Exposed over area of about 0.01 square mile at northwest corner of Mokapu Peninsula on northeast coast of Oahu, 13 miles northwest of Makapuu Head.

Pyrites Granite[1]

Precambrian: Northwestern New York.

Original reference: A. F. Buddington, 1929, New York State Mus. Bull. 281, p. 66, 71–73, 96.

Located just northeast of Pyrites, in southwestern corner of Canton quadrangle.

**Quabin Quartzite**[1]

Carboniferous: Western central Massachusetts.

Original reference: B. K. Emerson, 1917, U.S. Geol. Survey Bull. 597, p. 60. 72–75, map.

Composes large part of Quabin and Felton Mountains.

**Quadrant Quartzite**[1] or **Formation**[1]

Pennsylvanian: Wyoming and Montana.

Original reference: A. C. Peale, 1893, U.S. Geol. Survey Bull. 110.

C. C. Branson, 1939, Geol. Soc. America Bull., v. 50, no. 8, p. 1215–1217. Quadrant together with upper part of beds which Scott (1935) referred to as Amsden are herein regarded as attenuated edge of Tensleep sediments.

M. L. Thompson and H. W. Scott, 1941, Jour. Paleontology, v. 15, no. 4, p. 349–353. Lower part (beds 1 and 2) of Scott's (1935) section on Quadrant Mountain are Mississippian. In present report, Scott's section is revised: beds 1 and 2 are referred to Sacajawea(?) formation (Mississippian). Beds 3 to 21 are included in the Quadrant, and name Amsden is deleted from the section. At this locality, the Quadrant is 279 feet thick and underlies the Phosphoria. Fusulinids of type section discussed.

L. L. Sloss and C. A. Moritz, 1951, Am. Assoc. Petroleum Geologists Bull., v. 35, no. 10, p. 2164–2165. Thickness 2,662 feet in Big Sheep Creek section, Beaverhead County, Mont. The east-to-west increase in thickness of the Quadrant may suggest post-Pennsylvanian erosion of formation on tectonically positive areas and its preservation in negative trends.

M. R. Klepper, R. A. Weeks, and E. T. Ruppel, 1957, U.S. Geol. Survey Prof. Paper 292, p. 20–22, pl. 1. Formation in southern Elkhorn Mountains consists of interbedded light-colored quartzitic sandstone and light-gray sugary and sandy dolomite. Thickness 225 to 325 feet. Overlies Amsden formation; underlies Phosphoria formation.

D. O. Peterson, 1959, Dissert. Abs., v. 20, no. 7, p. 2757. Discussion of regional stratigraphy of Pennsylvanian in northeastern Utah, western Wyoming, northwestern Colorado, and southeastern Idaho. Many nomenclatural problems exist. One of the suggested changes is that Quadrant and Casper formational names be abandoned and the Tensleep-Amsden-Sacajawea terminology extended to include strata formerly referred to by these names.

Named for Quadrant Mountain, in Gallatin Range, northwest corner of Yellowstone Park, Wyo. Forms bluff encircling the mountain.

**Quail Porphyry**[1]

Upper Cretaceous or lower Tertiary: Western central Colorado.

Original reference: S. F. Emmons, 1898, U.S. Geol. Survey Geol. Atlas, Folio 48.

Ogden Tweto, 1953, U.S. Geol. Survey Mineral Inv. Field Studies Map MF-12. Fine-grained dark-gray monzonitic porphyry found only in a few dikes in eastern part of Pando area.

Largest sheet occurs under White Quail group of mines, Tenmile quadrangle. Pando area is in Eagle and Summit Counties.

Quajote Member (of Lowell Formation)

Lower Cretaceous: Southeastern Arizona.

A. A. Stoyanow, 1949, Geol. Soc. America Mem. 38, p. 9–10, 16–17, pl. 27. Consists of following divisions (ascending): friable yellow and greenish-yellow sandstone, friable yellow sandstone, whitish and yellow-green shale and greenish sandstone with layers of dark-green limestone, weak drab limestone, hard brownish limestone, and light-buff streaked sandstone. Thickness 32 feet. Underlies Perilla member (new); overlies unnamed shale and sandstone division.

In standard section of Lowell formation in the 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.

Quakertown cyclothem

Pennsylvanian (Pottsville Series): Southeastern Ohio.

N. K. Flint, 1949, Ohio Acad. Sci. [Guidebook] 24th Ann. Field Conf., p. 8. Incidental mention in road log.

N. K. Flint, 1951, Ohio Geol. Survey, 4th ser., Bull. 48, p. 23, table 1, geol. map. Includes (ascending): Quakertown shale and (or) sandstone, 8 feet thick, Quakertown clay, 1 to 5 feet; and Quakertown (No. 2) coal. Locally, the clay is replaced by Massillon sandstone. Overlies Huckleberry cyclothem; underlies Bear Run 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 western and northern Perry County.

Quakertown Fire Clay (in Pottsville Formation)[1]

Quakertown clay member

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

Original reference: I. C. White, 1879, Pennsylvania 2d Geol. Survey Rept. $Q_2$, p. 332.

N. K. Flint, 1951, Ohio Geol. Survey, 4th ser., Bull. 48, p. 23, table 1. Member of Quakertown cyclothem in report on Perry County. Plastic, sandy, and ferruginous at most outcrops. Commonly gray or dark gray. Thickness 1 to 5 feet. Underlain either by shale or sandstone and overlain by Quakertown coal. Locally clay replaced by Massillon sandstone.

†Quakertown Group (in Pottsville Formation)[1]

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

Original reference: J. P. Lesley, 1879, Pennsylvania 2d Geol. Survey Rept. $Q_2$, p. xxi–xxxvi, 319–333.

Quakertown Shale (in Breathitt Formation)

Pennsylvanian: Southeastern Kentucky.

R. E. Hauser, 1953, Kentucky Geol. Survey, ser. 9, Bull. 13, p. 11 (fig. 2), 14. Hard black fissile shale, 3 to 6 inches thick. Occurs from 6 to 18 feet above top of Lee formation. Underlies an unnamed shale 25 to 30 feet thick. In western part of area, a thin coal occurs in the position of the Quakertown; it may be that there is a lateral change from east to west of shale to coal.

This may or may not be a geographic extension of Quakertown shale listed below.

Occurs in Paintsville quadrangle.

Quakertown Shale (in Pottsville Formation)[1]

Pennsylvanian: Western Pennsylvania and western Maryland.

Original reference: I. C. White, 1879, Pennsylvania 2d Geol. Survey Rept. $Q_2$, p. 66.

W. O. Hickok 4th and F. T. Moyer, 1940, Pennsylvania Geol. Survey, 4th ser., Bull. C–26, p. 54–55. Quakertown coal and shale mentioned in report on Fayette County. Coal and shale separate the Upper and Lower Connoquenessing sandstone. As much as 15 feet thick in places.

Occurs at the "Falls" on Quakertown Run, near Quakertown Station, Lawrence County, Pa.

Quakertown Slate (in Kanawha Formation)[1]

Pennsylvanian: Northern West Virginia and western Maryland.

Original reference: D. B. Reger, 1918, West Virginia Geol. Survey Rept. Barbour and Upshur Counties, p. 273.

Named for occurrence along Tygart Valley River in northern Randolph County, W. Va., where it lies just above Quakertown (Winifrede?) coal.

**Quall Limestone**[1]

Lower Devonian: Western and central Tennessee.

Original reference: C. O. Dunbar, 1918, Am. Jour. Sci., 4th, v. 46, p. 746.

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., 1949, Tennessee Div. Geology Bull. 56, p. 307. Erosion following flooding of Pickwick Lake has exposed section of 40 feet of Harriman limestone just across valley from old Quall place—type locality of Quall limestone. On basis of recent studies, it is concluded that Dunbar's Quall limestone is an unweathered phase of Harriman formation, and it is recommended that name Quall be discontinued.

Named for development on farm of Jim Quall, in valley of Dry Creek, a small stream entering Tennessee River near Walnut Grove, Hardin County.

Quanah Granite[1]

Precambrian: Southwestern Oklahoma.

Original reference: H. F. Bain, 1900, Geol. Soc. America Bull., v. 11, p. 135, 137–138.

G. W. Chase, 1952, Oklahoma Geol. Survey Circ. 30, p. 11, 12. Makes up major part of the Quanah Mountain group and rests in a sill-like position on Lugert granite.

Named for Quanah Mountain in Wichita Mountains.

Quanah Gypsum[1]

Permian: Central northern Texas and southwestern Oklahoma.

Original reference: F. W. Cragin, 1897, Am. Geologist, v. 19, p. 356 (footnote), 357.

In Hardeman County, Tex., and Greer County, Okla. Named for Quanah, Hardeman County, Tex.

**Quantico Slate**[1]

Upper Ordovician: Northeastern Virginia.

Original reference: N. H. Darton, 1894, U.S. Geol. Survey Geol. Atlas, Folio 13.

Named for Quantico Creek, Prince William County.

Quapaw Chert[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. 102. Abandoned by Oklahoma Geological Survey.

Named from Quapaw Village in Ottawa County.

Quapaw Sandstone (in Wann Formation)

Pennsylvanian: Central northern Oklahoma.

C. C. Branson, 1955, The Hopper, v. 15, nos. 10–11, p. 129. Name applied by F. C. Greene (1918, Am. Assoc. Petroleum Geologists Bull., v. 2, p. 122) to massive sandstone exposed at Quapaw. Revard is valid name for this unit.

Quapaw was small village in sec. 35, T. 25 N., R. 10 E., Osage County,

Quarry Conglomerate

Miocene and Pliocene: Southern California.

G. J. Bellemin, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 4, p. 652 (fig. 1), 656–657. Named as one of five conglomerates interbedded in Miocene and Pliocene shales of the Puente Hills, Los Angeles County.

Named from an abandoned quarry on north side of Sycamore Canyon Road.

Quarry Creek Limestone[1]

Pennsylvanian: Southeastern Illinois.

Original reference: A. H. Worthen, 1875, Illinois Geol. Survey, v. 6, p. 10–17.

Named for Quarry Creek, 1½ miles east of Martinsville, Clark County.

Quarry Peak Rhyolite Complex

Tertiary: Southwestern New Mexico.

Elliot Gillerman, 1958, New Mexico Bur. Mines Mineral Resources Bull. 57, p. 65–68, table 1, pl. 1. Flows, breccias, and tuffs of rhyolite composition. Most of sequence consists of holocrystalline equigranular aphanitic white or light-gray rhyolite which contains a few small inconspicuous phenocrysts of quartz and feldspar. Many of the breccias and tuffs are well bedded. Thickness about 1,000 feet. Overlies unnamed andesite with slight angular unconformity; disconformably underlies unnamed basalt.

Forms prominent peak west of Steins and north of Southern Pacific Railroad and State Highway 14. For convenience of this report, the peak above the abandoned quarry is called Quarry Peak from which sequence of rhyolitic rocks takes its name. The complex also crops out west and northwest of Quarry Peak and north of Steins, Hidalgo County.

Quartermaster Dolomite (in Quartermaster Formation)[1]

Permian: Western Oklahoma.

Original references: Noel Evans, 1928, Am. Assoc. Petroleum Geologists Bull., v. 12, no. 7, p. 706, 708; G. G. Suffel, 1930, Oklahoma Geol. Survey Bull. 49, p. 107, 114, 124, 128.

In Weatherford district, Custer County.

**Quartermaster Formation[1]**

Quartermaster Formation (in Custer Group)

Quartermaster Group

Permian: Southwestern and northwestern Oklahoma, southern Kansas, and northwestern Texas.

Original reference: C. N. Gould, 1902, Oklahoma Geol. Survey 2d Bienn. Rept., p. 42, 57.

Robert Roth, 1937, Am. Assoc. Petroleum Geologists Bull., v. 21, no. 4, p. 421–433. Mentioned in general discussion of extension into Texas and loose use of Kansas and Oklahoma formation names in Texas.

D. A. Green, 1937, Am. Assoc. Petroleum Geologists Bull., v. 21, no. 12, p. 1526 (fig. 3), 1527–1528. Quartermaster used as group term to include Doxey shale and Elk City sandstone. Cloud Chief removed from Quartermaster and considered uppermost formation in underlying Whitehorse group.

Robert Roth, N. D. Newell, and B. H. Burma, 1941, Jour. Paleontology, v. 15, no. 3, p. 312–317. Age of Quartermaster formation of Oklahoma and Texas has been subject of controversy, being variously given as late Permian or Triassic(?). Fossils have been discovered in lower part of Doxey shale at base of Quartermaster. Some of the species recognized also characterize recently described Whitehorse fauna and indicate close relationship of enclosing beds with Whitehorse formation. If Whitehorse is Guadalupian (late Permian) in age, then fossiliferous Quartermaster beds probably are to be correlated with some part of Guadalupian or perhaps Ochoa of western Texas. Table shows Quartermaster formation as uppermost unit of Custer group.

R. C. Moore, J. C. Frye, and J. M. Jewett, 1944, Kansas Geol. Survey Bull. 52, p. 156–157. Permian beds above Day Creek dolomite are classified as belonging in Quartermaster group. They seem to be equivalent to lower part of Quartermaster formation of western Oklahoma and Panhandle of Texas. Maximum outcrop thickness in Kansas about 45 feet. Includes Taloga formation.

H. D. Miser and others, 1954, Geologic map of Oklahoma (1:500,000): U.S. Geol. Survey. As mapped, formation includes Doxey and Elk City members.

Named for exposures along banks of Quartermaster Creek, Roger Mills County, Okla.

Quartz Spring Sandstone Member (of Lost Burro Formation)

Upper Devonian: Southern California.

R. L. Langenheim, Jr. and Herbert Tischler, 1960, California Univ. Pubs., Geol. Sci., v. 38, no. 2, p. 92, 94 (fig. 2), 134–135, 136. Consists of quartzite and interbedded sandy dolomite and limestone; contains fauna characterized by *Cyrtospirifer cf. C. monticola* Haynes. Thickness about 38 feet. Underlies Tin Mountain limestone.

Type locality: Exposures below type section of Tin Mountain limestone which is on southern slope of hills about 2½ miles southeast of Quartz Spring, Inyo County, and about 3,000 feet north of road to Rest Spring.

Quatal Formation

Quatal Red Clay Member (of Santa Margarita Formation)

Miocene, upper(?): Southern California.

W. E. Ver Planck, 1952, California Div. Mines Bull. 163, p. 35–37, pl. 33. Nonmarine facies of the upper Santa Margarita. Underlies a sandstone bed; overlies a gypsum bed stratigraphically above Caliente red beds. Total thickness of shale and sandstone above the gypsum is 75 to 100 feet. Occurs in Quatal Canyon gypsum deposit, Ventura County.

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), 2978 (fig 3), 2996, 2997. Quatal formation is herein designated as the nonmarine claystone and sandstone, probably upper Miocene in age, that lies conformably between Caliente formation below and Morales formation above. At type locality, the formation, of probable lacustrine origin, is approximately 800 feet thick and consists of reddish-gray soft thin-bedded gypsiferous claystones weathering to reddish clay soil; contains basal bed of white massive gypsum that attains maximum thickness of 30 feet in Quatal Canyon. In southern part of Cuyama Badlands, formation thickens to about 2,700 feet and becomes mainly fluviatile pebbly sandstone of prevailing orange-buff color of which only basal 500 feet is lacustrine red claystone. West of mouth of Quatal Canyon, on west bank of Cuyama River, formation consists of about 600 feet of light brown sandstone-cobble conglomerate and sandstone which grades westward along strike into marine Santa Margarita sandstone. On northeast slope of Caliente Range adjoining Carrizo Plain, type Caliente redbeds are overlain conformably by about 700 feet of soft gray gypsiferous lacustrine claystone containing some thin-bedded hard sandstones in basal part; these claystones are believed to be correlative with Quatal red claystone of Cuyama Badlands but could belong to overlying Morales formation. Name replaces preoccupied Apache formation (Dibblee, 1947).

Type locality: Ballinger Canyon, Ballinger Canyon quadrangle. Named for exposures in Quatal Canyon.

Queantoweap Sandstone

Lower Permian: Northwestern Arizona.

A. H. McNair, 1951, Am. Assoc. Petroleum Geologists Bull., v. 35, no. 3, p. 515 (fig. 2), 525–526. Massive pink and gray ledge- and cliff-forming crossbedded sandstones which rest on Pakoon (new) and upper Callville limestones. Thicknesses: 393 feet, Hurricane Cliffs; 645 feet, North Grand Wash Cliffs; 400 feet Pakoon Ridge. Underlies Hermit formation with contact transitional in interval ranging from 5 to 50 feet. Not present in southwestern part of area where Supai is undifferentiated. Northward, could represent most, if not all, of massive-bedded tan, yellow, and pink sandstones of extreme northwest Arizona and southwest Utah that have commonly been referred to as "Supai."

Type section: On east side of Queantoweap Valley, Mohave County, between the upper and lower lava flows, near a well locally known as Gramps basin.

†Quebecan Substage (of Wisconsin Stage)[1]

Pleistocene: Great Lakes region.

Original reference: M. M. Leighton, 1931, Jour. Geology, v. 39, p. 51–53.

Named for Quebec, Canada.

Quebradillas Limestone[1]

Miocene: Puerto Rico.

Original reference: T. W. Vaughan, 1924, Geol. Soc. America Bull., v. 35, no. 4, table 3.

A. D. Zapp, H. R. Bergquist, and C. R. Thomas, 1948, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 85. Quebradillas and Los Puertos limestones form an indivisible unit and in this report are termed Aymamón limestone.

**Quebrancha Limestone Member** (of Caimito Formation)

Quebrancha Limestone

Oligocene, upper: Panamá.

T. F. Thompson, 1944, Geological explorations in the vicinity of Río Quebrancha for the Panamá Cement Co.: Panamá Canal, Spec. Eng. Div., p. 17–20. The so-called Quebrancha limestone deposit consists of a 110 to 135 meter thick layer of variably argillaceous, sandy, or semicrystalline limestone. Separated from underlying Gatuncillo shale (new) by an interval of gritty sandstone, basalt, and conglomerate, and from overlying Río Duque shales (new) by interval by calcareous siltstone.

W. P. Woodring and T. F. Thompson, 1949, Am. Assoc. Petroleum Geologists Bull., v. 33, no. 2, p. 234, 246 (fig. 2). Member of Caimito limestone. Thickness 350 to 450 feet. Grades upward into unnamed calcareous siltstone member; overlies, probably without marked discontinuity, volcanic member of Bohío formation.

Type region: On south limb of Quebrancha syncline; includes quarry of Panamá Cement Co.

**Queen Formation** (in Whitehorse Group or Artesia Group)

Queen Sandstone Member (of Chalk Bluff Formation)[1]

Permian (Guadalupe Series): Southeastern New Mexico and western Texas.

Original references: F. S. Prout, 1929, Am. Assoc. Petroleum Geologists Bull., v. 13, p. 656; K. H. Crandall, 1929, Am. Assoc. Petroleum Geologists Bull., v. 13, no. 8, p. 940–941.

R. K. DeFord and E. R. Lloyd, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 1, p. 9. Whitehorse group of West Texas and New Mexico divided into (ascending) Grayburg, Queen, Seven Rivers, Yates, and Tansill formations.

W. C. Fritz and James Fitzgerald, Jr., 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 1, p. 24–25. Includes Yoakum dolomite member (new) in subsurface.

N. D. Newell, 1953, The Permian reef complex of the Guadalupe Mountains region, Texas and New Mexico: San Francisco, W. H. Freeman and Co., p. 43–46. Overlies Grayburg formation; underlies Seven Rivers formation. Lower boundary used herein is essentially that selected by Crandall (1929, Am. Assoc. Petroleum Geologists Bull., v. 13, p. 982, 983, 987) on Queen Mesa, but top of formation is drawn above Shattuck member (new), a prominent sandstone approximately 100 feet thick over much of shelf area in Guadalupe Mountains, except near reef where it thins rapidly.

W. R. Moran, 1954, (abs.) Geol. Soc. America Bull., v. 65, no. 12, pt. 2, p. 1288. Crandall (1929) did not designate type locality. At type section herein designated, Queen is 421 feet thick and consists of alternating sandstone and sandy dolomite. At this section, Queen underlies Seven Rivers formation and overlies the Grayburg; Shattuck member is present in uppermost 100 feet of section.

P. T. Hayes and R. L. Koogle, 1958, U.S. Geol. Survey Geol. Quad. Map GQ-112. Formation described in Carlsbad Caverns West quadrangle which contains type section as designated by Moran. Overlies Grayburg formation; underlies Seven Rivers formation of Carlsbad group.

Term Artesia Group (D. B. Tait and others, 1962, Am. Assoc. Petroleum Geologists Bull., v. 46, no. 4) replaces terms Whitehorse and Chalk Bluff in New Mexico.

Type section (Moran): West wall of Dark Canyon, in SW¼ sec. 36, T. 24 S., R. 22 E., Eddy County, N. Mex. Named for exposures in vicinity of Queen post office, sec. 30, T. 24 S., R. 22 E., Eddy County.

**Queen City Sand Member** (of Mount Selman Formation)[1]

Queen City Sand or Formation (in Claiborne Group)

Eocene, middle: Northwestern Louisiana and eastern Texas.

Original reference: W. Kennedy, 1892, Texas Geol. Survey 3d Ann. Rept., p. 50–52.

H. B. Stenzel, 1939, Texas Univ. Bur. Econ. Geology Pub. 3818, p. 20 (table), 78–93 [1938]. Queen City sand described in Leon County where it is about 440 feet thick. Includes Omen glauconitic sand member at top and lower unit referred to as glauconitic sand at Venetia. Overlies Marquez shale member (new) of Reklaw formation; underlies Tyus marl member (new) of Weches formation.

H. B. Stenzel, 1953, Texas Univ. Bur. Econ. Geology Pub. 5305, p. 10 (fig. 3), 83–100. Formation described in Henrys Chapel quadrangle where it is youngest of Eocene formations present and is only incompletely preserved. Thickness 105 to 131 feet. Includes (ascending) Arp member, Omen glauconitic sandstone member, and unnamed upper sand member. Overlies Reklaw formation; underlies Pleistocene gravels.

C. R. Smith, 1958, Am. Assoc. Petroleum Geologists Bull., v. 42, no. 10, p. 2517–2522. Three-fold division of Queen City as recognized on surface in Texas is also present in surface in Caddo Parish, La. Lower sand unit is correlative with Arp member; middle glauconitic member is correlative with Omen member; upper sand member is herein named Myrtis sand member. Underlies Weches formation. Present study shows that sand on surface at Queen City, Cass County, Tex., is equivalent to sand at type locality of Sparta sand. The sand occupying stratigraphic position between Reklaw and Weches formations, "Queen City" by name, has incorrect type locality and alternate type locality is herein suggested.

Alternate type locality: Exposures extending from town of Vivian north and west along old Vivian-Atlanta Road for 4 miles through secs. 23, 15, 10, and 4 to Myrtis Mill Creek, Caddo Parish, La. Well developed in vicinity of Queen City, Cass County, Tex., in which area it was described by Kennedy (1892).

**Queen 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, 46, 47.

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), 154; F. C. Greene and W. V. Searight, 1949, Missouri Geol. Survey and Water Resources Rept. Inv. 11, p. 17. Queen Hill shale member of Lecompton formation; underlies Beil limestone member; overlies Big Springs 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. 24. Type locality and derivation of name stated.

H. G. Hershey and others, 1960, Iowa Highway Research Board Bull. 15, p. 20, fig. 5. Dark to greenish gray and argillaceous in upper part; and black and fissile below. Thickness 4½ feet. Not identified farther northeast than Montgomery County.

Type locality: Queen Hill, a prominent point in Missouri River bluffs, northeast of Rock Bluff, Cass County, Nebr.

**Queenston Shale**[1]

Queenston Shale (in Richmond Group)

Upper Ordovician: Western New York, and Ontario, Canada.

Original reference: A. W. Grabau, 1908, Science, new ser., v. 27, p. 622–623.

Tracy Gillette, 1940, New York State Mus. Bull. 320, p. 22 (fig. 6). Uppermost unit of Richmond group in Clyde and Sodus Bay quadrangles.

D. W. Fisher, 1954, Am. Assoc. Petroleum Geologists Bull., v. 38, no. 9, p. 1981 (fig. 2), 1986. Discussion of stratigraphy of Silurian Medinan group. Queenston shale underlies the Whirlpool, basal formation of Medinan. In some areas the Queenston underlies the Grimsby.

Named for town of Queenston on Niagara River, opposite Lewiston, Niagara County, N.Y.

Queets Beds

Pleistocene, upper: Northwestern Washington.

S. L. Glover, 1940, Northwest Sci., v. 14, no. 3, p. 69–71. Name applied to late Pleistocene deposits on coastal area of Olympic Peninsula. Probably correlate with sediments of Vashon age in Puget Sound area. Beds are generally flat lying. Thickness about 15 feet. Overlies Taholah formation (new).

S. L. Glover, 1940, (abs.) Geol. Soc. America Bull., v. 51, no. 12, pt. 2, p. 2022–2023. Younger than Browns Point formation (new).

Well exposed on south bank of Quinault River near Indian village of Taholah, Grays Harbor County.

Quercan Sandstone[1]

Miocene: Central western California.

Original reference: C. E. Weaver, 1909, California Univ. Pub., Bull. Dept. Geology, v. 5, p. 251.

In San Pablo Bay region. Derivation of name not stated.

Quichapa Formation or Group

Oligocene(?): Southwestern Utah.

E. F. Cook, 1957, Utah Geol. and Mineralog. Survey Bull. 58, p. 16 (fig. 2a), 18–24, 53–57. Group consists of three ignimbrite units in Pine Valley Mountains. Lowermost unit is hard dense welded tuff; pale red violet on fresh surfaces, weathers pale red brown; sparsely scattered through rock are angular red latite (?) fragments, averaging under 10 millimeters in diameter; ranges in thickness from less than 100 feet just east of Stoddard Mountain to about 800 feet near Pinto Peak; 5 to 20 feet of black glass containing angular red fragments at base of unit. Middle unit is a vitric rhyolite ignimbrite, consisting of strongly welded tuff, contains basal black glass, 10 to 20 feet thick, which unconformably overlies basal unit of group. Uppermost ignimbrite unit is red brown to purplish brown on fresh surfaces, weathers brown or dark brown; basal black glass of unit is as much as 35 feet thick; maximum thickness of unit in Pine Valley Mountains about 550 feet; conformably overlies middle unit. Thickness of group in Pine Valley Mountains ranges from a fraction of a foot to about 1,600 feet, the variation being due largely to an unconformity at top of group. In most exposures, lowermost unit of group appears to overlie Claron formation conformably. Underlies Rencher formation (new). Name credited to J. H. Mackin (personal commun.).

J. H. Mackin, 1960, Am. Jour. Sci., v. 258, no. 2, p. 89, 97. Rank reduced to formation. Subdivided into (ascending) Leach Canyon tuff, Swett tuff, Bauers tuff, and Harmony Hills tuff members (all new). Underlies Rencher formation; overlies Isom formation (new).

E. F. Cook, 1960, Utah Geol. and Mineralog. Survey Bull. 70, p. 18 (fig. 1), 37–40, maps 1 and 2. Formation, in Washington County, includes (ascending) Leach Canyon tuff, Bauers tuff, Little Creek breccia (new), and Harmony Hills tuff. Thickness 0 to 1,800 feet. Overlies Isom formation; underlies Rencher formation. Leach Canyon tuff has zircon age of 28 million years; this suggests that formation is Oligocene.

Named from exposures in Quichapa Canyon of the Harmony Hills, Iron and Washington Counties.

Quien Sabe Volcanics

Miocene, middle(?): West-central California.

N. L. Taliaferro, [1949], Geologic map of the Hollister quadrangle, California (1:62,500): California Div. Mines Bull. 143, pl. 1 [preprint?]. Shown on map legend as consisting of flows and agglomerates with plugs, dikes, and a sandstone member. Overlies Vaqueros formation.

C. J. Leith, 1949, California Div. Mines Bull. 147, p. 12 (fig. 2), 22–24, pl. 1. Described in Quien Sabe quadrangle. Thickness 4,000 feet. Unconformably underlies upper Pleistocene Peckham formation (new); unconformably overlies Vaqueros formation.

E. B. McKee, Jr., 1959, Dissert. Abs., v. 19, no. 11, p. 2913. In Pacheco Pass area, slightly folded erosional remnants of Quien Sabe group (late Cenozoic) locally lie with angular unconformity on Franciscan rocks.

Occurs in west-central part of Quien Sabe quadrangle and extend westward into Hollister quadrangle.

Quillayute Formation[1]

Miocene(?) or Pliocene: Northwestern Washington.

Original reference: A. B. Reagan, 1909, Kansas Acad. Sci. Trans., v. 22, p. 203.

C. E. Weaver, 1937, Washington [State] Univ. Pubs. in Geology, v. 4, p. 24 (chart), 195. Composed of medium- and coarse-grained pebbly sandstone, shaly sandstones, and sandy shales; prevailingly brownish gray. Maximum thickness probably under 1,000 feet; dips range between 5° and 15°. Rests with marked unconformity upon steeply dipping strata of older rocks which may be in part middle Miocene. Pliocene. Exposures noted.

Exposed in southwestern part of Clallam County in valley of Quillayute River near junction of Solduc and Bogachiel Rivers.

Quimbo Dolomite (in Joserita Member of Lowell Formation)

Lower Cretaceous: Southeastern Arizona.

A. A. Stoyanow, 1949, Geol. Soc. America Mem. 38, p. 11. Ochre-colored dolomite, in places grades laterally into light-yellow calcareous shale. Underlies Saavedra member (new); overlies Corta sandstone (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 on Southern Pacific Railway, Cochise County.

**Quimbys Mill Member** (of Platteville Formation)

Quimbys Mill Formation (in Platteville Group)

Middle Ordovician: Southwestern Wisconsin, northern Illinois and eastern Iowa.

A. F. Agnew and A. V. Heyl, Jr., 1946, Am. Assoc. Petroleum Geologists Bull., v. 30, no. 9, p. 1585–1587. Proposed for "glass rock" beds that overlie McGregor limestone member of Platteville and underlie Spechts Ferry shale member of Decorah formation. Consists of limestone and dolomite in medium to thin beds which are separated by thin carbonaceous shale laminae. Thickness at type locality 12 feet; upper 6 feet is dolomite with carbonaceous shale partings; lower 6 feet is limestone. Unit thins toward northwest and thickens southeast becoming completely a dolomite in latter direction.

J. S. Templeton and H. B. Willman, 1952, Tri-State Geol. Soc. Guidebook 16th Ann. Field Conf., p. 6, 10 (fig. 3), 18 (fig. 9). Geographically extended into Dixon-Oregon area, Illinois, where it is considered a formation at top of Platteville group; includes (ascending) Hazel Green, Shullsburg, and Strawbridge members (all new). Overlies Nachusa formation (new). Underlies Guttenberg formation of Galena group.

A. F. Agnew, 1955, Am. Assoc. Petroleum Geologists Bull., v. 39, no. 9, p. 1734. Geographically extended into eastern Iowa.

Type section: Quarry at Quimby's Mill, SE cor. sec. 11, T. 1 N., R. 1 E., Etna, Wis.

Quimper Sandstone

Oligocene, lower: Northwestern Washington.

J. W. Durham, 1942, Jour. Paleontology, v. 16, no. 1, p. 86–87. Massive-bedded sandstone 900 feet thick at type section. Underlies moderately well-bedded shale; overlies Townsend shale (new) or overlaps onto older rocks of Oligocene or Eocene age.

J. W. Wyatt, 1944, California Univ. Dept. Geol. Sci. Bull., v. 27, no. 5, p. 106. On Marrowstone Island, underlies Marrowstone shale (new). Here consists of nearly 700 feet of moderately well-bedded medium-grained arkosic sandstones; on south shore of Port Townsend Bay, section is approximately 800 feet thick; in this area, unconformity at base is well marked and Quimper overlies Lyre conglomerates, Townsend shale, and various parts of the Eocene section; rests successively on older rocks toward the northeast.

Type section: On east side of Kilisut Harbor, Marrowstone Island [Jefferson County], Quimper Peninsula.

**Quinault Formation**[1]

Pliocene: Northwestern Washington.

Original reference: R. Arnold, 1906, Geol. Soc. America Bull., v. 17, p. 451–468, map.

C. E. Weaver, 1937, Washington [State] Univ. Pubs. in Geology, v. 4, p. 191–194. On north side of Quinault River, consists of alternating layers of sandstone, shale, and conglomerate; on south side of river, consists of massive fossiliferous shaly sandstones. Thickness about 936 feet. At Cape Grenville, appears to rest unconformably upon a complex of basaltic lavas, tuffs, agglomerates and associated intrusive dikes which probably correspond to the Eocene Metchosin volcanics, a fault may separate these volcanics from the Quinault.

S. L. Glover, 1940, Northwest Sci., v. 14, no. 3, p. 70. Unconformably underlies newly defined lower Pleistocene Taholah formation.

T. J. Etherington, 1951, Am. Assoc. Petroleum Geologists Bull., v. 35, no. 2, p. 191. Chart shows Quinault formation stratigraphically above Montesano formation.

Occurs on Quinault Indian Reservation north and south of mouth of Quinault River between Cape Elizabeth and Point Grenville, Grays Harbor County.

**Quincy Amygdaloid**[1] (in Ashbed Group)

Precambrian (Keweenanwan): Northern Michigan.

Original reference: R. Pumpelly, 1893, Michigan Geol. Survey, v. 1, pt. 2. p. 21–25, 28.

Named for occurrence in Quincy mine, Houghton County.

**Quincy 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 Quincy mine, Houghton County.

**Quincy Granite**[1]

Mississippian(?): Eastern Massachusetts and Rhode Island.

Original reference: W. O. Crosby, 1876, Rept. on geol. map of Massachusetts, p. 1–42.

N. E. Chute, 1940, Massachusetts Dept. Public Works Bull. 1, p. 4, 11–12, pls. 2–A, 2–B. Devonian(?).

Alonzo Quinn, R. G. Ray, and W. L. Seymour, 1949, *in* Alonzo Quinn and others, Bedrock geology of the Pawtucket quadrangle, Rhode Island-

Massachusetts: U.S. Geol. Survey Geol. Quad. Map [GQ–1]. Mississippian (?).

Type area; In Quincy and Milton, Mass.

Quincy Syenite[1]

Precambrian: Massachusetts.

Original reference: C. H. Hitchcock, 1872, Am. Jour. Sci., 3d, v. 3, p. 47.

In Abington, Plymouth County.

**Quincy Pewabic Amygdaloid**[1]

Precambrian (Keweenawan): Northern Michigan.

Original reference: R. D. Irving, 1883, U.S. Geol. Survey Mon. 5, pl. 18.

Named for occurrence in Quincy and Pewabic mines, Houghton County.

**Quincy Pewabic Flow**[1]

Precambrian (Keweenawan): Northern Michigan.

Original reference: R. D. Irving, 1883, U.S. Geol. Survey Mon. 5, pl. 18.

Probably named for occurrence in Quincy and Pewabic mines, Houghton County.

**Quindaro Shale**[1] **Member** (of Wyandotte Formation)

Quindaro Member (of Iola Limestone)

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

Original reference: R. C. Moore, 1932, Kansas Geol. Soc. 6th Ann. Field Conf. Guidebook p. 92, 97.

E. B. Branson, 1944, Missouri Univ. Studies, v. 19, no. 3, p. 282. Member of Iola limestone; consists of gray calcareous shale 1 to 2 feet thick.

R. C. Moore, 1948, Am. Assoc. Petroleum Geologists Bull., v. 32, no. 11, p. 2031 (fig. 4), 2033; 1949, Kansas Geol. Survey Bull. 83, p. 103. Quindaro shale member of Wyandotte formation; underlies Argentine limestone member; overlies Frisbie limestone member. This is classification agreed upon by State Geological Surveys of Iowa, Kansas, Missouri, Nebraska, and Oklahoma, May 1947. The Frisbie limestone, Quindaro shale, and Argentine limestone, which were indicated as members of the Iola limeston in western Missouri. are classified with overlying Island Creek shale and Farley limestone as members of the Wyandotte.

T. L. Welp. L. A. Thomas, and H. R. Dixon, 1957, Iowa Acad. Sci. Proc., v. 64, p. 420. Thickness 4 feet in vicinity of Winterset, Iowa

H. G. Hershey and others. 1960, Iowa Highway Research Board Bull. 15. p. 25, fig. 5. Member of Wyandotte. Top poorly defined. Argentine-Quindaro contact arbitrarily placed where limestone is subordinate and shale dominates section. In Madison and Union Counties, Quindaro shale consists of black fissile shale overlain by gray to live-gray fossiliferous shale and underlain by gray shale. Thickness about 3.7 feet. Overlies Frisbie limestone member. Although Condra and Upp (1933, Nebraska Geol. Survey Paper 4) did not recognize Quindaro in their Middle River traverse in Iowa it is recognized here.

Typically exposed in floor of Boyn's quarry, near NW cor. sec. 30, T. 10 S., R. 25 E., northeast of Welborn, Wyandotte County, Kans. Named for Quindaro Township.

Quinn Clay (in Harpersville Formation)

Pennsylvanian (Cisco) : North-central Texas.

F. B. Plummer *in* M. G. Cheney, 1948, Abilene Geol. Soc. [Guidebook] Spring Field Trip, June 11–12, p. 7. Named in road log.

F. B. Plummer and H. B. Bradley, 1949, Texas Univ. Bur. Econ. Geology Pub. 4915, p. 5–17, pl. 3. Purplish-red, green, and maroon clay which occurs between Parks Mountain sandstone or its probable equivalent, the Cisco Lake sandstone, and upper Breckenridge limestone. Best described as the next to lowest clay in Harpersville formation, as defined by Plummer and Moore (1921, Texas Univ. Bull. 2132). Most conveniently mapped as the clay between the lower Crystal Falls limestone and the upper Breckenridge limestone. Average thickness 30 feet, maximum thickness 48 feet.

L. F. Brown, Jr., 1960, Texas Univ. Bur. Econ. Geology Rept. Inv. 41, p. 21–23. Quinn clay, according to Plummer and others (1949), is the clay between the Crystal Falls and upper Breckenridge limestone. Present study shows that this upper Breckenridge limestone in northern Stephens County is type Breckenridge and that no lower Breckenridge limestone occurs in subject area. Also correlation has not been demonstrated of type Quinn clay in northern Eastland County with Quinn clay mapped by Plummer and others in northern Stephens County. Quinn clay of present report (Stephens County) thins north of Clear Fork of Brazos River. Member is divided into upper clay and lower clay-shale units by thin sandstone south of Clear Fork of Brazos River and by a limestone north of the river. Clay contains several thin sandstone lentils, a limestone lentil, and a sandstone channel deposit. Thickness 30 to 50 feet.

D. H. Eargle, 1960, U.S. Geol. Survey Prof. Paper 315–D, p. 73. Beds that intervene between Breckenridge and Chaffin limestone members of the Thrifty in Brown County and north of Home Creek in eastern Coleman County are red clay containiing abundant hematite nodules and plant fossils. This is Quinn clay of Plummer and Bradley. In many places, lenticular beds of sandstone are present within unit, particularly near the base, and some channel-fill conglomerate is also present. Conglomerate may perhaps be correlated with Parks Mountain sandstone member of Thrifty.

Type locality: On north side of Eastland-Cisco Highway (U.S. Highway 80), 2 miles east of Cisco, Eastland County. Named for Quinn Ranch.

**Quinnesec Formation**

Quinnesec Greenstone[1]

Precambrian: Northern Michigan and northeastern Wisconsin.

Original reference: C. R. Van Hise and W. S. Bayley, 1900, U.S. Geol. Survey Geol. Atlas, Folio 62.

H. L. James, 1958, U.S. Geol. Survey Prof. Paper 314–C, p. 30 (table 1), 33. Term Quinnesec formation applied to greenstone amphibolite and schist that form a belt in southernmost Dickinson County and adjacent parts of Wisconsin. These rocks were referred to as schists by Van Hise and Bayley (1900) who assigned them to the Archean and as greenstone by Leith, Lund, and Leith (1935) who assigned them to the middle Huronian. Recent mapping in the type area shows that rocks placed in the Quinnesec by previous workers comprise metavolcanic rocks and younger metagabbro sills. Term Quinnesec formation is retained for the metavolcanic rocks, which are clearly older than granitic rocks that form a mass of batholithic dimensions to the south. Relationships of Quinnesec formation and of the granitic rocks to known Animikie strata are not clear; the metavolcanic and granitic rocks are believed to be pre-Animikie; the younger metagabbro sills are intrusive into the formation and are younger than the granitic rocks to the south; they are tentatively correlated with the post-Animikie and metagabbro.

Quinnesec Falls, Dickinson County, Mich., is on some of the harder ledges of these rocks.

Quinnesec Ore-Formation[1]

Precambrian: Northern Michigan.

Original reference: C. L. Rominger, 1881, Michigan Geol. Survey, v. 4, pt. 2, p. 182.

Crops out at many localities along the range, especially north of the Norway, Quinnesec, and Chapin mines, Menominee iron region.

†Quinnimont Beds[1]

†Quinnimont coal group[1]

Pennsylvanian: West Virginia, western Pennsylvania, and southwestern Virginia.

Original reference: J. P. Lesley, 1877, Pennsylvania 2d Geol. Survey Rept. $H_3$, p. xxii–xxiv.

Quinnimont Sandstone (in New River Group)

Quinnimont Sandstone (in Pottsville Group)[1]

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. 206.

P. H. Price, 1939, West Virginia Geol. Survey Greenbrier County, p. 216, 237–238. Hard, gray, massive, medium-grained, lenticular. As much as 70 feet thick. Underlies Beckley coal; overlies Quinnimont shale. New River group, Pottsville series.

Named for exposures in New River Canyon at Quinnimont, Fayette County.

Quinnimont Shale (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. 206.

Named for exposures at Quinnimont, Fayette County.

**Quinnimont Shale Member** (of New River Formation)

Quinnimont Shale (in New River Group)

Quinnimont Shale (in Pottsville Group)[1]

Lower Pennsylvanian: Southern West Virginia and southwestern Virginia.

Original reference: M. R. Campbell, 1896, U.S. Geol. Survey Geol. Atlas, Folio 29.

P. H. Price and E. T. Heck, 1939, West Virginia Geol. Survey Greenbrier County, p. 216, 238. Dark-gray siliceous to argillaceous laminated lenticular sandstone 5 to 40 feet thick. Underlies Quinnimont sandstone; overlies Fire Creek coal. New River group, Pottsville series.

U.S. Geological Survey currently classifies the Quinnimont Shale as a member of the New River Formation on basis of a study now in progress.

Named for exposures at Quinnimont, Fayette County, W. Va.

Quinto Formation (in Orestimba Group)

Quinto Member (of Moreno Group)

Upper Cretaceous (Chico Series): Northern California.

R. D. Reed, 1943, California Div. Mines Bull. 118, pt. 2, p. 109 (table 6) [preprint 1941]. Shown in table as Quinto formation in Orestimba group; underlies Garzas formation; overlies Moreno formation.

F. M. Anderson, 1943, California Div. Mines Bull. 118, pt. 2, p. 185 (fig. 69), 186 [preprint 1941]. Middle member of Moreno group. Underlies Garzas member; overlies Moreno member of group.

L. I. Briggs, Jr., 1953, California Div. Mines Bull. 167, p. 31. Quinto member described by Bennison (1941, unpub. map of late Upper Cretaceous deposits south of San Luis Creek, Merced and Fresno Counties) includes sandy shale and two beds of massive biotitic sandstone at Los Banos Creek and at Salt Creek, but units at Salt Creek are poorly exposed. Quinto discussed under heading of Panoche formation in this report [Ortigalita Peak quadrangle].

Has been traced at intervals from Los Banos Creek northward to Brentwood, Contra Costa County.

Quinto B reef beds

Upper Cretaceous: Central western California.

C. T. Smith, 1945, Jour. Paleontology, v. 19, no. 1, p. 37–38, 39 (table 1). Sandstones and sandy shales with some conglomerates. Contain almost exclusively *Glycymeris veatchii major*. Includes Los Banos Creek member. Discussion of biostratigraphy of *Glycymeris veatchii*. Name credited to Alan Bennison (unpub. thesis):

Exposed on Los Banos Creek, west of Los Banos, Merced County. Also crops out along Garzas Creek, Moreno Gulch, and other streams that flow into San Joaquin Valley.

Quitman Bed (in Trinity Group)[1]

Lower Cretaceous (Comanche Series): Western Texas.

Original reference: J. A. Taff, 1891, Texas Geol. Survey 2d Ann. Rept., p. 728, 736.

L. W. Stephenson and others, 1942, Geol. Soc. America Bull., v. 53, no. 3, chart 9. Quitman formation shown on correlation chart above Mountain formation and below Glen Rose equivalents.

Named for Quitman Mountain and Quitman Gap, El Paso County.

†Quitman Limestone[1]

Pennsylvanian: Northwestern Missouri.

Original reference: J. A. Gallaher, 1898, Missouri Bur. Geology and Mines Bienn. Rept., p. 54–55.

R. C. Moore, 1936, Kansas Geol. Survey Bull. 22, p. 204. Name preoccupied by Cretaceous formations in Texas.

Named for exposures at Quitman, Nodaway County.

Quitman Quartz Monzonite

Oligocene(?) : Western Texas.

R. M. Huffington, 1943, Geol. Soc. America Bull., v. 54, no. 7, p. 1034–1036, pl. 1. Chiefly quartz monzonite, includes some granodiorite; monzonite, syenite, and granite; holocrystalline, medium- and coarse-grained to porphyritic, generally pink or gray. Principal rock in Quitman pluton; and forms a discontinuous ellipse, elongated north-south, around volcanic rocks of area. Age of pluton cannot be dated exactly; youngest sedimentary rocks invaded are upper Washita [Lower Cretaceous] in age; also pluton cuts volcanic rocks which are presumably Eocene and Oligocene and is overlain by basin fill at least partly Pliocene; unlikely that pluton is later than Miocene; because it is comagmatic with the volcanic rocks, it is probably Oligocene.

Occurs in northern Quitman Mountains, Hudspeth County.

**Quivira Shale Member** (of Cherryvale Shale)

Quivira Formation (in Kansas City Group)

Quivira Shale (in Kansas City Formation)[1]

Pennsylvanian (Missouri Series) : Northeastern Kansas, southwestern Iowa, and northwestern Missouri.

Original reference: R. C. Moore, 1931, Kansas Geol. Soc. 5th Ann. Field Conf. Guidebook, correlation chart.

R. C. Moore, 1948, Am. Assoc. Petroleum Geologists Bull., v. 32, no. 11, p. 2030 (fig. 4); 1949, Kansas Geol. Survey Bull. 83, p. 96–97. Quivira shale member of Cherryvale formation; overlies Westerville limestone member; underlies Cement City limestone member of Drum limestone. This classification agreed upon by State Geological Surveys of Iowa, Kansas, Missouri, Nebraska, and Oklahoma. However, Kansas proposed to deviate from the interstate classification by adopting Dewey instead of Cement City [see explanation under Cement City].

G. E. Condra, 1949, Nebraska Geol. Survey Bull. 16, p. 37. In Nebraska, considered a formation in Kansas City group. Underlies P. W. A. Quarry limestone member (new) of Drum formation; overlies Westerville limestone member of Sarpy formation (new). Type locality stated.

T. L. Welp, L. A. Thomas, and H. R. Dixon, 1957, Iowa Acad. Sci. Proc., v. 64, p. 420. Thickness 5 feet in section measured near Winterset, Iowa.

H. G. Hershey and others, Iowa Highway Research Board Bull. 15, p. 26, fig. 5. Formation in Kansas City group. Thickness about 6 feet near Crescent, Pottawattamie County; here it is brownish calcareous fossiliferous shale containing thin coquina limestone seams. Thickness about 1 foot in Madison County. Underlies Drum limestone; overlies Westerville limestone.

Type locality: At Quivira Lake, near Kansas River east of Holliday, Johnson County, Kans.

**Quoddy Shale**[1]

Quoddy Formation

Silurian (Niagaran) : Southeastern Maine.

Original references: E. S. Bastin and H. S. Williams, 1913, Maine Water Storage Comm. 3d Ann. Rept., p. 168; 1913, Geol. Soc. America Bull., v. 24, p. 378, 379.

C. K. Swartz and others, 1942, Geol. Soc. America Bull., v. 53, no. 4, chart 3. Listed as a formation.

Named for exposures at West Quoddy Head, Washington County.

Quoggy Joe Quartz Trachyte[1]

Age (?) : Northeastern Maine.

Original reference: H. E. Gregory, 1900, U.S. Geol. Survey Bull. 165, p. 109, 111, 164–168.

Forms entire mass of Quoggy Joe group of hills, Aroostook County.

**Rabbit Hill Limestone**

Lower Devonian : Eastern Nevada.

E. L. Winterer and M. A. Murphy, 1960, Jour. Geology, v. 68, no. 2, p. 134 (fig. 6), 135, 136. Consists of tan-weathering silty limestone and calcareous shale; lighter colored than underlying Roberts Mountains formation and more silty and more thinly bedded than overlying Nevada formation; both contacts appear to be conformable and gradational. Contains Helderbergian fauna. Name credited to C. W. Merriam.

U.S. Geological Survey currently designates the age of the Rabbit Hill as Lower Devonian on basis of a study now in progress.

Type section : Monitor Range, Horse Heaven Mountain quadrangle.

**Rabbit Spring Formation**[1]

Pliocene (?) : Southwestern Nevada.

Original reference: F. L. Ransome, 1909, U.S. Geol. Survey Prof. Paper 66, p. 28, 71.

Exposed in bluffs above Rabbit Spring and in other places along edge of Maipais Mesa, Goldfield district.

Rabble Run Red Sandstone Member (of McKenzie Formation)[1]

Silurian (Niagaran) : Western Maryland and northern West Virginia.

Original reference: C. K. Swartz, 1923, Maryland Geol. Survey, Silurian Volume, p. 36.

H. P. Woodward, 1941, West Virginia Geol. Survey, v. 14, p. 54, 118, 128, 154, 174. McKenzie formation includes Rabble Run sandstone near its base in Maryland. Throughout southern Pennsylvania and east-central Maryland, has red shale member near top; this red unit, Rabble Run member, although 80 feet thick north of Potomac near Hancock County, Md., thins rapidly southward and is represented in Morgan County, W. Va., by only 5 feet of red sandy shale; it has no other important representative elsewhere in West Virginia. It is believed that Rabble Run red bed thickens northeastward to coalesce with the eastern red, nonmarine facies (Bloomsburg) of the Cayugan group.

Ernst Cloos, 1951, Maryland Dept. Geology, Mines and Water Resources Washington County [Rept. 14], p. 76. Rabble Run sandstone member is present about 100 feet below top of formation. Member is as much as 100 feet thick in Bear Pond area and thins westward and disappears before reaching Cumberland. It appears first in Cacapon section southeast of Hancock and replaces gray shale and limestone toward east in Washington County. Beds resemble the overlying Bloomsburg red sandstone and shale member of the Wills Creek formation.

Named for exposures in Rabble Run in North Mountain, Washington County, Md.

Rabens Branch Bed (in Parkers Formation)

C. A. Malott, 1947, Indiana Acad. Sci. Proc., v. 57, pl. 132, 133 (fig. 2) [1948]. Fossiliferous clay band or ferrous carbonate band about 1 inch thick that overlies a thin coal bed near base of formation; horizon is about 20 feet below the Parkers coal and its black sheety shale.

Named from exposure on Rabens Branch, a small stream crossing the north-south road about one-quarter mile south of center of sec. 11, T. 5 S., R. 12 W., 1½ miles southwest of St. Wendells, Posey County.

Raber bed or member

Silurian: Northeastern Michigan.

W. A. Kelly, 1954, Michigan Geol. Soc. [Guidebook 18th] Ann. Field Trip, p. 21. Mentioned in notes on correlation of Silurian of Manitoulin Island with Silurian of Michigan. Bed contains corals identical with Fossil Hill member [formation]. Underlies Engadine dolomite.

Type locality and derivation of name not given. Town of Raber is in Chippewa County.

Raccoon Shale[1]

Raccoon Shale Member (of Cuyahoga Formation)

Mississippian (Kinderhook): Central Ohio.

Original reference: L. E. Hicks, 1878, Am. Jour. Sci., 3d, v. 16, p. 216, 219.

F. T. Holden, 1942, Jour. Geology, v. 50, no. 1, p. 41 (table 2), 46, 47. Raccoon shale member included in Granville shale facies of Cuyahoga formation. Lateral and vertical extent not well known. Underlies Black Hand siltstone member (emended); overlies Sunbury shale.

Named for exposures on Raccoon Creek, Licking County.

**Raccoon Mountain Member** (of Gizzard Formation)

Raccoon Mountain Formation (in Gizzard Group)

Lower Pennsylvanian; 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, 4, 19, pls. 2, 3, 4, 12–D. Alternation of shales and sandstones with several coals. Includes all beds from base of Warren Point sandstone to base of Pennsylvanian which is recognized by lithologic contrast between Mississippian limestone and variegated (red, maroon, and green) shale and Pennsylvanian coals and plant bearing shales. Thickness in type locality 353 feet; elsewhere thickness varies, but formation is generally thick to east and thin to west. In northwest part of plateau, Warren Point sandstone thins, and the Raccoon Mountain, which cannot be differentiated, is included in lower part of Fentress formation. Basal formation of Gizzard group, Pottsville series.

U. S. Geological Survey classifies the Raccoon Mountain as a member of the Gizzard Formation on the basis of a study now in progress.

Type section: On a mine road beginning 0.4 mile northwest of Whiteside, Marion County, and leading to strip mines at head of Scratch Ankle Hollow, Shellmound quadrangle.

†Raccoon River Beds[1]

Pennsylvanian: Central southern Iowa and northwestern Missouri.

Original reference: H. F. Bain and A. G. Leonard, 1898, Geol. Soc. Amercia Bull., v. 10, p. 11–12.

Named for Raccoon River, Dallas County, Iowa.

Racer Canyon Tuff Member (of Cove Mountain Formation)

Tertiary: Southwestern Utah.

E. F. Cook, 1960, Utah Geol. and Mineralog. Survey Bull. 70, p. 18 (fig. 1), 44. Succession of rhyolitic ignimbrites with maximum thickness of about 1,500 feet. White, gray, pale-pink, or pale-yellow, nonwelded to moderately welded, vitric-crystal tuff in which red or purple lithic fragments are generally abundant. Weathers into spectacular "hoodoos." Overlies Willow Spring member (new); underlies Pilot Creek basalt member (new). Name credited to H. R. Blank (unpub. thesis).

Occurs in Washington County.

**Racetrack Dolomite**

Middle and Upper Cambrian: Southern California.

J. F. McAllister, 1952, California Div. Mines Spec. Rept. 25, p. 3, 8–9, 14 (fig. 6), pls. 1, 2, 3. Name applied to oldest rock unit in sedimentary sequence of Quartz Spring area. Predominantly gray dolomite. Thickness about 1,900 feet; possible unmapped faults make questionable the measurements of lowest units of formation. Underlies Nopah formation. Base not satisfactorily defined because alluvium overlaps lowest exposures. Middle (?) Cambrian.

Type locality: In Last Chance foothills on western side of Racetrack Valley, about 3 miles west of Quartz Spring, Inyo County. Locality extends from southern tip of spur west of Hidden Valley Road junction, for roughly 7,000 feet to saddle north of U.S. Geological Survey bench mark at 5,330 feet above sea level. Named for Racetrack Valley, the long depression draining southward to the Racetrack playa from a low divide between Tin Mountain and Dry Mountain.

**Racine Dolomite**[1]

Racine Dolomite (in Coe Group)

Silurian: Southeastern Wisconsin and northeastern Illinois.

Original reference: J. Hall, 1861, Wisconsin Geol. Survey Rept. 1860, p. 1–7.

C. K. Swartz and others, 1942, Geol. Soc. America Bull., v. 53, no. 4, chart 3. Correlation chart shows that Racine dolomite underlies Guelph dolomite and overlies Manistique dolomite in eastern Wisconsin. Underlies Guelph dolomite and overlies Bellwood dolomite (new) in northeastern Illinois.

H. B. Willman, 1943, Illinois Geol. Survey Rept. Inv. 90, p. 29–30. Formation in Chicago area has maximum thickness of 250 to 300 feet; thinner in western part of region. Racine strata contains many coral reefs which consist predominantly of high-purity dolomite. Overlies Waukesha dolomite. Locally in Chicago area, overlies Joliet formation. Term Bellwood as used in Silurian correlation chart (Swartz and others, 1942) includes strata herein considered Waukesha and Racine.

H. A. Lowenstam, 1949, Illinois Geol. Survey Rept. Inv. 145, p. 18. Coe group (new) comprises Waukesha, Racine, and Port Bryon formations, as Savage (1926, Geol. Soc. America Bull., v. 37, no. 4, p. 513) differentiated them in northwestern Illinois.

Named for exposures at Racine, Racine County, Wis.

Radcliff 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. Pubs. Geol. Sci., v. 30, no. 5, p. 355, 372, 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 Lower Paleozoic. Sentinel dolomite, Radcliff formation, and Redlands dolomite limestone are correlated with Noonday dolomite here assigned to Precambrian as defined in this report.

Occurs in southern part of Panamint Range, Inyo County.

**Rader 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. 583, 585 (fig. 1), pl. 2. Consists of massive light-gray limestone, with a few layers of thinner darker limestone. At type locality and elsewhere along foot of Reef escarpment, about 100 feet thick, and lies 225 feet above base of formation. Eastward into Delaware Mountains, thins to about 15 feet, massive beds disappear, and thinner darker beds predominate. Separated from overlying Lamar member by several hundred feet of predominantly sandstone beds. Lies above Pinery limestone member.

P. B. King, 1948, U.S. Geol. Survey Prof. Paper 215, p. 56–57, pl. 3 [1949]. Mapped in 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. Lies below the McCombs limestone member (new).

Named for Rader Ridge, which projects from foot of Reef escarpment near Hegler Ranch, Culberson County, Tex.

**Raft Formation**

Raft Lake Beds[1]

Pleistocene, middle or 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, 48–50, pl. 4. Thickness about 200 feet. Overlie Rockland Valley basalt and, locally, Massacre volcanics. Middle(?) Pliocene. Geographical extent indicated.

H. T. Stearns and Andrei Isotoff, 1956, Geol. Soc. America Bull., v. 67, no. 1, p. 27. In Eagle Rock area, Raft lake beds extend under most of older alluvium on west side of Snake River and probably also for some distance under Cedar basalt. Upper Pliocene(?).

U.S. Geological Survey has amended the name to Raft Formation and designates the age as middle or late Pleistocene on basis of a study now in progress.

Type section: Exposures along Raft River near mouth, Cassia County.

Raft River Formation[1]

Pliocene(?): Northwestern Washington.

Original reference: A. B. Reagan, 1909, Kansas Acad. Sci. Trans., v. 22, p. 202.

Crops out on north side of Raft River, Grays Harbor County.

Ragg quartzite

Precambrian (Keweenawic): Iowa.

Charles Keyes, 1941, Pan-Am. Geologist, v. 75, no. 2, p. 99 (chart), 107. Name applied to quartzites (sandstones) about 10 feet thick. On chart appears below Hull porphyry and above Splitrock slates.

Ragged Valley Formation

Ragged Valley Shale Member (of Arroyo Hondo Formation)

Ragged Valley Shale Member (of Moreno Grande Formation)

Upper Cretaceous: Central California.

H. E. Vokes, 1939, New York Acad. Sci. Annals, v. 38, p. 27–28. Name proposed for unit described as Clay Shale member of Martinez(?) by Anderson and Pack (1915, U.S. Geol. Survey Bull. 603). Underlies an unnamed white sandstone member. Cantua member of Arroyo Hondo lies entirely within Ragged Valley shale, and a basal part of the shale, approximately 100 feet thick, appears to underlie Cantua throughout; hence, Ragged Valley shale overlies Moreno formation.

P. P. Goudkoff, 1945, Am. Assoc. Petroleum Geologists Bull., v. 29, no. 7, p. 962 (fig. 2). Shown as a member (or formation) in Panoche formation (or group). Underlies Brown Mountain sandstone; overlies Joaquin Ridge sandstone.

A. S. Huey, 1948, California Div. Mines Bull. 140, p. 31. Ragged Valley shale (*Pachydiscus* silt) included as lower member of Moreno Grande formation (new). Underlies Brown Mountain sandstone member; overlies San Joaquin sandstone member of Panoche formation.

L. I. Briggs, Jr., 1953, California Div. Mines Bull. 167, p. 31. Ragged Valley shale and Brown Mountain sandstone, poorly defined stratigraphic units of late Upper Cretaceous, are included in uppermost part of Panoche formation of this report [Ortigalita Peak quadrangle].

Type locality: On Domengine Creek in Ragged Valley, north of Coalinga, Fresno County.

Raggedy Mountain Gabbro[1]

Raggedy Mountain Group

Precambrian: Southwestern Oklahoma.

Original reference: H. F. Bain, 1900, Geol. Soc. America Bull., v. 11, p. 135, 136.

G. W. Chase, 1952, Oklahoma Geol. Survey Circ. 30, p. 11. Raggedy Mountain group is composed of anorthosite that grades downward into augite gabbro. Meers quartzite [oldest rock in region] and Raggedy Mountain group are cut by intrusions of olivine gabbro.

Named for Raggedy Mountains, Kiowa County.

**Ragland Sandstone**[1]

Middle Devonian: Eastern Alabama.

Original references: Charles Butts, 1927, Washington Acad. Sci. Jour., v. 17, p. 128–129; 1927, Am. Jour. Sci., 5th, v. 14, p. 365–380; 1927, U.S. Geol. Survey Geol. Atlas, Folio 221, p. 9, footnote.

G. A. Cooper and others, 1942, Geol. Soc. America Bull., v. 53, no. 12, pt. 1, p. 1777, chart 4. Tentatively correlated with *Meristella*-Coral zone of Schoharie Valley sequence occurring about 250 feet above Onondaga limestone and containing "*Spirifer*" *venustus*. Shown on chart as younger than Frog Mountain sandstone.

Named for exposures in abandoned quarry 1½ miles south-southwest of Ragland, St. Clair County.

Raiff Limestone

Cambrian: Eastern Nevada.

J. C. Young, 1960, Intermountain Assoc. Petroleum Geologists Guidebook 11th Ann. Field Conf., p. 159–160. At type section, consists of 2,789 feet of limestones; lower A member, 1,456 feet thick, consists of medium-dark- to medium-light-gray aphanitic dolomite about 200 feet from light-gray aphanitic dolomite about 200 feet from top; B member, about 269 feet, composed of thin-bedded limestone and subordinate olive-drab shale; C member, 1,064 feet, characterized by two cliff-forming units. Overlies Monte Neva formation (new); underlies Dunderberg formation.

Type section: Northern Egan Range in NW¼ sec. 33, T. 22 N., R. 63 E. on divide north of Monte Neva Hot Springs. Name derived from Raiff siding on Nevada Northern Railroad, 3 miles east-northeast of type section.

Rail Cabin Formation

Upper Triassic: Northeastern Oregon.

W. R. Dickinson, 1960, Dissert. Abs., v. 20, no. 11, p. 4367. Upper Triassic sequence includes Begg, Brisbois, and Rail Cabin formations. Thickness of sequence, which is overlain by Lower Jurassic Graylock formation (new), is nearly 15,000 feet.

Type locality and derivation of name not stated. Report discusses Izee area, Grant County.

**Rail Canyon Sandstone Member** (of Vermejo Formation)[1]

Upper Cretaceous: Northeastern New Mexico.

Original reference: W. T. Lee, 1924, U.S. Geol. Survey Bull. 752.

W. A. Cobban and J. B. Reeside, Jr., 1952, Geol. Soc. America Bull., v. 63, no. 10, chart 10–b (column 21). Shown on correlation chart as occurring about middle of formation.

Named because of economic importance in making roof in Dawson mines, in Rail Canyon, Raton coal field.

Railroad Bridge Basalt[1]

Pliocene: Northwestern Nevada.

Original reference: R. E. Fuller, 1931, Washington Univ. Pub. Geology, v. 3, no. 1, p. 14.

Occurs in Thousand Creek Basin, south of Pueblo Mountain.

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†Rainbow Beds[1]

Miocene or Pliocene: Southern California.

Original reference: F. M. Anderson, 1905, California Acad. Sci. Proc., 3d ser., v. 2, p. 174–185.

Fresno and King Counties.

Rainbow Series[1]

Post-Franciscan: Northern California.

Original reference: W. Stalder, 1915, California State Mining Bur. Bull. 69, p. 447–449.

Humboldt County.

Rainbow Flat Group

Age unknown: Southern California.

K. J. Hsu, 1955, California Univ. Dept. Geol. Sci. Bull., v. 30, no. 4, p. 294–295, geol. map. Metasedimentary rocks and migmatites north of El Dorado Ridge quartz diorite (new) are included in Rainbow Flat group; they are folded into approximately east trending anticlines and synclines and have been intruded by Stoddard Canyon quartz monzonite (new) to north of area studied. Relation to [Aurela Ridge] granulite (new) not ascertained.

Area studied is Cucamonga Canyon-San Antonio Canyon, Cucamonga quadrangle, San Bernardino and Los Angeles Counties.

Raine Ranch Formation

Miocene, upper: Northeastern Nevada.

Jerome Regnier, 1960, Geol. Soc. America Bull., v. 71, no. 8, p. 1191, 1195–1198, pl. 1. Consists of 2,000 feet of pumice lapilli tuff, volcanic breccia, lava flows, conglomerates, rhyolitic tuff, diatomite, shale, and limestone. Vertebrate fossils. In Pine Valley, rests unconformably and older Tertiary formations; normal fault separates formation from Paleozoic rocks of Pinon Range; in Susie Creek Valley rests in sedimentary contact on Paleozoic rocks. Underlies Palisade Canyon rhyolite (new); also underlies Carlin formation (new).

Named for Raine Ranch, sec. 6, T. 31 N., R. 52 E. Crops out in northern part of Pine Valley and valley of Susie Creek, vicinity of Carlin.

Raines Corner Limestone (in Bluefield 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. 300, 404.

Type locality: In bed of Indian Creek one-half mile northwest of Raines Corner, Monroe County, W. Va.

Raines Corner Shale (in Bluefield 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. 300, 409.

Type locality: On west side of Indian Creek along the State road, about 1½ miles northeast of Raines Corner, Monroe County, W. Va.

Rainer Lavas or Volcanics

*See* Mount Rainier Lavas.

**Rainvalley Formation** (in Naco Group)

Rainvalley Formation (in Snyder Hill Group)

Permian: Southern Arizona.

D. L. Bryant, 1955, Dissert. Abs., v. 15, no. 7, p. 1224. Uppermost formation of Snyder Hill group. Overlies Concha limestone (expanded).

W. D. Pye, 1959, Arizona Geol. Soc. Guidebook 2, p. 277. Thickness 400 feet. Gray-brown, red, and black limestone and dolomite with sandstone. Type area stated.

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

Type area: Mustang Mountains.

**Rainy Limestone Member** (of Arroyo Formation)

Rainy Limestone Member (of Clear Fork Formation)[1]

Permian (Leonard Series): North-central Texas.

Original reference: M. G. Cheney, 1929, Texas Univ. Bull. 2913, p. 27, pl. 1.

M. G. Cheney, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 1, p. 66 (fig. 1). Shown on chart as basal member of Arroyo formation. Older than Lytle limestone; younger than Lake Kemp formation.

P. B. King, 1942, Am. Assoc. Petroleum Geologists Bull., v. 26, no. 4, pl. 2. Shown on correlation chart at base of Arroyo formation. Underlies Standpipe limestone member.

Type locality: Along Rainy [also spelled Rainey] Creek, 6 miles east of Abilene, Taylor County.

Rainy Mountain Limestone[1]

Lower Ordovician: Southwestern Oklahoma.

Original reference: H. F. Bain, 1900, Geol. Soc. America Bull., v. 11, p. 135, 138–140.

Charles Schuchert, 1943, Stratigraphy of the eastern and central United States: New York, John Wiley & Sons, Inc., p. 871. Abandoned.

Named for Rainy Mountain, Kiowa County.

**Raisin River Dolomite Member** (of Bass Islands Dolomite)[1]

Raisin River Formation (in Bass Islands Group)

Upper Silurian: Southeastern Michigan and northern Ohio, and Ontario, Canada.

Original reference: W. H. Sherzer and A. W. Grabau, 1909, Geol. Soc. America Bull., v. 19, p. 546.

Wilber Stout, 1941, Ohio Geol. Survey, 4th ser., Bull. 42, p. 38 40, chart facing p. 46. Uppermost formation in Bass Island[s] group in Ohio. Overlies Put-in-Bay formation; unconformably underlies Oriskany formation. Consists of fairly pure dolomite, regularly bedded, layers commonly 2 to 6 inches thick, locally more massive; color bluish gray to brownish gray. Thickness about 50 feet. Limited to small areas west of Toledo.

J. E. Carman, 1960, Fieldiana: Geology, v. 14, no. 1, p. 1–5. In Lucas County, Ohio, fossiliferous Holland Quarry shale (new) occupies depression in Raisin River dolomite.

Named for exposures on Raisin River, Monroe County, Mich.

Raker Peak Pyroxene Andesites,[1] Dacite

Cenozoic: Northern California.

Original reference: Howel Williams, 1932, California Univ. Pub., Bull. Dept. Geol. Sci., v. 21, no. 8, p. 287, geol. map.

O. P. Jenkins, 1943, California Div. Mines Bull. 118, p. 682. Cenozoic.

J. A. S. Adams, 1955, Geochim. et Cosmochim. Acta., v. 8, p. 77 (table 2), 79, 80 (table 4 and text), 81, 82. Listed on tables and mentioned in text in report on uranium geochemistry of Lassen volcanic rocks.

Raker Peak is in Lassen Volcanic National Park.

Rakes Creek Shale 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, 53.

G. E. Condra, 1949, Nebraska Geol. Survey Bull. 16, p. 23. Top member of formation; overlies Ost limestone member. Thickness 6 to 10 feet in Nebraska and northern Kansas. In southern Kansas, lower boundary is not distinct. [Not treated as a subdivision of the Tecumseh by Kansas Geological Survey.]

H. G. Hershey and others, 1960, Iowa Highway Research Board Bull. 15, p. 19, fig. 5. Identified in quarry in sec. 15, T. 71 N., R. 43 W., Mills County where it consists of greenish-gray sandy shale with thin stringer near base. Thickness about 7 feet. Uppermost member of formation; overlies Ost limestone member.

Type locality: On Rakes Creek in NW¼ sec. 5, T. 10 N., R. 14 E., Cass County, Nebr.

Raleigh Graphite

Precambrian: Central North Carolina.

J. W. Harrington, 1947, Jour. Geology, v. 55, no. 6, p. 516–521. Name applied to several parallel tilted beds of earthy schistose graphite enclosed in the Precambrian schists and gneisses of Wake County.

All exposures mapped lie in belt 10 miles long and 2 miles wide; northern end is at town of Six Forks, 10 miles north of Raleigh; southern end may be 18 miles southwest of Raleigh.

**Raleigh Sandstone Member** (of New River Formation)

Raleigh Sandstone (in New River Group)

Raleigh Sandstone (in Pottsville Group)[1]

Lower Pennsylvanian: Southern West Virginia and southwestern Virginia.

Original reference: M. R. Campbell and W. C. Mendenhall, 1896, U.S. Geol. Survey 17th Ann. Rept., pt. 2, p. 487, 493.

P. H. Price and E. T. Heck, 1939, West Virginia Geol. Survey Greenbrier County, p. 216, 234–236. Raleigh sandstone includes the Upper Raleigh and Lower Raleigh of White (1908, West Virginia Geol. Survey, v. 2a). The Upper Raleigh, 50 to 75 feet thick, underlies thin shale below Welch coal and overlies and is separated from Lower Raleigh sandstone by an interval containing shale and coal interval that includes Raleigh coals; locally coalesces with overlying Welch sandstone, cutting out Welch coal. Lower Raleigh sandstone, 50 to 100 feet thick, overlies Beckley coals above the Quinnimont sandstone. Both Lower and Upper Raleigh are included in New River group, Pottsville series.

U.S. Geological Survey currently classifies the Raleigh Sandstone as a member of the New River Formation on the basis of a study now in progress.

Named for exposures on road from Prince to Raleigh, Raleigh County, W. Va.

Ralston Formation[1]

Precambrian: Central northern Colorado.

Original reference: M. F. Boos and C. M. Boos, 1934, Geol. Soc. America Bull., v. 45, no. 2, p. 306.

In Boulder region.

Ralston Formation

Upper Jurassic: North-central Colorado.

W. A. Waldschmidt and L. W. LeRoy, 1944, Geol. Soc. America Bull., v. 55, no. 10, p. 1098. Underlies Morrison formation. Name credited to LeRoy (1944, unpub. thesis).

L. W. LeRoy, 1946, Colorado School Mines Quart., v. 41, no. 2, p. 46–55. Represented by two lateral lithic variations: a shale-marlstone facies and a gypsiferous facies. Former facies essentially gray to maroon shales. Thin dense gray impure lithographic to sandy marlstones, and fine- to medium-grained yellow to buff calcareous sandstones and silts commonly present as minor components. Marlstones best developed near Mount Vernon Canyon where they are conspicuously laminated and arenaceous. Bedding moderately uniform. Thickness at type section 83 feet. Gypsiferous facies essentially of thin beds of white massive to fibrous gypsum and numerous thin layers of gypsiferous silt. Several conspicuous beds of hard massive yellow calcareous medium-grained sandstone and minor amounts of thin-bedded maroon shale in upper part of facies. Thickness at type section 67½ feet. Formation disconformably underlies basal sandstone of Morrison; overlies Lykins formation.

E. A. Frederickson, J. M. DeLay, and W. W. Saylor, 1956, Am. Assoc. Petroleum Geologists Bull., v. 40, no. 9, p. 2120–2147. Four sedimentary facies recognized in Canon City embayment: conglomerate facies, sandstone facies, gypsum-shale facies and sand-shale facies. These are intergradational from west to east. Shale-marlstone and gypsum facies of Golden-Morrison area (of LeRoy) considered equivalent respectively to sand-shale and gypsum-shale facies of this paper. Thickness in embayment from fraction of a foot to as much as 180 feet.

Richard Van Horn, 1957, Am. Assoc. Petroleum Geologists Bull., v. 41, no. 4, p. 755–756. Proposed that rocks that LeRoy (1946) described as Ralston formation be renamed Ralston Creek formation because the former name had been applied to two other units at the time LeRoy published his paper—one of which had its type locality only a few miles from LeRoy's type section. Late Jurassic.

Type section of shale-marlstone facies: Along irrigation ditch and water level on west side of Ralston Reservoir, Ralston Creek, 5 miles north of

Golden, sec. 5, T. 3 S., R. 70 W., Blackhawk quadrangle, Jefferson County. Facies prevalent between Bear Creek and Ralston Creek.

Type section of gypsiferous facies: On east side of Glennon Canyon, 1½ miles southeast of Morrison, NW¼ sec. 12, T. 5 S., R. 70 W., Morrison quadrangle, Jefferson County. Facies well exposed along west slope of Dakota hogback between Bear Creek and Turkey Creek.

†Ralston Formation[1]

Eocene, lower: Northern Wyoming.

Original reference: W. J. Sinclair and W. Granger, 1912, Am. Mus. Nat. History Bull., v. 31, p. 60–62.

Occurs on north side of Shoshone River in bluff opposite Ralston Station Bighorn Basin region.

Ralston Group[1]

Pennsylvanian and Permian: Central northern Oklahoma.

Original reference: C. N. Gould, D. W. Ohern, and L. L. Hutchison, 1910, Oklahoma State Univ. Research Bull. 3, p. 7, 13.

C. C. Branson, 1957, Oklahoma Geology Notes, v. 17, no. 11, p. 102. Abandoned by Oklahoma Geological Survey. If validated, the name preoccupies name Ralston formation, Eocene, of Wyoming.

Named for Ralston, Pawnee County.

**Ralston Creek Formation**

Upper Jurassic: North-central Colorado.

Richard Van Horn, 1957. Am. Assoc. Petroleum Geologists Bull., v. 41, no. 4, p. 755–756. Name Ralston Creek formation used in place of name Ralston formation as described by LeRoy (1946). Change in name desirable to avoid confusion because Ralston formation has been used previously for several different formations. Encompasses same rocks that were described by LeRoy (1946) as Ralston formation. Consists of varicolored claystone, siltstone, and limestone and contains thin beds and disseminated nodules of moderate-red to dark-gray chalcedony. Underlies Morrison formation; overlies Lykins formation.

Richard Van Horn, 1957, U.S. Geol. Survey Geol. Quad. Map GQ–103. Shale-marlstone about 110 feet thick in Golden quadrangle. At base of formation, a 5-foot-thick bed of grayish-red to light-gray fine- to medium-grained calcareous sandstone is exposed below highwater mark of Ralston Reservoir. This bed not indicated in sections measured by LeRoy (1946; p. 41, 51) of the Ralston and Lykins formations in Ralston Creek, and here tentatively assigned to Ralston Creek formation.

Type section: At the locality described by LeRoy (1946, p. 51), on south side of Ralston Creek in NW¼SW¼ sec. 5, T. 3 S., R. 70 W., Ralston Buttes quadrangle. [LeRoy, 1946, p. 51 gives type section of shale-marlstone facies of Ralston formation as sec. 5, T. 3 S., R. 70 W., Blackhawk quadrangle.]

†Ramona Formation[1]

Pennsylvanian: Northeastern Oklahoma.

Original reference: D. W. Ohern, 1910, Oklahoma State Univ. Research Bull. 4, p. 36.

C. C. Branson, 1957, Oklahoma Geology Notes, v. 17, no. 11, p. 102. Abandoned by Oklahoma Geological Survey.

Named for Ramona, Washington County.

**Rampart Group**[1]

Mississippian (probably lower) : East-central Alaska.

Original reference: J. E. Spurr, 1898, U.S. Geol. Survey 18th Ann. Rept., pt. 3, p. 155–169.

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 Mississippian volcanic rocks.

Named for exposures in Lower Ramparts of the Yukon. Yukon-Tanana region.

Rampart Cave Member (of Muav Formation)

Lower and (or) Middle Cambrian: Northwestern Arizona.

E. D. McKee, 1945, Carnegie Inst. Washington Pub. 563, p. 14 (fig. 1), 19, 84–87. Consists almost entirely of gray or dark-gray aphanitic limestone with small amount of light-brown or tan silty mottling. Mostly thick bedded and massive, although thin beds found at top and bottom in many sections. In vicinity of Grand Wash Cliffs, maximum thickness about 160 feet. Thins to the east. Basal subdivision of Muav formation; overlies Flour Sack member (new) of Bright Angel shale.

Named from a cavern near base of member, a few miles east of Grand Wash Cliffs on south side of Lake Mead. In western half of Grand Canyon.

Ramp Creek Member (of Harrodsburg Limestone)[1]

Ramp 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. Lowest member of formation; underlies Leesville member (reallocated).

Exposed in ravine tributary to Ramp Creek, southeastern part of Monroe County.

**Ramshorn Slate**[1]

Lower Ordovician: Southern central Idaho.

Original references: C. P. Ross, 1932, Idaho correlation chart compiled by M. G. Wilmarth; 1934, Geol. Soc. America Bull., v. 45, p. 945.

C. P. Ross, 1937, U.S. Geol. Survey Bull. 877, p. 11, 14–17, pl. 1. In Bayhorse region, overlies Bayhorse dolomite and underlies Kinnikinic quartzite. Thickness 2,000 feet. Lower Ordovician.

Named for mine near head of Bayhorse Creek, Custer County.

†Ramshorn Volcanic Series[1]

Eocene, post-middle: Central Wyoming.

Original reference: D. Love, 1934, Wyoming Geol. Survey Bull. 24, pt. 4, p. 21–22.

J. D. Love, 1939, Geol Soc. America Spec. Paper 20, p. 79. Name preoccupied. Replaced by Wiggins formation.

Named for The Ramshorn, a mountainous ridge about 12 miles west of area studied (Owl Creek Mountains).

Rancheria 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. 9, 11, 17–19, 22, 34, 38. Sequence of cherty black bituminous argillaceous limestone beds that unconformably overlies Las Cruces formation (new) and unconformably underlies Helms formation (restricted) in Franklin Mountains of New Mexico. At type locality, section comprises (ascending) few inches of black, detrital, sandy shale; black, detrital quartz sandstone containing numerous plant fossils and considerable carbonaceous material; 8 feet of soft yellow to brown sandy siltstone; massive black bituminous detrital limestone made up largely of minute fragments of crinoidal material; and the remaining 235 feet of typical medium-bedded dense black silty limestone beds that weather brown and contain large amounts of brown-weathering porous chert. Thickness approximately 255 feet in type area; 215 feet at Rancheria Peak; thins by progressive overlap from south toward north in Sacramento Mountains and missing in northern part of range. Of Meramec age.

T. S. Jones, 1953, Stratigraphy of the Permian Basin of West Texas: West Texas Geol. Soc., p. 19. Moorefield faunule present mostly in lower part, which was Laudon and Bowsher's evidence of Meramec age, but which would place it in upper Osage also, if section in Llano region were used for comparison. Probably upper part of Rancheria in Hueco and Franklin Mountains is of Meramec age.

Type locality: On southwest side of small south 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 for Rancheria Peak in Hueco Mountains where it is well exposed. Also present in parts of San Andres Mountains, New Mex.

Rancholabrean Age

Pleistocene, late: North America.

D. E. Savage, 1951, California Univ. Pubs., Dept. Geol. Sci. Bull., v. 28, no. 10, p. 289. Provincial time term typified by Rancho La Brea (vertebrate) fauna. The Rancholabrean is post-Irvingtonian.

**Rancocas Formation[1] or Group[1]**

Paleocene and Eocene: New Jersey and Delaware.

Original references: W. B. Clark, 1894, New Jersey Geol. Survey Ann. Rept. 1893, p. 337–338; 1894, Jour. Geology, v. 2, p. 161–177.

J. P. Minard and J. P. Owens, 1960, U.S. Geol. Survey Prof. Paper 400–B, p. B184. Group comprises (ascending) Hornerstown sand, Vincentown formation, and Manasquan formation.

Rancocas Creek, Burlington County, N.J., cuts through the formation, exposing its full sequence.

Rand Schist[1]

Precambrian (?): Southern California.

Original reference: C. D. Hulin, 1925, California State Min. Bur. Bull. 95, p. 23–29, map.

T. W. Dibblee, Jr., 1952, California Div. Mines Bull. 160, p. 12 (fig. 1), 13–14, pls. 1–3. Partial section of Rand schist, totaling about 2,000 feet, is exposed on north slope of Rand Mountains in Saltdale quadrangle. Schist is compressed into several folds, and uppermost layers are in contact with intrusive quartz monzonite; greenish-gray actinolite facies, which is abundant in Randsburg quadrangle, is not common in Saltdale quadrangle. Columnar section shows Rand schist older than newly defined Mesquite schist. Precambrian(?).

First described in Kern County where it composes bulk of Rand Mountains.

Randels Island Gneiss[1]

Age(?) : New York.

Original reference: R. P. Stevens, 1867, New York Lyceum Nat. History Annals, v. 8, p. 116–120.

Along southern shore of Spuyten-Duyvel Creek and Harlem River, Manhattan Island.

Randle Laharic Breccia-Conglomerate or deposit

Eocene-Oligocene : Northwestern Washington.

R. V. Fisher, 1960, Geol. Soc. America Bull., v. 71, no. 2, p. 127–132. Consists of three well-exposed massive volcanic breccia-conglomerate beds. Beds are poorly sorted and show no marked vertical or horizontal grading of fragment sizes, no preferred orientation of fragments, and no internal laminae. These characterictics indicate deposition by either lahars or pyroclastic flows but preclude deposition from air.

Occurs 1 mile west of Randle, eastern Lewis County.

Randlett 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. 29, pl. 1. Underlies Halfway horizon; overlies Uinta formation. Eocene (Duchesnean).

Type locality : North and east of town of Randlett, Uintah County.

Randolph 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 at Randolph, Randolph Township, Orange County.

Randolph Granite[1]

Upper Devonian or Upper Carboniferous : Northern New Hampshire.

Original reference: M. Billings, 1928, Am. Acad. Arts and Sci. Proc., v. 63, p. 82, map.

Type locality: In Ravine of the Castles, which lies south of Randolph Range and Randolph Township, 1 mile northwest of Mount Jefferson, in Mount Washington quadrangle.

Randolph Limestone[1]

Lower Cretaceous(?) : Southeastern Arizona.

Original reference: W. P. Blake, 1902, Tombstone and its mines.

Tombstone district.

Randolph Phyllite[1]

Middle Ordovician: Northeastern and southeastern Vermont.

Original reference: C. H. Richardson, 1924, Vermont State Geologist 14th Rept., p. 90.

Extends in north-south direction, entirely across Randolph Township, Orange County.

Rand Ranch Formation

Oligocene(?): Northeastern Nevada.

Jerome Regnier, 1960, Geol. Soc. America Bull., v. 60, no. 8, p. 1191, 1193, pl. 1. Consists of 1,700 feet of sandstones and conglomerates; basal 450 feet is gray volcanic-pebble conglomerate and gray and yellow volcanic sandstones; upper 1,250 feet is interbedded white, yellow, and red sandstones and Paleozoic-pebble conglomerates. Conformably overlies volcanic rocks of Cortex Mountains. Believed to be older than Safford Canyon formation (new) which unconformably overlies the volcanic rocks of Cortex Mountains. Nonfossiliferous; tentatively referred to Oligocene.

Named for Rand Ranch, SW¼ T. 30 N., R. 52 E., near Carlin.

**Randville Dolomite**[1] (in Chocolay Group)

Precambrian (Animikie Series): Northern Michigan.

Original reference: C. R. Van Hise, 1899, U.S. Geol. Survey 19th Ann. Rept., pt. 3, p. 9–16.

J. E. Gair and K. L. Wier, 1956, U.S. Geol. Survey Bull. 1044, p. 14 (table 2), 28–34, pl. 1, Exposed in south-central part of Kiernan quadrangle, near south shore of Michigamme Reservoir, and on east flank of Amasa oval (uplift). Has maximum thickness of about 1,800 feet on flanks of oval and consists largely of almost pure dolomite; locally contains phases of quartz-sericite slate, sericite and chlorite schist, feldspathic quartzite, and arkose. Unconformably overlies Margeson Creek gneiss (new); unconformably underlies Goodrich quartzite; in Dickinson County, Sturgeon quartzite commonly lies between the Randville and older granitic rocks; in Kiernan area, there is no equivalent quartzite in the section.

H. L. James, 1958, U.S. Geol. Survey Prof. Paper 314–C, p. 30 (table 1), 35. Uppermost formation in newly defined Chocolay group; in parts of Iron and Dickinson Counties is only representative of group.

Named for exposures near Randville, west-central Dickinson County.

Rangeley Conglomerate[1]

Devonian(?): West-central Maine.

Original reference: E. S. C. Smith, 1923, Am. Jour. Sci., 5th ser., v. 5, p. 147–154.

E. S. Pratt and H. W. Allen, 1949, Maine State Geologist Rept. 1947–1948, p. 23. Oldest rock in region [Franklin County]. Overlain by staurolite schist of varying composition.

Named for development near Rangeley and at southeast end of Rangeley Lake, Franklin County.

Rangely Tongue (of Mancos Shale)

Upper Cretaceous: Northwestern Colorado and northeastern Utah.

L. A. Hale, 1955, Wyoming Geol. Assoc. Guidebook 10th Ann. Field Conf., p. 92, 93 (fig. 3). Equivalent to Black Butte tongue (new) of Rock Springs formation (or Mancos shale).

Rangely, Colo., to Vernal, Utah.

†Ranger Formation (in Canyon Group)[1]

Pennsylvanian: Central northern Texas.

Original reference: E. T. Dumble, 1890, Texas Geol. Survey 1st Ann. Rept., p. lxvii.

Named for exposures in vicinity of Ranger, Eastland County.

**Ranger Limestone Member** (of Brad Formation)[1]

Ranger Limestone (in Brad 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 3801, p. 111–115. Upper member of Brad formation (redefined). Overlies an unnamed shale member which represents upper part of Placid shale member of Plummer and Moore, the lower part of which is here included in Winchell member of Graford. Ranger appears to be equivalent of Drake's (1893) Home Creek limestone at the type locality. As exposed on Home Creek, about 35 feet thick. It is massive bluish-gray noncherty limestone; upper part broken by bedding planes. At section measured on river bluff half a mile west of mouth of Home Creek, the Ranger is 70 feet thick. Because the limestone section of the Ranger passes into overlying Home Creek of northern Brown County by a series of relatively thin limestone beds interstratified with shale, it is difficult to place top of member and top of Brad formation. Along Colorado River, shale partings are so thin that it seems reasonable to place top of Ranger at top of unbroken limestone and to consider first thick shale as first bed of Caddo Creek formation.

M. G. Cheney, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 1, p. 66 (fig. 1), 88. Rank raised to formation in Brad group. Underlies Hog Creek shale; overlies Placid shale.

M. G. Cheney, 1948, Abilene Geol. Soc. [Guidebook] Spring Field Trip, June 11–12, p. 20. Underlies Colony Creek shale (new) which replaces name Hog Creek shale.

D. H. Eargle, 1958, San Angelo Geol. Soc. Guidebook, April 17–19, p. 51. In Brown and Coleman Counties, member consists of limestone, pale yellowish brown to light gray, generally slabby, cherty; contains "seaweed" structures; locally abundant fusulinids and other foraminifers, brachiopods, and crinoid columnals. Reeflike in vicinity of Colorado River. Thickness about 20 feet. Overlies Placid shale member; underlies Colony Creek shale member of Caddo Creek formation.

Named for exposures west of Ranger, Eastland County.

Ranger Marble[1] (in Snowy Range Series)

Precambrian: Southeastern Wyoming.

Original reference: E. Blackwelder, 1926, Geol. Soc. America Bull., v. 37, p. 620, 622, 642.

J. J. Runner, 1928, (abs.) Geol. Soc. America Bull., v. 39, no. 1, p. 202. Included in Snowy Range series (new)

Exposed at various points northeastward to Brooklyn ranger station, Medicine Bow Mountains.

†Ranger Series[1]

Pennsylvanian: Central Texas.

Original reference: E. T. Dumble, 1890, Texas Geol. Survey 1st Ann. Rept., p. lxvii, pl. 3.

Rapid Limestone[1]

Rapid Limestone Member (of Cedar Valley Formation)

Upper Devonian: Central eastern Iowa

Original references: C. [R.] Keyes, 1912, Iowa Acad. Sci. Proc., v. 19, p. 149; 1913, Iowa Acad. Sci. Proc., v. 20, p. 205, 206.

G. A. Cooper and others, 1942, Geol. Soc. America Bull., v. 53, no. 12, pt. 1, p. 1751. Shown on correlation chart as middle member of Cedar Valley formation. Underlies Coralville limestone member; overlies Solon limestone member. Middle Devonian. Age of entire Cedar Valley is difficult to establish, and dating of some of its parts presents problems. Upper zone of the Rapid formation (*Atrypa waterlooensis*) probably should be correlated with part of the Callaway of Missouri.

W. A. Stainbrook, 1945, Am. Jour. Sci., v. 243, no. 2, p. 157. Independence shale is stratigraphically below the Cedar Valley and above the Wapsipinicon. The Independence, by its fossils, is lower Upper Devonian; hence, Cedar Valley limestone is Upper Devonian in age and post-Independence.

Named for locality in Johnson County.

Rapid City Lens (in Newcastle Formation)

Upper Cretaceous: Western South Dakota.

R. M. Grace, 1952, Wyoming Geol. Survey Bull. 44, p. 14, 17. Primarily shale but containing 3 feet of sandstone. Maximum thickness about 27 feet. In this report, seven lenses are named in the Newcastle.

Named for exposure near Rapid City, Pennington County.

Rapides Shale or Formation (in Austin Group)

Cretaceous (Gulfian): Central Louisiana (subsurface).

J. M. Forgotson, 1958, Gulf Coast Assoc. Geol. Soc. Trans., v. 8, p. 117, 124. Proposed for sediments lying immediately below the base of either the Ector chalk or the Ector format and concordant with the sedimentary sequence making up the Austin group. Consists of dark gray shale, dark chalky shale, thin beds of chalk, shaly chalk, and thin limestones. In type well, occurs between electrical log depths of 9,055 and 9,245 feet. Formation has unconformity for basal boundary, therefore, concordant beds added below those encountered in type well are included in this definition.

Type well: Union Producing Company No. 1 Belgard, sec. 14, T. 4 N., R. 3 E., Rapides Parish.

†Rapids Schist[1]

Lower Paleozoic or older: Northern Alaska.

Original reference: F. C. Schrader, 1900, U.S. Geol. Survey 21st Ann. Rept., pt. 2, p. 473.

Traversed by Chandler River in region of the rapids. Extends for several miles downstream nearly to West Fork in Chandler region.

†Rappahannock Series[1]

Lower Cretaceous: Eastern Virginia.

Original reference: L. F. Ward, 1895, U.S. Geol. Survey 15th Ann. Rept., p. 321.

Rarden Shale Member[1] (of Cuyahoga Formation)

Rarden Shale Member (of Logan Formation)

Rarden Shale Member (of New Providence Formation)

Lower Mississippian: Southern Ohio and northeastern Kentucky.

Original reference: J. E. Hyde, 1915, Jour. Geology, v. 23, p. 656, 657, 762.

P. B. Stockdale, 1939, Geol. Soc. America Spec. Paper 22, p. 77, 133. Rarden shale member of New Providence formation in Kentucky; included in Vanceburg facies of formation.

F. T. Holden, 1941, Illinois Acad. Sci. Trans., v. 34, no. 2, p. 173; 1950, Jour. Geology, v. 50, no. 1, p. 62–63. In Ohio considered a member of Logan formation; included in Vanceburg siltstone facies of formation.

Named for Rarden, Scioto County, Ohio.

†Raritan Clay[1]

Upper Cretaceous: New Jersey and eastern Maryland.

Original reference: T. A. Conrad, 1869, Am. Jour. Sci., 2d v. 47, p. 360–363.

Occurs along Raritan River, N.J.

Raritan fire clay[1] (in Raritan Formation)

Cretaceous: New Jersey.

Original references: G. H. Cook and J. C. Smock, 1877, New Jersey Geol. Survey may of district of Middlesex County; G. H. Cook, 1878, New Jersey Geol. Survey Rept. on clays, p. 34.

H. C. Barksdale and others, 1943, New Jersey State Water Policy Comm. [Spec. Rept. 8], p. 66, 140. Basal member of Raritan. Includes "Raritan potters clay" of earlier reports. Thickness 0 to 35 feet. Underlies Farrington sand member (new).

Crops out near Nixon, Bonhampton, Fords, Keasbey, and Milltown, Middlesex County.

**Raritan Formation**[1]

Upper Cretaceous: Eastern New Jersey, Delaware, and Maryland.

Original reference: G. H. Cook, 1888, Am. Geologist, v. 2, p. 260.

H. C. Barksdale and others, 1943, New Jersey State Water Policy Comm. [Spec. Rept. 8], p. 66–140. Formation, in Middlesex County, divided into several distinct mappable units. Clays of Raritan have been extensively used in ceramic industry and received informal names. The other members, composed dominantly of sands were not named but given numbers. In this report these are given member names. Thus, Raritan comprises from top to bottom Amboy stoneware clay, Old Bridge sand member (No. 3 sand of previous reports); South Amboy fire clay. Sayreville sand member (No. 2 sand of previous reports), Woodbridge clay, Farrington sand member (No. 1 sand of previous reports), and Raritan fire clay. Underlies Magothy formation. Upper Cretaceous.

W. B. Spangler and J. J. Peterson, 1950, Am. Assoc. Petroleum Geologists Bull., v. 34, no. 1, p. 15–21. Evidence cited to substantiate Lower and

Upper Cretaceous age. Writers believe that the nonmarine beds lying below the Magothy in New Jersey and called Raritan are equivalent to nonmarine sediments in Delaware-Maryland-Virginia lying below the Magothy and referred to the "Raritan," Patapsco, Arundel, and Patuxent, and that the entire series should be considered as single unit.

Erling Dorf, 1952, Am. Assoc. Petroleum Geologists Bull., v. 36, no. 11, p. 2161–2184. Presentation of paleobotanical analyses and discussion bearing on age, correlation, and stratigraphic relationships of Cretaceous plant-bearing beds of Coastal Plain from New Jersey to South Carolina. In New Jersey, evidence is presented which challenges recent correlation by Spangler and Peterson, of greater part of plant-bearing Raritan formation with Potomac group of Maryland-Delaware, and assignment, by same authors, of major part of Raritan formation to Early Cretaceous. It is shown that both floral and faunal evidence indicates that none of the Potomac group can be correlated with any part of the Raritan formation of New Jersey. In Delaware-Maryland-Virginia area, assignment of Arundel and Patapsco formations of Potomac group to Late Cretaceous, as is done in two recent reports, is shown to be based on doubtful evidence. These formations are regarded as more reasonably assigned to Early Cretaceous, on evidence of both plants and vertebrates. The beds overlying the Potomac group in Maryland and Delaware are here considered correctly assigned to Raritan formation.

Well exposed in vicinity of Raritan River and Raritan Bay, N.J.

Raso Limestone[1]

*See* Lasso Limestone.

**Raspberry Formation**

Upper Triassic: 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]. Gray, black, buff, or green slate, locally phyllitic; limestone lenses and limestone conglomerate, especially in lower part; quartzite lenses a few inches to 100 feet in thickness form about 5 percent of unit. Thickness in East Range approximately 3,000 feet; top and base not visible. In fault contact with older formations.

Type locality: Raspberry Creek, northwestern part of East Range.

Raspberry Mountain Granite[1]

Precambrian: Eastern Colorado.

Original reference: E. B. Mathews, 1900, Jour. Geology, v. 8, p. 214–240.

Named from its conspicuous development on Raspberry Mountain, Pikes Peak region.

**Rat Formation**

Tertiary or older: Alaska.

R. Q. Lewis, W. H. Nelson, and H. A. Powers, 1960, U.S. Geol. Survey Bull. 1028–Q, p. 558–560, pl 70. Porphyritic hornblende andesite lava flows and breccias, and conglomerates derived from them. No fossils found, and contact with Gunners Cove formation (new) not exposed; trace of contact trends north-south across high crest of island and is probably high-angle normal fault. Inferred to be older than Gunners Cove.

Limited to southeastern part of Rat Island which is on midpart of segment of Aleutian Ridge that includes Amchitka and southern Kiska Islands.

**Rat Creek Quartz Latite**

Rat Creek 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 development on Rat Creek, Creede district.

Rathbun Limestone Member (of Denmark Formation)

Rathbun Member (of Shoreham Formation)

Middle Ordovician (Mohawkian): East-central New York.

G. M. Kay, 1943, Am. Jour. Sci., v. 241, no. 10, p. 598, 599–600. Name proposed for basal member of Denmark formation. Described at type section as brachiopod coquina, calcilutite, and calcareous shale. Contrasts with underlying Shoreham limestone by abundance of calcilutite; contrasts sharply with overlying Poland limestone member (newly defined) by presence of coquinal beds. Lithologically more similar to Shoreham than to Poland, but arbitrarily placed in Denmark formation because persistent basal calcarenite suggests subjacent disconformity. Maximum thickness 10 feet; 6 feet in type section. Persists along West Canada Creek but thins southeastward and is absent to the east at Little Falls.

P. A. Chenoweth, 1952, Geol. Soc. America Bull., v. 63, no. 6, p. 525–526. Reallocated to Shoreham formation because beds in West Canada Creek valley are faunal and lithologic equivalents of top Shoreham beds of Black River valley. Shales generally thicker and more calcareous than those in underlying part of Shoreham. Coquinal beds increase in number toward top. Thickness at type section about 9 feet.

Type section: On Rathbun Brook, a tributary of West Canada Creek, 1½ miles northwest of Newport, Herkimer County.

Raton Basalts

Quaternary: Northeastern New Mexico.

Helen Stobbe, 1948, (abs.) Geol. Soc. America Bull., v. 59, no. 12, pt. 2, p. 1354. Incidental mention only.

R. F. Collins, 1949, Geol. Soc. America Bull., v. 60, no. 6, p. 1022, 1027–1028, pl. 1; H. R. Stobbe, 1949, Geol. Soc. America Bull., v. 60, no. 6, p. 1049, 1050. Medium- to dark-gray predominantly fine-grained vesicular olivine basalts. Some iddingsite. Rarely diabasic. Quaternary. Derivation of name and geographic distribution given.

G. H. Wood, Jr., S. A. Northrop, and R. L. Griggs, 1953, U.S. Geol. Survey Oil and Gas Inv. Map OM–141 (sheet 2). Consists of two series of flows. Cumulative local thickness ranges from 100 to 500 feet.

Brewster Baldwin and W. R. Muehlberger, 1959, New Mexico Bur. Mines Mineral Resources Bull. 63, p. 114–115. In Des Moines quadrangle, Raton basalts lie with apparent conformity on Ogallala formation. Topographically continuous with older Raton basalts mapped by Wood and others (1953) in Colfax quadrangle.

Named after Raton Mesa. Occurs in Colfax and Union Counties in Johnson Mesa, gap between Hunter and Johnson Mesas, Mesa Llargo, Hereford Park, Oak Canyon, Devoy Peak, mesa north of Valley post office, and Black Mesa.

**Raton Formation**[1]

Upper Cretaceous and Paleocene: Northeastern New Mexico and southeastern Colorado.

Original reference: F. V. Hayden, 1869, U.S. Geol. Survey Colorado and New Mexico 3d Ann. Rept., p. 89–91.

G. H. Wood, Jr., S. A. Northrop, and R. L. Griggs, 1953, U.S. Geol. Survey Oil and Gas Inv. Map OM–141. In Colfax County, N. Mex., formation is about 1,110 feet thick and consists of interbedded shale, siltstone, graywacke, arkosic or feldspathic sandstone, quartzose sandstone, conglomerate, and coal. Unconformably overlies Vermejo; in some areas overlies Trinidad sandstone. Upper Cretaceous and Paleocene.

R. B. Johnson and G. H. Wood, Jr., 1956, Am. Assoc. Petroleum Geologists Bull., v. 40, no. 4, p. 709 (fig. 2), 714–716. Crops out over most of Raton Mesa region; as much as 1,700 feet thick southeast of Spanish Peaks. Consists of thin basal sequence of gray to dark-purple-gray siliceous granule to pebble conglomerate or gray siliceous conglomeratic sandstone beds. Above basal sequence, formation is buff, gray, and olive-gray very fine- to coarse-grained arkose, graywacke, and quartzose sandstone beds; gray to dark-gray siltstone and silty shale beds; numerous coal beds. Intertongues and grades into Poison Canyon formation. Overlies Vermejo formation. Cretaceous and Tertiary.

Type area: In high mesa region between Trinidad, Colo., and Raton, N. Mex.

Ratonan series[1]

Eocene: New Mexico.

Original reference: C. R. Keyes, 1915, Iowa Acad. Sci. Proc., v. 22, p. 257–259.

†Raton Hills Group[1]

Upper Cretaceous and Eocene: Southeastern Colorado.

Original reference: F. V. Hayden, 1869, U.S. Geol. Survey Colorado and New Mexico 3d Ann. Rept., p. 89–91.

Occurs in Raton Hills, Raton Mesa region.

Raton Pass coal group (in Raton Formation)[1]

Eocene: Eastern Colorado.

Original reference: R. C. Hills, 1899, U.S. Geol. Survey Geol. Atlas, Folio 58.

Elmoro region.

†Rattlesnake Beds[1] or Formation[1]

Upper Cretaceous (Gulf Series): Western Texas.

Original reference: J. A. Udden, 1907, Texas Univ. Bull. 93, p. 17, 41–54.

Named for Rattlesnake Mountain, Brewster County.

**Rattlesnake Formation**[1]

Pliocene and Pleistocene: Central northern Oregon.

Original reference: J. C. Merriam, 1901, California Univ. Pub. Bull. Dept. Geology, v. 2, no. 9, p. 310.

W. D. Wilkinson, 1950, (abs.) Geol. Soc. America Bull., v. 61, no. 12, pt. 2, p. 1534. Contains layer of welded tuff that stands in cliffs 50 to 75 feet high and extends from type locality near Picture Gorge eastward along both sides of John Day Valley to vicinity of town of John Day.

T. P. Thayer, 1956, U.S. Geol. Survey Mineral Inv. Field Studies Maps MF–49, MF–50, and MF–51. In Aldrich Mountain quadrangle and Mount Vernon quadrangle, overlies Mascall formation with angular unconformity. In John Day quadrangle overlies Columbia River basalt with angular unconformity. Pliocene and Pleistocene(?).

T. P. Thayer, 1957, Some relations of later Tertiary volcanology and structure in eastern Oregon: Internat. Geol. Cong., 20th, Mexico, 1956. Consists of fanglomerate, boulder gravel, and welded rhyolite tuff. Gravels and about 15 feet of tuff near the center form a 650-foot bluff southeast of Dayville and extend below floor of valley. Tuff member has maximum thickness of about 110 feet. Vertebrate fossils below tuff date beds below tuff as lower Pliocene; beds above tuff range up to Pleistocene in age.

Type exposure: On Rattlesnake Creek about 1 mile west of Cottonwood, Malheur County.

Rattlesnake Granite[1]

Late Mesozoic: Southern California.

Original reference: F. S. Hudson, 1922, California Univ. Pubs., Dept. Geol. Sci. Bull., v. 13, no. 6, p. 181, 207–209, map.

W. J. Miller, 1946, Geol. Soc. America Bull., v. 57, no. 5, p. 485, table 4. Described under late Mesozoic plutonics. In plutonic sequence, central San Diego County, Rattlesnake granite is listed as youngest intrusive, younger than La Posta quartz diorite.

D. L. Everhart, 1951, California Div. Mines Bull. 159, p. 87–88, pls. 2, 3, 4. Mapped as Upper Cretaceous.

E. S. Larsen, Jr., 1958, U.S. Geol. Survey Bull. 1070–B, p. 44, 50. Lead-alpha age 117 million years.

Named for Rattlesnake Valley, Cuyamaca region, San Diego County.

Rattlesnake Point Granite

Precambrian: Southeastern Arizona.

F. F. Sabins, 1957, Geol. Soc. America Bull., v. 68, no. 10, p. 1322–1323, pl. 1. Coarse-grained with granitic-porphyritic texture. Fresh surfaces are greenish gray and weather light brown. Abundant large light-colored euhedral feldspar phenocrysts which have maximum dimensions of 15 by 25 mm. At Rattlesnake Point and other outcrops, there is pronounced flow-type preferred orientation of feldspar phenocrysts. Unconformably underlies Bolsa quartzite. Intrudes Pinal schist along west side of Bowie Mountain.

Crops out along northeast front of Chiricahua Mountains from vicinity of Emigrant Hills and Little Emigrant Canyon east to Rattlesnake Point from which granite takes its name, Cochise Head quadrangle, Cochise County. Also crops out along north flank of Blue Mountain, at Timber Mountain, and on southwest side of range in vicinity of Apache Pass.

Raul Canyon Basalt

Tertiary: Northwestern Utah.

G. H. Thomas, 1958, Brigham Young Univ. Research Studies, Geology Ser., v. 5, no. 4, p. 14, pl. 1. Dark fine-grained porphyritic basalt. Mapped as Raul Canyon intrusive.

Named for exposures in Raul Canyon, Tooele County.

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**Ravalli Group[1] or Argillite**

Ravalli Formation[1]

Precambrian (Belt Series): Northwestern Montana and northeastern Idaho.

Original reference: C. D. Walcott, 1906, Geol. Soc. America Bull., v. 17, p. 7, 9.

C. L. Fenton and M. A. Fenton, 1937, Geol. Soc. America Bull., v. 48, no. 12, p. 1880–1881. In Glacier National Park, Ravalli group represented by (ascending) Altyn formation, Appekunny formation, and Grinnell formation. Thickness 7,800 to 15,000 feet. Type locality cited.

C. E. Erdmann, 1944, U.S. Geol. Survey Water-Supply Paper 866–B, p. 47. Strata in Bad Rock Canyon on main Flathead River called Ravalli argillite.

Russell Gibson, 1948, U.S. Geol. Survey Bull. 956, p. 11–12, pl. 1. Formation in Libby quadrangle, Montana. Overlies Prichard formation; underlies Wallace formation. Thickness about 10,000 feet. Ravalli correlated with Burke formation, Revett quartzite, and St. Regis formation of Coeur d'Alene district.

C. P. Ross, 1949, (abs.) Washington Acad. Sci. Jour., v. 39, no. 3, p. 111–112. Term Ravalli group is used herein to include formations of Belt series that overlie or are believed to overlie Neihart and Prichard formations and are below Newland limestone of Piegan group or its stratigraphic equivalent. In and near Lincoln, Mineral and Sanders Counties, Mont., group contains Burke formation, Revett quartzite, and St. Regis formaton. In extreme northwestern part of Montana, maximum thickness may be 10,000 feet. In and south of Glacier National Park, group contains Altyn limestone, Appekunny argillite, and Grinnell argillite with aggregate maximum thickness of more than 12,000 feet. In Little Belt Mountains, Chamberlain shale (1,500 feet thick) is at present regarded as sole unit that can be correlated with Ravalli group.

C. P. Ross, 1959, U.S. Geol. Survey Prof. Paper 296, p. 18–27, pls. 1, 2. Altyn limestone assigned to Ravalli group provisionally. May prove to be pre-Ravalli.

Type locality: Hills along Jocko River, near Ravalli, Mont.

Ravallian series[1]

Precambrian: Montana.

Original reference: C. R. Keyes, 1925, Pan-Am. Geologist, v. 44.

Raven Member (of Montoya Dolomite)

Upper Ordovician: Southwestern New Mexico.

L. P. Entwistle, 1944, New Mexico Bur. Mines Mineral Resources Bull. 19, p. 18. Thick-bedded gray dolomite with some red chert. At base is a shell limestone. Thickness at Raven claim 120 feet. Overlies Par Value member (new); underlies Fusselman dolomite.

Typical exposures: On Raven claim, from which member is named, Boston Hill mining district, Grant County.

Ravenna Plutonic Series[1]

Mesozoic(?): Southern California.

Original reference: O. H. Hershey, 1902, California Univ. Pub., Dept. Geol. Bull., v. 3, pl. 1, map.

Probably named for occurrence at Ravenna Station, Los Angeles County.

Ravenna Shale Member or facies (of Portwood Formation)

Middle Devonian: Eastern Kentucky.

Guy Campbell, 1946, Geol. Soc. America Bull., v. 57, no. 9, p. 863, 864, 865. Black fissile shale with lenses of black or brownish limestone; indistinguishable from overlying Trousdale shale. Considered a coeval facies with Harg shale facies (new) and Duffin dolomite.

Type section: One mile west of Ravenna, along railroad at southwest corner of Irvine, Estill County. Occurs only on eastern border of New Albany outcrop.

Raven Rock Member (of Stockton Formation)

[Upper] Triassic: West-central New Jersey.

M. E. Johnson and D. B. McLaughlin, 1957, Geol. Soc. America Guidebook Atlantic City Mtg., p. 52 (table). Massive medium to coarse white and gray arkose. Thickness 293 feet. May or may not include overlying 724 feet of red and brown sandstone and underlying 787 feet of red and gray fine sandstone, red shale, and arkose [see Stockton formation]. Younger than Cutalossa member (new); older than Lockatong formation.

In area along Delaware River from Stockton northward to 3 miles west of Milford, Hunterdon County.

**Ravenswood Granodiorite**[1]

Precambrian: Southeastern New York.

Original reference: C. P. Berkey, 1910, New York Acad. Sci. Annals, v. 19, p. 250.

Wallace de Laguna and M. L. Brashears, Jr., 1946, New York State Water Power and Control Comm. Bull. GW–13, p. 8 [reprinted 1948, p. 7]. Intrudes Fordham gneiss in many localities. Composition ranges from granite to diorite but term granodiorite is appropriate for most of it.

Named for typical development in Long Island City, a part of which is called Ravenswood.

**Rawley Andesite**[1]

Miocene (?): Central southern Colorado.

Original reference: W. S. Burbank, 1932, U.S. Geol. Survey Prof. Paper 169.

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 the Bonanza latite is replaced by Hayden Peak latite.

Exposed on slopes of Rawley Gulch and in Rawley mine, Bonanza district, Saguache County.

Rawlins Ash Bed (in Ash Hollow Member of Ogallala Formation)

Pliocene: Northwestern Kansas and southwestern Nebraska.

Ada Swineford, J. C. Frye, and A. B. Leonard, 1955, Jour. Sed. Petrology, v. 25, no. 4, p. 244 (fig. 1), 254. Name applied to volcanic ash bed. Thickness 3½ feet at type locality. Basal 2 feet relatively pure and massive; upper part interbedded with fine to medium sand. Lies about 10 feet above base of Ash Hollow member; lies stratigraphically below Fort Wallace ash bed (new).

Named from exposures at center of west line SW¼ sec. 4, T. 4 S., R. 34 W., Rawlins County, Kans.

Rawlinsian series

Cretaceous (Cretacic) : Northwestern Kansas.

[C. R.] Keyes, 1941, Pan-Am. Geologist, v. 76, p. 304 (chart). Series in the late Cretacic. Includes Arickaree formation. Occurs below the Eocene and above an unnamed interval above the Buckskinian series.

Rawls Basalt (in Buck Hill Volcanic Series)

Pliocene (?) : Western Texas.

S. S. Goldich and C. L. Seward, 1948, West Texas Geol. Soc. [Guidebook] Fall Field Trip Oct. 29–31, p. 14 (table 1), 22. Name applied to the thick flows above the Tascotal formation (new) ; flows are youngest rocks of Buck Hill series known to date. At least four flows 180 feet thick are included in the Rawls at Wire Gap; in southern part of Tascotal quadrangle contains eight flows at least 300 feet thick. Flows are separated by several beds of sandy tuff.

W. N. McAnulty, 1955, Geol. Soc. America Bull., v. 66, no. 5, p. 555–558, pl. 1. Described in Cathedral Mountain quadrangle where it has a maximum thickness of 545 feet on Cathedral Mountain; at northernmost exposure—two outliers on butte west of McIntyre Peak—thickness is 30 and 75 feet respectively. Possibly early Pliocene.

Named for Rawls Ranch on Tascotal Mesa, Tascotal quadrangle, Presidio County.

Raymond Limestone (in Monongahela Formation)[1]

Pennsylvanian : Western West Virginia.

Original reference : I. C. White, 1882, The Virginias, v. 3, p. 142.

Exposed at Raymond City post office, Putnam County.

Raymond City Limestone[1]

Pennsylvanian : Western West Virginia.

Original reference : I. C. White, 1882, The Virginias, v. 3, p. 142.

Exposed at Raymond City post office, Putnam County.

Raymond Peak Andesites

Late Tertiary : Central eastern California.

H. G. Wilshire, 1957, California Univ. Dept. Geol. Sci. Bull., v. 32, no. 4, fig. 1. Named on map of Ebbetts Pass region. Older than Silver Peak andesites (new).

Ebbetts Pass region is in Alpine County.

Raymond Quarry Beds[1]

Devonian : Central eastern Iowa.

Original reference: M. F. Arey, 1906, Iowa Geol. Survey, v. 16, p. 420–448.

Blackhawk County.

†Raysor Marl[1]

Miocene, upper : Southern South Carolina.

Original reference : C. W. Cooke, 1936, U.S. Geol. Survey Bull. 867.

C. W. Cooke, 1945, Florida Geol. Survey Bull. 29, p. 182. Recommended that use of name Raysor marl be discontinued and the Miocene bed at Raysor Bridge be included in Duplin marl.

Named from Raysor Bridge, on Edisto River, 8 miles southwest of St. George, near which only known outcrops occur.

**Raytown Limestone Member** (of Iola Limestone)

Raytown Limestone Bed (in Kansas City Formation)[1]

Raytown Limestone Member (of Chanute Shale)

Pennsylvanian (Missouri Series): Northwestern Missouri, southwestern Iowa, and eastern Kansas.

Original reference: H. Hinds and F. C. Greene, 1915, Missouri Bur. Geology and Mines, v. 13, 2d ser., p. 7, 27–28, 118.

H. S. McQueen and F. C. Greene, 1938, Missouri Geol. Survey and Water Resources, 2d ser., v. 25, pl. 5. Member of Chanute shale. Thickness 5 to 8 feet. Overlies Muncie Creek shale member.

J. R. Clair, 1943, Missouri Geol. Survey and Water Resources, 2d ser., v. 27, pl. 1. Member of Chanute shale. Underlies Liberty Memorial shale member (new).

R. C. Moore, 1948, Am. Assoc. Petroleum Geologists Bull., v. 32, no. 11, p. 2031 (fig. 4), 2032: F. C. Greene and W. V. Searight, 1949, Missouri Geol. Survey and Water Resources Rept. Inv. 11, p. vi (fig. 2), 13. Miscorrelation of Iola formation by Haworth and Bennett (1908) in tracing limestone in this part of section northeastward to Kansas City has been responsible for long standing error in nomenclature of Missourian units in northeastern Kansas and northwestern Missouri. Settlement of Iola problem has led to changes in Missouri Survey's classification of middle and upper Kansas City beds so as to bring interstate agreement in nomenclature. Paola limestone, Muncie Creek shale, and Raytown limestone, which were treated as members of Chanute shale, are recognized as belonging to Iola formation. Underlies Lane shale (redefined for Missouri).

H. G. Hershey and others, 1960, Iowa Highway Research Board Bull. 15, p. 26, fig. 5. Member of Iola limestone. As recognized in Middle River section in Madison County, is composed of a 9-foot sequence of light-gray wavy-bedded fossiliferous limestones separated into two or three units by thin shales. This unit differs from the Raytown of Condra and Upp (1933, Nebraska Geol. Survey Paper 4). They describe it as several thin limestone beds, all of which are quite fossiliferous and report a thickness of about 3 feet. Overlies Muncie Creek shale member; underlies Lane shale.

Named for Raytown, Jackson County, Mo.

Rayville Formation (in Kickapoo Creek Group)

Pennsylvanian (Lampasas Series): North-central Texas.

M. G. Cheney, 1947, Jour. Geology, v. 55, no. 3, pt. 2, p. 207 (chart 1), 210–211. Proposed for bed from disconformity above Dennis Bridge limestone down to top of Parks formation. Includes approximately 1,000 feet of alternating limestone, blue and black shales, and sandstones. Outcropping members include Dennis Bridge limestone; an unnamed 100 to 125 foot section of shale, dolomitic limestones, and sandstone; Kickapoo Creek limestone; and Dickerson shale—a combined thickness of about 200 feet. Formation thins rapidly westward from type area, being less than 300 feet thick in Brown and Coleman Counties.

Type locality: Southwestern Parker County. Name derived from early settlement now almost abandoned, located 3½ miles southeast of Dennis and a like distance northeast of Kickapoo Falls.

**Razburg Sandstone Member** (of Pottsville Formation)[1]

Pennsylvanian: Northern central Alabama.

Original reference: C. Butts, 1910, U.S. Geol. Survey Geol. Atlas, Folio 175, p. 9.

Named for Razburg, Jefferson County.

Razorback Formation

Tertiary: Southwestern New Mexico.

F. J. Kuellmer and others, 1953, *in* New Mexico Geol. Soc. Guidebook 4th Field Conf., p. 50 (map). Name appears on legend of map of Mimbres Valley. Referred to as andesite, trachyte, and latite.

H. L. Jicha, Jr., 1954, New Mexico Bur. Mines Mineral Resources Bull. 37, p. 39 (table 3), 47–48, pl. 1. In Lake Valley quadrangle, consists mainly of pyroxene andesites. Thickness 250 to 500 feet. On west side of White Rock Canyon, a 40-foot layer of fairly coarse grained well-sorted sandstone is interbedded with two of flows of formation. Underlies Bear Springs basalt (new); overlies Mimbres Peak formation. Flows of Razorback formation overlie Pollack quartz latite (new) along Taylor Creek.

W. E. Elston, 1957, New Mexico Bur. Mines Mineral Resources Bull. 38, p. 17 (table 1), 32–34. Formation consists of two superficially similar members, the lower andesite and the upper rhyolite that is close to being a trachyte or latite. Both are black or dark gray and fine grained. Total thickness of both members varies between 300 feet west of Mimbres Peak, at least 700 feet at Caballo Blanco, and 800 feet or more in Donahue Canyon. In northwest part of Dwyer quadrangle, it lies on an irregular surface of Caballo Blanco rhyolite; near Box Well, on Piloncillo sediments (new); in Mimbres fault zone, on Caballo Blanco rhyolite; and east of fault, on beveled rhyolites of Mimbres Peak and Caballo Blanco formations. Derivation of name.

Named after a mountain in sec. 36, T. 18 S., R. 11 W., Dwyer quadrangle.

Reading Gneiss[1]

Upper Cambrian: Southeastern Vermont.

Original reference: C. H. Richardson, 1929, Vermont State Geologist 16th Rept., p. 237, table opposite p. 288.

In Windsor and Windham Counties. Named for fact that its outcrops occupy whole of southern part of Reading, Windsor County.

**Reading Limestone Member** (of Emporia Limestone)

Reading Limestone (in Wabaunsee Group)[1]

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

Original reference: A. J. Smith, 1905, Kansas Acad. Sci. Trans., v. 19, p. 150.

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 Emporia limestone here recognized and used as originally defined. Underlies Harveyville shale member; overlies Auburn shale.

P. B. Greig, 1959, Oklahoma Geol. Survey Bull. 83, p. 56–57. Described in Pawnee County, where it is 15 to 26 feet thick. Underlies Harveyville shale member; overlies Auburn shale. Unit not easily traced and both northern and southern extremities in county are indistinct. Occurs south of Pawnee County, but southern extent not yet 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. Consists of two beds of gray crinoidal limestone which characteristically weather to deep brown; commonly fossiliferous with crinoid and brachiopod fragments. Thickness about 3 feet. Underlies Harveyville shale; overlies Auburn shale.

Type locality: In vicinity of Reading, Lyon County, Kans. Well exposed in roadcut near NW cor. sec. 33, T. 17 S., R. 13 E., 1 mile north of Reading.

†Reading Sandstone[1]

Lower Cambrian: Southeastern Pennsylvania.

Original reference: E. V. D'Invilliers, 1883, Pennsylvania 2d Geol. Survey Rept. $D_3$, v. 2, p. 99–100.

Well exposed south of Reading, Berks County, in cuts of Philadelphia & Reading Railroad.

Readsboro Schist[1]

Upper Cambrian (?): Southwestern and southeastern Vermont.

Original reference: G. D. Hubbard, 1924, Vermont State Geologist 14th Rept., p. 282–288, 291, 294, map.

Named for extensive outcrops in Readsboro Township and around Readsboro, Wilmington quadrangle, Bennington County.

Ready Pay Member (of Percha Shale)

Upper Devonian or Lower Mississippian: Southern New Mexico.

F. V. Stevenson, 1944, Dallas Digest (Am. Assoc. Petroleum Geologists, Soc. Econ. Paleontologists and Mineralogists, and Soc. Explor. Geophysicists Joint Ann. Mtg.), p. 94–95. Black fissile nonfossiliferous shale. In most sections, comprises lower two-thirds of total thickness of formation. Underlies Box member (new) with gradational contact. Possibly a different facies of Contadero formation (new).

F. V. Stevenson, 1945, Jour. Geology, v. 53, no. 4, p. 241, 243, figs. 2, 6, 13. Upper Devonian. Thickness 132 feet. Overlies Sly Gap formation in San Andres Mountains. Derivation of name given.

M. A. Stainbrook, 1947, Jour. Paleontology, v. 21, no. 4, p. 298. Basal black shale of Percha termed Silver by Keyes (1908). There is little doubt that the Silver and Ready Pay were proposed for identical division of Percha and there is little reason to replace earlier names. Percha of early Mississippian age.

Named after gulch which drains to south into Percha Creek, 400 yards east of a narrow canyon called "The Box", in vicinity of Hillsboro.

**Reagan Sandstone**[1] (in Timbered Hills Group)

Upper Cambrian: Central southern Oklahoma.

Original reference: J. A. Taff, 1902, U.S. Geol. Survey Geol. Atlas, Folio 79.

C. E. Decker, 1933, Tulsa Geol. Soc. Digest, p. 55, 56. Basal formation in Timbered Hills group (new). Underlies Cap Mountain sandstone. Pebbly sandstone 500 feet thick; carries much glauconite and becomes calcareous at top. Separated from Precambrian by unconformity; Colbert porphyry and Tishomingo granite are oldest exposed rocks.

C. E. Decker, 1939, Oklahoma Geol. Survey Circ. 22, p. 16 (table 1), 18. Commonly rests unconformably on igneous rocks, but in one exposure about 98 feet of dense limestones separate it from igneous rocks. In some places, contact with overlying Honey Creek is fairly sharp; more commonly there is gradation zone at top, especially on northeast flank of Wichita Mountains. Here an alternation of sandstones and limestones make it impossible to choose distinct plane of separation between the two formations. Note on type section. Thickness 460 feet at type section.

E. A. Frederickson, 1948, Am. Assoc. Petroleum Geologists Bull., v. 32, no. 7, p. 1349–1355. Two units, namely, the so-called Cap Mountain formation and the "basal limestone" are, on basis of faunal evidence and stratigraphic position, herein considered to be equivalents of all or parts of Honey Creek formation.

Type section: About 5 miles southwest of village of Mill Creek, Johnston County. Named from town of Reagan in Tishomingo quadrangle.

Reager Ash Bed (in Ash Hollow Member of Ogallala Formation)

Pliocene: Northwestern Kansas.

J. S. Carey and others, 1952, Kansas Geol. Survey Bull. 96, pt. 1, p. 9–13, 27. Name applied to volcanic ash bed. Approximately 10 feet thick. Lies near middle of member and stratigraphically above Calvert ash bed (new) and stratigraphically below an unnamed ash bed.

Ada Swineford, J. C. Frye, and A. B. Leonard, 1955, Jour. Sed. Petrology, v. 25, no. 4, p. 244 (fig. 1), 254. Listed in stratigraphic sequence as overlying Dellvale ash bed (new) and underlying Reamsville ash bed (new).

Type locality: NW¼NE¼ sec. 35, T. 2 S., R. 25 W., Norton County. Named for exposures 1 mile north of stop on Burlington Railroad in west-central part of county.

Reamsville Ash Bed (in Ash Hollow Member of Ogallala Formation)

Pliocene: Northwestern Kansas.

Ada Swineford, J. C. Frye, and A. B. Leonard, 1955, Jour. Sed. Petrology, v. 25, no. 4, p. 244 (fig. 1), 254–255. Highest named [volcanic] ash bed in Ogallala formation of central Great Plains. Thickness at type locality 3 feet; occurs in sequence of partly cemented sand and silty sand. Lies slightly above middle of Ash Hollow member and stratigraphically above Reager ash bed.

Named from exposures along Kansas Highway 8 in center of west line SW¼ sec. 32, T. 1 S., R. 14 W., Smith County, west-southwest of Reamsville.

**Recapture Shale Member** (of Morrison Formation)[1]

Upper Jurassic: Southeastern Utah, northeastern Arizona, southwestern Colorado, and northwestern New Mexico.

H. E. Gregory, 1938, U.S. Geol. Survey Prof. Paper 188, p. 36 (table), 58, pl. 15, strat. sections. Series of strongly colored shales and sandstones 100 to 300 feet thick. Shales are prevailingly dark red, but some are variegated—pink, ash, brown, and gray; many include firm strongly calcareous beds that break into slabs and friable imbricated gypsiferous beds that weather as tiny cliffs. Sandstones are white beds of glistening quartz cemented by lime, a few of them more than 1 foot thick or continuous for more than 1,000 feet. Overlies Bluff sandstone member; underlies Westwater Canyon sandstone member (new).

W. L. Stokes, 1944, Geol. Soc. America Bull., v. 55, no. 8, p. 962–964, table 1. As interpreted here, type section of Recapture includes Salt Wash member as well as about 150 feet of overlying alternating sandstones and shales. The Salt Wash is thin and rests directly on the Entrada (Bluff), and the Summerville is absent. In Carrizo Mountains, distinction between Salt Wash and overlying part of Recapture is more clear cut, and term Recapture can best be used for the upper part only and is therefore a more restricted usage than Gregory employed. Gregory's description of the Recapture includes certain features of the Salt Wash; the two are very similar in gross lithologic characteristics but differ in type of sandstone and shale and in appearance and manner of weathering. [Also referred to as Recapture Creek shale.]

J. W. Harshbarger, C. A. Repenning, and R. L. Jackson, 1951, New Mexico Geol. Soc. Guidebook 2d Field Conf., p. 97. In Navajo country, Summerville formation, Recapture shale member, and Bluff sandstone member of Morrison formation grade laterally southward into distinct sand facies here named Cow Springs sandstone.

L. C. Craig and others, 1955, U.S. Geol. Survey Bull. 1009–E, p. 137–140. Member is present in northeastern Arizona, northwestern New Mexico, and small areas of southeastern Utah and southwestern Colorado. Unit was formed as large alluvial fan. To the north, member intertongues with and grades into Salt Wash member; upper part is most extensive and is recognized to south of Monticello, Utah. To the southwest, member pinches out along zero isopach line passing south of Gallup, N. Mex. Both at northwestern and southeastern extremities of this zero isopach, the line marks apparent limit of deposition, but in middle, south of Gallup, beds equivalent to Recapture have been removed by erosion; eastward extent of member in north-central New Mexico not known. Unit arbitrarily divided into three facies: conglomeratic sandstone; sandstone; and claystone and sandstone. Thick part of member is elongate curving area from northeastern Arizona into northwestern New Mexico; maximum thickness 680 feet in Arizona. Extension of Salt Wash as recognizable unit through southeastern Utah and into northeastern Arizona and northwestern New Mexico constitutes restriction of Gregory's original definition of the Recapture.

V. L. Freeman and L. S. Hilpert, 1956, U.S. Geol. Survey Bull. 1030–J, p. 313–314, 315 (fig. 60), 322, 325, 327, 328–329, 330–331, 333–334. In Gallup-Albuquerque area, member ranges from about 20 to as much as 276 feet in thickness, in general thinning southward. Consists largely of grayish-red sandy claystone and clayey sandstone with limy nodules and white clean fine- to medium-grained sandstone in alternating units 5 to 10 feet thick; the clean sandstone beds are most common in western part of area and probably represent tongues of Cow Springs sandstone. Clayey sandstone is dominant rock in eastern and southern parts of area. In most of area, conformable with underlying Bluff sandstone; to the north near Ysidro, rests directly on Summerville formation. Overlain by Westwater Canyon member.

J. W. Harshbarger, C. A. Repenning, and J. H. Irwin, 1957, U.S. Geol. Survey Prof. Paper 291, p. 52–53. Gregory (1938) apparently included in type section some basal sands that are now correlated with Salt Wash member (Stokes, 1944). Usage in this paper [Navajo country] follows that of Stokes in considering as Recapture only the upper sandstone and shale at Gregory's type locality. Lower sandstone beds are referred to as Salt Wash member. Present in northeastern part of Navajo country;

intertongues with and grades into Salt Wash member where both members are present; intertongues with overlying Westwater Canyon member. Not present in northwestern part of area because Salt Wash sandstone member occupies entire Morrison interval. Not recognizable in southwestern part of area; where it grades into main mass of Cow Springs sandstone; the white sandstone tongue of Cow Springs, at base of Morrison, is only tongue of Cow Springs that can be separated from Recapture on regional scale. Near Fort Wingate, upper tongues of Cow Springs grade into Recapture, and Recapture is thicker toward east. Exclusive of white sandstone tongue but including all other tongues and lenses of Cow Springs that are present, Recapture is 483 feet thick at northern end of Chuska Mountains and thins to 215 feet at Todilto Park and 104 feet at Lupton, Ariz.; not recognizable at Black Rock, N. Mex.; 59 feet thick at Fort Wingate and thickens eastward to 207 feet at Thoreau, N. Mex.

Named for exposures near mouth of Recapture Creek, San Juan County, Utah.

Recapture Creek Shale Member (of Morrison Formation)

*See* **Recapture Shale Member** (of Morrison Formation).

Reclamation 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, 28, 32. Consists mostly of limestones and shales colored shades of red, gray, and green. Comprises Division V of Hartville "formation" (Condra and Reed, 1935). Thickness 72 to 87 feet. Underlies Roundtop group (new); overlies Fairbank formation (new).

Type locality: Reclamation Hill, sec. 27, T. 27 N., R. 66 W., Platte County, Wyo.

Recreation Redbeds

Cretaceous: South-central Arizona.

W. H. Brown, 1939, Geol. Soc. America Bull., v. 50, no. 5, p. 710 (fig. 2), 715–716, pl. 1. Series of uniformly brick-red fine-grained sandstones. Uniformity broken by conglomerate 5 to 30 feet thick. Thickness 1,265 feet at Gould Gulch. Underlies Amole arkose; overlies Cretaceous volcanics.

W. A. Cobban and J. B. Reeside, Jr., 1952, Geol. Soc. America Bull., v. 63, no. 10, pl. 1. Upper Cretaceous.

D. L. Bryant and J. E. Kinnison, 1954, (abs.) Geol. Soc. America Bull., v. 65, no. 12, pt. 2, p. 1235. Lower Cretaceous.

Named because of its color and occurrence in Tucson Recreational area. Practically confined to Red Hills and numerous small outcrops in zone of the great thrust east of Amole Peak, Tucson Mountains, Pima County.

Rector Formation

Lower Cretaceous (Shasta Series); Northern California.

M. A. Murphy, 1956, Am. Assoc. Petroleum Geologists Bull., v. 40, no. 9, p. 210–2105. Includes 20 to 400 feet of sandstone, conglomerate, and mudstone just above unconformity at base of Cretaceous section. Unit rests unconformably on igneous and metamorphic rocks of Klamath Mountains complex. Conformably underlies Ono formation (new), contact gradational.

Named for typical development along Rector Creek, a small tributary to the North Fork of Cottonwood Creek at Ono, Shasta County.

Red Amphitheater Breccia

Pliocene(?): Southern California.

C. A. Richards, 1958, *in* Pacific Petroleum Geologist, v. 12, no. 3, p. 4. Proposed for the masses of huge blocks, breccia, and minor amounts of fanglomerate that are exposed on the hills around Red Amphitheater. Believed to be derived from landslides, debris slides, or mass wasting from the rising Pyramid Peak fault block.

Area is part of the Funeral Mountains of the Amargosa Range, Death Valley National Monument.

**Red Bank Sand** (in Monmouth Group)[1]

Red Bank Formation

Red Bank Member (of Monmouth Formation)

Upper Cretaceous: New Jersey.

Original references: W. B. Clark, 1894, New Jersey Geol. Survey Ann. Rept. 1893, p. 337; 1894, Jour. Geology, v. 2, p. 165–166.

W. B. Spangler and J. J. Peterson, 1950, Am. Assoc. Petroleum Geologists Bull., v. 34, no. 1, p. 8 (fig. 4), 28, 49–51. Rank reduced to member status in Monmouth formation. Conformably overlies Navesink member; conformably underlies Tinton member; toward south where Tinton is missing, Red Bank grades into overlying Hornerstown. Thickness in Monmouth County 125 feet; thins to southeast and not present south of Sykesville; decreases in thickness as sand member basinward or downdip and becomes more and more shaly and is inseparable from Hornerstown or Navesink.

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. Microfauna of Red Bank indicates correlation with latest Navarro of Gulf Coast section. 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. Red Bank and Navesink formations (Cretaceous) interfinger at least locally, and Red Bank formation extends southwestward to Delaware as unit referred to as "middle greensand."

R. K. Olsson, 1959, Dissert. Abs., v. 19, no. 8, p. 2063. Subdivided into two members: Shrewsbury and Sandy Hook.

J. P. Minard and J. P. Owens, 1960, U.S. Geol. Survey Prof. Paper 400–B, p. B184, B185. Uppermost formation in Monmouth group. Overlies Navesink formation; underlies Hornerstown sand of Rancocas group. Average dip southeast 35 feet per mile. Thickness 0 to 140 feet. Thickens in outcrop to northeast.

Well exposed in vicinity of Redbank, Monmouth County.

Red Beach Granite

Post-Silurian—pre-Upper Devonian: Southeastern Maine.

D. H. Amos, 1958, Dissert. Abs., v. 19, no. 5, p. 1053. All diorites and granites in area were emplaced in post-Silurian—pre-Upper Devonian interval. All but Red Beach granite were formed under relatively deep-seated conditions. Contact features establish that Red Beach granite is the youngest. [Other diorites and granites not named.]

Report discusses geology and petrology of Calais and Robbinston quadrangles.

**Red Bluff Clay**

Red Bluff Clay (in Vicksburg Group)[1]

Red Bluff Member (of Forest Hill Formation)

Oligocene, lower: Southern Mississippi and southwestern Alabama.

Original reference: E. W. Hilgard, 1860, Mississippi Geol. and Agric. Rept., p. 135.

F. S. MacNeil, 1944, Am. Assoc. Petroleum Geologists Bull., v. 28, no. 9, p. 1315 (fig. 1), 1318–1324. Cooke (1918) originally regarded Forest Hill sand as contemporaneous with Red Bluff clay but later accepted view of of Gulf Coast geologists that the Red Bluff comes in from east as wedge between Yazoo clay and Forest Hill sand. Concept derived from present study is that Forest Hill is deltaic equivalent of Red Bluff as Cooke originally believed. Vicksburg group is restricted below to exclude Forest Hill sand and Red Bluff clay. Chart shows Red Bluff clay overlies Yazoo clay and underlies Marianna limestone. Note on derivation of name.

G. E. Murray, 1947, Am. Assoc. Petroleum Geologists Bull., v. 31, no. 10, p. 1838 (fig. 6), 1839. Overlies Shubuta (clay) member (new) of Yazoo formation.

W. J. Hendy, 1948, Mississippi Geol. Soc. [Guidebook] 6th Field Trip, p. 27–28. Rank reduced to member status in Forest Hill formation. As restricted, consists of 10 to 14 feet of highly to slightly glauconitic fossiliferous dark-gray clay with one or more zones of argillaceous glauconitic limestone concretions.

C. W. Stuckey, Jr., 1953, Am. Assoc. Petroleum Geologists Guidebook Houston Mtg., p. 27. Included in Vicksburg group in this report.

Named for exposures at Red Bluff on Chickasawhay River just above railroad bridge 1½ miles south of Shubuta, Wayne County, Miss.

Red Bluff Epoch[1]

Pleistocene: California.

Original reference: O. H. Hershey, 1902, California Univ. Pub., Dept. Geol. Bull., v. 3, p. 1–29.

Name probably derived from Red Bluff, Tehama County.

Red Bluff Formation

Cenozoic: Southwestern Montana.

D. B. Andretta and S. A. Alsup, 1960, Billings Geol. Soc. Guidebook 11th Ann. Field Conf., p. 186, 189. Fine siltstone to coarse conglomerate and breccia. Beds chiefly deep red with purple, yellow, and white layers interspersed. Distinctly bedded, thoroughly indurated, and well sorted. Individual beds range from 3 inches to about 5 feet in thickness; each bed well defined and sharply differentiated from overlying and underlying beds. Appears to be deposited on topography of rolling relief on stripped Precambrian rocks. Middle Cenozoic.

Occurs between towns of Norris and Red Bluff along highway between Anceney and Norris, Madison-Gallatin Counties.

**Red Bluff Formation**[1]

Red Bluff Gravel

Pleistocene: Northern California.

Original reference: J. S. Diller, 1894, U.S. Geol. Survey 14th Ann. Rept., pt. 2, p. 413–416, pl. 44, map.

C. A. Anderson and R. D. Russell, 1939, California Jour. Mines and Geology. v. 35, no. 3. p. 235. Described as an alluvial deposit consisting largely of gravels with a minor amount of interbedded sand; commonly deep brick red in color. Thickness near Redding more than 100 feet. Overlies Tehama formation, locally overlies the Tuscan, and also overlaps upon the Cretaceous.

M. A. Murphy, chm., 1957, Sacramento Geol. Soc. [Guidebook] Ann. Field Trip, May 25–26, geol. map. Red Bluff gravel mapped in Ono quadrangle, Shasta County.

Named for exposures at Red Bluff, Tehama County.

Red Bluff Granite

Precambrian: Western Texas.

L. A. Nelson, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 1, p. 160. Name proposed for granite occurring in the Franklin Mountains.

T. S. Jones, 1953, Stratigraphy of the Permian basin of west Texas: West Texas Geol. Soc., p. 1. Underlies Lanoria quartzite.

Occurs at Red Bluff Park, in McKelligan Canyon, near El Paso.

†Red Bluff Sandstone (in Cimarron Group)[1]

Permian: Central southern Kansas.

Original reference: F. W. Cragin, 1896, Colorado Coll. Studies, v. 6, p. 3, 40.

Named for exposures at former post office of Red Bluff, Comanche County.

**Red Branch Member** (of Woodbine Formation)

Upper Cretaceous: Northeastern Texas and southwestern Oklahoma.

H. R. Bergquist, 1949, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 98. Described at its type locality as consisting of tuffaceous sandstone, carbonaceous shale, and lignite; elsewhere also includes sandy shale and ferruginous sandstone, entire sequence being from 50 to 80 feet thick. Overlies Dexter member; downdip grades into material indistinguishable from overlying Lewisville and is classed with that member.

N. M. Curtis, Jr., 1960, Oklahoma Geology Notes, v. 20, no. 9, p. 240–244. Geographically extended into Bryan County, Okla.

Type locality: Near Red Branch community in northwestern Grayson County, Tex.

Red Bridge Limestone Member (of Liston Creek Formation)

Silurian (Niagaran): Northeastern Indiana.

Original reference: E. R. Cumings and R. R. Shrock, 1927, Indiana Acad. Sci. Proc., v. 36, p. 74–75.

Crops out along Mississinewa River at village of Red Bridge, Wabash County.

**Red Buttes Quartz Basalt** (in Tropico Group)

Pliocene(?): Southern California.

T. W. Dibblee, Jr., 1958, Am. Assoc. Petroleum Geologists Bull., v. 42, no. 1, p. 137 (fig. 1), 138 (fig. 2), 142–143. Black basalt or mafic andesite consisting of several flows totaling about 360 feet in maximum thickness At Red Buttes, rests on pre-Tertiary quartz monzonite and unconformably underlies fanglomerate of probable Pleistocene age; in Kramer Hills, basalt overlies, probably unconformably, the lower part of the Tropico group and is overlain conformably by the upper part.

Type locality: Sec. 5, T. 8 N., R. 6 W., Kramer quadrangle, San Bernardino County. Also prominantly exposed in the Kramer Hills, Kramer and Barstow quadrangles. Name derived from Red Buttes.

Red Canyon Member[1] (of Lykins Formation)

Triassic(?): Southeastern Colorado.

Original reference: J. T. Duce, 1924, Colorado Geol. Survey Bull. 27, pt. 3, p. 81–82.

Probably named for exposures in eastern end of Red Rock Canyon, Las Amimas County.

Redcloud Dacite Flows, Lavas

Pleistocene: Southwestern Oregon.

Howel Williams, 1942, Carnegie Inst. Washington Pub. 540, p. 44, 49, 53, 63, 101, 138, pl. 1. Dacite lava flow that issued from vent on northern slope of former Mount Mazama and erupted after andesitic phase of Mazama's activity had ended. Watchman and Hillman vents were active before the vents of the Llao. Cleetwood and Redcloud dacite lavas younger than Mount Scott lavas. In section southwest of Wineglass, the steep margin of Redcloud flow (lava) presumably prevented Wineglass tuff from spreading farther south.

Redcloud Cliffs are on eastern side of Crater Lake.

**Red Cloud Sand and Gravel**

Pleistocene: Southern Nebraska.

C. B. Schultz, E. C. Reed, and A. L. Lugn, 1951, Science, v. 114, no. 2969, p. 548. Proposed that name Grand Island be restricted to the "Upper Grand Island" and name Red Cloud sand and gravel be applied to the "Lower Grand Island" of Condra and Reed (1950) which includes pro-Kansan sand and gravel. At type locality, consists of sand and gravel that grades from sand to medium-coarse gravel; gray in color throughout except for upper few feet which is strongly weathered to a yellowish brown, indicating a profile of weathering and unconformity at its top; thickness of 33 feet exposed in sand and gravel pit; occurs below Sappa formation and above Niobrara. Appears to be equal in age, at last in part, to pro-Kansan sand and silt (Atchison formation) in glaciated area of eastern Kansas and Nebraska.

Type locality: Red Cloud Township 2½ miles west-northwest of Red Cloud in E½ sec. 28, T. 2 N., R. 11 W., Webster County.

Red Cone Basalt Flow

Pliocene to Pleistocene, lower: Southwestern Oregon.

J. S. Diller and H. B. Patton, 1902, U.S. Geol. Survey Prof. Paper 3, p. 32. Name applied to basalt flow on Red Cone. [See Timber Crater Basalt Flow.]

Howel Williams, 1942, Carnegie Inst. Washington Pub. 540, p. 27. Here considered to be pre-Mazama.

Red Cone is in northwest corner of Crater Lake National Park.

**Red Creek Quartzite**[1]

Red Creek Complex

Precambrian: Northeastern Utah and northwestern Colorado.

Original reference: J. W. Powell, 1876, Geology of eastern portion of Uinta Mountains, p. 42, 62, 70, 137.

W. R. Hansen, 1955, Wyoming Geol. Assoc. Guidebook 10th Ann. Field Conf. p. 23–25, 26 (fig. 3), pl. 1; 1957, U.S. Geol. Survey Geol. Quad. Map GQ–101. Consists mostly of rocks of moderately high metamorphic grade. Underlies Uinta Mountain group. Mapped in Cold Spring Mountain area, Colorado.

H. R. Ritzma, 1959, Utah Geol. and Mineralog. Survey Bull. 66, p. 17–18, geol. map. Because of diversity of rock types present in older Precambrian of area, whole assemblage is referred to as Red Creek complex. Most abundant rock type is quartzite with quartzose mica schist second most common type. Unconformably underlies Uinta Mountain group.

Named for exposures in Red Creek Canyon at head of Willow Creek. Red Creek Canyon separates Quartz Mountain and Mount Wheeler, northeast corner Uintah County, Utah.

**Red Desert Tongue** (of Wasatch Formation)

Eocene, lower: Southwestern Wyoming.

G. N. Pipiringos, 1955, Wyoming Geol. Assoc. Guidebook 10th Ann. Field Conf., p. 100, 101 (chart). Sequence of coal beds, clay shale, siltstone, biotitic sandstone, and low-grade oil shale. Upper 400 feet contains many coal beds including Creston and Tierney coal zones. Only upper 400 feet of tongue exposed in central part of Great Divide Basin, but similar rocks on east flank of Rock Springs uplift are about 1,000 feet thick. Underlies Luman tongue (new) of Green River formation; unconformably overlies Fort Union formation. Intertongues with Battle Spring formation (new) to the north.

Named from exposures southwest of Red Desert Flat at Tipton Buttes and northeast of Red Desert Flat in NW cor. T. 21 N., R. 94 W., and adjoining parts of T. 21 N., R. 95 W., T. 22 N., R. 94 W., and T. 22 N., R. 95 W., Sweetwater County.

**Red Eagle Limestone** (in Council Grove Group)

Red Eagle Limestone Member (of Elmdale Formation)[1]

Red Eagle Limestone Member (of Konawa Formation)

Permian: Oklahoma, Kansas, Missouri, and Nebraska

Original reference: K. C. Heald, 1916, U.S. Geol. Survey Bull. 641, p. 24.

R. C. Moore, J. C. Frye, and J. M. Jewett, 1944, Kansas Geol. Survey Bull. 52, pt. 4, p. 167–168. Includes two limestones and a shale member. In southern Kansas, Red Eagle is a single ledge about 20 feet thick, but the two limestone members that are differentiated in central and northern Kansas can be identified in southern Kansas. Includes (ascending) Glenrock limestone, Bennett shale, and Howe limestone members. Underlies Roco shale; overlies Johnson shale. Council Grove group. Wolfcampian.

P. B. Greig, 1959, Oklahoma Geol. Survey Bull. 83, p. 87–89, Condra (1935, Nebraska Geol. Survey Paper 8) subdivided the Red Eagle into Glenrock limestone, Bennett shale, and Howe limestone members. These subdivisions have been recognized across Kansas and tentatively identified in Osage County, Okla. In north and central part of outcrop belt in Pawnee County, a threefold division of Red Eagle sequence is possible, but there is no sound basis for correlation with subdivisions in Kansas and Nebraska. For purpose of this report, Red Eagle is considered a single unit and defined as first persistent limestone zone above Long Creek limestone. Unit can be traced into Lincoln County. Consists of interbedded limestone and shale, thickening from less than 3 feet in north to more than 6 feet in south. Underlies Neva limestone.

A. E. West, 1960, Shale Shaker, v. 11, no. 3, p. 4–7. Described in Lincoln County, Okla., where it is classified as uppermost member of Konawa formation. Thickness 3 to 5 feet. Commonly made up of massive bed at base 2 to 3 feet thick with remainder of unit being thin-bedded limestones with shale partings. Overlies Long Creek limestone member. Overlain by redbeds.

Named for exposures near Red Eagle School, southwest of Foraker, Osage County, Okla.

†Red Eagle Shale (in Elmdale Formation)[1]

Pennsylvanian: Central northern Oklahoma.

Original reference: G. C. Clark and C. L. Cooper, 1927, Oklaholma Geol. Survey Bull. 40H.

Occurs in T. 22 N., Rs. 2 W.–5 E.

Redfield Formation

Eocene (Jacksonian): Southeastern Arkansas.

L. J. Wilbert, Jr., 1953, Arkansas Div. Geology Bull. 19, p. 80–87. Embraces the nonmarine Jacksonian deposits which overlie and are partially equivalent to the White Bluff formation. From north to south, the Redfield successively overlies the Pastoria and Rison members (both new) of the White Bluff; boundary is an erosion surface which is either subaerially exposed or is overlain by Pleistocene terrace deposits. Estimated maximum thickness 150 to 200 feet.

Name derived from village of Redfield in northern Jefferson County. Well exposed at White Bluff, 4 miles east of the village. Formation is restricted to northern part of Jacksonian outcrop area.

Red Gap Member (of Grinnell Argillite[1] or 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. 1889. Argillites, dominantly red, but incidentally brownish or green; interbedded with pink, white, or greenish-white quartzites, brown sandstones, and sandy argillites. Recognized some places by thick beds of red argillite with flat mud-crack polygons. Maximum thickness 2,800 feet. Thins to 700 or 800 feet in Blackiston Valley. Intergrades with Rising

Bull member above and Rising Wolf member below. Type locality designated.

Type locality: Mountain between Red Gap and Ptarmigan Wall, Glacier National Park. Typically developed in Lewis Range, north of Many Glaciers.

Red Hill Complex

Carboniferous(?): 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. Includes gray to yellowish coarse-grained syenite, light-gray medium- to coarse-grained nephelite-sodalite syenite, gray to pink medium-grained syenite, white to brownish medium-grained quartz syenite, gray fine-grained quartz syenite, and gray to yellowish-gray fine-grained granite. Belongs to White Mountain magma series.

Occurs on and around Red Hill in southwestern corner of Mount Chocorua quadrangle.

Redhill sandstone[1]

Miocene: Southeastern California.

Original reference: C. R. Keyes, 1923, Pan-Am. Geologist, v. 40, p. 52, 61, 80.

Probably named for red sandstone mountain north of Ryan and east of Furnace Creek Wash, Inyo Canyon.

Red Hill Shale Member (of Lykins Formation)

Permo-Triassic: Northern Colorado.

T. L. Broin, 1958, Dissert. Abs., v. 19, no. 1, p. 114. Uppermost member of formation; overlies Park Creek limestone member (new).

Red House Formation (in Magdalena Group)

Pennsylvanian: Southwestern New Mexico.

V. C. Kelley and Caswell Silver, 1952, New Mexico Univ. Pubs. in Geology 4, p. 91–92, 255–256, figs. 2, 11. Consists dominantly of thin-bedded limestone and shale or claystone with limestone nodules and lenses. Color gray to dark gray. Massive cherty limestone beds present locally. A thin sandstone bed locally marks base of formation; a coarse-grained conglomeratic sandstone ledge is widely present in northern part of mountains near middle of section. Comprises about lower third of group. Thickness 362 feet. Conformably underlies Nakaye formation (new); unconformably overlies Cutter formation at type section; elsewhere it overlies Upham dolomite (new), Percha formation, and Nunn member of Lake Valley formation.

Type section: Along South Ridge in sec. 10, T. 15 S., R. 4 W., Sierra County. Named from Red House Mountain in southern part of Caballo Mountains area.

Redil Shale (in Panoche Group)

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). Basal formation in group. White shale with silty and sandy interbeds. Includes Papanatas conglomerate member (new) at base. Thickness 5,325 feet. Underlies Benito sandstone (new). Fault contact with Franciscan. Name credited to D. W. Sutton (unpub. thesis).

Type locality: Papanatas Canyon, secs. 23 and 24, T. 14 S., R. 10 E., Fresno County. Name derived from Redil Canyon.

Red Knobs Formation

Middle Ordovician (Mohawkian) : Eastern Tennessee.

G. A. Cooper, 1956, Smithsonian Misc. Colln., v. 127, pt. 1, p. 86, chart 1 (facing p. 130). A thick succession of red to pink calcarenites and limy ferruginous sandstones. Lower part consists of red to pink marble, the Holston marble of other authors. Upper beds, which yield a characteristically dark-maroon sandy regolith, are calcareous sandstones and ferruginous sandy calcarenites with partings of greenish-gray to buff shale. Maximum thickness 750 feet. Underlies Sevier formation; overlies Arline formation (new). Name attributed to B. N. Cooper and G. A. Cooper.

Named from exposures near and along the Blount-Loudon County line, near Meadow, on Meadow quadrangle.

Redlands Limestone[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. Pubs. Geol. Sci., v. 30, no. 5, p 355, 372, 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 Lower Paleozoic. Sentinel dolomite, Radcliff dolomite, and Redlands dolomitic limestone are correlated with Noonday dolomite, here assigned to Precambrian as defined in this report.

Occurs in southern part of Panamint Range, Inyo County.

**Red Lion Formation[1]**

Upper Cambrian: Western Montana.

Original reference: F. C. Calkins and W. H. Emmons, 1913, U.S. Geol. Survey Prof. Paper 78.

E. N. Goddard, 1940, U.S. Geol. Survey Bull. 922–G, p. 165 (table). Thickness 225 to 350 feet in Philipsburg district. Overlies Hasmark formation; underlies Maywood formation.

L. L. Sloss and C. A. Moritz, 1951, American Assoc. Petroleum Geologists Bull., v. 35, no. 10, p. 2146–2147. Described in extreme southwestern Montana. Thickness as much as 57 feet. Overlies Hasmark formation; underlies unnamed basal Devonian unit; upper contact marked by disconformity with varying amounts of formation removed by pre-Middle Ordovician and pre-Middle Devonian erosion. Term Snowy Range would be appropriate to area; however, Red Lion, named in Philipsburg area in 1913, is equivalent to Snowy Range (Dorf and Lochman, 1938). Hence, term Red Lion is favored for beds formerly assigned to "Dry Creek" in this area.

A. M. Hanson, 1952, Montana Bur. Mines and Geology Mem. 33, p. 17–19, strat. sections. In many areas of southwestern Montana, term Dry Creek has been applied to a mappable unit composed of beds equivalent to Red Lion and overlying unfossiliferous red mudstones and silty dolomites of Maywood formation of Devonian age. Lochman (1950) restricted term Dry Creek to Peale's original usage and as thus defined, it becomes lower shale member of Red Lion and Lochman's Sage pebble conglomerate member of Snowy Range formation becomes upper member of Red Lion. Terms Dry Creek and Sage members are applicable as far west as Philipsburg. In Philipsburg area, overlies Hasmark formation; in central and southwestern Montana, overlies Pilgrim formation. Underlies Maywood formation and locally Bighorn dolomite. Thickness 34 to 350 feet.

Named for mine at head of North Fork of Flint Creek, Philipsburg region, Granite County.

Red Man Sandstone

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), 26–28, pls. 1, 2. Massive concretionary cavernous-weathering arkose with two thin conglomerates; contains *Parapachydiscus, Inoceramus* prisms, and Foraminifera. Thickness at type locality 1,180 feet. Conformably overlies Moonlight formation (new) in Sawtooth Ridge syncline, along south limb of Devil's Den syncline, and west of Sawtooth Ridge. Elsewhere is faulted against other units. Underlies Moreno formation. Probably equivalent to Brown Mountain sandstone (Anderson, 1941). Unit has been mapped by some workers as Point of Rocks formation.

Type locality: South limb Devil's Den syncline, Sawtooth Ridge Quadrangle, Kern County. About 2 miles northwest of synclinal axis formation crops out in prominent crags which are here named Red Man Rocks.

Red Mesa Member (of Entrada Formation)

Upper Jurassic: Northeastern Arizona, southwestern Colorado, northeastern New Mexico, and southeastern Utah.

W. B. Hoover, 1950, New Mexico Geol. Soc. Guidebook 1st Field Conf., p. 77, 78 (fig. 1), 79 (fig. 2). Introduced for the crinkly shale and sandstone beds, 100 feet thick, between the Entrada proper (lower bed of Entrada) and Bluff sandstone member.

Well exposed at west end of Red Mesa, on Utah-Arizona line, about 17 miles west of the four corners.

Red Mountain Andesite[1]

Pliocene(?): Southern California.

Original reference: C. D. Hulin, 1925, California State Min. Bur. Bull. 95, p. 55–58, map.

W. J. Miller, 1946, Geol. Soc. America Bull., v. 57, no. 5, p. 510, table 4. Overlies Rosamond beds; older than Black Mountain basalt. Probably Pliocene.

Named for its occurrence on Red Mountain, east of Randsburg, San Bernardino County.

Red Mountain Dacites

Quaternary: Northeastern New Mexico.

Helen Stobbe, 1948, (abs.) Geol. Soc. America Bull., v. 59, no. 12, pt. 2, p. 1355. Have built volcanic cones and occur as plugs and necks.

R. F. Collins, 1949, Geol. Soc. America Bull., v. 60, no. 6, p. 1021 (table 2), 1022, 1031–1033, pl. 1; H. R. Stobbe, 1949, Geol. Soc. America Bull., v. 60, no. 6, p. 1066–1067. Series of intrusives and extrusives. Flows exhibit uniformly whitish to light-gray fine-grained nonvesicular hornblende dacite. Partly weathers pinkish-red; the balance of rock remaining gray, markedly displaying flow structure. Age, type locality, derivation of name, and geographic distribution given.

Type locality: Red Mountain (also called Bell Mountain), after which the dacites are named, on Johnson Mesa in eastern Colfax County. Other outcrop areas include Towndrow Peak, Green Mountain, Cunningham Butte, Laughlin Peak, Palo Blanco, Raspberry Peak, and Sierra Grande.

**Red Mountain Formation**[1]

Silurian: Northern Alabama and northwestern Georgia.

Original reference: E. A. Smith, 1876, Alabama Geol. Survey Rept. Prog. for 1876, p. 11, 23, 25, 42, 207–208.

G. W. Stose, 1952, Washington Acad. Sci. Jour., v. 42, no. 8, p. 243. In Murphree Valley anticline, Alabama, formation crops out near center of anticline and underlies Chattanooga shale and overlies Chickamauga limestone.

W. H. Robinson, J. B. Ivey, and G. A. Billingsley, 1953, U.S. Geol. Survey Circ. 254, p. 50. Sandstone, shale, and calcareous and siliceous iron-ore beds. Thickness 200 to 300 feet. Overlies Chickamauga limestone; underlies Frog Mountain sandstone.

G. T. Malmberg and H. T. Downing, 1957, Alabama Geol. Survey Rept. 3, p. 25–28. Described in Madison County, Ala., where it has maximum exposed thickness of about 30 feet and is composed of thin to moderately thick beds of limestone intercalated with thin beds of sandstone and shale. Lies unconformably upon rocks ranging in age from Cambrian to Ordovician or Upper Ordovician; contact with underlying rocks not exposed in county; unconformably underlies Chattanooga shale.

Named for development on Red Mountain (presumably East Red Mountain), east of Birmingham, Ala.

Red Mountain Gneiss

Precambrian: Central Texas.

Frederick Romberg and V. E. Barnes, 1949, Geophysics., v. 14, no. 2, fig. 2 (geol. map). Shown on map legend below Big Branch gneiss and above Town Mountain granite.

V. E. Barnes *in* V. E. Barnes, D. A. Shock, and W. A. Cunningham, 1950, Texas Univ. Bur. Econ. Geology Pub. 5020, p. 7. Description of rocks and type locality should have been given in text of Romberg-Barnes paper but were inadvertently omitted. Paige (1912, U.S. Geol. Survey Geol. Atlas, Folio 183) described granite at Red Mountain. Derivation of name given.

V. E. Barnes [1952?], Geologic map of the Blowout quadrangle, Blanco, Gillespie, and Llano Counties, Texas (1:31,680): Texas Univ. Bur. Econ. Geology. The two large outcrops of Red Mountain gneiss entering the quadrangle are continuations of area of gneiss forming Red Mountain. Age relation of Red Mountain gneiss and Big Branch gneiss not known. The two gneisses may be nearly of same age and derived from common source.

Named from Red Mountain in southeastern corner of Llano quadrangle, Llano County.

†Red Mountain Group[1]

Cambrian, Ordovician, Silurian, and Devonian: Northern Alabama.

Original reference: M. Tuomey, 1850, Alabama Geol. Survey 1st Bienn. Rept., p. 9, 10.

Named for Red Mountain, east of Birmingham, Jefferson County.

Red Mountain Leucogranodiorite

Lower Cretaceous(?) : Northeastern Oregon.

W. H. Taubeneck, 1957, Geol. Soc. America Bull., v. 68, no. 2, p. 209–210, 235. Grayish rock characterized by scattered dark biotite clots. Intrudes Bald Mountain tonalite (new).

Exposed along ridge that trends northeast from summit of Red Mountain, Elkhorn Mountains [Grant County]. Forms part of Bald Mountain batholith.

Red Mountain Pyroxene Basalts,[1] Flows

Cenozoic: Northern California.

Original reference: Howel Williams, 1932, California Univ. Pub., Bull. Dept. Geol. Sci., v. 21, no. 8, p. 274, 281, 285, geol. map.

Red Mountain is in Plumas County, in southern part of Lassen Volcanic National Park.

Red Mountain Rhyolite[1]

Tertiary : Central Colorado.

Original reference : J. V. Howell, 1919, Colorado Geol. Survey Bull. 17.

Probably named for Red Mountain, Chaffee County.

Red Mountain Rhyolite

Tertiary : Southwestern Montana.

D. B. Andretta and S. A. Alsup, 1960, Billings Geol. Soc. 11th Ann. Field Conf., p. 187. Red rhyolite with small quartz phenocrysts. Rests on Flathead quartzite. Apperas to be truncated by Cherry Creek fault. This flow was listed as "Tertiary volcanics" on Montana State geological map.

Caps Red Mountain which is on west side of Madison River opposite mouth of Cherry Creek, Madison County.

Redoak Granite[1]

Precambrian : Central southern Virginia.

Original reference: F. B. Laney, 1917, Virginia Geol. Survey Bull. 14, p. 35–36, map.

Named for occurrence at Redoak, Charlotte County.

Red Oak Member (of Dunleith Formation)

*See* Buckhorn Member of Dunleith Formation.

Redoak Hollow Formation

Redoak Hollow Sandstone Member (of Goddard Shale)

Mississippian (Chester) : South-central Oklahoma.

M. K. Elias, 1956, *in* Ardmore Geol. Soc. Petroleum Geology of southern Oklahoma—a symposium, Tulsa, Okla., Am. Assoc. Petroleum Geologists, v. 1, p. 70 (table 2), 83–85. Fossiliferous sandstone in lower part of Goddard shale.

M. K. Elias, 1957, Jour. Paleontology, v. 31, no. 3, p. 487–527. Fossils described from Redoak Hollow formation.

Name derived from Redoak Hollow, a westward-draining valley in S½ sec. 19, T. 2 S., R. 1 W., Carter County.

Redoak 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. 1, 11, 19, pls. 2, 3, 4, 6, 8. Includes all strata between top of Graves Gap group (new) below and base of Vowell Mountain group (new) above, that is, between top of Windrock coal and top of Pewee coal. Thickness 300 to 440 feet; in Cross Mountain section 345 feet. Includes (ascending) shale interval, Caryville sandstone (new), shale interval, Fodderstack sandstone (new), shale interval, Silvey Gap sandstone (new), and Pewee coal.

Type locality: Cross Mountain, Lake City quadrangle, Anderson County. Name derived from Redoak Mountain in southwestern part of quadrangle, beds of group being exposed on south end of mountain above Graves Gap.

**Redonda Formation**

Redonda Member (of Chinle Formation)

Upper Triassic: Northeastern New Mexico.

Ernest Dobrovolny and C. H. Summerson, 1946, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map. 62. Member consists of variegated red shale, argillaceous limestone, and red or buff sandstone, and siltstone. Overlies lower unnamed member; underlies Wingate(?) sandstone. Thickness 25 to 425 feet.

R. L. Griggs and C. B. Read, 1959, Am. Assoc. Petroleum Geologists Bull., v. 43, no. 8, p. 2004–2006. Rank raised to formation. Consists of alternating beds of clayey siltstone and fine-grained sandstone. Thickness of beds of each lithologic type ranges from about 2 to 10 feet; greater part of unit is siltstone. Siltstone beds predominantly brownish red and commonly marked with thin streaks and spots of grayish green; sandstone beds distinctively orange red. Thickness ranges from zero at points where truncated to about 225 feet at section 18 miles west of Tucumcari; thickness commonly about 50 feet. Unconformably overlies Chinle formation; unconformably underlies Entrada sandstone. Absent over large areas owing to pre-Entrada erosion. Probably of latest Triassic age as indicated by presence of tracks of bipedal dinosaurs and a phytosaur skull. Derivation of name given.

Name taken from Redonda (also spelled Redondo) Mesa, about 15 miles south of Tucumcari, Quay County.

Redondo sandstone

Mesozoic (Early Cretacic) : New Mexico.

Charles Keyes, 1940, Pan-Am; Geologist, v. 74, no. 2, p. 105 (chart), 153. Lowest unit of Tucumcarian series. Underlies Pyramid shales; overlies Dixie shales unconformably. Thickness 250 feet.

**Red Peak Member** (of Chugwater Formation)

Red Peak Formation (in Chugwater Group)

Triassic: Northwestern Wyoming.

J. D. Love, 1939, Geol. Soc. America Spec. Paper 20, p. 12, 44. Red shales and sandstones, about 566 feet thick. Underlies Crow Mountain member (new); overlies Dinwoody formation. Thickness changes considerably even in adjacent sections, owing to lack of persistent beds at top of member.

E. B. Branson and C. C. Branson, 1941, Am. Assoc. Petroleum Geologists Bull., v. 25, no. 1, p. 134–135. Referred to as Red Peak formation in Chugwater group. In Wind River Mountains, consists of 600 to 1,000 feet of commonly designated "red" siltstone. Overlies Dinwoody formation; underlies Alcova dolomite.

T. C. Woodward, 1957, Am. Assoc. Petroleum Geologists Bull., v. 41, no. 2, p. 230–231. Described in Deadman Butte area where it is basal member of formation, underlies Alcova limestone member, and overlies Dinwoody formation. Consists of series of pale to moderate reddish-brown siltstones with minor number of thin interbedded yellowish-gray sandstones. Thickness 600 to 875 feet.

S. S. Oriel and L. C. Craig, 1960, *in* Guide to the geology of Colorado: Denver, Rocky Mountain Assoc. Geologists, p. 45. Adoption of name Goose Egg formation by many geologists in Wyoming has resulted in restriction of names Red Peak and Chugwater to beds above Little Medicine tongue of Dinwoody formation. Red Peak member, therefore, now includes only rocks of Early and possibly of Middle Triassic age. Age designation is based primarily on intertonguing relations westward with well-dated marine Thaynes limestone in western Wyoming.

Named after Red Peak, a few miles east of Red Creek, southern margin of Absaroka Range.

Red Pine Shale (in Uinta Mountain Group)

Precambrian: Northeastern Utah.

N. C. Williams, 1953, Am. Assoc. Petroleum Geologists Bull., v. 37, no. 12, p. 2736 (fig. 1), 2737 (fig. 2), 2738, 2740 (fig. 3). Mottled-brown, greenish-brown, and gray thinly bedded micaceous shale. Thickness variable due to irregular surface on which unit was deposited; 1,775 feet at mouth of Red Pine Creek; 1,200 feet, 2 miles westward in same canyon; decreases westward to South Fork basin, where it is locally absent. Conformably overlies Mutual quartzite; unconformable below Tintic quartzite (Pine Valley of previous works); where Tintic and overlying formations are absent, underlies Madison limestone. Unit has been referred to as Ophir.

R. E. Cohenour, 1959, Intermountain Assoc. Petroleum Geologists Guidebook 10th Ann. Field Conf., p. 34, 37 (fig. 2), 38. In this report [Uinta-Wasatch Mountain junction and part of central Utah], Red Pine shale and Mutual formation not included in Uinta Mountain group.

Type section: Along Red Pine Canyon, a tributary to Smith and Morehouse Creek, Summit County. Forms uniform slope ascending from lower contact in bottom of canyon to base of Paleozoic cliff-making formations.

**Red River Formation**[1] (in Bighorn Group)

Upper Ordovician: Surface and subsurface in Manitoba, Canada, and subsurface in Montana, North Dakota, South Dakota, and Wyoming.

Original reference: A. F. Foerste, 1929, Denison Univ. Bull., v. 29, no. 2, Sci. Lab. Jour., v. 24, p. 35, 37.

V. H. Kline, 1942, Am. Assoc. Petroleum Geologists Bull., v. 26, no. 3, p. 345. Geographically extended into subsurface in North Dakota.

A. D. Baillie, 1952, Manitoba Dept. Mines and Nat. Resources Mines Br. Pub. 51-6, p. 14–18, geol. map. Formation consists of predominantly carbonate strata between underlying shales and sandstones of Winnipeg formation and overlying argillaceous limestones and dolostones of Stony Mountain formation. Strata comprising formation were first described by Dowling (1900, Canada Geol. Survey Ann. Rept. 1898, pt. F) who divided them into three divisions: Lower Mottled, Cat Head, and Upper Mottled. Foerste (1929) introduced term Red River formation for these strata and designated three members, Dog Head, Cat Head, and Selkirk, to correspond with the three divisions of Dowling. Thickness about 250 feet in outcrop and in wells.

H. D. Erickson, 1954, South Dakota Geol. Survey Rept. Inv. 74, p. 43. Names Trenton, Decorah, and Platteville have been used for strata now termed Red River. Present in subsurface in South Dakota.

R. J. Ross, Jr., 1957, U.S. Geol. Survey Bull. 1021–M, p. 446 (fig. 68), 447–448. Discussion of Ordovician fossils from wells in Williston basin, eastern Montana. Red River formation is basal unit of Bighorn group. Underlies Stony Mountain formation. Overlies Winnipeg formation. Members not differentiated. Upper Ordovician.

M. R. McCoy, 1958, Wyoming Geol. Assoc. Guidebook 13th Ann. Field Conf., p. 27 (fig. 1), 29. Geographically extended into Powder River Basin, Wyoming, where, in most areas, it overlies Roughlock siltstone. Where Stony Mountain formation is not present, the Red River is overlain by Lodgepole formation or farther south by either Pahasapa limestone or Englewood shale.

Crops out on western and southern shores of Lake Winnipeg, Manitoba, Canada. Red River flows through southern part of outcrop.

†Red River Group[1]

Upper Cretaceous (Gulf Series): Northeastern Texas.

Original reference: B. F. Shumard, 1860, St. Louis Acad. Sci. Trans., v. 1, p. 583, 589.

Named for exposures along Red River, northeastern Texas.

Red River Loess[1]

Pleistocene: Southwestern Arkansas, Louisiana, southeastern Oklahoma, and northeastern Texas.

Original reference: R. T. Hill, 1888, Arkansas Geol. Survey Ann. Rept. 1888, v. 2, p. 29–32, 188.

Named for exposures in Red River Valley at Fulton, Hempstead County, Ark.

**Red Rock Channel Sandstone**[1]

Pennsylvanian: Central southern Iowa.

Original reference: C. R. Keyes, 1891, Am. Jour. Sci., 3d, v. 4, p. 273–276.

Named for Red Rock, Marion County.

Red Rock Limestone

Triassic: Central Nevada.

F. N. Johnston, 1941, Jour. Paleonotology, v. 15, no. 5, p. 448. Massive limestone, badly jointed fractured and veined with calcite. Thickness 800 feet.

In South Canyon, New Pass or Desatoya Range. So named because it is believed to be equivalent to the "Red Rocks" at the head of Congress Canyon, West Humboldt Range.

Red Rock member[1]

Precambrian (Keweenawan) : Northeastern Minnestoa.

Original reference: A. H. Elftman, 1898, Am. Geologist, v. 21, p. 90–109, 175–188.

Named for its persistent red color.

Red Rock Rhyolite (in Yavapai Group)

Precambrian : Central Arizona.

E. D. Wilson, 1937, (abs.) Geol. Soc. America Proc. 1936, p. 112; 1939, Geol. Soc. America Bull., v. 50, no. 7, p. 1118 (table 1), 1120–1121, pl. 10. Dominantly rhyolitic rocks, consisting of flows and minor amounts of agglomerate, breccia, and intrusives. Characteristically massive, with flow banding or bedding apparent only in places. Intrusive masses not readily distinguishable from flows. Typical rhyolite is grayish-brown to reddish-brown dense rock that breaks with splintery fracture; in places porphyritic. Thickness apparently exceeds 1,000 feet. Middle member of group; in fault contact with Yaeger greenstone (new) below and Alder series (new) above.

Gordon Gastil, 1958, Geol. Soc. America Bull., v. 69, no. 12, pt. 1, p. 1498 (table 2). Placed stratigraphically above Alder series; unconformably underlies Deadman quartzite.

Named from typical occurrence in Red Rock Butte, in central segment of Mazatzal Range. Also crops out prominently in Pine Creek, eastern Tonto Basin, and southern Black Hills areas.

†Red Rock Canyon Beds[1]

Pliocene, lower : Southern California.

Original reference: J. C. Merriam, 1919, California Univ. Pub., Dept. Geol. Bull., v. 11, no. 5.

In Red Rock Canyon at Ricardo, eastern part of Kern County.

**Redrock Canyon Sandstone Member** (of Santa Margarita Formation)[1]

Miocene, upper : Southern California.

Original reference: W. A. English, 1916, U.S. Geol. Survey Bull. 621, p. 191–215.

Named for occurrence in small area in Redrock Canyon, Cuyama Valley, southwestern part of Kern County.

Red Shale Butte Complex

Pleistocene : Northern California.

C. A. Anderson, 1941, California Univ. Dept., Geol. Sci. Bull., v. 25, no. 7, p. 364–365. Made up of a number of coalescing flows characterized by andesitic lavas.

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

**Red Spring Sandstone Member** (of Hignite Formation)[1]

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, 43.

Named for association with Red Spring coal in Cumberland Gap coal field.

Redstone Clay (in Monongahela Formation)[1]

Redstone underclay member

Pennsylvanian: Western Pennsylvania and eastern Ohio.

[Original reference]: M. G. Wilmarth, 1938, U.S. Geol. Survey Bull. p. 1789.

D. L. Norling, 1958, Ohio Geol. Survey Bull. 56, p. 70. Redstone clay member (Monongahela series) recognized in several exposures in Union Township, Morgan County.

M. T. Sturgeon and others, 1958, Ohio Geol. Survey Bull. 57, p. 159 (table 13), 169. Underclay member of Redstone cyclothem in report on Athens County. Average thickness 1 foot. Monongahela series.

Redstone cyclothem

Pennsylvanian (Monongahela Series): Southeastern Ohio.

M. T. Sturgeon and others, 1958, Ohio Geol. Survey Bull. 57, p. 159 (table 13), 167–170. Embraces interval between Upper Pittsburgh cyclothem (new) below and Fishpot cyclothem (new) above. Except for locality where Upper Pittsburgh cyclothem is developed, the Redstone includes rock units from top of Pittsburgh roof shale to top of Redstone roof shale. Wherever Redstone cyclothem extends downward to top of Pittsburgh roof shale, all members common to Monongahela cyclothems are present; normal sequence includes six members (ascending): Upper Pittsburgh shale and sandstone, Redstone redbed, Redstone limestone, Redstone underclay, Redstone (Pomeroy) (No. 8a) coal, and roof shale. Where base of Redstone rests on Upper Pittsburgh coal, thickness of cyclothem is 25 feet; where base overlies Pittsburgh roof shale, which is commonly the case, average thickness is 35 feet. In area of this report Monongahela series is discussed on a cyclothemic basis; 12 cyclothems are named. [For sequence see Pittsburgh cyclothem.]

Present in Athens County.

Redstone Granite[1]

Pre-Triassic: Southeastern Connecticut and southwestern Rhode Island.

Original reference: L. H. Martin, 1925, Connecticut Geol. Nat. History Survey Bull. 33.

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

Named for Redstone Ridge north of Westerly, R. I., and Pawcatuck, Conn.

**Redstone Limestone Member** (of Monongahela Formation)[1]

Redstone Limestone (in Monongahela Group)

Redstone limestone and shale member

Upper Pennsylvanian: Western Pennsylvania, western Maryland, Ohio, and northern West Virginia.

Original reference: F. Platt and W. G. Platt, 1877, Pennsylvania 2d Geol. Survey Rept. $H_3$, p. 55–104, 286.

W. O. Hickok 4th and F. T. Moyer, 1940, Pennsylvania Geol. Survey, 4th ser., Bull. M–26, p. 119. Included in Monongahela group.

D. L. Norling, 1958, Ohio Geol. Survey Bull. 56, p. 10 (fig. 3), 70–71, geol. map. Redstone limestone and shale member (Monongahela series) occupies interval between Upper Pittsburgh sandstone and shale member and the Redstone (Pomeroy) (No. 8–A) coal. In Morgan County, the Redstone is represented only locally by limestone; the usual exposure consists of calcareous shales, whose boundaries are indefinite. In many areas, Redstone limestone and shale interval is occupied by the merging Upper Pittsburgh and Pomeroy sandstones. Superjacent Redstone (No. 8–A) coal present only locally; hence, summit boundary indefinite in areas where Pomeroy sandstone is not well developed or where that unit is represented by thin limestones and shales. Where boundaries of Redstone limestone and shale member can be determined, a thickness of 10 to 18 feet is indicated.

M. T. Sturgeon and others, 1958, Ohio Geol. Survey Bull. 57, p. 159 (table 13), 169. Redstone limestone member of Redstone cyclothem in report on Athens County. Average thickness 5 feet. Monongahela series.

Named because it occurs immediately below Redstone coal, which outcrops along Redstone Creek, Fayette County, Pa.

Redstone Member (of Monongahela Formation)[1]

Redstone redbed member

Pennsylvanian: Western Pennsylvania and eastern Ohio.

Original reference: M. E. Johnson, 1929, Pennsylvania Geol. Survey Topog. and Geol. Atlas 27, p. 31.

M. T. Sturgeon and others, 1958, Ohio Geol. Survey Bull. 57, p. 159 (table 13), 169. Member of Redstone cyclothem in report on Athens County. Thickness 3 to 20 feet. Wherever Upper Pittsburgh sandstone is exceptionally thick, Redstone redbed member may be missing, its interval occupied by sandstone. Monongahela series.

†Redstone Quartzite[1]

Precambrian: Central southern Minnesota.

Original reference: F. W. Sardeson, 1908, Geol. Soc. America Bull., v. 19, p. 221–242.

Composes Redstone Hill in Courtland Township, midway between towns of New Ulm, Brown County, and Courtland, Nicollet County.

Redstone Sandstone (in Monongahela Formation)[1]

Pennsylvanian: Western Maryland.

Original reference: C. K. Swartz, W. A. Price, and H. Bassler, 1919, Geol. Soc. America Bull., v. 30, p. 567–596.

Thomas Arkle, Jr., 1959, Geol. Soc. America Guidebook Pittsburgh Mtg., p. 119 (table 1). Table of classification and nomenclature lists Redstone sandstone in Monongahela series. Equivalent to Fishpot limestone.

Probably named for its relation to Redstone coal.

Redstone Ridge Group[1]

Silurian: Central Pennsylvania.

Original reference: J. P. Lesley, 1892, Pennsylvania 2d Geol. Survey Summ. Final Rept., v. 2, p. 823.

Probably named for Redstone Ridge.

**Red Tanks 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. Lower part of member consists of dark-red-brown siltstone, sandstone, and shale. Locally, as in Carrizo Arroyo, base contains buff sandstone and limestone conglomerate. Upper part consists mostly of cement-gray thin-bedded nodular limestone and gray shale. Most prominent limestone generally at top of member. Thickness 200 to 300 feet. Some intertonguing of marine sediments of Red Tanks member with continental beds of overlying Abo formation. Conformably underlain by Atrasado member (new) of Madera limestone.

Forms continuous belt along eastern side of Los Vallos from Breach Canyon on north to west floor of Monte de Belen on south. Also exposed in wide fork extending south from Carrizo Arroyo where the most complete section of the member is exposed. Crops out in several places in tributaries of Red Tanks Arroyo, for which member is named, located in secs. 4 and 5, T. 3 N., R. 3 W., Valencia County. Also crops out in Comanche Arroyo.

Red Top Limestone[1] (in Stevens Series)

Middle Cambrian: Northeastern Washington.

Original reference: C. E. Weaver, 1920, Washington Geol. Survey Bull. 20, p. 80, map.

C. D. Campbell, 1947, Geol. Soc. America Bull., v. 58, no. 7, p. 602 (table 4), 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. Correlative with the Middle Cambrian Metaline limestone are most of Weaver's Northport limestone, Republican Creek limestone, Red Top limestone, and Deep Lake argillite, and part of Boundary phyllite.

Probably named for occurrences on Red Top Mountain, Stevens County.

**Redwall Limestone**[1]

Mississippian: Northern Arizona, New Mexico, and Utah.

Original reference: G. K. Gilbert, 1875, U.S.G. and G.S.W. 100th M., v. 3, p. 162, 177–186, 197, figs. 81, 82.

A. A. Stoyanow, 1936, Geol. Soc. America Bull., v. 47, no. 4, p. 495. At Jerome, Ariz., unconformably overlies Devonian Jerome formation; disconformably underlies Permian Supai. Thickness 300 feet.

R. C. Gutschick, 1943, Plateau, v. 16, no. 1, p. 1–11. In Yavapai County, comprises four unnamed members (ascending): white crystalline oolitic limestone; fine-grained cherty porous limestone; massive coarsely crystalline limestone; gray micro-oolitic dense limestone. Thickness about 285 feet. Overlies Jerome formation; underlies Supai formation. Kinderhook and Osage.

E. D. Koons, 1945, Geol. Soc. America Bull., v. 56, no. 2, p. 154. In Grand Canyon, east of Toroweap fault, overlies Temple Butte formation; underlies Supai formation. Thickness 600 feet.

J. M. Weller and others, 1948, Geol. Soc. America Bull., v. 59, no. 2, chart 5 (column 28). Correlation chart shows age range (southwestern Utah) Kinderhook-Chester.

A. N. McNair, 1951, Am. Assoc. Petroleum Geologists Bull., v. 35, no. 3, p. 515 (fig. 2), 518. Section from South Hurricane Cliffs to a little beyond Peach Springs Canyon, Ariz., shows Redwall limestone underlying tongue of Callville formation; southeastward underlies Supai red beds. Laterally equivalent to Rogers Spring limestone.

J. W. Huddle and Ernest Dobrovolny, 1952, U.S. Geol. Survey Prof. Paper 233–D, p. 77 (fig. 14), 81 (fig. 19), 86–90, geol. sections. Thin limestone of Mississippian age in central Arizona is equivalent of Redwall limestone of northwestern Arizona and Escabrosa limestone of southeastern Arizona. Name Redwall extended for use in central Arizona as it has priority over Escabrosa. Consists of lower impure dark-gray limestone, 50 to 70 feet thick; a middle massive cliff-forming limestone; and an upper thin- to medium-bedded cherty limestone. North of Salt River these divisions tend to disappear, and formation there consists of loose blocks of limestone, surrounded by red sandy mudstone, and a few solid limestone beds. Thickness as much as 552 feet. Overlies Devonian Martin formation; underlies Pennsylvanian Naco formation.

G. W. Crosby, 1959, Brigham Young Univ. Research Studies, Geology Ser., v. 6, no. 3, p. 20–21, 52. In Millard County, Utah, disconformably overlies Cove Fort quartzite (new).

Type locality: Shinumo drainage basin, on north side of Grand Canyon. Named for red appearance of its escarpment on either side of Grand Canyon.

**Red Warrior Limestone**[1]

Silurian (?) and Devonian (?) : Southwestern Utah.

Original reference: B. S. Butler, 1913, U.S. Geol. Survey Prof. Paper 80.

J. J. McFarlane, 1955, Brigham Young Univ. Research Studies, Geology Ser., v. 2, no. 5, p. 19 (fig. 1), 21. Although formation was thought to be Silurian and Devonian, it actually includes representatives of Ordovician, Silurian, and Devonian systems. Lower Red Warrior limestone was correlated with Ordovician Fish Haven dolomite of northern Utah. Chart shows Red Warrior limestone above Morehouse quartzite and below Mowitza shale.

Type locality: Red Warrior mine, southeast of Frisco district.

Red Wash Formation

Lower Triassic: Northeastern Utah and northwestern Colorado.

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 flank of Uinta Mountains, each becomes thinner, and in vicinity of Whiterocks Canyon the Thaynes disappears completely. Red beds east of that point are in part equivalent to Ankareh (restricted) sandstone and shale and in part to Woodside shale. Since none of the terms Woodside, Ankareh, or Moenkopi can appropriately be applied to these beds, name Red Wash formation is proposed. Thickness at type locality 1,080 feet. At type section, overlies Park City formation and underlies Shinarump conglomerate, both contacts unconformable.

B. F. Curtis, 1951, Wyoming Geol. Assoc. Guidebook 5th Ann. Field Conf., p. 39. Stratigraphic column shows Red Wash formation present in vicinity of Vermillion Creek, Colo. Occurs below Stanaker formation and above Phosphoria formation. Permian and Triassic.

W. F. Scott, 1959, Intermountain Assoc. Petroleum Geologists Guidebook 10th Ann. Field Conf., p. 101–102. Discussion of stratigraphy of Triassic sequence in Wasatch and Uinta Mountains. William's introduction of name Red Wash rather than Moenkopi does not seem justified.

Type section: In Red Wash Canyon north of Dinosaur quarry in Dinosaur National Monument, Utah; section measured on Brush Creek along traverse beginning near mouth of Brush Creek Gorge in sec. 3, T. 2 S., R.

22 E., Uinta Base and Meridian, and running southward to base of Shinarump conglomerate.

**Redwater Shale Member** (of Sundance Formation)

Upper Jurassic: Southwestern South Dakota and northwestern Wyoming.

R. W. Imlay, 1947, Am. Assoc. Petroleum Geologists Bull., v. 31, no. 2, p. 259–264, geol. sections. Consists of 80 to 190 feet or more of greenish-gray to gray soft fissile shale that includes some soft glauconitic sandstone in lower 20 to 30 feet and some thin beds of coquinoid or oolitic limestone in upper half. At type section, lower 18 feet consists of alternating beds of gray shale and soft yellow sandstone; upper 118 feet consists mainly of soft dark-gray shale but contains lenses of sandy limestone at several levels and many limestone concretions in upper half. Overlies Lake member (new); underlies Morrison formation, contact gradational through an interval of 10 to 15 feet.

Type section: Bluff one-half mile north of Redwater Creek, near mouth of Crow Creek, 9 miles northwest of Spearfish, in S½ sec. 2, T. 7 N., R. 1 E., Butte County, S. Dak.

Redwood Formation[1]

Oligocene: Southeastern Alaska.

Original reference: N. L. Taliaferro, 1932, Geol. Soc. America Bull., v. 43, no. 3, p. 770–782.

Occurs between Redwood and Burls Creeks and ridge between Cave and Hey Point, Katalla district, Controller Bay region

Redwood Creek Schist

*See* Kerr Ranch Schist.

Ree Beds[1]

Eocene or Oligocene: South Dakota.

Original reference: E. D. Cope, 1892, Am. Assoc. Adv. Sci. Proc., v. 40, p. 285.

Ree Heights is in Hand County.

**Reed Dolomite**[1]

Precambrian(?): Eastern California.

Original reference: E. Kirk, 1918, U.S. Geol. Survey Prof. Paper 110.

C. R. Longwell, 1952, Washington Acad. Sci. Jour., v. 42, no. 7, p. 42. In view of a study made of lower limit of the Cambrian in the Cordilleran region, it is believed that Reed dolomite should be carried under the heading of "age unknown." Designation of definitely Precambrian does not seem warranted by evidence now available.

Named for exposures along east side of Reed Flat; best section in canyon at head of Wyman Creek, in sec. 7, T. 6 S., R. 35 E., Inyo Range.

Reed Formation[1]

Upper Mississippian: Central northern Utah.

Original reference: F. F. Hintze, Jr., 1913, New York Acad. Sci. Annals, v. 23, p. 109.

J. M. Weller and others, 1948, Geol. Soc. America Bull., v. 59, no. 2, p. 136. Reed (or Reade) and Benson formations are approximately equivalent to

Brazer and Madison, respectively; not certain that boundaries between formations correspond.

Exposed in Big Cottonwood Canyon at north end of Reade and Benson Ridge, which separates Big Cottonwood Canyon from Day's Fork, central Wasatch Mountains.

Reed Canyon Silt 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 upper member of Tejon formation in type area of Tejon. Thickness 160 feet. Shown as unconformably underlying continental deposits of Oligo-Miocene age and overlying Metralla sandstone member (new) of Tejon formation.

J. G. Marks, 1943, California Div. Mines Bull. 118, pt. 3, p. 535, 536 (fig. 232), 537 (fig. 233). Shale, glauconitic silt, and fine sand. Shown on stratigraphic column as unconformably underlying Tecuya formation.

Type locality: Reed Canyon, Tehachapi Mountains, Kern County.

†Reeder Sandstone[1]

Uppper Cretaceous: Central southern Kansas.

Original reference: F. W. Cragin, 1895, Am. Geologist, v. 16, p. 381, 382.

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 contains stratigraphic units formerly called "Rocktown channel sandstone," "Ellsworth formation," "Solomon formation," "Reeder sandstone," "Marquette sandstone," "Spring Creek clay," and others.

Named for exposures in upper valley of Medicine Lodge River near post office at Reeder. Town of Reeder now abandoned. Upper valley of Medicine Lodge River is in Kiowa and Barber Counties.

Reedian series

Precambrian (Protozoic): Eastern California.

C. R. Keyes, 1942, Pan-Am. Geologist, v. 77, no. 4, p. 307 (chart). Listed as a series consisting of 2,500 feet of dolomites. Unconformable below Deepian series and above Wymanian series.

Occurs in Death Valley region.

Reeding Sandstone

Permian: Western Oklahoma.

Henry Schweer *in* O. E. Brown, 1937, Am. Assoc. Petroleum Geologists Bull., v. 21, no. 12, p. 1553 (fig. 9). Shown on cross section a little above middle of Hennessey formation.

Type locality and derivation of name not given.

Reeds Creek Andesite

Eocene, middle, to Oligocene, lower: Northern California.

B. L. Clark and C. A. Anderson, 1938, Geol. Soc. America Bull., v. 49, no. 6, p. 935 (fig. 2), 938, 940–941. Andesitic conglomerates and breccias. Rests in part on basement complex and is in part intercalated with or lies above Ione formation.

Occurs in Sacramento Valley near Wheatland, Yuba County.

**Reeds Spring Chert Member** (of Boone Formation)

**Reeds Spring Limestone**[1]

Reeds Spring Formation

Reeds Spring Member (of Chouteau Formation)

Lower Mississippian : Southwestern Missouri and northeastern Oklahoma.

Original reference: R. C. Moore, 1928, Missouri Bur. Geology and Mines v. 21, 2d ser., p. 143–145, 161–163, 169, 170, 190, 191, 193.

E. B. Branson, 1944, Missouri Univ. Studies, v. 19, no. 3, p. 184 (fig. 28), 196–199, 202–204. Report refers to Reeds Spring limestone and quotes extensively from unpublished manuscript by Clark (1941) who classed Grand Falls chert as member of the Reeds Spring. Report also refers to Reeds Spring member of Chouteau formation.

G. G. Huffman and others, 1958, Oklahoma Geol. Survey Bull. 77, p. 14 (fig. 2), 43–44, pls. Formation described in northeastern Oklahoma where it is as much as 175 feet thick and consists of nearly equal amounts of thin alternating fine-grained dense thin-bedded limestone and dark-gray to blue-gray chert. Unconformably overlies St. Joe, Chattanooga, and St. Clair formations; unconformably underlies Keokuk formation. Osagean.

C. H. Behre, Jr., and A. V. Heyl, Jr., 1958, Deutschen Geol. Gesell., Zeitschr., v. 110, pt. 3, p. 517 (fig. 2). Chart shows Reeds Spring member in lower part of Boone formation. Thickness 30 to 45 feet.

Named for exposures in vicinity of Reeds Spring, Stone County, Mo.

**Reedsville Shale**[1]

Upper Ordovician: Central Pennsylvania, eastern Tennessee, and southwestern Virginia.

Original reference: E. O. Ulrich, 1911, Geol. Soc. America Bull., v. 22, pl. 27.

Charles Butts and E. S. Moore, 1936, U.S. Geol. Survey Bull. 855, p. 43–45, pls. 1, 3. In Bellefonte quadrangle, Pennsylvania, 1,000 feet thick and consists of dark calcareous shale with thin layers of fossiliferous limestone. Thick-bedded calcareous sandstone at top, 40 feet thick, carrying *Orthorhynchula* and *Byssonichia; Orthorhynchula* zone. Overlies Trenton limestone; underlies Oswego sandstone.

G. M. Kay, 1944, Jour. Geology, v. 52, no. 2, p. 114. Restricted below to exclude about 400 feet of dark brownish-weathering shale herein named Antes shale.

John Rodgers, 1953, Tennessee Div. Geology Bull. 58, pt. 2, pls. Mapped in eastern Tennessee where, east of Kingston fault, it overlies unit 4 of Chickamauga limestone; thickness 250 to 400 feet. Underlies Sequatchie formation. In folio mapping the Reedsville was largely ignored though Hayes (1894, folio 4; 1895, folio 20) called it Athens shale and Keith (1901, folio 85) thought it represented featheredge of Sevier shale.

R. L. Miller and W. P. Brosgé, 1954, U.S. Geol. Survey Bull. 990, p. 71–73, measured sections. Described in Jonesville district, Lee County, Va., where it conformably overlies Trenton limestone and conformably underlies Sequatchie formation. Thickness 282 to 460 feet.

F. M. Swartz, 1957, Pennsylvania State Univ., Dept. Geology Contr. 3, 58p. From Tyrone Gap to Susquehanna Gap, underlies Bald Eagle sandstone (Centennial School member, new, in western part of area).

H. H. Arndt and others, 1959, Geol. Soc. America Guidebook Pittsburgh Mtg., p. 7, pl. 1. Reedsville of central Pennsylvania is equivalent to Martinsburg formation of eastern Pennsylvania. Transitional with underlying Trenton limestone; underlies Bald Eagle formation. Thickness approximately 1,000 feet.

Named for exposures at Reedsville, Mifflin County, Pa.

**Reef Ridge Shale**[1]

Reef Ridge Shale Member (of Monterey Formation)

Miocene, upper: Southern California.

Original reference: W. F. Barbat and F. L. Johnson, 1933, Pan-Am. Geologist, v. 59, no. 3, p. 239.

R. M. Kleinpell, 1938, Miocene stratigraphy of California: Tulsa, Okla., Am. Assoc. Petroleum Geologists, p. 165. Treated as a member of Monterey formation.

S. S. Siegfus, 1939, Am. Assoc. Petroleum Geologists Bull., v. 23, no. 1, p. 24–44. Restricted at its type locality to exclude brown shales and silts in lower part of the originally defined Reef Ridge shale because that part of the section has been included in McLure shale by Henney (1930). As thus restricted, formation corresponds more nearly with the "caving blue shale" of Kettleman Hills. Thickness about 300 feet. Underlies Jacalitos formation; overlies McLure shale; upper and lower contacts gradational at type locality.

Exposed on Reef Ridge, west of Kettleman Hills, Fresno and Kings Counties.

Reel Limestone Member (of Bond Formation)

Reel Limestone (in McLeansboro Group)

Pennsylvanian: Southeastern and eastern Illinois.

G. H. Cady and others, 1955, Illinois Geol. Survey Rept. Inv. 183, p. 7 (fig. 3), 8–9. Fine-grained compact fossiliferous limestone faintly mottled in shades of dove to gray with irregular reddish-brown spots; weathers grayish yellow. Identification of limestone not based upon lithologic characteristics but upon its relative position and the absence of other limestone beds for some distance above and below; 1 foot of dark-gray to black shale underlies limestone and overlies a coal bed 7 to 10 inches thick. Columnar section shows Reel limestone stratigraphically below Friendsville limestone and above Mount Carmel 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 Flannigan coal member and below Livingston and Millersville limestone members. Presentation of new rock-stratigraphic classification of Pennsylvanian strata in Illinois.

Type locality: Sec. 8, T. 1 S., R. 12 W., Wabash County. Named from exposures on Emmanual Reel Farm.

**Reelsville Limestone**

Reelsville Limestone[1] (in West Baden Group)

Reelsville Limestone Member (of Paint Creek Formation)

Mississippian (Chester Series): Southwestern Indiana and northern and central Kentucky.

Original reference: C. A. Malott, 1919, Indiana Univ. Studies, v. 6, no. 40, p. 7–20.

R. E. Stouder, 1938, Am. Assoc. Petroleum Geologists Bull., v. 22, no. 3, p. 268 (fig 1), 269, 270 (fig. 2), 274 (fig. 3), 275–276. Paint Creek is used here to include group of formations above Sample sandstone and below Cypress sandstone between Ohio River and southern end of Hardin and Breckinridge Counties, Ky. The three formations of the Paint Creek are correlatives of three formations of Indiana (ascending): Reelsville limestone, Elwren sandstone and shale, and Beech Creek limestone. Names Reelsville and Elwren are here proposed for two lower members of the Kentucky formation; term *Productus inflatus* zone is used for upper member. Thickness of Reelsville 28 feet near Germantown, Breckinridge County; in Gasper River region, thickens and rests on underlying Renault with no apparent break in sedimentation.

J. M. Weller and A. H. Sutton, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 5, p. 828; J. M. Weller and others, 1948, Geol. Soc. America Bull., v. 59, no. 2, chart 5 (column 76). Considered member of Paint Creek formation in Indiana.

C. A. Malott, 1952, Stratigraphy of the Ste. Genevieve and Chester formations in southern Indiana: Ann Arbor, Mich., The Edwards Letter Shop, p. 7, 26–27. Paint Creek of standard Chester column has triple expression in southern Indiana (ascending): Reelsville limestone, Elwren sandstone, and Beech Creek limestone. Each of these is a distinct stratigraphic unit in parity with other formations of the Chester and deserves name in its own right. At designated type section, Reelsville limestone is 2⅔ feet thick. Truncated and overlapped by Pennsylvanian Mansfield sandstone and not present north of Reelsville. Putnam County.

T. G. Perry and N. M. Smith, 1958, Indiana Geol. Survey Bull. 12, p. 24–25, pl. 1. In Indiana, Reelsville limestone is less than 10 feet thick and commonly is exposed as a single massive bed in which entire thickness is represented; locally absent and stratigraphic interval represented by clastic rocks. Underlies Elwren sandstone; overlies Sample sandstone.

H. H. Gray, R. D. Jenkins, and R. M. Weidman, 1960, Indiana Geol. Survey Bull. 20, p. 36 (table 5), 45–46, pl. 1. Included in West Baden group (redefined). Thickness 0 to 7 feet. Underlies Elwren formation; overlies Sample formation.

Type section: Near center sec. 21, T. 13 N., R. 5 W., along highway downhill, south bluff of Walnut Creek, just south of Reelsville, Putnam County, Ind.

**Reese Formation**[1]

Eocene(?): Central southern Montana.

Original reference: W. R. Calvert, 1912, U.S. Geol. Survey Bull. 471, p. 412.

Type locality: Reese Creek, Park County.

**Reeve Meta-Andesite**[1]

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. Mapped with Permian marine sedimentary and metasedimentary rocks.

Named for unidentified locality near Genesee, east of Taylorsville, Plumas County.

Reformatory 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. 33–38, pl. 1. Described in Lake Altus area as coarsely crystalline reddish granite, locally containing xenoliths of gabbro, andesite or aplite. Considered to include unit formerly termed Flat Top granite, that occurs on Flat Top and Soldier's Spring Mountains.

Exposed in Quartz Mountain-Headquarters Mountain area. Named after the quarry rock at the State Reformatory near Granite, Greer County.

Refugian Stage[1]

Oligocene: California.

Original reference: H. G. Schenck and R. M. Kleinpell, 1936, Am. Assoc. Petroleum Geologists Bull., v. 20, no. 2, p. 215–225.

R. M. Kleinpell, 1938, Miocene stratigraphy of California: Tulsa, Okla., Am. Assoc. Petroleum Geologists, p. 99–103, fig. 14 (correlation chart). Stage nearly everywhere occurs conformably above beds considered age equivalents of Upper Tejon formation, although irregular contacts are reported in some areas. Subjacent to lower Miocene Zemorrian stage.

V. S. Mallory, 1959, Lower Tertiary biostratigraphy of the California Coast Ranges: Tulsa, Okla., Am. Assoc. Petroleum Geologists, p. 73. Refugian stage occurs conformably above beds of Narizian age nearly everywhere.

Type locality: Canada de Santa Anita, on south side of Santa Ynez Mountains, Santa Barbara County, about 5 miles west of Gaviota Pass. Name derived from the Spanish land grant "Nuestra Senora del Refugio".

Reisner Limestone Member (of Mattoon Formation)

Pennsylvanian: Central and southeastern Illinois.

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 41, 51 (table 1), pl. 1. Proposed to replace name Newton limestone; name Newton preempted. Uppermost member of formation; stratigraphically above Woodbury limestone member. Thickness about 9 inches. Presentation of new rock-stratigraphic classification of Pennsylvanian of Illinois. Cyclical classification is retained but is entirely independent of rock-stratigraphic classification.

Type locality: NE¼NE¼ sec. 16, T. 7 N., R. 10 E., Jasper County. Named for Reisner School 1½ miles southwest of type outcrop.

**Reklaw Member** (of Mount Selman Formation)[1]

Reklaw Formation (in Claiborne Group)

Eocene, middle: Eastern Texas and northwestern Louisiana.

Original reference: A. C. Ellisor, 1929, Am. Assoc. Petroleum Geologists Bull., v. 13, p. 1339–1346.

H. B. Stenzel, 1939, Texas Univ. Bur. Econ. Geology Pub. 3818, p. 20 (table), 65–78 [1938]. Rank raised to formation in Claiborne group. Thickness about 80 feet. Comprises Newby glauconitic sand member below and Marquez shale member above (both new). Unconformably overlies Carrizo sand; underlies Queen City sand.

B. W. Blanpied and R. T. Hazzard, 1939, Shreveport Geol. Soc. Guidebook 14th Ann. Field Trip, p. 128 (correlation chart). Correlation chart shows Reklaw formation includes Arp sand member (new).

H. B. Stenzel, 1950, Texas Univ. Bur. Econ. Geology Pub. 5019, p. 23–27, pl. 1. Recent work indicates that the Reklaw, as described by Wendlandt and Knebel (1929, American Assoc. Petroleum Geologists Bull., no. 10) that is, the 20 to 40 feet of brown to dark-blue micaceous sandy clay, does not belong in Reklaw because it interfingers with and grades laterally into Carrizo sand and is separated from Reklaw glauconites by regionally continuous disconformity. Reklaw, as restricted here, consists of two divisions, a lower glauconite 4 to 15 feet thick and an upper brown shale as much as 100 feet thick. These two divisions are precisely the two members described by Stenzel (1939) [1938] in Leon County.

L. W. Stephenson, 1952, U.S. Geol. Survey Prof. Paper 243–C, p. 37. Because of similarity of their stratigraphic position above Carrizo sand and similarity of ferruginous beds partly composing them, Reklaw and Bigford members of Mount Selman formation have been regarded as contemporaneous. Geographic and stratigraphic positions of fossiliferous ferruginous sandstones north of Leming, Atascosa County, suggest that they represent eastward extension of the Bigford from Frio County; if the Leming and Scruggs Creek localities should prove to represent the same zone, then on assumption that the conglomerate is basal part of the Reklaw, it would appear that the Bigford is not exact equivalent of the Reklaw, but is older and intervenes between the Carrizo sand and the Reklaw.

H. B. Stenzel, 1953, Texas Univ. Bur. Econ. Geology Pub. 5305, p. 34–83. Described in Henrys Chapel quadrangle where it includes Newby glauconitic sand member and Marquez shale member. Thickness about 40 feet. Overlies Carrizo sand; underlies Arp member of Queen City formation.

Well exposed at Reklaw, Cherokee County, Tex.

Relay Quartz Diorite[1]

Ordovician [?]: Northeastern Maryland.

Original reference: E. B. Knopf and A. I. Jonas, 1929, Maryland Geol. Survey Baltimore County Rept., p. 104.

H. E. Vokes, 1957, Maryland Dept. Geology, Mines and Water Resources Bull. 19, p. 43 (table 7), 63. At least three periods of granite formation are recognized in Maryland rocks. The oldest are the probable migmatites associated with Baltimore gneiss; those of second period cut the Glenarm series; the Relay quartz diorite is among representatives of the second period. Table lists unit under Ordovician with comment, age uncertain.

Occurs at Relay on Patapsco River, Baltimore County.

**Relay Creek Dolomite Beds** (in Marlow Formation)

Relay Creek Dolomite[1]

Relay Creek Dolomite or Dolostone Member (of Whitehorse Formation)

Permian: Northwestern Oklahoma and southern Kansas.

Original reference: N. Evans, 1931, Am. Assoc. Petroleum Geologists Bull., v. 15, no. 4, p. 405–432.

G. H. Norton, 1939, Am. Assoc. Petroleum Geologists Bull., v. 23, no. 12, p. 1803, 1804–1805. Dolomite member of Whitehorse sandstone. In Kansas, Whitehorse sandstone is divided into four members: Marlow, Relay Creek dolomite, an even-bedded sandstone member, and an upper shale member. In Oklahoma, Relay Creek dolomites are regarded as being upper part of Marlow.

L. V. Davis, 1955, Oklahoma Geol. Survey Bull. 73, p. 64. Relay Creek dolomite beds included in upper part of Marlow formation. Consists of two thin beds separated by 15 to 20 feet of red sandy shale.

J. M. Jewett, 1959, Graphic column and classification of rocks in Kansas: Kansas Geol. Survey. Shown on chart as Relay Creek dolostone member of Whitehorse formation.

Named for exposures both north and south of Relay Creek in T. 15 N., R. 12 W.

**Relief Quartzite**[1]

Mississippian: Northern California.

Original reference: W. Lindgren, 1900, U.S. Geol. Survey Geol. Atlas, Folio 66.

J. M. Weller and others, 1948, Geol. Soc. America Bull., v. 59, no. 2, chart 5 (column 15). Shown on correlation chart above Kanaka formation and below Cape Horn slate.

Named for exposures at Relief, Colfax quadrangle.

Relizian 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. 117–121, fig. 14 (correlation chart). Superjacent to Saucesian stage and subjacent to Luisian stage. Comprises two zones: *Siphogenerina hughesi* and *Siphogenerina branneri*. Systematic catalogue.

Type locality: Reliz Canyon, Monterey County.

**Remick Tonalite**[1] (in New Hampshire Plutonic Series)

Upper Devonian(?): Northwestern New Hampshire.

Original reference: M. P. Billings, 1935, Geology of Littleton and Moosilauke quadrangles, New Hampshire, p. 28, maps.

M. P. Billings, 1937, Geol. Soc. America Bull., v. 48, no. 4, p. 507–508, pls. 1, 12. Included in New Hampshire magma series. Distribution on map indicates it is younger than Albee and Ammonoosuc formations.

M. P. Billings, 1955, Geologic map of New Hampshire (1:250,000): U.S. Geol. Survey. Included in New Hampshire plutonic series whose age is Upper Devonian(?).

M. P. Billings, 1956, Geology of New Hampshire, pt. 2, Bedrock geology: Concord, New Hampshire State Plan. Devel. Comm., p. 54. Derivation of name.

Named for Remick Park, a municipal park in Littleton, Grafton County.

Remmel Granodiorite[1]

Jurassic(?): Central northern Washington, and southern British Columbia, Canada.

Original reference: R. A. Daly, 1906, Geol. Soc. America Bull., v. 17, p. 329–376.

Probably composes the cliffs of Mount Remmel, Wash., 5 miles south of international boundary.

**Renault Formation**[1]

Renault Formation (in New Design Group)

Upper Mississippian (Chester Series): Southwestern and southeastern Illinois, southern Indiana, western and central Kentucky, and southeastern Missouri.

Original reference: S. Weller, 1913, Illinois Acad. Sci. Trans., v. 6, p. 120, 122.

R. E. Stouder, 1938, Am. Assoc. Petroleum Geologists Bull., v. 22, no. 3, p. 268 (fig. 1), 269, 270 (fig. 2), 271–273. In Meade, Hardin, and Breckinridge Counties, Ky., Renault formation consists of (ascending) unnamed limestone ranging in thickness from 0 to 23 feet, Mooretown sandstone, and Beaver Bend limestone members; the latter two names being geogphically extended from Indiana. Overlies Ste. Genevieve limestone; underlies Sample sandstone.

J. M. Weller and A. H. Sutton, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 5, p. 766 (fig. 1), 824–826. Renault formation assigned to New Design group (new). In standard Mississippian section, overlies Aux Vases sandstone and underlies Bethel sandstone. In southwestern Illinois, underlies Yankeetown chert. Locally in southern half of Monroe County, Ill., overlaps Aux Vases and becomes basal member of Chester series. In Johnson, Pope, and Hardin Counties, Ill., and adjacent parts of Kentucky, formation is divisible into two members which are locally unconformable; the lower, or Shetlerville member, is typically developed in Hardin County, Ill. Eastward in Kentucky, shaly layers of Renault become less conspicuous, and formation consists of a limestone that cannot be distinguished from Paint Creek formation where Bethel sandstone is absent; from Todd to Grayson County, this limestone unit is known as Girken limestone. In Indiana, consists of three members (ascending): Paoli, Mooretown, and Beaver Bend. Also present in Ste. Genevieve County, Mo.

Elwood Atherton, 1947, Illinois Acad. Sci. Trans., v. 40, p. 129, 130 (fig. 7), 131 (fig. 8). In Hardin County, Ill., formation comprises Shetlerville member below and Downeys Bluff member (new). Overlies Levias member of Ste. Genevieve formation.

C. A. Malott, 1952, Stratigraphy of the Ste. Genevieve and Chester formations of southern Indiana: Ann Arbor, Mich., The Edwards Letter Shop, p. 7. Renault formation of standard Chester column has triple expression in 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.

Named for Renault Township, Monroe County, southwestern Illinois. Typically developed in valley of Horse Creek and its tributaries in eastern part of Township.

Rencher Formation

Tertiary: Southwestern Utah.

E. F. Cook, 1957, Utah Geol. and Mineralog. Survey Bull. 58, p. 16 (fig. 2a), 18–25, 57–59. Complex assemblage of welded tuff and tuff-breccia, breccia, air-fall tuff, bedded tuff-breccia, volcanic sandstone, and lenticular limestone and conglomerate. Maximum thickness of 600 feet. Overlies

Quichapa group (new) unconformably; underlies Atchinson formation (new).

J. H. Mackin, 1960, Am. Jour. Sci., v. 258, no. 2, p. 90 (table 1), 92 (fig. 2), 97, 98. Overlies Quichapa formation; underlies Page Ranch formation. Zircon age dating suggests that Rencher-Page Ranch period of extrusive-intrusive igneous activity is late Oligocene or early Miocene.

Type locality: Vicinity of Rencher Ranch at north end of Grass Valley, Pine Valley Mountains, Washington and Iron Counties.

†Renfroes Marl[1]

Upper Cretaceous: Western Georgia.

Original reference: J. O. Veatch, 1909, Georgia Geol. Survey Bull. 18, p. 86–89.

Named for exposures at Renfroes, Chattahoochee County.

**Rennie Shale**[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. 2–3. Consists of soft olive argillaceous shale, sometimes micaceous. Thickness 50 to 75 feet. Overlies Gold Creek quartzite; underlies Lakeview limestone.

Crops out in stream along west side of Rennie Ridge, a spur on south side of Packsaddle Mountain, Pend Oreille district.

Rennix Limestone[1]

Upper Ordovician (Richmond): Southeastern Kentucky.

Original reference: A. F. Foerste, 1901, Geol. Soc. America Bull., v. 12, p. 435.

Named for Rennix Creek, Cumberland County.

Reno Member (of Franconia Formation)

Upper Cambrian: Eastern Minnesota and southwestern Wisconsin.

R. R. Berg, 1951, Minnesota Geologist, v. 8, no. 4, p. [2]; 1953, Jour. Paleontology, v. 27, no. 4, p. 555; 1954, Geol. Soc. America Bull., v. 65, no. 9, p. 858 (fig. 1), 864–865, measured sections. Consists of beds of wormstone with high glauconite content, separated by thinner beds of crossbedded greenstone; thin beds of greenstone conglomerate are common; top of member is marked by a 1- to 6-foot bed of dolomitic, flat-pebble conglomerate. Thickness at type locality 116 feet. Overlies Tomah sandstone member (new); interfingers with Mazomanie member (new).

Type locality: In Hell Hollow, 1½ miles north of Reno, SE¼ sec. 23, T. 102 N., R. 4 W., Houston County, Minn.

**Rensselaer Graywacke**[1]

Lower Cambrian(?): Eastern New York.

Original reference: T. N. Dale, 1893, U.S. Geol. Survey 13th Ann. Rept., pt. 2, p. 301–340, map.

Rudolf Ruedemann, 1942, New York State Mus. Bull. 327, p. 1–17. Discussion of supposed occurrence of *Oldhamia* in Rensselaer grit. It is apparent that *Oldhamia occidens* of the Nassau beds and the supposed *Oldhamia* of the grit are of entirely different nature and origin and the

Rensselaer grit "*Oldhamia*" can not be used for correlation of the Rensselaer with the Nassau beds or any other Cambrian formation.

Theodore Arnow, 1951, New York Water Power and Control. Comm. Bull. GW–25, p. 8 (table 1), 11, pl. 2. Only outcrop of Rensselaer graywacke in Columbia County is small outlier in northern part of county. Thickness of outlier not known but believed to approximate the 1,400 feet assigned to main body of Rensselaer graywacke plateau that lies north of Columbia County. Lower Cambrian(?). Considered to have been deposited at same time Schodack and Nassau formations were deposited. Underlies Stockbridge limestone.

Named for exposures on upper part of east side of Renssalaer grit plateau, eastern New York; also the southeastern, western, and northern faces of the plateau.

**Renwick Shale Member** (of Genesee Formation)

Renwick Shale (in Ithaca Shale)

Renwick Shale Member[1] (of Middlesex Shale)

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. Shale reallocated to base of Ithaca shale. Underlies Six Mile shale; overlies Cornell shale and sandstone.

Wallace de Witt, Jr., and G. W. Colton, 1959, Am. Assoc. Petroleum Geologists Bull., v. 43, no. 12, p. 2814 (fig. 3), 2815, 2817 (fig. 4), 2821, 2827. At Cayuga Lake, Sherburne flagstone member of Genesee is overlain by a 5- to 40-foot unit of black and very dark brown shale containing siltstone scour channels. Base of unit is sharply defined, but upper boundary is gradational. This unit of dark shaly rock was informally named Ithaca *Lingula* shale by Williams (1906, Science, new ser., v. 24) and was apparently named Renwick shale member of Middlesex shale by Caster (1933). Caster's Renwick was proposed in an abstract, and type area and boundaries were not described. Name Renwick shale member of Genesee formation is herein adopted for stratigraphic unit above Sherburne. Thickness at reference section (herein designated) 38 feet. Underlies Ithaca member; boundary placed at top of beds of dark-brown shale above which rocks are gray silty shale and thin beds of dark-gray siltstone. Renwick extends westward to vicinity of Keuka Lake where member is present as thin tongue of black shale in middle of Penn Yan shale member.

Reference section: In Renwick Brook on east side of Cayuga Lake, 0.3 mile north of Ithaca, Tompkins County.

Repettian Stage

Pliocene: Southern California.

Manley Natland, 1953, Pacific Petroleum Geologist, v. 7, no. 2, p. 2. Lowermost of four stages, based on foraminiferal assemblages, in the Pliocene and Pleistocene of southern California. Occurs below the Venturian stage. In western part of Ventura Basin, lower and middle Repettian are absent and the upper Repettian lies apparently conformably on Delmontian upper Miocene.

†Repetto Formation[1] or Siltstone[1] (in Fernando Group)

Pliocene, lower: Southern California.

Original reference: R. D. Reed, 1932, 16th Int. Geol. Cong. Guidebook 15, p. 31.

M. L. Krueger, 1936, (abs.) Am. Assoc. Petroleum Geologists Bull., v. 20, no. 11, p. 1520. In Whittier Hills area, underlies Sycamore Canyon formation (new).

W. P. Woodring, M. N. Bramlette, and W. S. W. Kew, 1946, U.S. Geol. Survey Prof Paper 207, p. 40–42, pl 1. In type region, formation consists of 2,000 to 3,000 feet of siltstone and rests conformably on diatomaceous shale referred to upper Miocene. Farther east in Puente Hills, the Repetto includes thick beds of conglomerate and sandstone. In Palos Verdes Hills [this report], the Repetto consists entirely of siltstone, and term Repetto siltstone is used. Siltstone is about 150 feet thick and disconformably overlies Malaga mudstone member of Monterey shale. Underlies Lomita marl in type region of Lomita. Lower Pliocene.

G. B. Oakeshott, 1950, California Jour. Mines and Geology, v. 46, no. 1, p. 51 (table 1), 54 (table 2), 55–56. Name Repetto formation is used in this report [Placerita oil field, Los Angeles County] for lower Pliocene sedimentary rocks, including basal Elsmere member and Repetto siltstone member. Relationship between Elsmere and siltstone members not certain. Elsmere member is used for lower Pliocene beds including typical Elsmere fauna described by Grant and Gale (1931, San Diego Soc. Nat. History Mem., v. 1). The two members may be in part contemporaneous although siltstone member probably overlies Elsmere. Thickness of Elsmere about 100 feet; thickness of siltstone 300 feet. Unconformably overlies Mint Canyon formation; unconformably underlies Pico formation; in some areas unconformably underlies Sunshine Ranch member (new) of Pico formation.

G. B. Oakeshott, 1958, California Div. Mines Bull. 172, p. 22 (fig. 2), 23 (fig. 3), 75–78, pl. 1. Formation described in San Fernando quadrangle where it is distributed in discontinuous belt along western and southern margin of San Gabriel Mountains for 13½ miles, as far east as Sunland and Tujunga. Maximum thickness 3,000 feet, measured in Lopez Canyon (south of San Gabriel fault) from top of underlying Modelo contact to base of overlying Saugus formation. South of San Gabriel fault, includes Elsmere member, which reaches maximum thickness of 1,400 feet, from its contact on pre-Tertiary crystalline rocks to overlying base of Pico formation, in upper Elsmere Canyon. North of San Gabriel fault, thickness of formation, from top of Modelo to base of Saugus formation, in Humphreys syncline, is about 500 feet.

D. L. Durham and R. F. Yerkes, 1959, U.S. Geol. Survey Oil and Gas Inv. Map OM–195. Included in Fernando group. Basal formation of group; underlies unnamed formation that constitutes upper part of group. In eastern Puente Hills, conformably overlies Sycamore Canyon member of Puente formation. Maximum thickness of 1,600 feet exposed on ridge south of Olinda.

U.S. Geological Survey has abandoned the term Repetto.

Type locality: In Repetto Hills, along west side of Atlantic Boulevard, Los Angeles.

Republic Chert[1]

Pennsylvanian: Southwestern Missouri.

Original reference: E. M. Shepard, 1898, Missouri Geol. Survey, v. 12, pt. 1, p. 125–126, 141.

Named for Republic, Greene County.

Republic Conglomerate

Precambrian: Northern Michigan.

R. M. Dickey, 1938, Jour. Geology, v. 46, no. 3, p. 331–334. Named in discussion of Ford River granite (new) of Southern Complex of Michigan.

Named for occurrence south of town of Republic, Marquette County. Upper part of principal exposure is near Republic baseball park near State Highway 95.

†Republic Formation[1]

Pre-Cambrian (Huronian): Northwestern Michigan.

Original reference: M. E. Wadsworth, 1890, Lake Superior along the south shore, by Julian Ralph, p. 77–99; 1891, 2d ed.

Named for occurrence at Republic, Marquette County.

Republic Granite[1]

Precambrian: Northern Michigan.

Original reference: C. A. Lamey, 1933, Jour. Geology, v. 41, no. 5, p. 487–500.

C. A. Lamey, 1937, Jour. Geology, v. 45, no. 5, p. 487–510. Two granites, one of Archean age and one of post-Huronian, possibly Killarnean, are now generally recognized as present in Southern Complex. Agreement does not exist regarding relative amounts of these granites nor the criteria by which their extent should be judged. Evidence is cited to show that granite at Republic is younger than a conglomerate there which has been described as containing granite fragments. Believed that there is sufficient evidence to warrant conclusion that northern part of Southern Complex, extending from about 5 miles west of Republic to at least 3 miles east of Palmer, is a post-Huronian granitic unit to which name Republic granite is applicable. Republic granite is probably continuous with more northern intrusions, thus making northern part of Southern Complex a post-Huronian unit.

R. M. Dickey, 1938, Jour. Geology, v. 46, no. 3, p. 321–335. Granite-porphyry, herein named Ford River granite, is post-Lower Huronian and pre-Middle Huronian. It has been considered post-Huronian and called Republic granite by Lamey. Term Republic granite is not desirable, since known post-Huronian granite is exposed only in small quantities in vicinity of Republic. Since name Republic is established in literature, it is retained as designation for port-Huronian granite found in some abundance about margins of Southern Complex.

Named for exposures in vicinity of Republic, Marquette County.

Republic Quartzite[1]

Precambrian (Huronian): Northwestern Michigan.

Original reference: M. E. Wadsworth, 1893, Michigan Geol. Survey Rept. 1891–1892, p. 63–64, 84–85, 102–127.

Probably named for occurrence at Republic, Marquette County.

Republican Creek Limestone[1] (in Stevens Series)

Middle Cambrian: Northeastern Washington.

Original reference: C. E. Weaver, 1920, Washington Geol. Survey Bull. 20, p. 78, map.

C. D. Campbell, 1947, Geol. Soc. America Bull., v. 50, no. 7, p. 602 (table 4), 611. Remapping of northeastern Stevens County and discovery of Cambrian and Ordovician fossils are thought to justify the adoption there of formation names established by Park and Cannon (1943) for the Metaline quadrangle. Correlative with the Middle Cambrian Metaline limestone are most of Weaver's Northport limestone, Republican Creek limestone, Red Top limestone, and Deep Lake argillite, and part of Boundary argillite.

Extends from head of Republican Creek southwest past north end of Deep Lake, Stevens County.

†Republican River Formation[1]

Pliocene, lower: Northern Kansas and central southern Nebraska.

Original reference: H. F. Osborn, 1907, Am. Mus. Nat. Hist. Bull., v. 23, p. 250, 251; W. B. Scott, 1907, Textbook of Geology, p. 724.

A. L. Lugn, 1939, Geol. Soc. America Bull., v. 50, no. 8, p. 1271–1273. Exposures generally referred to the Republican River beds in southwestern Nebraska and parts of Kansas are now known to belong to lower part of Ogallala group, that is, they are equivalent to upper part of Valentine formation and lower part of Ash Hollow formation.

Exposed along Republican River.

Resendez 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), 267–268. Proposed for series of shaly beds with local developments of argillaceous sandstone and oyster streaks. Underlies Roma sandstone tongue and overlies Salineno sandstone tongue. Thickness about 80 feet in Roma area; apparently grades northward into nonmarine bentonitic red and green shale.

Named from Resendez ranchhouse, 1 mile northwest of Roma, Roma quadrangle, Starr County.

Reserve Shale Member[1] (of Falls City Limestone)

Pennsylvanian: Northeastern Kansas and southeastern Nebraska.

Original reference: G. E. Condra, 1935, Nebraska Geol. Survey Paper 8, p. 5, 9.

Type locality: In upland near State line, northwest of Reserve, Brown County, Kans.

Reservoir Formation

Pliocene(?) and Quaternary, lower: Southwestern Utah.

E. F. Cook, 1960, Utah Geol. and Mineralog. Survey Bull. 70, p. 45–46. Mentioned in discussion of "Muddy Creek" formation. Name credited to H. R. Blank (unpub. thesis).

Present in Washington County.

Reservoir Granite[1]

Precambrian: Southeastern New York.

Original reference: C. P. Berkey and Marion Rice, 1919, New York State Museum Bull. 225, 226, map and passim.

K. E. Lowe, 1950, Geol. Soc. America Bull., v. 63, no. 3, p. 143. In place of Canada Hill, Reservoir, and Mahopac granites described by Berkey and Rice (1919), the term Canada Hill granite phase of Hudson Highlands complex is used here 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: At north end of Boyd Corners Reservoir, Putnam County.

Reservoir Hill Granite[1]

Precambrian: Northwestern New York.

Original reference: H. P. Cushing and D. H. Newland, 1925, New York State Mus. Bull. 259, p. 42–47.

Reservoir Hill, southeast of Gouverneur, St. Lawrence County.

**Resolution Dolomite Member** (of Minturn Formation)

Pennsylvanian: Colorado.

Ogden Tweto, 1949, Colorado Sci. Soc. Proc., v. 15, no. 4, p. 152 (table 1), 199–201, 215–216. Consists of lower dolomite bed 35 to 40 feet thick, middle shale and grit unit 15 to 35 feet thick, and upper dolomite bed 15 to 22 feet thick. Separated from overlying Robinson limestone member by a 400-foot section of grayish clastic rocks. Separated from underlying Hornsilver dolomite member (new) by interval, about 800 feet thick, of grit, conglomerate, shale, and dolomite. About 3,700 feet above base of formation.

Named for the fact that it caps Resolution Mountain, an 11,927-foot peak on the divide between Resolution and Wearyman Creeks, Pando area.

**Resting Springs Formation**

Pleistocene(?): Southern California.

D. F. Hewett, 1956, U.S. Geol. Survey Prof. Paper 275, p. 2, 102–103, pl. 1. Succession of limy sandstone, conglomerate, and pumice at least 1,000 feet thick, deposited upon remnants of a thrust plate of late Pliocene age.

Occurs in Pahrump Valley, Inyo County, near Resting Springs.

Rest Island Granite[1]

Precambrian: Minnesota, and Ontario, Canada.

Original reference: I. H. Cram, 1932, Jour. Geology, v. 40, no. 3, p. 270–278.

Named for the granite of Rest Island batholith, in Rainy Lake area.

Restoration Point horizon[1]

Oligocene: Northwestern Washington.

Original reference: B. L. Clark, 1930, Geol. Soc. America Bull., v. 41, p. 751–770.

Restoration Point Member (of Blakeley Formation)

Miocene, lower: Northwestern Washington.

C. V. Fulmer, 1954, (abs.) Geol. Soc. America Bull., v. 65, no. 12, pt. 2, p. 1341. At type section of Blakeley, Restoration Point member consists of approximately 4,000 feet of marine hard massive gray-tan siltstone interbedded with thin hard fine-grained sandstone; soft limonitic-stained sandstone largely covered by beach gravels; and massive dark-gray, silty shale; contains the typical Blakeley molluscan faunule. Overlies Orchard Point member; underlies an unnamed lithologic unit consisting of approximately 4,650 feet of massive nonmarine conglomerates interbedded with thin gray sandstone and soft carbonaceous siltstones.

Named for occurrence at Restoration Point near entrance to Bremerton Inlet, Kitsap County.

**Rest Spring Shale**

Mississippian and Pennsylvanian (?) : Southern California.

J. F. McAllister, 1952, California Div. Mines Spec. Rept. 25, p. 3, 14 (fig. 6), 25–26, pls. 1, 2, 3. Characteristically an argillaceous shale grading into siltstone; basal shale contains discoidal concretions 2 to 6 inches in diameter shale grades upward into siltstone, fine-grained sandstone and in some places thin isolated beds of light-gray quartzite; some sandstone is conglomeratic in thin inconspicuous beds. Thickness about 310 feet. Underlies Tihvipah limestone (new) ; overlies Mississippian Perdido formation (new).

J. F. McAllister, 1956, U.S. Geol. Survey Geol. Quad. Map GQ–95. In long exposure from western side of Ubehebe Peak stock to northern side of [Ubehebe Peak] quadrangle, outcrop width of nearly vertical, highly sheared Rest Spring shale ranges from 200 to 1,000 feet; on flank of open fold west of Lee Flat the thickness is about 300 feet. Overlies Perdido formation; underlies Bird Spring (?) formation.

Type locality: Extends from head of gulch 2,000 feet south of Rest Spring northward to within 200 feet of top of hill that is 2,000 feet northwest of Burro Spring, Inyo County. Named from extensive exposures around Rest Spring.

**Retort Phosphatic Shale Member** or **Tongue** (of Phosphoria Formation)

Permian: Southwestern Montana, eastern Idaho, northeastern Utah, and western Wyoming.

R. W. Swanson, 1956, *in* V. E. McKelvey and others, Am. Assoc. Petroleum Geologists Bull., v. 40, no. 12, p. 2832 (fig. 3), 2836 (fig. 4), 2850–2851; 1959, U.S. Geol. Survey Prof. Paper 313–A, p. 29–30, pls. 2, 3. Upper phosphatic shale member of Phosphoria formation, provisionally called D member in recent preliminary reports on area in Montana and Wyoming, is here named Retort phosphatic shale member. At type locality, divided into three principal zones: lower phosphatic zone, 26 feet thick; middle somewhat calcareous mudstone, 15 feet thick, lower 10 feet of which includes oil shale beds; upper phosphatic zone, 19 feet thick. Thickness of member 55 to 90 feet. Thins progressively northward from Retort Mountain to about 30 feet near Melrose, 20 feet near Philipsburg, 10 feet near Maxville, and 3 to 5 feet in Garrison region where it is composed almost wholly of phosphorite; east of Ruby River, thins abruptly to generally less than 10 feet; in Centennial Mountain about 20 feet; 35 feet or less in Jackson Hole region; thins to the north; probably in large part by facies change to chert, and toward the southwest in Idaho where it intertongues with and grades laterally into cherty shale member. Overlies Rex chert member; underlies Tosi chert member (new) ; both contacts appear conformable. Also intertongues with Franson member (new) of Park City formation and Shedhorn sandstone (new).

T. M. Cheney, 1957, Utah Geol. and Mineralog. Survey Bull. 59, p. 28. Geographically extended into northeastern Utah.

Type locality: Small Horn Canyon, just northwest of Retort Mountain in sec. 23, T. 9 S., R. 9 W., about 10 miles south of Dillon, Beaverhead County, Mont. Retort Mountain was named from retort built there nearly 40 years ago in attempt to recover oil from the shale.

**Retreat Group**

Silurian and Devonian: Southeastern Alaska.

Fred Barker, 1957, U.S. Geol. Survey Geol. Quad. Map GQ–100. Dominant rock types are fine-grained gray to greenish-gray sericite schist, sericite-chlorite-albite schist, medium-grained quartz-muscovite schist, fine-grained green chlorite-albite-epidote schist, black graphitic quartzose pyrite-bearing slate, and black graphitic slate. Gray fine- to medium-grained graywacke and silvery sericte schist form minor part of group. Gray to buff marble with dark-gray laminae in beds 0.5 foot to more than 100 feet thick exposed at several localities. Individual beds of all above-mentioned rock types are a few inches to a few hundred feet thick. Thickness of group at least 6,000 feet. In contact with Barlow Cove formation (new) along a bedding plane fault. On southwest limb of Shelter syncline.

U.S. Geological Survey currently designates the age of the Retreat Group as Silurian and Devonian on basis of a study now in progress.

Underlies western part of Mansfield Peninsula from Point Retreat to south boundary of Juneau (B–3) quadrangle.

Reusens Migmatite

Reusens migmatite facies (of Moneta Gneiss)

Precambrian: South-central Virginia.

W. R. Brown, 1951, (abs.) Virginia Jour. Sci., new ser., v. 2, no. 4, p. 346. Complex of quartz monzonite gneiss and dark hornblendic gneisses. Unconformably underlies Rockfish conglomerate. Grades into Lovingston quartz monzonite gneiss.

W. R. Brown, 1953, Kentucky Geol. Survey, ser. 9, Spec. Pub. 1, p. 91 (fig. 1). Precambrian. Type locality designated.

W. R. Brown, 1958, Virginia Div. Mineral Resources Bull. 74, p. 12–16, pl. 1. Facies of Moneta gneiss which is included in Virginia Blue Ridge complex (new). In most typical development, it consists of from two to four distinct interbanded and interlensed phases, ranging from almost black hornblende gneiss to white basic pegmatite.

Type locality: In vicinity of Reusens on James River 2 miles northwest of Lynchburg, Campbell County. Lynchburg quadrangle.

**Revard Sandstone Member** (of Tallant Formation)

Revard Sandstone Member (of Nelagoney Formation)[1]

Pennsylvanian (Missouri Series): Central northern Oklahoma.

Original reference: D. E. Winchester, K. C. Heald, and others, 1918, U.S. Geol. Survey Bull. 686–G, p. 60–64.

M. C. Oakes, 1951, Tulsa Geol. Soc. Digest, v. 19, p. 119–120. Reallocated to member status in Tallant formation (new). Stratigraphically above Bigheart sandstone member.

W. F. Tanner, 1956, Oklahoma Geol. Survey Circ. 40, p. 36–37, 38. Thickness commonly 18 to 22 feet; locally (west of Okesa), thickens to between 35 and 40 feet. Base commonly falls between two-fifths and one-half of the way from the bottom to the top of formation. South of Caney River, Hulah sandstone member appears in upper part of the Revard and would seem to be an equivalent of the latter; elsewhere the bed named Hulah appears as a lens between the Bigheart and Revard members.

P. B. Greig, 1959, Oklahoma Geol. Survey Bull. 83, p. 14–15, 22–24, pls. Limits of Revard are obscure even at type locality, and consequently the unit is of doubtful stratigraphic value. Name is applied to persistent sandstone normally present in upper part of Tallant. Lenticular nature of upper Missouri sandstones makes it doubtful if the "Revard" of one locality is exact equivalent of the "Revard" of adjacent localities unless beds can be continuously traced. Revard of Pawnee County [this report] is a massive crossbedded sandstone containing thin lenses of red shale and white siltstone. Thickness 35 feet. Separated from underlying Bigheart sandstone member by 100-foot unnamed shale interval. Underlies unnamed red shale sequence.

Type locality : Revard Point, sec. 13, T. 26 N., R. 10 E., Osage County.

**Revett Quartzite** (in Ravalli Group)[1]

Precambrian (Belt Series) : Northeastern Idaho and northwestern Montana.

Original reference: F. L. Ransome, 1905, U.S. Geol. Survey Bull. 260, p. 277–285.

F. L. Ransome and F. C. Calkins, 1908, U.S. Geol. Survey Prof. Paper 62, p. 35–36, pl. 11. White quartzites, commonly rather thick bedded; interstratified with subordinate amounts of micaceous sandstone. Thickness about 1,200 feet. Overlies Burke formation; underlies St. Regis formation.

F. C. Calkins, 1909, U.S. Geol. Survey Bull. 384, p. 38. Middle formation in Ravalli group.

J. W. Hosterman, 1956. U.S. Geol. Survey Bull. 1027–P, p. 729, pl. 57. Described in Murray area, Shoshone County, Idaho, where it is approximately 2,200 to 2,400 feet thick. Except for transition zone with underlying Burke formation, uniform throughout section; consists of fine- to medium-grained almost white; pure quartzite; beds commonly 1 to 6 feet thick; a few thin greenish-gray argillite beds. Underlies St. Regis formation.

Named for exposures surrounding Revett Lake, Coeur d'Alene district, Idaho.

Revuelto formation or shales

Mesozoic (Early Cretacic) : Northeastern New Mexico.

Charles Keyes, 1940, Pan-Am. Geologist, v. 74, no. 3, p. 209; v. 74, no. 4, p. 306–307. Name presented as a substitute for Pyramid shales, the latter name found to be preoccupied. Included in the Tucumcarian series. Thickness 50 feet. Overlies Redondo sandstone.

Name derived from Revuelto Mesa, Cerro Tucumcari region.

**Reward Conglomerate Member** (of Owens Valley Formation)

Reward Conglomerate[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. Rank reduced to member status in Owens Valley formation (new). Permian.

Named for exposures south of Reward mine, Inyo Mountains.

**Rex Chert Member** (of Phosphoria Formation)[1]

Permian: Northeastern Utah, eastern Idaho, southwestern Montana and southwestern Wyoming.

Original reference: R. W. Richards and G. R. Mansfield, 1912, Jour. Geology, v. 20, p. 683-689.

V. E. McKelvey and others, 1956, Am. Assoc. Petroleum Geologists Bull., v. 40, no. 12, p. 2847-2849; 1959, U.S. Geol. Survey Prof. Paper 313-A, p. 25-28. Richards and Mansfield did not publish description of section from Crawford Mountains; only section of Rex described by them is one measured in sec. 12, T. 10 S., R. 44 E., a few miles west of Phosphoria Gulch. Because they described the section near Phosphoria Gulch (which has chert as dominant constitutent), in preference to Crawford Mountain section (where beds of Rex age are mainly carbonate rock), it is assumed that they intended Phosphoria Gulch to be type locality for Rex chert member as well as of Phosphoria formation as a whole. Adoption of alternate interpretation—that they meant Rex Peak to be type locality—would require displacing name Rex with new name for chert member in southeastern Idaho, if rules of stratigraphic nomenclature were adhered to strictly. Because Rex chert is known internationally as name of main chert in Phosphoria, its displacement by new name seems undesirable. Richards and Mansfield described the Rex in Phosphoria Gulch as consisting of 100 feet of gray limestone and black chert in lower part, 60 feet of red-stained black chert in middle, and 80 feet of dark cherty shale in upper part. Latter unit has been recognized over wide area and in recent reports has been separated from Rex and referred to as "upper shale member"; this separation is continued here, and name Rex is restricted to hard resistant dark chert above Meade Peak phosphatic shale member. North, east, and south from typical area, upper part of Rex passes into carbonate rock of Franson member (new) of Park City formation; lower part continues as far as southwestern Montana, western Wyoming, and north-central Utah, where it passes into the Franson. North-northwest of typical area, Rex passes into cherty mudstone, which composes entire upper part of Phosphoria in Portneuf quadrangle and Fort Hall Indian Reservation and is designated as separate member.

Type locality: Phosphoria Gulch, 2½ miles northwest of Meade Peak, Bear Lake County, Idaho. Measured in sec. 12, T. 10 S., R. 44 E. Named for Rex Peak in Crawford Mountains, 4 miles east of Randolph, Rich County, Utah, where chert forms an anticlinal cap.

**Rexroad Formation**

Rexroad Member (of Ogallala Formation)

Pliocene, upper: Kansas and Oklahoma.

H. T. U. Smith, 1940, Kansas Geol. Survey Bull. 34, p. 95-99, 112. At localities where diagnostic fossils have been found, formation consists of alternating beds of gray to reddish mudstone, buff sandy silt, rusty sand and gravel, and a few thin seams of lignite. Has been mapped as Ogallala, and some Rexroad beds are indistinguishable from typical Ogallala. Base not exposed in Meade County; hence, complete thickness is problemmatical. Individual exposures do not exceed 35 feet, but it is probable that thickness is at least as great as local relief of topography, which is about 80 feet. Contact with overlying Ogallala not exposed. In some areas, as in Clark County, underlies Kingsdown formation (redefined).

J. C. Frye and C. W. Hibbard, 1941, Kansas Geol. Survey Bull. 38, pt. 13, p. 395 (fig. 2), 399 (table), 400 (fig. 3A), 407–410. Smith (1940) named the Rexroad from exposures along tributary to Crooked Creek on Rexroad Ranch, in same general locality from which Rexroad fauna was collected by Hibbard (1938, Kansas Acad. Sci. Trans., v. 40). Choice of type locality was unfortunate because only uppermost part of formation is here exposed. Top of formation was not defined by Smith, although it is exposed in this area, and beds of Pleistocene sand and gravel, which unconformably overlie Pliocene beds, were not clearly excluded from the Rexroad. Beds called Rexroad by Smith are here designated Rexroad member (upper Pliocene) of Ogallala formation. Thickness 50 to 250 feet. Lower and thicker part of Rexroad member does not crop out at surface in Meade basin area; hence, thickness and character of member are known only from test-hole samples and well logs. Upper beds of member, which are exposed at surface, consist of blue-gray, tan, and gray sand, silt, and clay. Where entire member is present, it is about 200 feet thick, but in deepest part of basin it may attain maximum thickness of 250 feet, and east of Crooked Creek fault it is only about 30 feet thick. Unconformably overlain by basal sand or gravel of Meade formation (redefined) of Pleistocene age.

C. W. Hibbard, 1949, Michigan Univ. Mus. Paleontology Contr., v. 7, no. 5, p. 91–105. Includes XI member (new) in lower part. Overlies Laverne formation, angular unconformity.

C. W. Hibbard, 1950, Michigan Univ. Mus. Paleontology Contr., v. 8, no. 6, p. 113–192. Treatment of Rexroad formation by many authors working in different areas of western Kansas has been varied. This report traces development of the term Rexroad formation and Meade formation and relationship of Rexroad fauna to other known faunas.

J. C. Frye and A. B. Leonard, 1952, Kansas Geol. Survey Bull. 99, p. 65. Blanco formation has its maximum development in southwestern Kansas where formation attains maximum thickness of more than 250 feet. In this area, Smith (1940) described and named Rexroad formation from exposures now classed as Blanco formation. Frye and Hibbard (1941) redescribed these beds as Rexroad member of Ogallala.

C. W. Hibbard, 1958, Am. Jour. Sci., v. 256, no. 1, p. 55, 56. Underlies Angell member of Ballard formation (both new). Rexroad formation was included in Blanco formation of former State Geological Survey of Kansas classification. Position of Rexroad formation was discussed at Pleistocene conference held in Lawrence, Kans., but decision on it was deferred. Formation is now recognized as older than Meade group. It is here considered to be of late Pliocene age.

Named from exposures along tributaries of Crooked Creek on Rexroad Ranch, in sec. 22, T. 33 S., R. 29 W., Meade County, Kans.

**Reynales Limestone** (in Clinton Group)

Reynales Limestone Member (of Clinton Formation)[1]

Silurian: Western New York.

Original reference: G. H. Chadwick, 1918, Geol. Soc. America Bull., v. 29, p. 327–368.

C. K. Swartz and others, 1942, Geol. Soc. America Bull., v. 53, no. 4, chart 3. Shown on correlation chart as formation in Clinton group. Occurs above Maplewood shale and below Sodus shale.

D. W. Fisher, 1959, New York State Mus. Sci. Service Geol. Survey Map and Chart Ser. 1. In Clinton group. Occurs above Neahga shale; interfingers with Brewer Dock limestone to east and overlies Maplewood shale. Unconformable below Irondequoit limestone. Name Wallington limestone proposed for limestone formerly regarded as Reynales at Rochester and eastward. This limestone is younger than type Reynales of Niagara and Clinton Counties. Middle Silurian.

Named for exposures at Reynales Basin (also spelled Reynolds), 8 miles east of Lockport.

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

Mississippian: Southeastern West Virginia.

Original reference: D. B. Reger, 1926, West Virginia Geol. Survey Rept. Mercer, Monroe, and Summers Counties, p. 301, 426.

P. H. Price and E. T. Heck, 1939, West Virginia Geol. Survey Greenbrier County p. 255, 264. In Greenbrier County, a shaley blue to yellowish-blue fossiliferous limestone, 15 to 40 feet thick. Underlies a yellow to olive shale beneath the Droop sandstone; separated from underlying Webster Springs sandstone by a yellow sandy shale which may be the equivalent of the Bickett shale of Reger (1926). Mauch Chunk series.

Type locality: In public road 0.3 mile eastward from Reynolds School and 0.6 mile northwest of Knobs village, Monroe County.

**Reyolds Sandstone Member** (of Hignite Formation)[1]

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, 43.

H. R. Wanless, 1946, Geol. Soc. America Mem. 13, p. 12, 111, 119, 125, 149. Massive locally conglomeratic sandstone. In Hignite formation between High Splint coal above and Fossil limestone.

Named for Hanging Rock of Reynolds Mountain, Bell County, Ky.

Reynoldsburg Coal Member (of Abbott Formation)

Pennsylvanian: Southern Illinois.

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 31, 44 (table 1), pl. 1. Assigned to member status in Abbott formation (new). Occurs at base of formation below Grindstaff sandstone member. Coal named by J. M. Weller (1940, Illinois Geol. Survey Rept. Inv. 71).

Type locality: North of Cedar Creek, W½ sec. 32, T. 11 S., R. 4 E., Johnson County.

†Reynosa Formation,[1] Limestone,[1] or Caliche

Pleistocene: Northern Mexico and southern Texas.

Original reference: R. A. F. Penrose, Jr., 1890, Texas Geol. Survey 1st Ann. Rept., p. 57, 58, 63.

A. W. Weeks, 1945, Am. Assoc. Petroleum Geologists Bull. ,v. 29, no. 12, p. 1695 (fig. 1), 1715. Referred to as Reynosa caliche. Covers parts of Fleming and Goliad formations.

Named for occurrence at Reynosa, Tamaulipas, Mexico.

†Rhems Shale[1]

Eocene, lower: Eastern South Carolina.

Original reference: E. Sloan, 1908, South Carolina Geol. Survey, ser. 4, Bull. 2, p. 449, 451, 452, 453.

Type locality: Perkins Bluff, Black River, 5 miles from Rhems, Williamsburg County.

**Rhinestreet Shale Member** (of West Falls Formation)

Rhinestreet 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.

J. F. Pepper, Wallace de Witt, Jr., and George W. Colton, 1956, U.S. Geol. Survey Oil and Gas Inv. Chart OC–55. Rank reduced to member status in West Falls formation (new). In Lake Erie area, underlies Angola shale member and overlies Cashaqua shale; in Genesee River valley-Letchworth Park area, underlies Gardeau shale member and overlies Cashaqua shale, in Naples-Hammondsport area, underlies Hatch shale member and overlies Cashaqua shale. Thins eastward; 195 feet on Eighteen Mile Creek; 19 feet at Conklin Gully.

G. W. Colton and Wallace de Witt, Jr., 1958, U.S. Geol. Survey Oil and Gas Inv. Chart OC–54. Overlies Cashaqua shale member of Sonyea formation.

R. G. Sutton, 1960, New York State Mus. Bull. 380, p. 18–19. Included in Naples group. Overlies Rye Point member (new) of Cashaqua formation; underlies Hatch formation. Term Attica shale abandoned and Rhinestreet understood to be applicable westward to Lake Erie. Thickness 4 to 152 feet.

Named for exposures along Rhinestreet north from Naples, Ontario County.

Rhinoceros Hill Beds (in Ogallala Formation)[1]

Rhinoceros Hill Beds (in Ash Hollow Formation)

Pliocene, lower: Western Kansas.

Original reference: M. K. Elias, 1931, Kansas Univ. Bull., v. 32, no. 7, p. 159–163.

M. K. Elias, 1942, Geol. Soc. America Spec. Paper 41, p. 144–145. Included in Ash Hollow formation (Ogallala group). Consist of about 10 to 15 feet of unconsolidated sand with mammalian remains and a 6- to 7-foot deposit of white diatomaceous marl (above) that contains plant remains and fresh-water fishes. Occur a few tens of feet above Edson beds. Rhinoceros Hill sands may belong in the channel of the same late Tertiary river system as the Wray beds and the Long Island beds and are probably nearly or quite contemporaneous with them.

Named from Rhinoceros Hill in northwestern part of Wallace County.

Rhoda Creek Formation

Pennsylvanian (Springer Series): South-central Oklahoma.

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), 91–95. Uniformly gray shale; ferruginous concretions (at several horizons) that are locally concentrated in zones or lentils. Thickness at type locality 140 feet. At type locality, overlies Sand Branch member (new) of Caney shale with angular unconformity and underlies an unexposed and unnamed shale interval, which in turn underlies Union Valley formation.

Type locality: NW¼ sec. 8; T. 2 N., R. 7 E., about 1 mile northwest of Frisco; Pontotoc County. Name derived from Rhoda Creek, largest eastern tributary to Clear Boggy Creek.

**Rhode Island Formation**[1]

Pennsylvanian: Eastern Rhode Island and southeastern Massachusetts.

Original reference: J. B. Woodworth, 1899, U.S. Geol. Survey Mon. 33, p. 134, 159–201.

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]. Interfingers with Wamsutta formation in southern part of Pawtucket quadrangle, partly younger than "red beds" of the Wamsutta and partly equivalent to them.

A. W. Quinn, 1952, Bedrock geology of the East Greenwich quadrangle, Rhode Island: U.S. Geol. Survey Geol. Quad. Map [GQ–17]. Underlies large part of East Greenwich quadrangle. Overlies Pondville conglomerate with gradational contact. Wamsutta formation and Pondville conglomerate, as mapped by Emerson (1917) south of Greenwich Bay, R.I., are assigned to this unit. Subdivision of formation in this quadrangle not possible.

D. R. Nichols, 1956, U.S. Geol. Survey Geol. Quad. Map GQ–91. Two units of formation mapped in Narragansett Pier quadrangle, Rhode Island; may include some of Pondville conglomerate south of Pettaquamscutt River. Beds of schistose conglomerate and pebbly sandstone occur on the mainland and on Dutch Island. These are described as glossy gray to dark-gray rocks with intercalated muscovite schist and meta-anthracite. Bedding is variable with crossbedding locally. Pebbles of quartz and quartzite greatly elongate. Stratigraphically higher is the soft fissile phyllite exposed on Conanicut Island. Phyllite is black to light gray and greenish gray with a silvery luster; bedding usually indeterminate.

Named for fact that it includes graphite coal beds of Rhode Island.

Rhodes Canyon Formation

Devonian: Southern New Mexico.

R. H. Flower, 1958, Roswell Geol. Soc. Guidebook, 11th Field Conf., p. 74. Comprises 75 feet of soft shale, the lower part with white marly beds, middle with silty beds, and top with soft thin clay shale. Overlies Thoroughgood formation (new).

F. E. Kottlowski, 1959, Soc. Econ. Paleontologists and Mineralogists, Permian Basin Sec., and Roswell Geol. Soc. Guidebook Joint Field Conf. Apr. 17–18, p. 265–266. Thoroughgood and Rhodes Canyon formations are informal units not yet properly defined. The "Rhodes Canyon" consists of 50 feet of interbedded light- to dark-gray silty fissile shale and dark-gray to brownish-gray micaceous siltstone with some thin tan sandstone beds in Hembrillo Canyon (called Contadero in 1956) and 75 feet of pale- to dark-olive-gray calcareous silty micaceous shale with a few lenses of gray or olive-gray calcareous micaceous siltstone in Rhodes Canyon (called Percha in 1956).

In Rhodes Canyon [San Andres Mountains, Sierra County].

**Rhododendron Formation**[1]

Miocene, upper: Central northern Oregon.

Original reference: E. T. Hodge, 1933, Geol. Soc. America Bull., v. 44, no. 1, p. 157.

D. E. Trimble, 1955, (abs.) Geol. Soc. America Bull., v. 66, no. 12, pt. 2, p. 1667. Formation is now known to overlie middle Miocene Molalla formation of Harper and underlie Troutdale formation of Hodge, originally designated as Pleistocene but referred to lower Pliocene by Chaney in 1944. In northeast-trending outcrop belt about 5 miles wide and 25 to 30 miles long southeast of Portland, formation ranges from about 100 to about 500 feet thick and consists predominantly of hypersthene andesite tuff breccias. Weathering of pre-Troutdale age suggests that Rhododendron formation is no younger than upper Miocene.

Columbia River Gorge. Derivation of name not given.

Rhyolite Canyon Formation

Rhyolite Canyon Series

Cenozoic: Southeastern Arizona.

H. E. Enlows, 1951, Tulsa Geol. Soc. Digest, v. 19, p. 105–107. Series is volcanic sequence made up of rhyolite flows and tuffs. Composite thickness of 1,025 to 1,405 feet. Underlies Sugarloaf series (new); unconformably overlies Faraway Ranch series (new).

H. E. Enlows, 1955, Geol. Soc. America Bull., v. 66, no. 10, p. 1218–1236, pl. 1. Referred to as formation. Most of the rhyolite deposits of Cenozoic age in Chiricahua National Monument, heretofore termed flows, are more correctly classified as welded rhyolite tuff or ignimbrite, the result of many eruptions of nuess ardentes. Beds of formation are pale brown to pinkish gray, darkening to pale brown or grayish red on exposure. All are porphyritic containing phenocrysts of quartz and sanidine. Consists of nine unnamed members of which all but the uppermost member are rhyolites. Upper member of black to medium-dark-gray rhyodacite. Thickness of formation 1,900 feet. [Presumably includes rocks described as Sugarloaf series (Enlows, 1951).] Unconformably overlies Faraway Ranch formation. Traced southward into main portion of Chiricahua Mountains, and apparently crops out all along central and western parts of range, extending eastward into Portal area. Raydon (unpub. thesis) named 4,500 feet of rhyolite tuffs and welded tuffs which cap section in Cave Creek area, the Cave Creek formation, and states they are probably correlative with those of Chiricahua National Monument.

Best exposed in Rhyolite Canyon from which it is named, Chiricahua National Monument, Cochise County.

Ribbon Gneiss[1]

Precambrian (?): Central Washington.

Original reference: A. Waters, 1927, Jour. Geology, v. 35, p. 159–160.

Named for Ribbon Rock, Ribbon Cliff, and Ribbon Mesa, Douglas County.

Rib Hill Formation or Sandstone

Pennsylvanian or Permian: Eastern Nevada.

E. N. Pennebaker, 1932, Mining and Metallurgy, v. 13, no. 304, p. 164. Series of sandstone and sandy limestone about 3,200 feet thick. Lower 1,100 feet consists of medium- and fine-grained sandstone weathering yellow and buff with local patches of red; succeeding 800 feet are made up of lenticular sandy limestone beds; upper part predominantly sandstone. Overlies Ely limestone with no apparent unconformity; underlies Arcturus limestone. Formerly included in Ely limestone. Name credited to Roland Blanchard.

W. H. Easton and others, 1953, Am. Assoc. Petroleum Geologists Bull., v. 37, no. 1, p. 147 (fig. 2). Age of Rib Hill sandstone shown as Permian.

R. K. Hose and C. A. Repenning, 1959, Am. Assoc. Petroleum Geologists Bull., v. 43, no. 9, p. 2170. Pennebaker (1932) in report on Robinson (Ely) mining district, separated a predominantly sandstone unit of Permian age, which he called Rib Hill formation, from beds that were previously mapped at Rib Hill as Ely limestone by Spencer (1917). Present writers [Hose and Repenning] believe that in vicinity of Rib Hill, where exposures are poor, inclusion of this predominant sandstone sequence in the Ely by Spencer was inadvertent and that it should have been included in Arcturus formation.

Grant Steele, 1960, Intermountain Assoc. Petroleum Geologists Guidebook 11th Ann. Field Conf., p. 102–103. Preoccupied name Rib Hill abandoned. Pennebaker's Rib Hill lies stratigraphically above Spencer's (1917, U.S. Geol. Survey Prof. Paper 96) Ely limestone and within Lawson's (1906) Arcturus limestone. Pennebaker placed upper boundary of Rib Hill 2,000 feet above base of previously named Arcturus limestone. Basal 1,000 feet, predominantly sandstone, is distinctive mappable unit. This basal sandstone member of Pennebaker's Rib Hill is herein named Riepetown sandstone.

Present in Robinson mining district west of Ely, White Pine County. Derivation of name not given.

**Rib Hill Quartzite**[1]

Precambrian (middle Huronian?) : Central northern Wisconsin.

Original reference: S. Weidman, 1907, Wisconsin Geol. Nat. History Survey Bull. 16, p. 41.

Exposed on Rib Hill, southwest of Wausau, Marathon County.

Ribolt Clay Shale[1]

Ribolt Member (of Crab Orchard Clay Shales)

Silurian (Niagaran) : Northeastern Kentucky and southwestern Ohio.

Original reference: A. F. Foerste, 1931, Kentucky Geol. Survey, ser. 6, v. 36, p. 171, 172, 173, 189, 202.

R. N. Thomas, chm., 1955, Kentucky Geol. Soc. [Guidebook] Field Trip 1955, p. 31 (fig. 11). Shown on generalized section of Serpent Mound region, Adams and Highland Counties, Ohio, as Ribolt member of Crab Orchard clay shales. Shales with thin dolomite lenses; thickness about 50 feet. Overlies Estill member; underlies Bisher formation.

Type exposure: Ribolt, Lewis County, Ky., 10 miles west of Vanceburg.

**Ricardo Formation**[1]

Pliocene, lower : Southern California.

Original reference: J. C. Merriam, 1914, California Univ. Pubs., Dept. Geol. Bull., v. 8, p. 276, 278.

H. S. Gale, 1946, California Jour. Mines and Geology, v. 42, no. 4, p. 326, 335, 338–350, pl. 52. Described in Kramer borate district where it is divisible into three units or members, post-borate conglomerate (at top), "lake bed" deposits, and Saddleback basalts, which form the base on which the borate-bearing lake beds rest. Approximate thickness 1,500 feet. Unconformably underlies older alluvium; unconformably overlies Rosamond formation.

T. W. Dibblee, Jr., 1952, California Div. Mines Bull. 160, p. 12 (fig. 1), 25–30, pls. 1, 2, 3. Described in Saltdale quadrangle where it is well developed on northwest flank of El Paso Mountains extending from Redrock Canyon northeast through Last Chance Canyon to Black Hills. Consists of a series of continental and lacustrine sediments containing lava flows and tuff of supposed Pliocene age. Maximum exposed thickness 7,000 feet; northeast of Last Chance Canyon, thins to less than 1,000 feet in Black Hills. Separated from underlying Goler formation (new) by pronounced angular unconformity; overlapped by Black Mountain basalt.

T. W. Dibblee, Jr., 1958, Am. Assoc. Petroleum Geologists Bull., v. 42, no. 1, p. 142. Unit defined as Saddleback basalt in Ricardo formation by Gale (1946) is here redefined as formation in Tropico group (new).

Occurs in vicinity of Ricardo, Kern County.

Rices Mudstone Member (of San Lorenzo Formation)

Oligocene (Refugian and Zemorrian): Western California.

E. E. Brabb, 1960, Dissert. Abs., v. 21, no. 5, p. 1163. Overlies Twobar shale member (new). This is type Oligocene of California, although it does not correspond to Oligocene of Europe.

Type section: Along Kings Creek, Big Basin area, Santa Cruz Mountains. Derivation of name not stated.

**Riceville Shale**

Riceville Shale Member (of Chemung Formation)[1]

Upper Devonian: Northwestern Pennsylvania.

Original reference: I. C. White, 1881, Pennsylvania 2d Geol. Survey Rept. $Q_4$.

Wallace de Witt, Jr., 1951, Geol. Soc. America Bull., v. 62, no. 11, p. 1352. In Crawford County, Riceville shale, which is equivalent to uppermost part of Chagrin shale of Ashtabula County, Ohio, consists of interbedded gray silty shale, greenish-gray to tan semifissile to massive mudrock, and white to tan thin- to thick-bedded fossiliferous siltstones. The siltstones are lenticular and cannot be correlated between adjacent exposures. Underlies Cussewago sandstone; where the Cussewago is absent, the Riceville is capped by Corry sandstone.

Well exposed on Oil Creek in bluff just west of Riceville, Crawford County.

Riceville Stage[1] or monothem[1]

Upper Devonian: Northwestern Pennsylvania.

Original reference: K. E. Caster, 1934, Bulls. Am. Paleontology, v. 21, no. 71, table opposite p. 61.

W. M. Laird, 1941, Pennsylvania Topog. and Geol. Survey Prog. Rept. 126, p. 11. Riceville stage listed in Conewango series. Unit termed Sandstone D of Riceville stage will probably be named Jumonville sandstone when more definitive study of area is published.

Riceville is in Crawford County.

**Richard Sandstone Member** (of Pierre Shale)[1]

Upper Cretaceous: Central northern Colorado.

Original reference: M. W. Ball, 1924, Am. Assoc. Petroleum Geologists Bull., v. 8, p. 81–87.

G. R. Scott and W. A. Cobban, 1959, Rocky Mountain Assoc. Geologists 11th Field Conf., Symposium, p. 128–129. Olive-gray massive fine-grained sandstone is characteristic. Large orange-brown calcareous sandstone concretions common. Thickness about 60 feet at Richard Lake and Round Butte.

Exposed along north bank of Richard Lake, sec. 30, T. 8 N., R. 68 E., Larimer County.

Richardson Subgroup[1] (of Wabaunsee Group)

Pennsylvanian (Virgil Series): Southeastern Nebraska, southwestern Iowa, eastern Kansas, northwestern Missouri, and northern Oklahoma.

Original reference: G. E. Condra, 1935, Nebraska Geol. Survey Paper 8, p. 4, 5, 9.

R. C. Moore, 1948, Am. Assoc. Petroleum Geologists Bull., v. 32, no. 11, p. 2035, 2037 (fig. 6); 1949, Kansas Geol. Survey Bull. 83, p. 188; G. E. Condra, 1949, Nebraska Geol. Survey Bull. 16, p. 12–15; F. C. Greene and W. V. Searight, 1949, Missouri Geol. Survey and Water Resources Rept. Inv. 11, p. 20–21. The subgroups named (ascending) Sacfox, Nemaha, and Richardson by Condra (1935) have been included in the interstate classification agreed upon by the Geological Surveys of Iowa, Kansas, Missouri, Nebraska, and Oklahoma. As thus defined the Richardson subgroup in standard section includes (ascending) Wamego shale, Maple Hill limestone, Langdon shale, Dover limestone, Dry shale, Grandhaven limestone, Friedrich shale, Jim Creek limestone, French Creek shale, Caneyville limestone, Pony Creek shale, and Brownville limestone. Nomenclature in the several States may deviate from this by a 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 newly proposed Zeandale formation. This change has been agreed to by the Nebraska and Kansas Geological Surveys which are chiefly concerned. As herein redefined, the Richardson subgroup comprises five formations (ascending): Zeandale limestone, Pillsbury shale, Stotler limestone, Root shale, and Wood Siding formation (with Brownville limestone member at top).

Type locality: Big Nemaha Valley of southern Richardson County, Nebr., between points south of Humboldt and southwest of Falls City.

**Rich Butt Sandstone**

Precambrian (Ocoee Series): Southeastern Tennessee.

P. B. King and others, 1958, Geol. Soc. America Bull., v. 69, no. 8, p. 953 (fig. 2), 955 (table 1), 956 (fig. 3), 960. In type area, characteristic rock is light feldspathic sandstone, medium- to fine-grained and medium- to thick-bedded, that contains sharply contrasting pelitic layers; on Rich Butt Mountain, sandstone is coarser grained and thicker bedded and contains a few lenses of very coarse feldspathic sandstone and fine arkosic conglomerate; locally contains dark argillaceous rocks that are generally thinly and evenly layered and in places are interbedded with fine reddish-weathering ankeritic sandstone. Conformably overlies and somewhat intertongues with Pigeon siltstone of Snowbird group; top of formation cut off by Greenbrier fault; along Big Creek about 3,000 feet of formation is preserved beneath the fault, on Rich Butt Mountain about 1,800 feet.

Type section: Southeast of Mount Cammerer on Big Creek, above community of Mount Sterling, [Cocke County]. Named for Rich Butt Mountain, a northwestern spur of Mount Cammerer, near northeast end of Great Smoky Mountains.

**Richfield Member** (of Lucas Formation)

Middle Devonian: Michigan (subsurface).

K. K. Landes, 1951, U.S. Geol. Survey Circ. 133, p. 7. Term applied to porous dolomite at base of Lucas. In center of basin and on west flank, contains beds of sandstone. Thickness as much as 80 feet.

Named for Richfield (now Au Sable) Township in northern Roscommon County.

Richfield Quarry Shale Member (of Drum Formation)

Pennsylvanian (Missouri Series): Eastern Nebraska and south-central Iowa.

G. E. Condra, 1949, Nebraska Geol. Survey Bull. 16, p. 37. Consists of grayish shale and dark fissile shale. Thickness 1 to 1½ feet in Sarpy County, Nebr., and south-central Iowa, and may pinch out southward. Underlies Cement City member; overlies P. W. A. Quarry limestone member (new).

Type locality: Richfield quarry located in Platte Valley bluffs 2½ miles south of Richfield, Sarpy County, Nebr.

Rich Fountain Formation (in Jefferson City Group)

Lower Ordovician: Northern Arkansas and southern Missouri.

J. S. Cullison, 1944, Missouri Univ. School Mines and Metallurgy Bull., Tech. Ser., v. 15, no. 2, p. 15, 17–24, pl. 2. Massive to thin-bedded white to buff to gray fine-grained argillaceous to coarsely crystalline dolomite; thin buff to brown dolomitic sandstone lenses and layers abundant; chert commonly dull white to brown massive or nodular to thin lenticular; lower part predominantly thick-bedded coarsely crystalline dolomite here named School Mine ledge bed; upper part predominantly argillaceous dolomite. Thickness 140 to 180 feet. As defined, name replaces the Jefferson City (restricted) of Grawe and Cullison (1931, Jour Geology, v. 39, no. 4) except that slightly younger rocks are included in new unit; also includes lower part of Jefferson City dolomite of Winslow (1894). Unconformably underlies Theodosia formation (new); unconformably overlies Roubidoux formation.

Type section: Near Rich Fountain, Osage County, Mo.

**Rich Hill Limestone Member** (of Cherokee Shale)[1]

Pennsylvanian (Des Moines Series): Central western Missouri.

Original reference: F. C. Greene and W. F. Pond, 1923, Missouri Bur. Geology and Mines, v. 19, 2d ser., p. 37, 51–53.

Named for occurrence at Rich Hill, Bates County.

**Richland Formation** (in Conococheague Group)

Richland 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. Dolomite sequence that stratigraphically overlies Millbach member (new); top is drawn at base of first thick bed of medium-light-gray limestone containing crinoid fragments and other fossils; contact with Ordovician Stonehenge formation concealed. Basal part of member consists of thick-bedded medium-light- to medium-dark-gray finely crystalline dolomite that is in part laminated and contains beds of edgewise conglomerate and calcarenite; *Cryptozoon* present at two horizons in lower 120 feet of beds. Chert, which is frequently oolitic, and oolitic medium-gray limestone interbeds occur in the more limy center of member. Upper part of member reflects cyclic sedimentation, medium-gray siliceous dolomites are repeated at least 12 times; these beds are usually overlain by limy dolomite, magnesian limestone, or banded limestone and dolomite; the bands are often broken into conglomerate; above this are typically medium-gray to light-gray dolomites with shaly partings or bands; the cycle then begins again with siliceous dolomite. Total thickness of member probably in excess of 1,300 feet; approximately 1,264 feet at type section with base not exposed.

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: Along Reading Railroad about one-fourth mile east of Richland and along road immediately west of Sheridan, Lebanon County.

Richland Limestone and Flint[1]

Mississippian: Southeastern Ohio.

Original reference: E. Orton, 1878, Ohio Geol. Survey, v. 3, pl. opposite p. 933.

Probably named for Richland, Vinton County.

Richland Loess

Pleistocene (Wisconsinan): Northern Illinois.

J. C. Frye and H. B. Willman, 1960, Illinois Geol. Survey Circ. 285, p. 7, 11. Name applied to loess that lies on Shelbyville till and successively younger Woodfordian moraines. Thickness about 8 feet; lower 3 feet calcareous and fossiliferous. Woodfordian substage. Has been commonly referred to as Tazewell loess.

M. M. Leighton, 1960, Jour. Geology, v. 68, no. 5, p. 546. Classification presented of Wisconsin glacial stage of north-central United States. Consideration also given to other classifications including one proposed by Frye and Willman. Name Richland loess proposed by Frye and Willman considered superfluous.

Named from exposures in east bluff of Illinois Valley north of Richland Creek in roadcut in NW¼SE¼SW¼ sec. 11, T. 28 N., R. 3 W., Woodford County.

†Richland Sandstone[1]

Pennsylvanian: Central Texas.

Original reference: E. T. Dumble, 1890, Texas Geol. Survey 1st Ann. Rept., p. lxv, pl. 3.

Named for Richland Creek, San Saba County.

†Richmond earth[1]

Miocene: Eastern Virginia and eastern Maryland.

Original reference: W. B. Clark, 1897, Maryland Geol. Survey, v. 1, p. 197.

Can be traced from Eastern Shore of Maryland entirely across the State and thence southward into Virginia. Probably named from its wide occurrence in vicinity of Richmond, Henrico County, Va.

**Richmond Group**[1] or **Formation**

Richmond Formation (in Cincinnati Group)

Upper Ordovician: Indiana, Illinois, Kentucky, Michigan, Missouri, southwestern Ohio, and West Virginia.

Original reference: N. H. Winchell and E. O. Ulrich, 1897, Minnesota Geol. and Nat. History Survey Final Rept., v. 3, pt. 2, p. ciii.

Tracy Gillette, 1940, New York State Mus. Bull. 320, p. 17–23. Group, in Clyde and Sodus Bay quadrangles, contains Queenston shale; base of Queenston not exposed in area. Underlies Whirlpool sandstone and Grimsby sandstone of Silurian Albion group.

Wilber Stout, Karl Ver Steeg, and G. F. Lamb, 1943, Ohio Geol. Survey, 4th ser., p. 110, 113–114, chart facing p. 108. Group in Ohio comprises (ascending) Arnheim, Waynesville, Liberty, and Whitewater formations. Thickness about 265 feet. Overlies Maysville group; underlies Silurian Medina group (top of which is Elkhorn formation).

C. W. Wilson, Jr., 1949, Tennessee Div. Geology Bull. 56, p. 201–239. Discussion of pre-Chattanooga stratigraphy in central Tennessee. Richmond group comprises (ascending) Arnheim formation, Sequatchie formation, Fernvale limestone, and Mannie shale. Overlies Maysville group; underlies Brassfield limestone of Silurian Medinan series.

H. P. Woodward, 1951, West Virginia Geol. Survey, v. 21, p. 27, 28, 32, 113, 327, 330. Group comprises Oswego sandstone and Juniata formation. Overlies Maysville group which here includes Martinsburg formation. Rock units here called Juniata and Oswego have previously been described in West Virginia reports as "Red Medina" and "Gray Medina," respectively.

R. C. Hussey, 1952, Michigan Dept. Conserv., Geol. Survey Div. Pub. 46, Geol. Ser. 39, p. 13, 14. Richmond comprises (ascending) Bills Creek, Stonington, and Big Hill members. Some beds formerly included in Bills Creek are included in Haymeadow Creek member (new) of Trenton formation.

J. B. Patton, T. G. Perry, and W. J. Wayne, 1953, Indiana Geol. Survey Field Conf. Guidebook 6, pl. 1. Group comprises (ascending) Waynesville, Liberty, Saluda, Whitewater, and Elkhorn formations. Overlies Maysville group, top of which is Arnheim formation; underlies Medina group (Brassfield formation). Cincinnatian series.

W. H. Twenhofel and others, 1954, Geol. Soc. America Bull., v. 66, no. 3, p. 247–298, chart 2; Marshall Kay, 1960, Internat. Geol. Cong., 21st, Copenhagen, pt. 7, p. 28–33. Cincinnatian series comprises (ascending) Edenian, Maysvillian, Richmondian, and Gamachian stages.

A. M. Gutstadt, 1958, Am. Assoc. Petroleum Geologists Bull., v. 42, no. 3, p. 518–521. Term Cincinnati group revived to include (ascending) Eden shale, Maysville formation, and Richmond formation.

W. N. Melhorn, 1958, Am. Assoc. Petroleum Geologists Bull., v. 42, no. 4, p. 819 (fig. 1). As shown on generalized stratigraphic section of Southern Peninsula, Mich., Richmond formation comprises (ascending) Utica shale, Lorraine shale, and Queenston shale. Underlies Cataract formation.

W. C. Sweet and others, 1959, Jour. Paleontology, v. 33, no. 6, p. 1029–1030. In Cincinnati region, Arnheim, Waynesville, Liberty, Whitewater, and Elkhorn formations [of Richmond group] define Richmond stage of the Cincinnatian. Richmond stage succeeds Maysville stage. Covington group contains standard sections of both Eden and Maysville stages.

Named for Richmond, Ind.

Richmond or Richmondian Stage

*See* **Richmond Group** or **Formation.**

Richmondville Sandstone[1]

Mississippian: Michigan.

Original reference: A. C. Lane, as reported by M. E. Wadsworth, 1893, Michigan Geol. Survey Rept. 1891–1892, p. 66.

Named for exposures at Richmondville, Sanilac County.

Rich Mountain Conglomerate (in Pottsville Group)[1]

Pennsylvanian: Northern West Virginia.

Original reference: D. B. Reger, 1918, West Virginia Geol. Survey Rept. Barbour and Upshur Counties, p. 292.

Named from its exposure along Rich Mountain Range.

Rich Valley Formation

Middle Ordovician: Southwestern Virginia.

G. A. Cooper, 1956, Smithsonian Misc. Colln., v. 127, pt. 1, p. 86–87, chart 1 (facing p. 130). Consists of black and chocolate-brown shales, which contain graptolites, brachiopods, and trilobites. Ranges in thickness from a few feet to 350 feet. Overlies Arline formation (new); underlies Chatham Hill formation (new). Beds herein defined as Rich Valley are the lower and characteristic part of a unit widely identified by Butts, Decker, and others as Athens shale. Rich Valley corresponds to lower part of Liberty Hall black limestone-black shale succession of central western Virginia. Name credited to B. N. Cooper and G. A. Cooper.

Type section: Immediately south of Porterfield quarry and Worthy mine of Mathieson Chemical Corp., about 7 miles east-southeast of Saltville on Maccrady quadrangle, Smyth County.

Richville Formation

Pleistocene, upper: Northeastern Arizona.

G. K. Sirrine, 1959, Dissert. Abs., v. 19, no. 8, p. 2064. Incidental mention.

Springerville-St. Johns area, Apache County.

Rickard facies (of Schoharie Formation)

Lower or Middle Devonian: East-central New York.

J. H. Johnsen, 1957, Dissert. Abs., v. 17, no. 10, p. 2247. Schoharie formation redefined. Includes Carlisle Center (lower) facies, Rickard facies (new), and Leeds facies. Richard facies overlies Carlisle Center facies and corresponds to Schoharie formation of Vanuxem (1840). Rickard facies passes eastward into Leeds facies.

**Rickenbach Dolomite** (in Beekmantown Group)

Rickenbach Formation (in Beekmantown Group)

Lower Ordovician: Southeastern Pennsylvania.

J. P. Hobson, Jr., 1957, Am. Assoc. Petroleum Geologists Bull., v. 41, no. 12, p. 2713, 2715–2719. Proposed for thick- to thin-bedded fine-grained and coarse-grained dolomite overlying Stonehenge limestone and underlying interbedded limestone and dolomite here referred to as Epler formation. Upper and lower contacts transitional. Consists of two unnamed members, an upper fine-grained and a lower coarse-grained. Total thickness about 580 feet. Type sections for both members given.

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. Described in Lebanon County where it is about 335 feet thick, base not exposed.

Type sections: Lower member, cut along west side of Reading Co.'s railroad tracks beginning about 1,000 feet south of crossing at Rickenbach, Berks County; upper member, on southwest bank of Schuylkill River one-half mile east by northeast of Epler School.

Ricker Limestone

*See* Ricker Station Limestone.

**Ricker Sandstone Member** (of Mineral Wells Formation)[1]

Ricker Conglomerate

Middle Pennsylvanian: Central Texas.

Original reference: N. F. Drake, 1893, Texas Geol. Survey 4th Ann. Rept., pt. 1, p. 374, 386.

C. O. Nickell, 1938, Texas Univ. Bur. Econ. Geology Pub. 3801, p. 92–94, 98. Ricker member, on State Highway 7, 6 miles east of Brownwood, near type locality, consists of 6 feet of conglomerate and an estimated 20 feet of sandstone beneath it. Conglomerate is irregularly stratified, coarse sandstone and conglomerate grading upward into brown sandstone; contains some dense hard fossiliferous limestone pebbles 3 inches or less in diameter, and many small pebbles of chert—red, brown, yellowish, white, purple, gray, black, and green. In Brownwood area; separated from overlying Capps limestone member by 30 feet of gray shale, near base of which is small coral reef.

M. G. Cheney, chm., 1949, Abilene Geol. Soc. [Guidebook], p. 8 (chart), 17. At Stop No. 5, Ricker conglomerate, 5 feet thick, overlies about 25 feet of sandstone. Type locality of Ricker conglomerate is on hill about 1.3 miles to the southeast. About 100 feet below Ricker conglomerate and one-fourth mile southwest of Ricker Station is a 3-foot limestone with abundant fusulinids and other fossils. Correlation of Ricker conglomerate with Brazos River conglomerate and Ricker Station limestone with Goen limestone of Palo Pinto County appears plausible.

M. G. Cheney, chm., 1950, Abilene Geol. Soc. Guidebook Nov. 2–4, p. 13. Road log refers to Ricker conglomerate (Drake's bed no. 23 [Ricker bed]) which is correlated with Brazos River sandstone and conglomerate.

D. H. Eargle, 1960, U.S. Geol. Survey Prof. Paper 315–D, p. 61, pl. 27. Drake's Ricker bed, which he placed at top of his Strawn division, is separated from underlying Ricker Station limestone of Cheney by 50 to 70 feet of interbedded gray shale and sandstone. Drake (1893) stated that the sandstone and conglomerate of his Ricker bed caps an isolated butte north of Ricker Station, 5½ miles east of Brownwood. Other exposures, he said, were along west side of Steppes Creek and along crest of high escarpment west of Pecan Bayou. Nickell (1938) correlated a bed of sandstone along Colorado River, 5 to 9 miles east of Winchell, with this unit. In his stratigraphic section in Brownwood area, Nickell placed the Ricker sandstone in Mineral Wells formation. Best exposure of basal sandstone of Ricker bed of Drake is in cut on recently relocated Fort Worth division of Gulf, Colorado, and Santa Fe Railroad, 5 miles east of courthouse at Brownwood and 0.3 of a mile south of U.S. Highway 84 in spur in west valley wall of Steppes Creek. At this locality, the bed is a 25- to 35-foot brown sandstone containing chert pebbles. It irregularly overlies 17 feet of greenish-gray shale. Lower part of the Ricker in this cut locally occupies channels cut 10 to 12 feet into underlying shales. Top of the conglomeratic Ricker sandstone member is in face of a borrow pit north of crossing of Santa Fe Railroad on military road to Camp Bowie, 2 miles south of this junction with U.S. Highway 84. Shales of Ricker sandstone member of Nickell is separated from Capps limestone lentil of Moore and Plummer by gray silty shale.

Named for Ricker post office, near Brownwood, Brown County.

Ricker Station Limestone (in Lone Camp Group)

Ricker Station Limestone Member (of Grindstone Creek Formation)

Pennsylvanian: Central Texas.

M. G. Cheney, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 1, p. 66 (fig. 1). Ricker limestone shown on correlation chart as member at top of Grindstone Creek formation (Goen limestone-Ricker limestone). Occurs above Santo limestone member.

Gayle Scott and others, 1941, *in* West Texas Geol. Soc. [Guidebook] Spring Field Trip, p. 24. Following correlation now seems well established both by paleontology and well-log cross sections: Ricker Station limestone (Colorado River Valley) with Goen-Santo limestone (Brazos River Valley). In the column, Ricker Station limestone occurs below Ricker-Rochelle conglomerate which is said to rest on limestone of Big Saline group, 70 miles southwest of Palo Pinto County.

M. L. Thompson, 1945, Am. Jour. Sci., v. 243, no. 8, p. 453. Collection made from highly arenaceous limestone near depot at Ricker. This limestone, commonly known as Ricker limestone, occurs immediately below Ricker conglomerate sandstone, that is, in lower part of Drake's (1893, Texas Geol. Survey, 4th Ann. Rept. pt. 1) Ricker bed.

M. G. Cheney and others, 1949, Abilene Geol. Soc. [Guidebook], p. 8 (chart), 17. About 100 feet below Ricker conglomerate and one-fourth mile southwest of Ricker Station is a 3-foot limestone with abundant fusulinids and other fossils. Correlation of Ricker conglomerate with Brazos River conglomerate and Ricker Station limestone with Goen limestone of southeastern Palo Pinto County appears plausible.

M. G. Cheney, chm., 1950, Abilene Geol. Soc. Guidebook Nov. 2–4, p. 14. Stop No. 2 on road log is at Ricker Station limestone; thickness 2 feet; contains fusulinids and gastropods. Overlies a well-bedded sandstone. This thin limestone and sandstone section evidently belongs in Drake's (1893) Indian Creek shale (No. 22). Type locality mentioned.

M. G. Cheney and D. H. Eargle, 1951, Geologic map of Brown County, Texas (1:62,000): Texas Univ. Bur. Econ. Geology. Columnar section shows Ricker Station limestone in Lone Camp group below Ricker sandstone.

D. H. Eargle, 1960, U.S. Geol. Survey Prof. Paper 315–D, p. 60, pl. 27. Limestone unit that Cheney called Ricker Station limestone was listed by him (1940) as Ricker limestone in his table of Paleozoic strata but not described. He listed it again in 1949 in a similar table but called it Ricker Station limestone apparently to avoid confusion with Ricker bed described by Drake (1893). The limestone, although discontinuous, is an important stratigraphic unit. It is lowermost limestone bed of Strawn group in Colorado River valley. Outcrop of the Ricker Station limestone is indicated by scattered blocks of limestone as much as 3 feet across in a pasture 0.1 mile south of road crossing at Ricker Railroad siding, 5½ miles S. 76° E. of courthouse at Brownwood on the Gulf, Colorado, and Santa Fe Railroad. Limestone traced discontinuously for 5 miles southwest of this locality but has not been found to northeast. Where well exposed on face of cuesta locally called Six-Mile Mountain (6 miles southeast of Brownwood Courthouse), the unit is a 4-foot-thick bed of grayish-brown limestone containing fine-grained sand; fusulinids abundant. Limestone is overlain by 12 feet of greenish-gray clay. Drake's Ricker bed, which he placed at top of his Strawn division, is separated from underlying Ricker Station limestone by 50 to 70 feet of interbedded gray shale and sandstone.

Type locality: Three and one-half miles northeast of Stop No. 2, Brown County. [This would be approximately at Ricker.]

**Rico Formation**[1]

Rico Member (of Cutler Formation)

Pennsylvanian and Permian: Southwestern Colorado, northwestern New Mexico, and southeastern Utah.

Original reference: W. Cross, 1899, U.S. Geol. Survey Geol. Atlas, Folio 57.

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. Underlies Halgaito tongue or member (new) of Cutler formation.

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 Rico formation" overlying "type of sediments like Hermosa formation."

L. G. Henbest, 1948, (abs.) Geol. Soc. America Bull., v. 59, no. 12, pt. 2, p. 1329–1330. Species of *Fusulina* in Rico indicates middle, or possibly upper, Des Moines age. *Triticites* sp. from Rico of Moab region. Utah indicates that Rico of that region is of upper Pennsylvanian age. Thus, evidence indicates that type Rico is of Des Moines age and the transition facies of the Rico rises in time scale toward west and southwest.

S. A. Wengerd, 1951, Am. Assoc. Petroleum Geologists Bull., v. 35, no. 5, p. 1041–1042, 1044 (fig. 5). In San Juan Canyon, Utah, gradationally overlies Hermosa formation. Considered transitional from Late Pennsylvanian to early Permian.

S. A. Wengerd and J. W. Strickland, 1954, Am. Assoc. Petroleum Geologists Bull., v. 38, no. 10, p. 2174–2175. Rico, transitional between Hermosa marine strata below and Cutler continental strata above is here considered basal member of Cutler. It is not a mappable unit of any stratigraphic constancy over a wide area and probably should not be called a formation.

George Herman and S. L. Sharps, 1956, Intermountain Assoc. Petroleum Geologists [Guidebook] 7th Ann. Field Conf., p. 81. Writers disagree with Wengerd and Strickland (1954) in considering Rico as basal facies of Cutler. It is unfortunate that type section lies within area of continuous sedimentation across Permo-Pennsylvanian boundary because, in center of embayment where time break is present, the so-called transition series lies beneath unconformity. In Rico quadrangle, the unit is of Des Moines age, equivalent to post-salt Des Moines upper Hermosa of southern part of embayment and to uppermost saline and penesaline sequence in northern part of Paradox Salt embayment.

S. A. Wengerd and M. L. Matheny, 1958, Am. Assoc. Petroleum Geologists Bull., v. 212, no. 9, p. 2054, 2056 (fig. 3). New terminology shows Rico transition facies at base of Cutler group. Transitional between Hermosa group below and Halgaito formation.

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.

Named for exposures in Rico Mountains, Colo.

**Riddle Formation** (in Myrtle Group)

Upper Jurassic: Southwestern Oregon.

R. W. Imlay and others, 1959, Am. Assoc. Petroleum Geologists Bull., v. 43, no. 12, p. 2774–2782. Introduced for clastic sedimentary rocks of Late Jurassic (Portlandian) age in southwestern Oregon. Consists mostly of medium- to dark-gray siltstone in which pebble lenses are common. Where well exposed, divisible into two members: a lower, of medium- to dark-gray siltstone in which pebble lenses and limestone lenses are common, chert conglomerate locally at top; conglomerate and metavolcanics locally at base; and an upper, dominantly medium-gray siltstone, sandstone beds fairly common; limestone lenses few; conglomerate of chert and graywacke common at top. Thickness about 1,088 feet. Underlies Days Creek formation (new) with probable disconformity; overlies Rogue formation near Days Creek and in valley of Myrtle Creek; overlies Dothan formation in Dutchman Butte, Roseburg, and Bone Mountain quadrangles. Name Riddle replaces Jurassic part of Knoxville formation as used by Diller and Kay (1924, U.S. Geol. Survey Geol. Atlas, Folio 218) in southwestern Oregon.

Type section: About 10 miles east of Riddle along South Umpqua River from ½ to 1 mile above mouth of Days Creek in E½ sec. 16 and W½ sec. 15, T. 30 N., R. 4 W., Douglas County. Named for town of Riddle. Well exposed in valley of South Umpqua River and its tributaries, Days

Creek, Cow Creek, and Myrtle Creek, in Days Creek, Canyonville, Roseburg, and Dutchman Butte quadrangles.

**Riddlesburg Shale Member** (of Pocono Formation)[1]

Mississippian: Western Pennsylvania and southwestern Virginia.

Original reference: D. B. Reger, 1927, Geol. Soc. America Bull., v. 38, p. 156–157, 397–410.

W. M. Laird, 1941, Am. Assoc. Petroleum Geologists Bull., v. 25, no. 1, p. 161–163. Name Riddlesburg shale extended to cover basal Mississippian beds along Allegheny front from Altoona, Pa., southward to U.S. Route 30.

Type section: One and one-half miles north of Riddlesburg, Bedford County, Pa.

**Ridenhower Shale**[1]

Ridenhower Member (of Paint Creek Formation)

Upper Mississippian (Chester Series): Southeastern Illinois and western Kentucky.

Original reference: Charles Butts, 1917, Mississippian formations of western Kentucky: Kentucky Geol. Survey, pt. 1, p. 73.

Elwood Atherton and D. H. Swann, 1948, (abs.) Am. Assoc. Petroleum Geologists Bull., v. 32, no. 2, p. 300. Lower Chester formations are correlated in western Illinois, the subsurface of southeastern Illinois basin, Hardin County, Ill., and Indiana. Paint Creek of southern and western Illinois is divided into three members: upper limestone and shale zone, named Ridenhower member and correlated with "Paint Creek" of southeastern Illinois; middle sandstone and shale zone correlated with Bethel sandstone of southeastern Illinois; and a lower "pink crinoidal limestone" correlated with upper part of "Renault" formation and called Downeys Bluff member in southeastern Illinois. Correlations credited to F. E. Tippie (unpub. ms.).

A. H. Sutton and W. A. Oesterling, 1952, Am. Assoc. Petroleum Geologists Bull., v. 36, no. 9, p. 1786. Paint Creek was named by Weller (1913) from exposures in southwestern Illinois. Name Ridenhower was applied by Butts (1917) to same part of Chester section, the shale between the Bethel and Cypress sandstones in Fluorspar district.

Named for Ridenhower, Johnson County, Ill.

Ridge Formation

*See* Ridge Route Formation.

Ridge Basin Group

Miocene, upper, and Pliocene: Southern California.

D. I. Axelrod, 1950, Carnegie Inst. Washington Pub. 590, p. 161, 165–168, pl. 1. Name applied to a section of sediments, about 22,000 feet thick, that crop out on U.S. Highway 99 between Los Angeles and Bakersfield. Wide variety of clastics is represented, ranging from marginal fanglomerates to finely bedded calcareous shales. Sediments form an asymmetrical syncline plunging northwestward, with the axis lying just east of the highway. Apparently includes (ascending) French Flat sandstone (new), Piru Gorge sandstone (new), Peace Valley beds, and Hungry Valley formation.

J. C. Crowell, 1954, California Div. Mines Bull. 170, map sheet 7. In mapped area, includes Violin breccia (new), 27,000 feet thick, and Hungry Valley formation, 4,500 feet thick. Conformably overlies Castaic formation (new) with interfingering contact that is marked by an abrupt upward increase in the proportion of sandstone beds.

Well exposed in region 5 miles north of Castaic to vicinity of Gorman about 20 miles northwestward, Los Angeles County.

**Ridgeley Sandstone** (in Oriskany Group)[1]

Ridgeley Sandstone Member (of Oriskany Formation)

Lower Devonian: Eastern West Virginia, central Pennsylvania to central western Virginia.

Original reference: C. K. Swartz and others, 1913, Maryland Geol. Survey Lower Devonian vol., p. 92, table facing p. 30.

B. N. Cooper, 1944, Virginia Geol. Survey Bull. 60, p. 130–132, pl. 14. Thickness about 4 feet in Burkes Garden quadrangle. Overlies Rocky Gap sandstone; underlies Huntersville chert.

H. P. Woodward, 1948, West Virginia Geol. Survey, v. 15, p. 32, 130–149, 278–306. Ridgeley sandstone replaces Oriskany "sandstone" of previous reports. Maximum thicknesses—275 to 350 feet—occur in Hampshire and Morgan Counties. Overlies Port Jervis limestone of Helderberg group. Underlies Huntersville chert or in some areas Needmore shale.

Ernst Cloos, 1951, Maryland Dept. Geology, Mines and Water Resources [Rept. 14] Washington County, p. 86–87. Member of Oriskany formation. Overlies Shriver chert member. Underlies Romney shale.

F. G. Lesure, 1957, Virginia Polytech. Inst. Bull., Expt. Sta. Ser. 118, p. 52–53, pl. 1. Described in Clifton Forge district. Thickness 2 to 25 feet. Overlies Licking Creek sandstone; underlies Needmore shale.

Carlyle Gray and others, 1960, Geologic map of Pennsylvania (1:250,000): Pennsylvania Geol. Survey, 4th ser. Oriskany formation, as mapped, includes Ridgeley sandstone at top and Shriver chert below.

Named for Ridgeley, W. Va.

Ridge Route Formation

Miocene, upper, or Pliocene, lower: Southern California.

Thomas Clements, 1937, Am. Assoc. Petroleum Geologists Bull., v. 21, no. 2, p. 217 (fig. 1), 218. Continental beds consisting of rather well-bedded sandstones and shales with many beds of conglomerate. Overlies Modelo with slight angular discordance; underlies Saugus formation.

L. R. David, 1945, Jour. Paleontology, v. 19, no. 3, p. 315. Paleontological evidence indicates that age may be Pliocene or upper Miocene.

Peter Dehlinger, 1952, California Div. Mines Spec. Rept. 26, p. 6–8, pl. 1. Ridge Route formation, as exposed in area of study, consists of about 5,050 feet of sediments. Contact with underlying Modelo is not a sharp break. Ridge Route beds have been folded concordantly with the Modelo strata into the northwestward plunging Ridge Basin syncline.

Occurs in southeastern part of Tejon quadrangle.

**Ridgetop Shale**[1]

Lower Mississippian: Western Tennessee.

Original reference: E. O. Ulrich, 1911, Geol. Soc. America Bull., v. 22, pl. 29.

C. W. Wilson, Jr., and E. L. Spain, Jr., 1936, Am. Assoc. Petroleum Geologists Bull., v. 20, no. 6, p. 805–809. From stratigraphic and paleontologic evidence, it is believed that "Ridgetop shale" is not separate formation and that strata previously assigned to the "Ridgetop" are only a phase of the New Providence. If beds of Kinderhook age (other than probably the Chattanooga shale) are present in central Tennessee, they are not represented in beds formerly separated as "Ridgetop shale."

J. M. Weller and others, 1948, Geol. Soc. America Bull., v. 59, no. 2, p. 164. New Providence and Ridgetop shales, as locally recognized, appear to be slightly different developments of beds of same age.

W. H. Hass, 1956, U.S. Geol. Survey Prof. Paper 286, p. 33. At type locality, overlies Maury formation.

Type section: Outcrops along Louisville and Nashville Railroad between Bakers Station in Davidson County, and Ridgetop in Robertson County.

†Ridgway shale member[1]

Devonian or Carboniferous: Northwestern Pennsylvania.

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

**Ridgway Till**[1]

Ridgway Conglomerate

Ridgway Glacial Epoch[1]

Paleocene: Southwestern Colorado.

Original reference: W. W. Arnold, 1915, U.S. Geol. Survey Prof. Paper 95, p. 16, map.

E. S. Larsen, Jr., and Whitman Cross, 1956, U.S. Geol. Survey Prof. Paper 258, p. 14, 58, 59. Near Ridgway, the till is made up of two members; lower, as much as 100 feet thick, is typical glacial till; upper overlies erosional surface of lower and is clay with small pebbles. In all areas, overlies Mancos shale or older rocks; in Ridgway area, underlies Telluride conglomerate; near Gunnison, underlies San Juan tuff or other volcanic rocks. Now considered to be Paleocene.

F. B. Van Houten, 1957, Geol. Soc. America Bull., v. 68, no. 3, p. 385–388. Referred to as Ridgway conglomerate. On stratigraphic evidence, the Ridgway is a general correlative of the Upper Cretaceous and lower Paleocene Animas formation; on lithologic evidence, it is as reasonably a mudflow and stream deposit as it is a tillite.

Type locality: One mile west of Ridgway, Ouray County.

**Ridley Limestone** (in Stones River Group)[1]

Middle Ordovician: Central Tennessee.

Original reference: J. M. Safford, 1869, Geology of Tennessee, p. 258–267.

C. W. Wilson, Jr., 1949, Tennessee Div. Geology Bull. 56, p. 2 (fig. 1), 34–39. Predominantly gray limestone that is locally bluish or dove color; beds are massive, many ranging from 4 inches to 4 feet in thickness; between 20 and 35 feet above base of formation is a thin-bedded member about 10 feet thick that consists of beds ½ to 4 inches in thickness; chert is common and consists of (1) stringers, nodules, and blebs of dense black or dark-brown chert and (2) irregular masses of brown to light-brown or white chert. Thickness at type locality—herein designated—95 feet; in southern part of Rutherford County 115 feet. Underlies Lebanon limestone; overlies Pierce limestone.

Type section: Beginning in river bluff a short distance downstream from Davis mill and continuing across Jefferson-Lascassas Road and along secondary road to south and up hill on west side of road behind first house on right. Safford named limestone for exposures at Judge Ridley's mill near old Jefferson. Name has now been changed to Davis mill which is located 0.7 mile east of Jefferson on Jefferson-Lascassas Road in north-central Rutherford County.

Ridley Park Granodiorite

Age unknown: Southeastern Pennsylvania.

A. W. Postel, 1940, (abs.) Geol. Soc. America Bull., v. 51, no. 12, pt. 2, p. 2004–2005; 1941, Acad. Nat. Sci. Philadelphia Proc., v. 92, p. 125–133. Igneous rocks in Wissahickon schist in Philadelphia region originated in two ways: definite magmatic intrusions into Wissahickon and hydrothermal replacement of Wissahickon by potash and soda-rich solutions. Ridley Park granodiorite and Springfield aplitic granodiorite are products of magmatic intrusion; Springfield porphyroblastic granodiorite is product of hydrothermal reaction. Precise chronological position cannot be assigned as age of Wissahickon is in doubt. Relative age sequence is considered to be (oldest to youngest) metagabbro, Springfield porphyroblastic granodiorite, Springfield aplitic granodiorite, and Ridley Park granodiorite. Ridley Park occurs typically as conformable bodies from 2 to 100 feet in width, intrusive into Wissahickon schist parallel to the schistosity.

Area mapped is roughly rectangular, bounded on northwest by Narbeth, on northeast by Manayunk, on southwest by Chester, and on southeast by Philadelphia. Town of Ridley Park is in Delaware County.

Riepe Spring Limestone

Permian (Wolfcampain): East-central Nevada and western Utah.

Grant Steele, 1960, Intermountain Assoc. Petroleum Geologists Guidebook 11th Ann. Field Conf., p. 93 (chart 1), 102. Name given to massive coralline and fusulinid-bearing limestones originally included in Ely limestone by Spencer (1917) and by Pennebaker (1932) but restricted from Ely in present paper at type locality. Riepe Spring is 410 feet thick and is underlain by South Ridge sandstone (new) and overlain by Riepetown sandstone (new). On north side of Rib Hill, in Ruth mining district, upper 300 feet of Ely limestone, as described by Spencer (1917), is assigned to Riepe Spring; here unit rests disconformably on Ely (restricted) with no development of South Ridge sandstone separating the formations. Recognized in Carbon Ridge area south of Eureka, unit is 618 feet thick and rests on unnamed sequence of calcareous silts and mudstones and is overlain by Riepetown sandstone. Beds here assigned to Riepe Spring, plus underlying silts and mudstones, and overlying sands of Riepetown and limestones of Pequop formation were named Carbon Ridge formation by Nolan (1956). Riepe Spring is present in Confusion Range, Utah, where it was included in Ely limestone by Hose and Repenning (1959). In Tooele County, Utah, overlies Oquirrh formation.

Type section: At north end of Ward Mountain, SE¼ sec. 7, T. 15 N., R. 63 E., White Pine County, Nev. Name derived from Riepe Spring in SE¼SE¼ sec. 36, T. 16 N., R. 62 E.

Riepetown Sandstone (in Carbon Ridge Group)

Permian (Wolfcampian) : East-central Nevada and western Utah.

Grant Steele, 1960, Intermountain Assoc. Petroleum Geologists Guidebook 11th Ann. Field Conf., p. 93 (chart 1), 103. Name applied to basal sandstone member of Pennebaker's (1932) "Rib Hill" formation (herein abandoned). Thickness 1,008 feet at type locality where it consists of pale yellowish-gray, very fine to medium-grained, rounded to subrounded, platy to thick-bedded quartz sandstone which weathers brownish red and yellowish tan. Overlies Riepe Spring limestone (new) ; underlies Arcturus formation. At Moorman Ranch, Riepetown is about 1,200 feet thick, conformably overlies Riepe Spring limestone and underlies Moorman Ranch facies of Pequop formation. Identified in Utah. Hose and Repenning (1959) did not apply "Rib Hill" to beds in Confusion Range, but used Lawson's Arcturus limestone for those rocks stratigraphically above Riepe Spring limestone (referred to as Ely by them) and below Kaibab formation.

Type section: At Rib Hill, NW¼ sec. 21, T. 16 N., R. 62 E., White Pine County, Nev. Name derived from village of Riepetown, about 2 miles north-northwest of Rib Hill.

**Rierdon Formation** (in Ellis Group)

Rierdon Formation (in Sundance Group)

Upper Jurassic: Montana, South Dakota, and Wyoming.

W. A. Cobban, 1945, Am. Assoc. Petroleum Geologists Bull., v. 29, no. 9, p. 1264 (fig. 1), 1277–1281, strat. sections. Name applied to group of alternating gray limy shales and limestones overlying Sawtooth formation (new) and disconformably underlying Swift formation (new). At type locality, consists of (ascending) 20½ feet of medium-gray chunky limy shale containing a few dense gray nodular limestones, 33½ feet of dark-medium-gray fissile calcareous to almost noncalcareous shale containing thin beds of gray dense nodular limestone, 43½ feet of medium-gray chunky shale containing a few thin beds of limestone in lower part, and 39 feet of alternating 4- to 6-inch limestone layers and thicker beds of medium-gray chunky limy shale. At type locality, lower part of formation is of upper Bathonian age and rest lower Callovian. Basal beds are younger on flanks of South arch than along Rocky Mountain front.

R. W. Imlay and others, 1948, U.S. Geol. Survey Oil and Gas Inv. Prelim. Chart 32. In south-central Montana, overlies Piper formation (new).

J. A. Peterson, 1954, Am. Assoc. Petroleum Geologists Bull., v. 38, no. 4, p. 466 (table 2), 475–477, 482. Swift-Rierdon nomenclature of Ellis group in Montana is applied in eastern Wyoming to formational units of Sundance group. Indications are that names are applicable to the marine Upper Jurassic throughout most of Wyoming and western South Dakota, but term Sundance should be retained because of historical significance. Section of Rierdon, measured northeast of Newcastle, Wyo., gives thickness 212 feet; formation includes (ascending) Stockade Beaver shale, Hulett sandstone, and Lak members. Overlies Gypsum Spring formation; underlies Swift formation. In some Black Hills areas, formation includes a fourth member, Canyon Springs, at base.

T. P. Storey, 1958, Alberta Soc. Petroleum Geologists Jour., v. 6, no. 4, p. 90–104. Discussion of Jurassic of Williston basin and adjacent areas. On basis of regional extent and significance of sub-Swift and sub-Rierdon unconformities, a different stratigraphic interpretation is presented. Swift is divided into Lower, Middle, and Upper units. Lower Swift in Williston basin is equivalent to Stockade Beaver and Hulett members of Sundance and unconformably overlies Rierdon, which has been considered equivalent to the Stockade Beaver and Hulett. Rierdon herein corresponds essentially to type Rierdon of Sweetgrass arch where it occurs with notable unconformity, both below Middle and Upper Swift and above Sawtooth and older Gypsum Spring beds. Lower Swift of Williston basin is absent over Sweetgrass arch and over most of western Montana, where it is overlapped by Swift formation of Cobban.

Type locality: Rierdon Gulch, sec. 23, T. 24 N., R. 9 W., Teton County, Mont.

Rifle Member (of De Beque Formation)

[Tertiary] : Colorado.

D. B. Kitts, 1956, Am. Mus. Nat. History Bull., v. 110, Art. 1, p. 47, 49, 51. Incidental mention in fossil locality data.

Type locality and derivation of name not stated.

Rift Shale (in Pocahontas Group)

Rift Shale (in Pottsville Group)[1]

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. 217.

H. R. Wanless, 1939, Geol. Soc. America Special Paper 17, p. 100; P. H. Price and E. T. Heck, 1939, West Virginia Geol. Survey [Rept.] Greenbrier County, p. 217, 244. Included in Pocahontas group, Pottsville series.

Named for exposures at Rift, McDowell County.

†Riga Schist[1]

Ordovician : Northwestern Connecticut and southwestern Massachusetts.

Original reference: W. H. Hobbs, 1893, Jour. Geology, v. 1, p. 717–736, 780–802.

Typically developed on Mount Riga Peak, Conn.

Riggs Formation

Paleozoic(?) : Southern California.

D. H. Kupfer, 1960, Geol. Soc. America Bull., v. 71, no. 2, p. 187, 194–196, 199, pls. 1, 2. Name provisionally applied to carbonate rocks of unknown age that compose Riggs thrust plate. Stratigraphic section not worked out and structure only partially known. Formation consists of interbedded recrystallized limestone and dolomite with a few thin beds of orthoquartzite and other clastic rocks. Estimated thickness about 2,500 feet; measured sections are of little help in estimating true thickness because structure is not understood and formation is locally dolomitized; sections may not give minimum thickness because area is highly faulted and repetitions could occur; several sections could fit together to give composite section many thousands of feet thick. No fossils found and little is known of stratigraphic position of formation. It may have been unconformable on Pahrump group before thrusting. Unconformably overlain by Tertiary(?) rocks. Formation may represent part of geologic column hitherto unidentified in this region. Tentative correlations suggest formation is younger than Crystal Spring formation (late Precambrian). Best evidence for age is Paleozoic(?). If future work should establish an unmetamorphosed correlative of Riggs rocks with a more nearly complete and structurally less complicated section, name Riggs should not be considered as having priority over any name given to new section.

Caps major peaks and ridges and is well exposed along Riggs Ridge north of Riggs silver mine and in Hill 2979 just east of Riggs Ridge (pl. 1). Area of report is Silurian Hills, San Bernardino County, 15 miles southeast of Death Valley.

**Riley Formation**

Upper Cambrian: Central Texas.

P. E. Cloud, Jr., V. E. Barnes, and Josiah Bridge, 1946, Texas Univ. Bur. Econ. Geology Pub. 4301, p. 154–155 [1945]; Josiah Bridge, V. E. Barnes, and P. E. Cloud, Jr., 1947, Geol. Soc. America Bull., v. 58, no. 1, p. 111–112, pl. 2; P. E. Cloud, Jr., and V. E. Barnes, 1948, Texas Univ. Bur. Econ. Geology Pub. 4621, p. 29, 225, 253, 290, 309 [1946]. Proposed to include all Cambrian strata in central Texas beneath Wilberns formation. Includes, from base to top, rocks formerly known as Hickory sandstone, Cap Mountain formation, and Lion sandstone member of Cap Mountain formation. Contacts of these rock units intergrade laterally, crossing faunal zones. They are here considered to be members of the Riley. Thickness in Moore Hollow area 780 feet. Riley as here defined is distinct from and not a revival of Riley series (Comstock and Dumble, 1890).

Named from Riley Mountains, southeastern Llano County, where included members are typically exposed.

†Riley Series[1]

Upper Cambrian: Central Texas.

Original reference: T. B. Comstock and E. T. Dumble, 1890, Texas Geol. Survey 1st Ann. Rept., p. lxi, 286–289, pl. 3.

P. E. Cloud, Jr., V. E. Barnes, and Josiah Bridge, 1946, Texas Univ. Bur. Econ. Geology Pub. 4301, p. 154–155 [1945]; Josiah Bridge, V. E. Barnes, and P. E. Cloud, Jr., 1947, Geol. Soc. America Bull., v. 58, no. 1, p. 111–112, pl. 2; P. E. Cloud, Jr., and V. E. Barnes, 1948, Texas Univ. Bur. Econ. Geology Pub. 4621, p. 29, 225, 253, 290, 309 [1946]. Riley formation as herein defined is distinct from, and not a revival of Riley series of Comstock and Dumble (1890).

Named for Riley Mountains, Llano County.

**Riley Creek Glaciation**

Pleistocene: Central southern Alaska.

Clyde Wahrhaftig, 1953, *in* T. L. Péwé and others, 1953, U.S. Geol. Survey Circ. 289, p. 8, 13 (table 1); Clyde Wahrhaftig, 1958, U.S. Geol. Survey Prof. Paper 293–A, p. 18, 45–47, pls. 2, 3, 5. Four distinct glacial advances separated by marked ice withdrawals recognized along Nenana River. Riley Creek succeeded Healy glaciation (new). Drift much better preserved than older deposits. End moraine forms ridge along south bank of Riley Creek near its mouth at McKinley Park station. Lateral moraines and ice-contact deposits traced several miles up valleys of Yanert Fork and Nenana Rivers. Ground moraine has well-preserved drumlinoid hills, medium moraine ridges; and numerous lakes. Outwash plain extends downstream as set of terraces.

In Nenana River valley area.

Rillito Andesite

Tertiary: Southeastern Arizona.

W. H. Brown, 1939, Geol. Soc. America Bull., v. 50, no. 5, p. 736, fig. 2, pl. 1. On fresh surfaces, red to brown and contains numerous prominent feldspar crystals, most about one-half centimeter in length. Weathers drab to brown. Dense and breaks into angular blocks which retain their angularity and smoothness until a late stage of weathering. Maintains smooth surfaces on weathered outcrops. Thickness 450 feet west of Safford Peak. Underlies Safford tuff (new). Separated from underlying Cretaceous volcanics by poorly exposed conglomerate.

A prominent cliff-former extending from cliffs west of Safford Peak to Silver Bell pass, near north end of Tucson Mountain Range, Pima County.

**Rimroad Gravel**

Oligocene or Miocene: Eastern Montana.

A. D. Howard, 1958, Geol. Soc. America Bull., v. 69, no. 5, p. 578; 1960, U.S. Geol. Survey Prof. Paper 326, p. 16 (table 2), 17, pl. 1. Fluvial sands and gravels, similar to younger Flaxville gravel. Average thickness 30 feet.

Distributed along high divide between Yellowstone River and parallel-flowing Redwater Creek to west, Dawson and Prairie Counties. Town of Rimroad is in southwestern Dawson County.

Rim Rock Sandstone (in Mesaverde Group)

Upper Cretaceous: Northwestern Colorado and northeastern Utah.

P. T. Walton, 1944, Geol. Soc. America Bull., v. 55, no. 1, p. 111–114, pls. 1, 2, 3. At type locality, gray medium- to fine-grained sandstone, cross-bedded in some places, thinly bedded in others, and containing a few beds of shale that are tongues from main body of Mancos; varying amounts of black chert grains. Thickness at type locality 416 feet; at Rangely anticline 580 feet; at north end Asphalt Ridge 112 feet. Overlies Asphalt Ridge sandstone (new), contact gradational. In western part of area, at lower boundary a thin tongue of Mancos shale separates it from underlying Asphalt Ridge; upper boundary at base of Williams Fork formation is marked by green or gray shale overlain by brackish-water brown thin-bedded sandstones interbedded with pink, purple, white, and black shale and thin coal beds.

Type locality: At the Rim Rock, 9 miles east of the Green River, Uintah County, Utah. Continuous outcrops from Asphalt Ridge to Rio Blanco County, Colo., as hogback ridge called the "Rim Rock."

Rincon Limestone[1]

Upper Cambrian: Southeastern Arizona.

Original reference: A. A. Stoyanow, 1936, Geol. Soc. America Bull., v. 47, no. 4, p. 469, 471, 472, 480–482.

D. L. Bryant, 1952, Arizona Geol. Soc. Guidebook 2, p. 37, figs. 6, 7. Composed of 40 feet of thick-bedded massive coarse-grained pink limestone containing abundant trilobite fragments in Picacho de Calera Hills. Disconformably underlies Picacho de Calera formation. Type section cited.

Type locality: Rincon Mountains, 25 miles southeast of Tucson. Type section: near Colossal Cave in Whetstone Mountains.

**Rincon Shale[1] or Mudstone**

Rincon Claystone

Miocene, lower: Southern California.

Original reference: P. F. Kerr, 1931, Econ. Geology, v. 26, no. 2, p. 156, 157.

T. W. Dibblee, Jr., 1950, California Div. Mines Bull. 150, p. 33, 38 (fig. 2), pls. In southwestern Santa Barbara County, Rincon claystone is about 1,500 feet thick. Conformably overlies Vaqueros sandstone except in Tranquillon Mountain ridge where it lies unconformably on Espada formation (new), the Vaqueros having buttressed out. Conformably underlies Monterey shale except where Tranquillon volcanics (new) intervenes. Lower third of Rincon carries upper Zemorrian (lower Miocene) foraminiferal fauna; upper two-thirds carries Saucesian (upper lower Miocene) fauna.

J. E. Upson, 1951, U.S. Geol. Survey Water-Supply Paper 1108, p. 14. Consists of massive dark-bluish-gray mudstone which develops a dark-greenish-black mucky soil. Characterized by discontinuous bands of ovoid calcareous concretions, usually limonitic and yellowish-brown in color. Thickness about 1,700 feet. Overlies Vaqueros sandstone; underlies Monterey shale; both contacts conformable. Lower Miocene.

P. C. Orr, 1960, Geol. Soc. America Bull., v. 71, no. 7, p. 113–115. On Santa Rosa Island, Rincon shale underlies Garanon member of Santa Rosa Island formation (both new).

Type section: Along Los Sauces Creek east of Rincon Mountain, Ventura County.

Rinconada Schist Member or phase (of Ortega Quartzite)

Precambrian (Proterozoic): Central northern New Mexico.

Evan Just, 1937, New Mexico School Mines Bull. 13, p. 13 (table 1), 22, pl. 2. Consists of gray to buff quartz-muscovite schist, which in many places has interbedded quartzite members. Most of the schist is more or less even textured. Some is conglomeratic. In one area, it directly overlies Hopewell series (new).

Arthur Montgomery, 1953, New Mexico Bur. Mines Mineral Resources Bull. 30, p. 6, 8 (fig. 2), 12–19, pl. 1. Rinconada schist member consists of four distinctive and mappable units: andalusite-biotite hornfels, staurolite gneiss and schist, quartzite, and muscovite-quartz-biotite-garnet phyllite. Total thickness estimated to be 1,800 feet. Lies between a lower quartzite member and the upper Pilar phyllite member (new). Derivation of name given.

Named for settlement of Rinconada 2 miles north of Dixon in the Rio Grande Canyon. Occurs in Picuris Mountain area, Taos County.

Rincon Valley Granite

Laramide: Southern Arizona.

C. J. Acker, (abs.) 1958, Arizona Geol. Soc. Digest, p. 47. Massive blocks of Paleozoic sedimentary rocks have been thrust from a southerly direction over an irregular surface of Rincon Valley granite of Laramide age.

In Colossal Cave area, Pima County.

**Rindgemere Formation**[1]

Pennsylvanian (?) : Southeastern New Hampshire and southwestern Maine.

Original reference: F. J. Katz, 1917, Washington Acad. Sci. Jour., v. 7, p. 199.

Occupies broad area in Rochester, N.H., and Acton and Lebanon Townships, Maine. Named for exposures at Rindgemere Station, East Rochester, Strafford County, N.H.

**Ringbone Shale** (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. 18–19, pl. 1. Comprises a basal conglomerate, containing boulders as large as 2½ feet in diameter, followed by dark shale, subordinate sandstone, and here and there a bed of black limestone. Thickness of any single bed rarely exceeds 5 feet. Upper 150 feet composed of tuffaceous sandstone and shale containing two purer volcanic members, one a basalt flow and one an andesite breccia, each approximately 50 feet thick. Maximum total thickness about 650 feet. In vicinity of Ringbone Ranch, formation is interfingered with conglomerate of the underlying Broken Jug limestone (new); thins out southward against old surface of Broken Jug limestone; underlies Hidalgo volcanics (new). Trinity age.

Named from Ringbone Ranch, near which formation is best exposed, Eureka district in Little Hatchet Mountains.

**Ringold Formation**[1]

Pleistocene, middle to upper: Northeastern Oregon and southeastern Washington.

Original reference: J. C. Merriam and J. P. Buwalda, 1917, California Univ. Pub., Bull. Dept. Geology, v. 10, no. 15, p. 255–266.

R. C. Newcomb, 1958, Am. Jour. Sci., v. 256, no. 5, p. 328–340. Type section of formation consists of about 620 feet of horizontally bedded continental sediments lying between river level [Columbia River] and the tops of the White Bluffs, from about 340 to 960 feet in altitude. Uppermost 505 feet of section composed largely of lacustrine sand and silt; lower part is a weakly indurated conglomerate that was deposited by river currents; the conglomerate extends below river level, down to an altitude of about 290 feet; it is underlain by 100 to 290 feet of lacustrine silt, clay, and sand, and some gravel. This lower lacustrine composite, commonly called the "blue clays," is here considered a part of the Ringold; it overlies the basalt bedrock.

Type locality: White Bluffs of Columbia River, Franklin and Benton Counties, Wash. Named for Ringold post office which is situated at base of White Bluffs.

Río Conglomerate[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. 278.

R. C. Mitchell, 1954, Puerto Rico Univ. Agr. Expt. Sta. Tech. Paper 13, p. 36 (table 2), 60 (table 7). Thickness 300 feet. Underlies Luquillo formation; overlies La Muda limestone.

C. A. Kaye, 1959, U.S. Geol. Survey Prof. Paper 317–A, p. 9 (fig. 3). Table shows Río conglomerate (Meyerhoff and Smith, 1931) is possibly equivalent to Figuera volcanics of present report.

J. D. Weaver, 1956, *in* R. Hoffstetter and others, Lexique Strat. Internat., v. 5, Amérique Latine, fasc. 2b, p. 338. Upper Cretaceous. Type locality stated.

Type locality: At Barrio Río, about 8 miles south of San Juan. Also crops out near Aguas Buenas and along railway west of Trujillo Alto. Conglomerate stands as prominent ridge which crosses the Río Piedras-Caguas Highway at northern limit of La Muda, Fajardo district.

Río Blanco Formation

Río Blanco Series[1]

Upper Cretaceous: Puerto Rico.

Original reference: B. Hubbard, 1923, New York Acad. Sci. Scientific survey of Porto Rico and Virgin Islands, v. 2, pt. 1, p. 26.

R. C. Mitchell, 1954, Puerto Rico Univ. Agr. Expt. Sta. Tech. Paper 13, p. 36 (table 2). Thickness about 7,000 feet. Underlies Río Yauco series; overlies Río Culebrinas series. Term "series" is taken from original surveys, but is misnomer.

T. R. Slodowski, 1958, Dissert. Abs., v. 18, no. 1, p. 200. In Yauco area, a complex, more than 9,000 meters thick, of volcanic flows with interbedded marine limestones, mudstones, tuffs, and sedimentary rocks derived from the volcanic rocks, is divided into eight formations: Sabana Grande, El Rayo, Ensenada, Río Yauco, Río Loco, Río Blanco, San Germán, and Jicara (new). Río Blanco and Río Yauco formations in a northern basin are considered to have been deposited penecontemporaneously with deposition of Ensenda in a southern basin. Complex ranges in age from Senonian to late Paleocene, possibly Eocene.

P. H. Mattson, 1960, Geol. Soc. America Bull., v. 71, no. 3, p. 344–345, pl. 1. In Mayagüez, contains massive tuffaceous volcanic rock with tongues of lava and breccia near top, bottom, and middle of unit. Includes Las Marías limestone member. Occurs between Yauco mudstone and Río Culebrinas map unit and dips generally 60° to 70° SW. Attitudes are conformable with map units above and below. Thickness 4,700 meters, of which 2,700 is measured in Mayagüez area, and 1,200 in San Sebastián area. Structural position of Yauco mudstone indicates that the Río Blanco should be stratigraphically below Yauco if the two units are conformable. Age determinations show that the Río Blanco is equivalent to or younger than the Yauco. If the Yauco is in fault contact with the Río Blanco, the age relationship may be satisfied, but there is no evidence of faulting. At present time, a fault is assumed.

E. A. Pessagno, Jr., 1960, Geology of the Ponce-Coamo area, Puerto Rico: Puerto Rico Econ. Devel. Adm. and Princeton Univ. Dept. Geology, p. 47–56. In area of this report, Río Blanco formation crops out in Ponce, Peñuelas, and Adjuntas quadrangles. Consists of unknown thickness of pyroclastic rocks alternating with andesite flows. Lenses of massive limestone and lenses of calcareous mudstone, thin-bedded argillaceous limestone, and calcareous tuff present locally. Mattson included rocks assignable to Río Yauco formation in his Mayagüez. Formation along northern border is brought in contact with middle Eocene Jacaguas group (new) by Cerrillos-Descalabrado fault. To the west, interfingers with Río Yauco formation. To east of the Río Guayo, formation is covered by sediments of "undeformed sequence." Inasmuch as the Río Yauco and Río Blanco formations interfinger, the Río Blanco should be included in Mayagüez group.

Named from exposures along Río Blanco, Lares district.

Río Chiquito Formation

Upper Cretaceous: Puerto Rico.

E. A. Pessagno, Jr., 1960, Caribbean 2d Geol. Conf. Trans., Mayagüez, Puerto Rico, p. 84. Consists of unknown thickness of pyroclastics alternating with andesite flows. Locally contains lenses of limestone that correlate lithologically and faunistically with massive limestones of Mattson's (1960) San Germán formation. Relationship of Río Chiquito with Río Yauco formation to west not precisely known. Cover of Oligocene and younger sediments obscures relationship of the Río Chiquito with other Cretaceous rocks to east. Intruded by Tibes diorite (new). Footnote states that name Río Chiquito is no longer used. Unit currently assigned to Río Blanco formation.

In Ponce-Coamo area, south-central part of island.

Río Culebrinas Formation

Río Culebrinas Series[1]

Cretaceous: Puerto Rico.

Original reference: B. Hubbard, 1923, New York Acad. Sci. Scientific Survey of Porto Rico and Virgin Islands, v. 2, pt. 1, p. 25.

M. D. Turner, 1958, (abs.) Caribbean Geol. Conf., 1st, Antigua, British West Indies, 1955, p. 25. In San Sebastián area, the Older Series is made up of (1) tuffaceous rocks, agglomerates, and associated sedimentary rocks known as Río Culebrinas series and (2) stratigraphically younger massive volcanic flows, agglomerates, and tuffaceous rocks termed Río Blanco series. Thickness of each series about 1,000 meters. The Río Culebrinas is tightly folded and both Cretaceous units are cut across by faults.

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. Río Culebrinas formation may interfinger with Augustinillo formation (new).

Named for exposures in Río Culebrinas Valley, Lares district.

Río de la Plata Series[1]

Lower 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. 130.

R. C. Mitchell, 1954, Puerto Rico Univ. Agr. Expt. Sta. Tech. Paper 13, p. 36 (table 2), 39, 40, 41. Predominantly tuffs. Thickness about 2,000 feet. Recent fossil discoveries help to substantiate Lower Cretaceous age. Term "series" is taken from original survey but is misnomer.

Named for Río de la Plata River which flows across the rocks, Coamo-Guayama district.

Rio Dell Formation (in Wildcat Group)

Pliocene, middle to upper: Northwestern California.

B. A. Ogle, 1953, California Div. Mines Bull. 164, p. 13 (fig. 3), 31–33, 107–111, pls. 1, 2. Massive mudstone, alternating thin sandstone and mudstone, "phantom-banded" mudstone, and very fine grained sandstone. In Ferndale quadrangle, divided into: upper member—mudstone; middle member—alternating sandstones and mudstones; lower member—mudstone with sandstones; units not distinguished to the east where there is more very fine grained sandstone in upper part. Thickness 3,000 to 6,000 feet; thins northward. Underlies Scotia Bluffs formation (new); unconformably overlies Eel River formation (new); top of Rio Dell arbitrarily taken as lowermost buff-weathering sandstone of Scotia Bluffs; base of Rio Dell chosen as a thin glauconite mudstone or fine-grained sandstone overlying a cut surface of upper Eel River mudstone.

Type section: East bank Eel River north of Scotia and west bank of river west of Scotia, Humboldt County.

Río Descalabrado[s] Member (of Naranjo Formation)

Río Descalabrados Series[1]

Eocene: 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. 161.

R. C. Mitchell, 1954, Puerto Rico Univ. Agr. Expt. Sta. Tech. Paper 13, p. 54. Name Río Descalabrado[s] series discarded and name Cañas Arriba formation adopted.

E. A. Pessagno, Jr., 1960, Geology of the Ponce-Coamo area, Puerto Rico: Puerto Rico Econ. Devel. Adm. and Princeton Univ. Dept. Geology, p. 78–85. Member of Naranjo formation (new). Hodge applied name Río Descalabrado[s] series to these rocks. He overlooked the possiblity of Cretaceous sequence being repeated by faulting and mistakenly included Upper Cretaceous rocks belonging to the units now named Ildefonso and Robles formations in his "Río Descalabrado[s] series." Term "series" is here amended to member. Consists of marls, argillaceous limestones, and calcareous siltstones together with lenses and beds of Coamo Springs and Guayo conglomeratic sandstone. Thickness 0 to 7,600 feet. Interfingers with Guayo conglomeratic sandstone member (new) to west and is completely covered by alluvium east of Salinas. Lower part interfingers with Coamo Springs limestone member. Where Coamo Springs member is absent, the Río Descalabrado[s] rests directly on Miramar member (new) or on underlying Upper Cretaceous rocks.

Type area: West and north of village of Las Ollas.

Río Duque Shales

Eocene: Panamá.

T. F. Thompson, 1944, Geological explorations in vicinity of Rio Quebrancha for the Panama Cement Company: Panama Canal, Spec. Eng. Div., p. 21–23. Fine-grained silty dark-gray locally carbonaceous soft shales with thin sandstone beds. Thickness probably more than 600 meters. Believed that Río Duque and Vamos formations are identical and that age of both are either lower Miocene or uppermost Oligocene.

W. P. Woodring, 1960, *in* R. Hoffstetter and others, Lexique Strat. Internat., v. 5, Amérique Latine, fasc. 2a, p. 345. Synonym of Gatuncillo formation. Eocene.

Río Duque is a small tributary of Río Agua Sucia in Panamá immediately west of the Quebrancha syncline.

Rio Grande Drift[1]

Pleistocene: Southwestern Texas.

Original reference: J. A. Udden, 1904, Texas Univ. Min. Survey Bull. 8, p. 41.

Shafter district, Presidio County.

Rio Grande Gravels[1] or Beds

Tertiary: New Mexico.

Original reference: C. L. Herrick, 1898, Am. Geologist, v. 22, p. 26–43.

Kirk Bryan and F. C. McCann, 1937, Jour. Geology, v. 45, p. 807. Instead of Santa Fe formation, Bryan (1909, New Mexico Univ. Bull., Geol. Ser., v. 3, no. 1) used term "Rio Grande beds," which should be abandoned.

Occurs in vicinity of Albuquerque.

Rio Grande Loess[1]

Tertiary, upper: Central northern New Mexico.

Original reference: C. L. Herrick, 1898, Am. Geologist, v. 22, p. 26–43.

Rio Grande Marl[1]

Probably Miocene and Pliocene: Central northern New Mexico.

Original reference: A. B. Reagan, 1903, Am. Geologist, v. 31, p. 87, 89.

Occurs in inner valley of Rio Grande.

†Rio Grande series[1]

Pennsylvanian: New Mexico.

Original reference: C. R. Keyes, 1903, *in* Report of the Governor of New Mexico to the Secretary of the Interior.

Rio Grande Series[1]

Tertiary, upper: Central northern New Mexico.

Original reference: C. L. Herrick, 1898, Am. Geologist, v. 22, p. 26–43.

In Albuquerque region.

**Río Guatemala Group**

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. Cibao marl, Lares limestone, and San Sebastián formation are largely facies equivalents showing rapid lateral transition; term "Río Guatemala group" is introduced to refer to the whole sedimentary complex. Names Cibao, Lares, and San Sebastián are retained to designate, respectively; predominantly marl and chalky limestone, predominantly reef-type limestone and predominantly clastic facies of the group. Maximum thickness about 700 meters in area between Río Camuy and longitude line through San Sebastián.

Named from the Río Guatemala, which flows its entire course in outcrop belt of group north and west of San Sebastián. Group crops out in belt extending from vicinity of Moca on west to vicinity of Bayamón on east.

Río Jueyes Series[1]

Eocene, middle(?)-upper: 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. 149.

R. C. Mitchell, 1954, Puerto Rico Univ. Agr. Expt. Sta. Tech. Paper 13, p. 36 (table 2), 51, 52. In Coamo-Guayama district underlies Coamo Springs series; unconformable above Guayama series. Thickness 3,500 feet. On basis of fossil evidence age is considered to be Eocene, probably upper-middle. Term "series" is taken from original surveys, but is misnomer.

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. Part of Hodge's Río Jueyes series also included in Ildefonso formation (new).

Named from river which flows over central exposures, Coamo-Guayama district.

Río Loco Formation

Upper Cretaceous (Cenomanian) : Southwestern Puerto Rico.

T. R. Slodowski, 1958, Dissert. Abs., v. 18, no. 1, p. 200, 201. In Yauco area, 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: Sabana Grande (new), El Rayo (new), Ensenada, Río Yauco, Río Loco, Río Blanco, San Germán, and Jicara (new). The Río Loco is considered to intertongue with Río Yauco formation.

P. H. Mattson, 1958, Dissert. Abs., v. 18, no. 1, p. 197; 1960, Geol. Soc. America Bull., v. 71, no. 3, p. 324–329, pl. 1. Redefined to include bronzite andesite near Parguera and Guanica and to exclude a large fairly continuous mudstone unit considered Yauco mudstone. Contains bronzite andesite porphyry lavas, more than half with pillow form, and subordinate tuff, breccia, hornblende andesite, dacite(?), and limestone. Thickness about 300 meters in northern exposures; no thicknesses measured elsewhere. Lies between Mayagüez group (new) and Bermeja complex (new).

E. A. Pessagno, Jr., Geology of the Ponce-Coamo area, Puerto Rico: Puerto Rico Econ. Devel. Adm. and Princeton Univ. Dept. Geology, p. 23. Underlies Robles formation in Barranquitas quadrangle.

Occurs on flanks of Las Mesas-Fraile anticline and in southeastern part of Mayagüez area.

**Río Matón Limestone 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. Occurs sporadically at base of formation from central Puerto Rico southward to a point near south coast where it lies unconformably on volcanic breccia of volcanic complex. In part a reef and in part a near-reef accumulation; consists of both massive and bedded limestones; in southernmost outcrops, interbedded with volcanic sandstone and contains volcanic debris. Fossils indicate Senonian (Coniacian-Campanian) age. 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. Underlies Cayey siltstone member (new). Thickness about 50 meters at type locality.

Type locality: Just west of Highway 1, at point 2.7 kilometers S.65°W. of Cayey Plaza, Cayey quadrangle. Named for exposures on south side of Río Matón.

Rio Tinto Formation

Carboniferous(?): Northeastern Nevada.

A. E. Granger and others, 1957, Nevada Bur. Mines Bull. 54, p. 116, pl. 14. In Elko County, a thrust fault crops out south of Rio Tinto mine and divides Paleozoic rocks into two groups of formations which cannot as yet be correlated. Rio Tinto formation is lowest exposed rock of lower plate sequence and forms wall rock of Rio Tinto mine. Predominantly fine-grained quartz-sericite schist, shale, and locally fine-grained dark quartzite and dense black chert containing poorly preserved Radiolaria. Estimated minimum thickness 4,000 feet (Nolan, unpub. rept.). Stephens (unpub. rept. )gives 2,085 feet. Unconformably underlies Banner limetone (new). Age not established. Mapped as Carboniferous(?).

Named for occurrence at Rio Tinto mine, Elko County.

Río Yauco Formation or Shale

Río Yauco Series[1]

Upper Cretaceous: Puerto Rico.

G. J. Mitchell, 1922, New York Acad. Sci. Scientific survey of Porto Rico and Virgin Islands, v. 1, pt. 3, p. 249. Strongly bedded black shale about 1,200 feet thick exposed on upper Río Yauco, Ponce district. Conformably interbedded with San Germán limestone considered to be Upper Cretaceous.

Bela Hubbard, 1923, New York Acad. Sci. Scientific survey of Porto Rico and Virgin Islands, v. 2, pt. 1, p. 25, 29–35. In southern part of Lares district, Río Yauco series is named from the Río Yauco shale, a term applied by Mitchell to black shales which form a prominent part of this series between Mayagüez and Consumo. In this area sequence is Río Culebrinas series (oldest), Río Blanco series, and Río Yauco series. In Río Yauco series, about 6,000 feet of shales and tuffs are exposed along Mayagüez-Las Marías Road from kilometer 13 to kilometer 19; traverse across series northeast from Rincon shows total thickness of over 8,000 feet; allowance made for duplication of strata by folding and faulting.

R. C. Mitchell, 1954, Puerto Rico Univ. Agr. Expt. Sta. Tech. Paper 13, p. 36 (table 2), 60 (table 7). Thickness of shale in Ponce district about 7,000 feet; thickness of series in Lares district also 7,000 feet. Heading on table 2 (stratigraphic table for Puerto Rico) reads Upper(?) Cretaceous; however text and other table headings do not qualify the Upper Cretaceous.

T. R. Slodowski, 1958, Dissert. Abs., v. 18, no. 1, p. 200–201. In Yauco area, a complex, more than 9,000 meters thick, of volcanic flows with interbedded marine limestones, mudstones, tuffs, and sedimentary rocks derived from the volcanic rocks, is divided into eight formations: Sabana Grande, El Rayo, Ensenada, Río Yauco, Río Loco, Río Blanco, San Germán, and Jicara (new). Río Yauco and Río Blanco formations are considered to have been deposited in a northern basin penecontemporaneously with deposition of Ensenada in a southern basin. The Río Yauco and Ensenada overlie the Sabana Grande and El Rayo formations unconformably and are separated from overlying San Germán and Jicara formations, at least locally by unconformities. Complex ranges in age from Senonian 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.

55–62. Name Río Yauco shale first used by Mitchell (1922). Slodowski (1956, unpub. thesis, [1958, Dissert. Abs.]) proposed that term shale be replaced by formation inasmuch as sequence is composed of many lithic types. Mitchell (1922) used name Peñuelas shale for rocks correlated with Río Yauco formation of present report. Mattson [1960] includes rocks assignable to Río Yauco formation in his Mayagüez group. In area of present report, Río Yauco formation is exposed in western part of Peñuelas quadrangle. Consists of heterogeneous marine assemblage of mudstone, tuffs, tuff breccias, limestones sedimentary breccias, and basalt flows. Thickness unknown; Slodowski (1956) estimated 4,500 feet. Interfingers with Río Blanco formation

Named for exposures on upper Río Yauco, Ponce district.

**Ripley Formation**[1] (in Selmá Group)

Upper Cretaceous; northern and central Mississippi, Alabama, Georgia, western Kentucky, and western Tennessee.

Original reference: E. W. Hilgard, 1860, Mississippi Geol. and Agric., p. 3, 62, 83–95.

B. Wade, 1917, Johns Hopkins Univ. Circ., new ser., no. 3, Whole No. 203, p. 74, 101. Includes Coon Creek tongue (new).

W. H. Monroe, 1941, Alabama Geol. Survey Bull. 48, p. 103–129. In this report, base of formation in eastern Alabama is placed at base of a thick deposit of coarse sand and gravel rather than at contact of *Exogyra ponderosa* and *Exogyra costata* zones as was proposed by Stephenson and Monroe (1938, Am. Assoc. Petroleum Geologists Bull., v. 22, no. 12). This further restricts the Ripley by about 50 feet, but gravel bed rather than faunal zone contact is more logical base for formation. Proposed restriction has advantage in that base of Ripley is at very nearly the same stratigraphic position from Chattahoochee River to Sumter County. Conformably overlies Demopolis member of Selma chalk from Mississippi State line through Lowndes County, but, in eastern part of Sumter County, uppermost part of Demopolis chalk merges laterally toward the east into sand which is included in Ripley; in western part of Montgomery County, Ripley rests on westward-extending tongue of Cusseta sand; unconformably underlies Prairie Bluff chalk; in some areas overlapped by Providence sand.

D. R. Stewart, Lyle McManamy, and H. S. McQueen, 1943, Missouri Geol. Survey and Water Resources 62d Bienn. Rept., app. 3, p. 9. Represented in Stoddard County, Mo., by McNairy member.

W. E. Belt and others, 1945, Geologic map of Mississippi (1:500,000): Mississippi Geol. Survey. Included in Selma group.

D. H. Eargle, 1955, U.S. Geol. Survey Bull. 1014, p. 54–69. In Alabama, name Ripley is used in western Sumter County for chalky sand and clay beds essentially contemporaneous and continuous with Ripley of Mississippi. Farther east in Alabama, successively lower parts of Demopolis chalk grade laterally into a sand and clay facies that is designated Ripley. In eastern Alabama, the Ripley includes all strata between underlying Blufftown formation and overlying Prairie Bluff chalk or its correlative, the Providence sand. Coarse sandy beds at base of Ripley in eastern Alabama, designated Cusseta sand member, represent western featheredge of Cusseta sand of Georgia. In Georgia, name Ripley is applied to sand and sandy clay that contain fossils in upland areas. The strata, originally described as Renfroes marl (Veatch, 1909), lie between

Cusseta sand and Providence sand. Detailed description of outcrops in Georgia.

L. W. Stephenson, 1955, U.S. Geol. Survey Prof. Paper 274–E, p. 98, 100, 101. In this report, McNairy member is raised to formational rank in Missouri and Illinois. [Hence the Ripley is geographically restricted.]

F. F. Mellen, 1958, Mississippi Geol. Survey Bull. 85, p. 49–54. Includes Chiwapa sandstone member (new).

N. F. Sohl, 1960, U.S. Geol. Survey Prof. Paper 331–A, p. 9–22. Formation discussed in Tennessee and Mississippi. Thickest in northern areas of outcrop, where, in vicinity of Tennessee-Mississippi State line, it is close to 350 feet thick; thins southward until near Alabama-Mississippi State line, it is about 60 feet thick. In northern Mississippi, divided into (ascending) transitional clay, Coon Creek tongue, McNairy sand member, sand of upper part of Ripley, and Keownville limestone member (new). Base of formation is gradational downward to Demopolis chalk through transitional clay. In Tennessee and northernmost Mississippi this clay unit lies entirely within *Exogyra cancellata* zones, but, south of southern Tippah County, the transitional clay lies in part above that zone. This clay, along with rest of formation, grades into sandy chalk in Noxubee County, Miss. Upward, clay becomes increasingly sandy and grades into highly fossiliferous sand units of Coon Creek tongue. In Pontotoc and Kemper Counties, Miss., McNairy sand member is absent, and greater part of formation cannot be divided. In Noxubee County, Miss., whole formation grades into chalk facies. Unconformity at top of Ripley varies locally in magnitude. In some places, Keownville limestone member appears to be entirely eroded off, and overlying Prairie Bluff chalk rests on sand of middle part of Ripley.

W. S. Parks, 1960, Mississippi Geol. Survey Bull. 87, p. 22 (table 2), 26 (fig. 4), 61–68, pl. 4. Ripley formation of this report [Prentiss County] refers to all beds above Demopolis chalk and consists of three units: transitional clay, Coon Creek tongue, and McNairy sand member. Disconformably underlies Owl Creek and Prairie Bluff formation. Maximum thickness about 300 feet.

Named for Ripley, Tippah County, Miss.

Ripleyan series[1]

Upper Cretaceous: Mississippi.

Original reference: C. R. Keyes, 1915, Iowa Acad. Sci. Proc., v. 22, p. 252.

Ripogenous (Ripogenus) Series[1]

Silurian: North-central Maine.

Original reference [name appears as Ripogenous series]: F. W. Toppan, 1932, Geology of Maine, Contr. Dept. Geol. Union Coll., Schenectady, p. 71–72.

Bradford Willard, 1945, Jour. Paleontology, v. 19, no. 1, p. 67. Series revised to include Chesuncook limestone and Ripogenus volcanics (both new).

Exposed in Ripogenous [Ripogenus] Gorge, where it is intruded by Katahdin granite, just below prominent rock known as the "Little Heater," Piscataquis County.

Ripogenus Volcanics

Lower or Middle Silurian: North-central Maine.

Bradford Willard, 1945, Jour. Paleontology, v. 19, no. 1, p. 67. Named as a subdivision of the Ripogenus series: intrudes sediments of the series. Name credited to L. W. Fisher (written commun. 1941). Age not stated.

A. J. Boucot, 1954, Am. Jour. Sci., v. 252, no. 3, p. 144–145. Discussion of stratigraphic relationships near contact of Katahdin granite. Oldest stratum exposed on west side of Ripogenus Dam is basalt. Fisher (in Willard. 1945) suggested term Ripogenus volcanics be applied to the basalt. Name Ripogenus is preoccupied by Toppan's Ripogenous [Ripogenus] series. Katahdin granite cuts the basalt. No new name is suggested for the basalt.

Named from Ripogenus Dam at south end of southeast arm of Chesuncook Lake, Piscataquis County.

Ripple Quartzite[1]

Precambrian: Southern British Columbia, Canada, and northeastern Washington.

Original reference: R. A. Daly, 1912, Canada Geol. Survey Dept. Mines Mem. 38, map 7.

Forms summit of Mount Ripple, British Columbia.

Ripton Conglomerate[1]

Precambrian: Northwestern Vermont.

Original reference: W. G. Foye, 1919, Vermont State Geologist 11th Rept., p. 84–85.

In Brandon quadrangle, Addison County.

Risco 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), 12–16, pls. 2, 3. Massive greenish-gray concretionary graywacke, forming rugged cliffs; lower half contains six tuffaceous sandstones; conglomerate present at base of formation west of Polonio Pass fault. At type locality, formation is roughly divisible into three parts in approximate thickness ratio (from bottom to top) of 2:3:5. Upper and lower parts consists of massive concretionary coarse sandstone, sandwiching a group of thin finer-grained sandstones relatively free of concretions. Roughly the same ratio holds in Three Peaks anticline, despite thinning and facies change. Thickness 2,965 feet at type locality; 4,400 feet north of Antelope Pumping Station; 1,650 in Three Peaks anticline; thinning is toward the northeast; unit pinches out on north limb of Three Peaks anticline. Conformably underlies Johnson Peak formation (new); overlies Badger shale (new), at type locality, contact is a thrust, but elsewhere contact is conformable. No diagnostic fossils.

Type locality: Comprises upper parts of both Risco Canyon and next adjacent canyon to west, west of Orchard Peak, Annette quadrangle, Kern County. Formation extends as nearly continuous band of outcrop from northwest corner of Orchard Peak area southeastward, then eastward almost to Devil's Den where it ends abruptly against Hex thrust.

Rising Bull Member (of Grinnell Argillite[1] or 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. 1889–1890. Thickness 600 to 1,100 feet. Argillites, quartzites, and mud breccias forming initial transition between Grinnell and Siyeh. Type locality designated.

Type locality: Upper cliffs of Mount Rockwell (Rising Bull of the Blackfeet), south of Upper Two Medicine Lake, Glacier National Park.

Rising Wolf Member (of Appekunny Argillite)[1]

Rising Wolf Member (of Grinnell 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. 1889. Thickness 200 to 700 feet. Reassigned to Grinnell Formation. Type locality designated.

Richard Rezak, 1957, U.S. Geol. Survey Prof. Paper 294–D, p. 137. Discussion of stromatolites of Belt series. Rising Wolf member of Fenton and Fenton (1937) is represented by *Collenia undosa* zone 1 in Grinnell argillites.

Type locality: Southern slopes of Rising Wolf Mountain, Glacier National Park.

Rison Clay Member (of White Bluff Formation)

Eocene (Jacksonian): Southeastern Arkansas.

L. J. Wilbert, Jr., 1953, Arkansas Div. Geology Bull. 19, p. 39–40, 70–80. Defined to include all marine Jacksonian beds developed above the Caney Point member in the southern part of the outcrop area of the White Bluff. Typical lithology—silts and blocky clay containing arenaceous foraminifers, molluscan molds, local thin lenticular concretions of molluscan molds. Maximum thickness of about 140 feet attained in eastern Cleveland County; member thins to a featheredge at southern margin of outcrop area. Overlies Caney Point marl member; interfingers with and is overlapped by Redfield formation.

Type locality: Along U.S. Highway 79, near junction with Arkansas State Highway 35, west of Rison city limits, Cleveland County.

Risser Beds

Silurian: Central western North Dakota (subsurface)

Saskatchewan Geological Society, 1958, Report of the Lower Palaeozoic names and correlations committee: Saskatchewan Geol. Soc., p. 16, 17, charts A and B. Buff to cream-colored dense to chalky microcrystalline dolomites; porous in part; occasional fossil fragments. Characteristically with reddish sandy development at base (13,120 to 13,174 feet in type well). Maximum known thickness 556 feet near center of Williston Basin (in west-central North Dakota). Everywhere truncated by a pre-Middle Devonian surface of unconformity; rest with possible unconformity on Hanson beds (new). No fossil evidence of Silurian age; may be in part Devonian. Name credited to unpublished Shell Oil Co. usage.

Type locality: Amerada No. 1 Risser (center SW¼ SE¼ sec. 12, T. 149 N., R. 96 W., McKenzie County) between 12,615 and 13,174 feet; Williston Basin.

Rita Blanca deposits

Pleistocene: Western and northwestern Texas.

G. L. Evans and G. E. Meade, 1945, Texas Univ. Bur. Econ. Geology Pub. 4401, p. 493. Lacustrine deposits in part equivalent to Blanco beds. Basal contact not exposed. Lowermost exposed strata consist of 30 feet or more of dark distinctly laminated clays containing plant remains and small fossil fish. Some sand beds and thin uniform layers of fresh-water dolomite are interbedded in the shales. Overlying the laminated clays is section, 50 feet or more thick, consisting mainly of sands, bentonitic clays, and thin-bedded calcareous sandstone.

Exposed along Rita Blanca Creek and its tributaries about 8 miles west of Channing, Hartley County.

Ritchie Limestone

Upper Cambrian or Lower Ordovician: East-central New York.

D. W. Fisher and G. F. Hanson, 1951, Am. Jour. Sci., v. 249, no. 11, p. 797 (fig. 1), 799 (fig. 2b); 803 (fig. 3), 804–806. Massive very thick bedded ash-white weathering gray-blue calcilutite only slightly dolomitized. Contains black chert nodules and *Rhachopea*(?). Thickness 43 feet. Formation exposed by faulting; measured thickness may be excessive. Apparently unconformably underlain by noncherty dark-gray coarse-grained dolomite of upper Hoyt and unconformably overlain by 7 feet of conglomerate composed of dolomite cobbles in a sand matrix. Latter grades laterally into a coarse sandstone with well-rounded quartz grains, which grades abruptly upward into cherty arenaceous blue-gray dolomite with Lower Ordovician fauna. Coarse clastic layer is interpreted as Mosherville sandstone (new) and dolomite as Gailor dolomite (new). Upper Cambrian or Lower Ordovician.

John Rodgers, 1952, *in* M. P. Billings, John Rodgers, and J. B. Thompson, Jr., Geol. Soc. America Guidebook for Field Trips in New England, Nov. 10–12, p. 34 (table 1). Listed on table as Lower Ordovician. Age is uncertain; may be facies of beds above or below.

Type locality: Just south of Petrified Sea Gardens, owned by Mr. Ritchie, about 3 miles west of Saratoga Springs, Saratoga County. This is only known exposure.

Ritchie Red Beds (in Monongahela Formation)[1]

Ritchie redbed member

Pennsylvanian: Northern West Virginia and eastern Ohio.

Original reference: J. J. Stevenson, 1907, Geol. Soc. America Bull., v. 18, p. 30, 44.

M. T. Sturgeon and others, 1958, Ohio Geol. Survey Bull. 57, p. 158 (table 13), 181. Member of Lower Uniontown cyclothem in report on Athens County. Composed of variegated clay shale with calcareous inclusions. Thickness about 10 feet. Above Arnoldsburg shale and sandstone member; below Lower Uniontown limestone member. The Ritchie is also considered a member of Uniontown cyclothem wherever upper boundary of Lower Uniontown cyclothem is lost. Monongahela series.

Named for exposures in Ritchie County, W. Va.

Ritito Conglomerate

Miocene(?): Central northern New Mexico.

Fred Barker. 1958, New Mexico Bur. Mines Mineral Resources Bull. 45, p. 3, 38, 42–43, pl. 1. Consists commonly of rounded to subangular pebbles and small boulders of fine-grained to pebbly quartzite, amphibolite, and metarhyolite. Most amphibolite fragments are weathered and very friable. Matrix of conglomerate is quartzose and composed of poorly sorted, subangular to subrounded grains. Generally the rock is weakly cemented and typically has medium-gray color. Maximum thickness of 400 feet on east side of Ritito Creek and in Escondido Canyon; pinches out entirely a mile to east of Canada del Oso. Lies directly upon Precambrian rocks along lower Vallecitos Valley.

Named after exposures in Ritito Canyon, in secs. 11 and 14, T. 27 N., R. 7 E. Other exposures 2 miles southeast and 1 mile west to south of Canon Plaza, along northeast side of Vallecitos Valley from Canon Plaza to Jarosita Creek, and along parts of Escondida and Felipito Canyons.

Rittman Conglomerate Lentil (of Cuyahoga Formation)[1]

Rittman Conglomerate Submember (of Armstrong Sandstone Member of Cuyahoga Formation)

Rittman Member (of Cuyahoga Formation)

Lower Mississippian: North-central Ohio.

Original reference: G. W. Conrey, 1921, Ohio Geol. Survey, 4th ser., Bull. 24, p. 56.

F. T. Holden, 1942, Jour. Geology, v. 50, no. 1, p. 41 (table), 49, 51. Termed Rittman conglomerate submember of Armstrong sand member of Cuyahoga formation in area of River Styx conglomerate facies. Unit consists of a layer of about 2 feet of brown and tan coarse conglomerate which is fossiliferous and rather friable, overlying a dark olive medium- and coarse-grained sandstone containing considerable mica. Not traceable throughout facies.

E. J. Szmuc, 1958, Dissert. Abs., v. 18, no. 6, p. 2109. Rank raised to member of Cuyahoga formation. Overlies Meadville member; underlies Armstrong member. Lower Mississippian.

Well exposed at Rittman, Wayne County.

River Glacial Stage

Pleistocene (Iowan): North-central Colorado.

R. L. Ives, 1937, (abs.) Colorado Univ. Studies, v. 25, no. 1, p. 75. Younger than Stillwater glacial stage (new); older than Arapaho glacial stage (new). Evidenced by terminal moraine.

R. L. Ives, 1938, Geol. Soc. America Bull., v. 49, no. 7, p. 1057–1058, 1062. Time covered by the deposition of a terminal moraine across mouth of Arapaho Creek which was mapped as moraine two. Ice and moraines of River stage dammed the Colorado River for short time, and some morainal material of this age was deposited in Colorado Valley on northwest side of river opposite Arapaho Creek.

In Monarch Valley, Grand County.

Riverbank Formation

Pleistocene, middle: Central California.

S. N. Davis and F. R. Hall, 1959, Stanford Univ. Pub. Geol. Sci., v. 6, no. 1, p. 6, 12, 16–20, pls. 2, 3. Composed of clays, silts, and sands; distinctive feature is a resistant silica hardpan in lower part of soil profile. Thickness at type section 53½ feet; however, thickness cannot be given with certainty because of difficulties in picking lower contact in subsurface; probable thickness as shown on geologic cross section (pl. 3) 150 to 200 feet. Overlies Turlock Lake formation (new); underlies Modesto formation (new). Modesto and Riverbank formations together represent the

Victor formation, and they can be traced northward into the Mokelumne area.

Type section: NW¼NE¼ sec. 26, T. 2 S., R. 9 E., Riverbank quadrangle, San Joaquin County. Exposures are in south bluff of Stanislaus River just north of intersection of Jackson and Topeka Streets in Riverbank. Exposed in a northwest-southeast trending belt of variable width that lies just west of Turlock Lake formation and east of towns of Modesto and Turlock.

**River Portal Mica Schist**[1]

Precambrian (Gunnison River Series): Central western Colorado.

Original reference: J. F. Hunter, 1925, U.S. Geol. Survey Bull. 777.

Named for excellent exposures in vicinity of the river portal of Gunnison Tunnel, Gunnison River region.

†River Quarry Beds[1]

Middle Ordovician: Southwestern Ohio.

Original reference: E. Orton, 1873, Ohio Geol. Survey, v. 1, p. 370–387.

Named for river quarries at Cincinnati.

Riverside Sand[1]

Miocene(?): Northwestern Iowa.

Original reference: H. F. Bain, 1896, Iowa Geol. Survey, v. 5, p. 255, 277–279.

Named for Riverside, Woodbury County.

Riverside Sandstone[1]

Lower Mississippian: Western and southern Indiana.

Original reference: T. C. Hopkins, 1896, Indiana Dept. Geology and Nat. Resources 20th Ann. Rept., p. 196, 317, pl. 9.

J. M. Weller and others, 1948, Geol. Soc. America Bull., v. 59, no. 2, pl. 1. Riverside sandstone listed in Riverside facies of Edwardsville formation.

First described in Fountain County. Quarried at Riverside.

Riverside sandstone facies (of Edwardsville Formation)

Lower Mississippian: Southeastern Indiana.

P. B. Stockdale, 1931, Indiana Div. Geology Pub. 98, p. 76, 293–300. Edwardsville formation is differentiated into following facies: Stewarts Landing, Springler Knob, Medora Knob, Allens Creek, Bear Wallow, and Riverside sandstone.

J. M. Weller and others, 1948, Geol. Soc. America Bull., v. 59, no. 2, p. 127–128, pl. 1. Mississippian facies nomenclature discussed. Riverside sandstone facies listed in Edwardsville formation. Includes Riverside sandstone.

Exposed in Fountain and Warren Counties along Wabash River. Probably named for quarries at Riverside, Warren County.

River Styx conglomerate 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); 50–51. One of seven facies distinguished in the formation. Includes Black Hand conglomerate and Armstrong sandstone members. Merges with Tinkers Creek shale facies (new) on the northeast and the Killbuck shale facies (new) on the southwest.

Occurs in Medina and Wayne Counties.

Riverton Formation or cyclothem (in Cherokee Group)

Riverton Formation (in Krebs Group)

Pennsylvanian (Des Moines Series) : Southeastern Kansas and southwestern Missouri.

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. Riverton, first in the sequence (ascending), occurs below the Neutral formation (cyclothem) and unconformably overlies eroded surface of the Mississippian. Average thickness 38 feet. Includes Riverton coal, 3 to 10 inches thick. [For complete sequence see Cherokee group this entry.].

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 Riverton formation in Krebs group. Underlies Warner formation.

W. V. Searight, 1955, Missouri Geol. Survey and Water Resources Rept. Inv. 20, p. 10–11. In Jasper County, Mo., formation is about 17 feet thick. Underlies Warner formation and overlies Boone chert. Krebs group. Derivation of name given.

W. B. Howe, 1956, Kansas Geol. Survey Bull. 123, p. 29–32. Described in southeastern Kansas as formation in Krebs subgroup of Cherokee group. Thickness 10 to 20 feet; average 15 feet. Consists of a basal shale 4 or 5 feet to 13 feet thick, an underclay 2 to 4 feet thick and Riverton coal. Overlies leached chert rubble derived from underlying Mississippian rocks. As presently defined, it is in part equivalent to McCurtain shale of eastern Oklahoma.

Name derived from Riverton coal in Cherokee County, Kans.

**Riverton Iron-Formation** (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. Consists dominantly of interbedded chert and siderite. Thickness ranges from less than 100 feet in western part of district to about 600 feet in eastern part. Locally upper part of formation is absent due to erosion prior to deposition of overlying Hiawatha graywacke. Overlies Dunn Creek slate (new).

Name derived from Riverton mine at Iron River, Iron County, first site of mining in district 75 years ago. Formation is visible in walls of the caved workings of the old mine.

Riverview 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 (fig. 8), 1710, 1717 (fig. 16). Quaternary section of Texas Coastal Plain between Brazos River and Rio Grande is divided into 11 terraces and terrace deposits. Name Riverview is applied to terrace deposit younger than and lying about 8 feet below First Street; a bench about 6 feet lower is designated as Riverview No.

2. Like First Street and Beaumont (Sixth Street) deposits, it is composed of dark-weathering silt overlying limestone gravel.

Type locality: Junction of Riverview and Chicon Streets, Austin, Travis County.

Rivoli 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. 24, figs. 3, 12. Argillaceous dolomite about 5 feet thick. Shown on columnar section as underlying Sherwood member (new) and overlying Mortimer member (new).

Occurs in Dixon-Oregon area.

Roach Creek Sandstone (in Graves Gap Group)

Pennsylvanian (Pottsville Series): Southeastern Kentucky and 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, pls. 2, 3, 4. Thickness near Roach Creek 60 feet; in western part of Cumberland Mountains 20 to 80 feet; thins to southeast; 20 to 25 feet near Fonde, Ky. Separated from overlying shales of Redoak Mountain group (new) by a shale interval 50 to 90 feet thick that contains Craig coal and Windrock coal; separated from underlying Armes Gap sandstone (new) by a shale interval 60 to 130 feet thick that contains Pioneer coal.

Named from exposures above Roach Creek, near Dean, Block quadrangle, Scott County, Tenn.

†Roan Gneiss[1]

Precambrian: Eastern Tennessee, northern Georgia, western North Carolina, and northwestern South Carolina.

Original reference: A. Keith, 1903, U.S. Geol. Survey Geol. Atlas, Folio 90, p. 2.

T. L. Kesler, 1944, Geol. Soc. America Bull., v. 55, no. 6, p. 756, 775–781. Near Kings Mountain, mica schists and gneisses, previously mapped as Carolina gneiss, and hornblende gneisses, previously mapped as Roan gneiss, actually constitute metamorphosed upper part of Gaffney. Similar rocks in Beaver Creek area are apparently stratigraphically higher. Evidence in other parts of Carolina Piedmont indicates that intrusive diorite and possibly recrystallized mafic volcanic rocks have been included in the Roan and possibly recrystallized felsic volcanic rocks in the Carolina gneiss. Names Carolina and Roan have lithologic but not stratigraphic significance.

F. D. Eckelmann and J. L. Kulp. 1956, Am. Jour. Sci., v. 254, no. 5, p. 291, 314. In Spruce Pine district, interlayered with Carolina gneiss, and the two types of rocks grade into each other along and across the strike. The Roan-Carolina sequence appears to be a single sedimentary unit with varying lithology, complicated by intense isoclinal folding and plastic deformation. Roan-Carolina complex is interlayered with Cranberry and Henderson gneisses. These formations are in a consistent and conformable stratigraphic position below the Carolina-Roan complex as seen in Cranberry, Roan Mountain, and Mount Mitchell quadrangles where the granitic gneisses are distributed about borders of the Roan-Carolina rocks which form the central part of the southwest-plunging Spruce Pine synclinorium.

Named for development on Roan Mountain, Carter County, Tenn.

Roaring Branch 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.

Occurs along Roaring Branch.

Roaring Branch Shales (in Pocono Formation)[1]

Mississippian: Northeastern Pennsylvania.

Original reference: I. C. White, 1881, Pennsylvania 2d Geol. Survey Rept. $G_5$, p. 56–57, 235.

Occurs along Roaring Branch.

†Roaring Creek Sandstone (in Kanawha Formation[1] or Group)

Pennsylvanian: Eastern West Virginia.

Original reference: I. C. White, 1903, West Virginia Geol. Survey, v. 2, p. 462.

H. R. Wanless, 1939, Geol. Soc. America Spec. Paper 17, p. 100. Massive sandstone; uppermost member of Kanawha group.

Well developed along Roaring Creek, a branch of Tygart Valley River, Randolph County.

**Roaring Fork Sandstone** (in Snowbird Group)

Precambrian (Ocoee Series): Southeastern Tennessee.

P. B. King and others, 1958, Geol. Soc. America Bull., v. 69, no. 8, p. 954–956. Thick unit of dark sandstone and interbedded pelitic rocks; in vicinity of Roaring Fork, somewhat less that half of formation consists of massive light-greenish-gray sandstone beds 5 to 50 feet thick, which ar fine to medium grained, highly feldspathic, and moderately well sorted; interbedded with them are thick- to thin-bedded finer grained sandstone, siltstone, and argillaceous rocks; current bedding common especially in finer grained and thinner bedded sandstone. At type locality, about 8,000 feet of Roaring Fork sandstone conformably underlies Pigeon siltstone, but base is cut off by faults; on Pigeon River, where complete section is present, formation is 2,700 feet thick; this decrease is interpreted as resulting from intertonguing eastward with Longarm quartzite (new) through an interval of several thousand feet.

Typical section: On Roaring Fork, 1 to 3 miles southeast of Gatlinburg, Sevier County.

Roaring River Sandstone Member (of Noel Shale)

Upper Devonian: Southwestern Missouri.

M. G. Mehl, 1960, Denison Univ. Jour. Sci. Lab., v. 45, art. 5, p. 91–92. Light gray to pale buff on fresh exposures; medium or dark reddish brown on weathering. At type locality, consists of two irregular beds 9 to 12 inches thick. Basal part of Noel. Rests unconformably on several formations involved in a surface that appears to have presented very slight relief. Most common underlying rock is Cotter dolomite; in some areas, overlies Fortune formation.

Type locality: About center of east side sec. 34, T. 22 N., R. 27 W., along Missouri State Highway 112, Barry County. Name derived from Roaring River.

Roaring River Tongue (in Ono Formation)

Lower Cretaceous; Northern California.

M. A. Murphy, 1956, Am. Assoc. Petroleum Geologists Bull., v. 40, no. 9, p. 2103, 2111. Conglomerate, sandstone, and mudstone. Typical section along Roaring River consists of four beds of massive cobble. Beds range in thickness up to 40 feet and are lenticular along the strike. Interbeds are massive sandstone with minor amounts of mudstone in lower part of tongue; upper part is predominantly graywacke with increasing amounts of mudstone toward top; approximately 850 feet thick on Roaring River; thickness differs greatly along strike.

Named from Roaring River, a tributary of Cottonwood Creek, Shasta County.

Robbers Roost Formation

Permian (Wolfcamp): South-central Nevada.

J. S. Berge, April 1960, Brigham Young Univ. Research Studies, Geol. Ser., v. 7, no. 5, p. 11 (fig. 3). Named on correlation chart. Overlies Butte formation (new). Name credited to G. P. Lloyd (unpub. thesis).

North end of White River valley, White Pine County.

Robbers Roost Gravel

Quaternary: Northwestern Arizona.

Donaldson Koons, 1948, Plateau, v. 20, no. 4, p. 54 (fig. 1), 58. Composed of poorly rounded and sorted pebbles of limestone, sandstone, and chert of local derivation. Rests on steep bedrock slopes. Interpreted as a talus or alluvial cone deposit.

Name derived from Robbers Roost Mesa, Coconino County, near which the unit is well exposed.

**Robbins Shale Member**[1] (of Stranger Formation)

Robbins Shale

Pennsylvanian (Virgil Series): Southeastern Kansas and southeastern Nebraska.

Original reference: R. C. Moore, 1936, Kansas Geol. Survey Bull. 22, p. 146, 153–156.

G. E. Condra, 1949, Nebraska Geol. Survey Bull. 16, p. 29. Stranger age beds are exposed in three small areas on Table Rock-Richfield anticlines in Cass and Sarpy Counties in North Branch Weeping Water Creek valley, Eightmile Creek valley and Platte River bluffs in vicinity of South Bend. Well logs show that these beds extend subsurface through Forest City basin and rise to surface in outcrop areas of Missouri and Kansas. Stranger section in Cass County is Robbins shale above and Cass formation below. Robbins shale is about 3 feet thick in Burlington quarries near South Bend. Rests conformably on Haskell member of Cass formation, but its upper boundary is at post-Stranger unconformity below the Lawrence formation.

H. C. Wagner and L. D. Harris, 1953, U.S. Geol. Survey Oil and Gas Inv. Chart OC–48. Described in Fredonia quadrangle, Kansas, where it is more than 120 feet thick in southern part of quadrangle, thins to 50 feet in northern part. Predominantly a light-olive-gray slightly silty shale that is characterized by beds and lenses of small ironstone concretions. Overlies Haskell limestone member; underlies Ireland sandstone member of Lawrence shale.

Type locality: Robbins Farm, sec. 11, T. 26 S., R. 15 E., southwest of Yates Center, Woodson County, Kans.

**Rob Camp 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). Very massive bedded very dense cryptocrystalline, tan and dove-gray limestone with abundant small patches of white crystalline calcite; zones of thinner bedded limestone containing chert nodules present in eastern part of area. Thickness as much as 150 feet. Unconformably underlies Martin Creek limestone (new); overlies Poteet limestone (new). Same as Mosheim limestone (after Butts) on map by Miller and Fuller (1947, 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), 33–34, 39–43, 105, 107, 109, pl. 1. Further described; typical section and derivation of name given. Rob Camp probably correlates with Five Oaks limestone of Cooper and Prouty (1943) in Tazewell County. Summary of nomenclature of Middle Ordovician formations in Lee and Tazewell Counties.

Named from exposures one-half mile north of Rob Camp Church in Rose Hill district. Church is in northwest corner of Hancock County, Tenn., 3 miles south of Lee County line.

Roberta Sandstone Member (of Barnwell Formation)

Eocene, upper: Central and northeastern Georgia.

J. F. L. Connell, 1958, Southwestern Louisiana Jour., v. 2, no. 4, p. 321–322, 329, 343 (fig. 15). Name applied to the argillaceous red sands composing the typical Barnwell, that is above and outside the area of outcrop of the Irwinton and Upper Sand members. Thickness 15 to 40 feet. In extreme northeastern Georgia, beds occur higher in the section than the other members; in Crawford and possibly Peach County, occur unconformably upon uppermost Twiggs clay member.

Type locality: At Rich Hill, a prominent topographic feature 6 miles east of Roberta, Crawford County. Present also in Glascock and Jefferson Counties.

Roberts Formation[1]

Precambrian: East-central California.

Original reference: J. H. Maxson, 1934, Pan-Am. Geologist, v. 61, no. 4, p. 311.

J. C. Hazzard, 1937, California Jour. Mines and Geology, v. 33, no. 4, p. 280 (fig. 4). Thickness about 2,500 feet. Underlies Wyman formation.

In Wyman Canyon, Inyo Range.

Roberts Sand[1]

Miocene(?): Southwestern Alabama.

Original reference: W. H. Dall and J. Stanley-Brown, 1894, Geol. Soc. America Bull., v. 5, p. 167, 170.

Named for exposures at Roberts, Escambia County.

**Roberts Mountains Formation** or **Limestone**

Middle Silurian: Eastern Nevada and western Utah.

C. W. Merriam, 1940, Geol. Soc. America Spec. Paper 25, p. 11–12, pl. 1. Formation lies between the light-gray dolomites of Lone Mountain (restricted) and Ordovician Hanson Creek formation (new). Predominantly limestone, well-bedded and dark slate gray. Thickness at type section 1,900 feet; at Lone Mountain 741 feet. Lower contact drawn at base of laterally persistent belt of bluish-black chert 560 feet above Eureka quartzite; at Lone Mountain, same type of chert beds occur 318 feet above the Eureka. Partial equivalent of this formation at Lone Mountain was included in Lone Mountain limestone by Hague (1892; U.S. Geol. Survey Mon. 20).

R. W. Rush, 1956, Utah Geol. and Mineralog. Survey Bull. 53, p. 12 (fig. 3), 20–21, 22 (fig. 5). Geographically extended into Millard County, Utah, where it is 369 feet thick, underlies Jack Valley formation (new) and overlies Fish Haven dolomite.

E. L. Winterer and M. A. Murphy, 1960, Jour. Geology, v. 68, no. 2, p. 134 (fig. 6), 135, 136. Underlies Rabbit Hill formation (new).

Type section: West side Roberts Creek Mountain, about 30 miles north of Eureka, Eureka County, Nev.

Robertson Formation (in Mowich Group)

Lower Jurassic: East-central Oregon.

R. L. Lupfer, 1941, Geol. Soc. America Bull., v. 52, no. 2, p. 227 (table 1), 229, 238–239, 241–242. Includes, in most places, two lithologic facies: (1) a basal section of conglomerate and coarse greenish-gray sandstone upon truncated beds of the Upper Triassic, and (2) an overlying reef limestone. Average thickness 250 feet; maximum about 500. Underlies Suplee formation (new).

W. R. Dickinson, 1960, Dissert. Abs., v. 20, no. 11, p. 4367. Lower Jurassic sequence in Izee area, Grant County, includes Robertson, Supple, Nicely, and Hyde formations. Uppermost unit in Triassic sequence is Graylock formation (new).

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 Robertson Ranch in sec. 28, T. 18 S., R. 26 E., Crook County.

Roberts Ranch Member (of Dagger Flat Formation)

Upper Cambrian: Southwestern Texas.

J. L. Wilson, 1954, Jour. Paleontology, v. 28, no. 3, p. 251, 252; 1954, Am. Assoc. Petroleum Geologists Bull., v. 38, no. 12, p. 2465. Principally shale with thin beds of dark sandy finely crystalline limestone and calcareous micaceous graywacke sandstone. Thickness 225 to 570 feet. Overlies Buttrill Ranch member (new); underlies Marathon formation.

Type locality: Dagger Flat, Brewster County. Crops out along crest of Marathon anticlinorium which is traversed by Roberts Ranch Road.

Robeson Conglomerate

Triassic: Southeastern Pennsylvania.

D. B. McLaughlin, 1939, Michigan Acad. Sci. Arts, and Letters, Papers, v. 24, pt. 4, p. 60, 73. Name applied to a thick succession of conglomerates and coarse sandstones with almost no shale that occur in an alluvial fan in the Triassic. Considered to be stratigraphic equivalent of Lockatong and Brunswick formations. Dip and width of outcrop indicate thickness of approximately 15,000 feet.

Named from Robeson Township, Berks County.

Robinson Diorite[1]

Miocene or Pliocene: Central southern Montana.

Original reference: W. H. Weed, 1899, U.S. Geol. Survey Geol. Atlas, Folio 56.

Occurs on west of main summit of Castle Mountain, between Robinson and Blackhawk, Meagher County.

**Robinson Formation**[1]

Pennsylvanian: 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. Mapped with Permian marine sedimentary and metasedimentary rocks.

Named for exposures on Robinson Ranch near Taylorsville, Plumas County.

**Robinson Limestone Member** (of Minturn Formation)

Robinson Limestone Member (of Battle Mountain Formation)

Robinson Limestone Member (of Maroon Formation)[1]

Pennsylvanian: Northwestern 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. 69, 198, 279, 598, 646; 1898, U.S. Geol. Survey Geol. Atlas, Folio 48.

K. G. Brill, Jr., 1942, Am. Assoc. Petroleum Geologists Bull., v. 26, no. 8, p. 1376 (fig. 1), 1378 (fig. 2), 1380–1383, 1384. Reallocated to member status in Battle Mountain formation (new). Overlies Belden shale member (new); underlies Jacque Mountain member.

Ogden Tweto, 1949, Colorado Sci. Soc. Proc., v. 15, no. 4, p. 152 (table 1), 201–202, 211–215. Reallocated to member status in Minturn formation. Overlies Resolution dolomite member (new); underlies Elk Ridge limestone member. Thickness 300 to 400 feet; comprises three to five beds of gray limestone separated by clastic rocks; limestone beds are 3 to 31 feet thick and 40 to 85 feet apart. Limestones contain fusulinids classed as Des Moines in age. Work in Pando area has proved that Lime Cliffs group of limestones of Minturn quadrangle are equivalent to Robinson limestone, and bed that Brill designated Robinson limestone in his type section of Battle Mountain formation, along Turkey Creek, in southern part of Minturn quadrangle, is in reality the bed here called Hornsilver dolomite member.

Named for fact it forms ore-bearing horizon of Robinson mine in Tenmile district.

†Robinson Quartzite[1]

Lower Cambrian : Central northern Utah.

Original reference: G. W. Tower, Jr., and G. O. Smith, 1899, U.S. Geol. Survey 19th Ann Rept., pt. 3, p. 620–622.

Probably named for town of Robinson, Juab County.

†Robinson Shale[1]

Mississippian : Central eastern Nevada.

Original references: C. R. Keyes, 1923, Pan-Am. Geologist, v. 40, p. 52; 1924, Pan-Am. Geologist, v. 41, p. 78.

Ely district.

Robinson Branch Formation or coal cycle (in Cabaniss Group)

Robinson Branch Formation (in Cherokee Group)

Pennsylvanian (Des Moines Series) : Southwestern Missouri, and southeastern Kansas, northeastern Oklahoma.

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 Robinson Branch formation. Underlies Fleming formation; overlies Mineral formation. Included in Cabaniss group.

C. C. Branson, 1954, Oklahoma Geol. Survey Guide Book 2, p. 5. Listed as Robinson Branch coal cycle in Senora formation, Cabaniss group in Oklahoma.

W. V. Searight, 1955, Missouri Geol. Survey and Water Resources Rept. Inv. 20, p. 39. Top is Robinson Branch coal bed. In lower part, in places in Vernon and Bates Counties, Mo., in southeastern Kansas, and in northeastern Oklahoma, contains a bed of black calcareous shale containing *Marginifera muracatina*, *Linoproductus cora*, gastropods, and pelecypods. Sporadic limestone in lower part, in western Missouri, southeastern Kansas, and northeastern Oklahoma, is called Doneley limestone in Oklahoma. Upper limestone was named Ardmore (Gordon, 1893), and entire limestone and shale succession was included in the Ardmore by Cline (1941). The prominent ledge of limestone in Vernon County, Mo., is known as "diamond rock," and name Rich Hill has been applied to it (Greene and Pond, 1926).

W. B. Howe, 1956, Kansas Geol. Survey Bull. 123, p. 22 (fig. 5), 62–66, 105. A formation in Cabaniss subgroup of Cherokee group. Includes (ascending) limestone and calcareous shale (cap rock of Mineral coal), dark shale, fine-grained sandstone, underclay, and Robinson Branch coal. In eastern Labette County, Kans., and Craig County, Okla., the limestone forms an almost continuous bed, averaging 18 inches in thickness; in Cherokee and Crawford Counties, Kans., ranges in thickness from featheredge to 3 feet; Branson (1952) [1954] applied name Russell Creek to this limestone in Craig County, Okla. Overlies Mineral formation; underlies Fleming formation. Derivation of name given.

Named from Robinson Branch coal, which in turn is named for Robinson Branch, a stream in Vernon County, Mo. Complete succession was formerly exposed in strip pits northeast of Walker, SW¼ sec. 2, T. 36 N., R. 30 W., Vernon County.

Robinson Creek Vitrophyre

Pliocene: Northeastern Nevada.

R. R. Coats, 1957, U.S. Geol. Survey Trace Elements Inv. Rept. TEI–690, Book 2, p. 307. Several small gray vitrophyric perlite domes, characterized by labradorite, hypersthene, augite, magnetite, and apatite. Maximum exposed thickness of any one dome about 200 feet and greatest length about three-fourths of a mile; generally bases on which domes were extruded not visible.

Near northeastern border of Jarbidge quadrangle.

Robinson 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. 121–122, 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. Robinson Mountain is fifth in known sequence; younger than Bellisle Mountain and older than Jose Butte.

Robinson Mountain, a prominent, deeply eroded vent is about 5 miles west-northwest from Capulin Mountain and 3 miles west of Union County line.

**Roblar Leucogranite**

Cretaceous: Southern California.

E. S. Larsen, Jr., 1948, Geol. Soc. America Mem. 29, p. 97, pl. 1. Flesh-colored and aplitic; shows a little biotite and white feldspar. In most places, shows poor outcrops; exposures are of a friable sandy nature; where better exposed, yields small angular blocks due to the closely spaced sheeting. Younger than Woodson Mountain granodiorite.

Named for its exposures in Roblar Canyon, San Luis Rey quadrangle.

**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. 143–147. Three facies recognized. Sandstone-siltstone facies of central and south-central part of island includes Río Matón, Lapa lava, and Las Tetas lava members (all new); this facies interfingers northward into pillow-lava-volcanic-breccia facies that intertongues to northeast with impure limestone-volcanic-breccia-conglomerate facies. Thickness of formation and probable equivalent strata ranges from approximately 3,000 feet in southern part of island to about 4,000 feet in central part; equivalent strata may be as much as 8,000 feet thick in northeastern part of island. Unconformably overlies volcanic complex in southern part of island; in central part, appears to lie conformably on lavas equivalent to Fajardo formation; underlies Cariblanco formation (new). Probably ranges from late Coniacian to early Campanian in age. Name credited to Pease and Briggs (in press).

H. L. Berryhill, Jr., and Lynn Glover 3d, 1960, U.S. Geol. Survey Misc. Geol. Inv. Map I–319. In Cayey quadrangle, consists of five distinct members and a sixth unnamed member which lies at base of formation in places south of Proyecto Vazquez. Named members (ascending) Río Matón limestone, Lapa lava, Cayey siltstone (new), Las Tetas lava, and Collao (new). Maximum thickness about 1,000 meters.

M. H. Pease, Jr., and R. P. Briggs, 1960, U.S. Geol. Survey Misc. Geol. Inv. Map I–320. Described in Comerío quadrangle which contains type area.

Includes Río Matón limestone, Lapa lava, and Las Tetas lava members. Maximum composite thickness more than 1,000 meters. Overlies unit termed formation K; underlies formation L.

E. A. Pessagno, Jr., 1960, Geology of the Ponce-Coamo area, Puerto Rico: Puerto Rico Econ. Devel. Adm. and Princeton Univ. Dept. Geology, p. 21–24. In Ponce-Coamo area, crops out south of Cerrillos-Descalabrado fault in Coamo and Río Descalabrado quadrangles. Includes Lapa andesite member. Underlies Ildefonso formation (new); base not exposed. Thickness about 3,000 feet in Barranquitas quadrangle; here it overlies Río Loco formation and unconformably overlies Ildefonso formation.

Type area: Barrio Robles of Municipio of Aibonito, Comerío quadrangle.

**Roca 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 and others, 1951, Kansas Geol. Survey Bull. 89, p. 48. Defined to exclude Legion shale and Sallyards limestone. Consists of gray, red, and green shale, and thin impure limestone. Thickness 15 to 20 feet. Underlies Sallyards limestone member of Grenola limestone; overlies Howe limestone member of Red Eagle limestone. Wolfcamp series.

P. B. Greig, 1959, Oklahoma Geol. Survey Bull. 83, p. 90–94. Roca shale, as used in this report, includes rocks between Red Eagle and Neva limestones. In essence, this is original definition of unit proposed by Condra (1927). Condra's definition has been modified by establishment of Grenola formation (Condra and Busby, 1933) which, except for Neva limestone, consists of beds formerly included in upper part of Roca. Definition of Roca as restricted by Condra and Busby is the one currently followed in Kansas and Nebraska. In Pawnee County, top of Kansas Roca is indeterminate, and only Neva limestone member of Grenola can be recognized with assurance. Hence, Roca of this report includes in its upper part a section representative of all but Neva limestone member of Grenola formation of Kansas. Thickness 80 to about 120 feet in Pawnee County.

Named for Roca, Lancaster County, Nebr.

**Rochdale Limestone** (in Beekmantown Group)[1]

Lower Ordovician: Southeastern New York.

Original references: W. B. Dwight, 1887, Am. Jour. Sci., 3d v. 34, p. 32; Vassar Bros. Inst. Trans. Sci. Sect., v. 4, pt. 2, p. 213.

E. B. Knopf, 1946, (abs.) Geol. Soc. America Bull., v. 57, no. 12, pt. 2, p. 1212. Consists of limestones and dolomites carrying *Lecanospira* and orthoceratite cephalopods. Thickness about 400 feet. Overlies Halcyon Lake calc-dolomite (new). Discussion of stratigraphy of lower Paleozoic rocks surrounding Stissing Mountain, Dutchess County.

Named for exposures near village of Rochdale, Dutchess County.

Rochelle Conglomerate (in Canyon Group)

Rochelle Conglomerate (in Graford Formation)[1]

Rochelle Conglomerate Member (of Garner Formation)

Pennsylvanian: Central Texas.

Original references: R. S. Tarr, 1890, Texas Geol. Survey 1st Ann. Rept., p. 204, 205; Am. Geologist, v. 6, p. 147–153.

M. G. Cheney, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 1, p. 66 (fig. 1) ; 90–91. Shown on chart as member at top of Garner formation. Rochelle conglomerate, Capps and Adams Branch limestones have been miscorrelated between their type localities in Colorado River district and Brazos River district; this fact should be borne in mind in using early literature. Rochelle conglomerate can be traced northward below Capps limestone; hence it is now considered at least as old as Brazos River conglomerate. Strawn series.

F. B. Plummer, 1950, Texas Univ. Bur. Econ. Geology Pub. 4329, p. 93–94, pl. 20. Lowest division of Canyon group in Llano region. Thickness 8½ to 18 feet. Underlies Brownwood shale; east of Rochelle, unconformably overlies dark-gray and dark-maroon sandy shale of Strawn age; southwest of Rochelle overlaps on Marble Falls limestone.

J. W. Shelton, 1958, Geol. Soc. America Bull., v. 69, no. 12, pt. 1, p. 1515–1524. Discussion of Strawn-Canyon boundary.

L. F. Brown, Jr., 1959, Am. Assoc. Petroleum Geologists Bull., v. 43, no. 12, p. 2866–2871. Discussion of problems of stratigraphic nomenclature and classification. Upper Pennsylvanian, north-central Texas—erecting series from groups, suppression of formations, redefining and raising rank of rock-stratigraphic units, time-stratigraphic boundaries versus lithographic contacts.

Type locality: Four miles east and 1.3 miles north of Rochelle-San Saba Road, near top of prominent escarpment.

Rocher Member (of Salem Limestone)

Mississippian (Valmeyer Series) : Southwestern Illinois.

J. W. Baxter, 1959, Dissert. Abs., v. 19, no. 11, p. 2910, 2911. Salem limestone is subdivided into four members [sequence not stated] to which names Kidd, Fults, Chalfin, and Rocher are assigned. Rocher member is a skeletal calcarenite in which the tests of *Endothyra* are a prominent element; commonly more or less oolitic.

J. W. Baxter, 1960, Illinois Geol. Survey Circ. 284, p. 2–3, 10–11, 13, 27–30, pl. 1. Consists of thick limestone beds separated by more thinly bedded strata. Maximum thickness about 60 feet near Prairie du Rocher; thins to north to 10 to 15 feet near Valmeyer, Overlies Chalfin member; underlies St. Louis limestone.

Type section: Above spring, 1 mile south of Monroe-Randolph County line at site of a limestone mine in T. 5 S., R. 9 W. Named from exposures in northern Randolph County less than 1 mile north of town of Prairie du Rocher.

Rochester Biotite Granite[1]

Devonian(?) : Southeastern New Hampshire.

Original reference: A. Wandke, 1922, Am. Jour. Sci., 5th, v. 4, p. 148, 149.

Probably named for exposures at Rochester, Stafford County.

Rochester Quartzite[1]

Precambrian: Vermont.

Original reference: W. G. Foye, 1919, Vermont State Geologist 11th Rept., p. 87.

Exposed along the Mine Railroad in Rochester, Windsor County.

**Rochester Rhyolite** (in Koipato Group)

Rochester Trachyte[1]

Permian: Northwestern Nevada.

Original reference: A. Knopf, 1924, U.S. Geol. Survey Bull. 762.

R. E. Wallace and others, 1959 U.S. Geol. Survey Mineral Inv. Field Studies Map MF-220. Rhyolite included in Koipato group in Buffalo Mountain quadrangle. Consists of rhyolite tuff-breccia in heterogeneous intertongued pile; relatively few masses that are true flow rocks; predominantly devitrified glass, containing sparse small phenocrysts, metacrysts of tuffaceous fragments of feldspar and quartz. Thickness not uniform probably exceeding 2,000 feet in places. Older than Weaver rhyolite. Permian.

Named for occurrence in Rochester Canyon, Rochester district.

**Rochester Shale** (in Clinton Group)

Rochester Formation

Rochester Member (of Mifflin Formation)

Rochester Shale Member (of Clinton Formation)[1]

Middle Silurian: Maryland, New York, Pennsylvania, and West Virginia, and Ontario, Canada.

Original reference: T. A. Conrad, 1839, New York Geol. Survey 3d Rept., p. 62–63.

C. K. Swartz and F. M. Swartz, 1931, Geol. Soc. America Bull., v. 42, no. 3, p. 624, 627–628, 630, 632. Geographically extended into Pennsylvania where it includes Keefer sandstone member. Thickness 70 feet. Underlies McKenzie formation; overlies Rose Hill formation.

E. R. Cumings, 1939, *in* Geologie der Erde, North America, v. 1, p. 595, 597. In Ontario, Clinton group includes Reynales and Irondequoit limestones and Rochester shale. Decew waterlime bed, formerly included in the Lockport, is here made upper member of Rochester formation. It is overlain by Gasport dolomite. Thickness 70 feet in Niagara Gorge.

W. P. Woodward, 1941, West Virginia Geol. Survey, v. 14, p. 8, 106–116. Rochester shale described in West Virginia where it is as much as 30 feet thick. Overlies Keefer sandstone and underlies McKenzie formation. This usage indicates general correlation of Rochester shale with the so-called "upper Clinton shale" of previous Survey county reports. Middle Silurian, Niagaran series.

H. L. Alling, 1946, Rochester Acad. Sci. Proc., v. 9, no. 1, p. 52–53. Term Gates is a rock facies and retention of name as formation or member of the Rochester is inadvisable.

D. W. Fisher, 1959, New York State Mus. Sci. Service Map and Chart Ser. 1. There is variance of opinion as whether time break exists between Lockport group and underlying Rochester shale. Some claim that Brownsport, Waldron, and Laurel fill this "gap." Evidence is not 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 is evident from Rochester eastward. The Rochester in Clinton group grades imperceptibly upward into Decew, which is transferred to Tonwandan stage (new). Grades eastward into Herkimer sandstone; overlies Irondequoit limestone.

H. H. Arndt and others, 1959, Geol. Soc. America Guidebook Pittsburgh Mtg., p. 5–6, 20, 23. Rank reduced to member status in Mifflin formation (new). Underlies McKenzie member; overlies Keefer member. Thickness 30 to 40 feet in central Pennsylvania. In Mount Union section referred to as formation. Thickness 40 feet. Overlies Keefer formation; underlies McKenzie formation. Silurian.

Named for exposures at Rochester, Monroe County, N.Y.

Rociada limestone[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 district, northwest of Las Vegas, San Miguel County.

Rockaway Conglomerate Beds (in Lutie Member of Theodosia Formation)

Lower Ordovician: Northern Arkansas and southern Missouri.

J. S. Cullison, 1944, Missouri Univ. School Mines and Metallurgy Bull., Tech. Ser., v. 15, no. 2, p. 25, 27, pls. 2, 6. Name applied to chert conglomerate and breccia beds that mark the base of the Lutie; number of beds vary from place to place and are commonly separated by "cotton rock" or crystalline dolomite. Beds are stratigraphically below the Hercules Tower sandstone (new) and are immediately overlain by a massive, crystalline dolomite, commonly more or less chert free.

Named from Rockaway Beach, Lake Taneycomo, Taney County, Mo.

Rock Bench Quarry Beds (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. 234–236, 238 (table). Proposed for rocks yielding the *Ptilodus-Elphidotarsius-Plesiolestes-Ancondon* fauna. A coarse buff sandstone, 9 to 31 feet thick, that occurs about 200 feet above base of formation and about 70 feet above top of Mantua lentil (new); stratigraphically below Silver Coulee beds (new).

Rock Bench is local name for part of the Polecat Bench, in Big Horn basin, near Powell, Park County.

**Rock Bluff Limestone Member** (of Deer Creek 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. 40, 43, 50.

R. C. Moore, 1948, Am. Assoc. Petroleum Geologists Bull., v. 32, no. 11, p. 2035 (fig. 5). Rock Bluff limestone member of Deer Creek limestone; underlies Larsh shale member; overlies Oskaloosa shale member. This is classification agreed upon by State Geological Surveys of Iowa, Kansas, Missouri, Nebraska, and Oklahoma, May 1947; classification is subject to modifications imposed by lateral variations of deposits.

R. C. Moore, 1949, Kansas Geol. Survey Bull. 83, p. 157–158. Dense blue limestone; commonly a single massive stratum 1 to 2 feet thick. In Kansas, underlies Larsh-Burroak shale member.

F. C. Greene and W. V. Searight, 1949, Missouri Geol. Survey and Water Resources Rept. Inv. 11, p. 17. In Missouri, underlies Larsh-Burroak shale member.

H. G. Hershey and others, 1960, Iowa Highway Research Board Bull. 15, p. 18, fig. 5. Dark blue to gray, dense; commonly one massive bed, but locally weathers into two layers. Thickness 1½ to slightly more than 2 feet. Underlies Larsh shale member; overlies Oskaloosa shale member.

H. G. O'Connor, 1960, Kansas Geol. Survey Bull. 148, p. 45–46, pl. 1. In Douglas County, consists of single bed of hard dense to fine-grained dark-blue-gray limestone about 2 feet thick. Overlies Oskaloosa shale member; underlies Larsh-Burroak shale member.

Named for exposures high in Missouri River bluffs northeast of Rock Bluff, Cass County, Nebr.

Rock Branch Coal Member (of Modesto Formation)

Pennsylvanian: Southwestern Illinois.

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 37, 49 (table 1), pl. 1. Name applied to coal previously called Scottville so that latter name can be restricted to Scottville limestone. Stratigraphically above Piasa limestone member and below Athensville coal member (new). Presentation of new rock-stratigraphic classification of Pennsylvanian of Illinois. Cyclical classification retained but is entirely independent of rock-stratigraphic classification.

Type locality: SW¼SW¼NW¼ sec. 21, T. 8 S., R. 9 W., Macoupin County. Named for exposures along Rock Branch in northwestern part of county.

Rock Candy Agglomerate and Latite (in Bullion Canyon Series)

Tertiary: Central Utah.

P. F. Kerr and others, 1957, Geol. Soc. America Spec. Paper 64, p. 14, 15 (fig. 6), pl. 12. Rock Candy agglomerate, 600 feet thick, underlies Rock Candy latite 50 to 500 feet thick.

Mapped in vicinity of Big Rock Candy Mountain, Marysvale area.

†Rock Canyon Conglomeratic Member (of Moenkopi Formation)[1]

Lower Triassic: Northwestern Arizona and southwestern Utah.

Original reference: H. Bassler and J. B. Reeside, Jr., 1921, U.S. Geol. Survey Bull. 726–C, p. 90–92.

H. E. Gregory, 1950, U.S. Geol. Survey Prof. Paper 220, p. 54. Abandoned as stratigraphic term. Rock Canyon conglomerate at its type locality is substantially equivalent to Harrisburg gypsiferous member of Kaibab.

Named for Rock Canyon, 5 miles north of Antelope Spring, Mohave County, Ariz.

**Rockcastle Conglomerate Member** (of Lee Formation)[1]

**Rockcastle Sandstone** (in Lee Group)[1]

Rockcastle Conglomerate (in Crab Orchard Mountains Group)

Lower Pennsylvanian: Eastern Tennessee, northern Georgia, and east-central Kentucky.

Original reference: M. R. Campbell, 1898, U.S. Geol. Survey Geol. Atlas, Folio 46, p. 3.

V. H. Johnson, 1946, Coal deposits of Sand and Lookout Mountains, Dade and Walker Counties, Georgia: U.S. Geol. Survey Prelim. Map. Geographically extended into northern Georgia where it is exposed on Lookout Mountain and overlies Vandever shale.

C. W. Wilson, Jr., J. W. Jewell, and E. T. Luther, 1956, Pennsylvanian geology of the Cumberland Plateau: Tennessee Div. Geology [folio], p. 4, 19, pls. 2, 3, 4, 12–A. Youngest unit in Crab Orchard Mountains group (new). Term conglomerate considered more appropriate than sandstone in this area. In type area (as used in this report), conglomerate is 160 feet thick; maximum thickness 300 feet; in general, greatest thickness is along Eastern Escarpment; thins progressively southward. Along Piney River in Rhea County, the massive conglomeratic sandstone splits eastward to form a sequence of thin sandstones and shales. Contains Nemo coal. Overlies Vandever formation; underlies Dorton shale (new). Pottsville series.

Type locality: Rockcastle Cove, near Jamestown, Fentress County, Tenn.

†Rockcastle Group (in Pottsville Group)[1]

Pennsylvanian: Southeastern Kentucky.

Original reference: A. R. Crandall, 1889, Kentucky Geol. Survey Rept. Whitley County.

Named for Rockcastle River.

†Rock City Conglomerate[1]

Pennsylvanian: New York.

Original reference: J. P. Lesley, 1875, Pennsylvania 2d Geol. Survey Rept. 1, p. 96.

Named for erosional feature locally called "rock cities," Cattaraugus and Chautauqua Counties.

†Rock Creek Beds[1]

Pleistocene: Western Texas.

Original reference: J. W. Gidley, 1903, Am. Mus. Nat. Hist. Bull., v. 19, p. 622, 625.

G. L. Evans and G. E. Meade, 1945, Texas Univ. Bur. Econ. Geology Pub. 4401, p. 494. Same as Tule formation (Cummins, 1893).

Named for Rock Creek, Swisher County.

†Rock Creek Conglomerate Member (of Maroon Formation)

Permian(?): Northwestern Colorado.

C. F. Bassett, 1939, Geol. Soc. America Bull., v. 50, no. 12, pt. 1, p. 1864. Whole thickness consists of pink to red coarse sandstone and arkosic grits and conglomerates highly crossbedded. Lower part contains a few thin interbedded gray shales and limestones. Thickness approximately 1,224 feet. Underlies State Bridge siltstone member (new); conformably overlies McCoy formation. Permian(?). Name credited to Donner (unpub. thesis).

H. F. Donner, 1949, Geol. Soc. America Bull., v. 60, no. 8, p. 1223. Name abandoned and beds included in McCoy formation of Pennsylvanian age in McCoy area. Derivation of name given.

Named for its fine exposures along west bank of Rock Creek north of McCoy. In Eagle and Routt Counties.

Rock Creek Granodiorite,[1] Gabbro,[1] and Diorite[1]

Jurassic: Southern British Columbia, Canada, and northeastern Washington.

Original reference: R. A. Daly, 1913, Canada Dept. Int. Rept. Chief Ast., 1910, v. 2, p. 401.

Named for occurrence near forks of Rock Creek, British Columbia.

**Rock Creek Limestone** (in McLeansboro Group)

Rock Creek Limestone Member (of McLeansboro formation)[1]

Middle and Upper Pennsylvanian: Central western Illinois.

Original reference: A. H. Worthen, 1873, Illinois Geol. Survey, v. 5, p. 309, 312, 314, 315.

U.S. Geological Survey classifies the Rock Creek as a formation on the basis of the fact that the McLeansboro is given group status in Illinois.

Named for outcrops along Rock Creek, Menard County.

Rock Creek Limestone Member (of Vamoosa Formation)

Rock Creek Limestone (in Nelagoney Formation)[1]

Pennsylvanian (Virgil Series): Northeastern Oklahoma.

Original reference: F. C. Greene 1918, Am. Assoc. Petroleum Geologists Bull., v. 2, p. 122.

C. C. Branson, 1955, The Hopper, v. 15, nos. 10–11, p. 126–127. Referred to as Rock Creek limestone member of Vamoosa formation. Name Rock Creek is synonym and not in good standing.

C. C. Branson, 1957, Oklahoma Geology Notes, v. 17, no. 11, p. 108. Abandoned by Oklahoma Geological Survey. Name was earlier used for a Pennsylvanian limestone in Illinois, for Pleistocene beds in the Texas Panhandle, and for a gabbro in British Columbia. Bowen (1918) named the same limestone Labadie and this is accepted name.

Well developed in T. 26 N., R. 10 E., Osage County. Rock Creek is small tributary of Sand Creek and flows through sections 3,4, 9, 10, and 15.

Rockcut Formation

Lower Paleozoic: Northeastern Washington.

J. L. Barlow, 1958, U.S. Atomic Energy Comm. [Pub.] RME–2068, p. 7. Oldest rocks in district are biotite-amphibole schists, gneisses, limestones, and quartzites which Weaver (1920) designated Orient gneiss and tentatively assigned a Precambrian age. Hougland (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 metamorphosed rocks in area. These schists are intercalated within the Rockcut. No evidence for establishing age of these rocks has been found; they are referred to as lower Paleozoic complex.

Report covers northern Ferry County.

Rockdale Dolomite

Silurian (Niagaran): Northeastern and northwestern Illinois.

T. E. Savage *in* C. K. Swartz and others, 1942, Geol. Soc. America Bull., v. 53, no. 4, chart 3. Name appears on correlation chart. Underlies Joliet dolomite (restricted).

Type locality and derivation of name not given.

Rockdale Drift[1]

Pleistocene (Wisconsin) : Northeastern Illinois.

Original reference: D. J. Fisher, 1925, Illinois Geol. Survey Bull. 51, p. 17.

J. S. Templeton and H. B. Willman, 1952, Tri-State Geol. Soc. 16th Ann. Field Conf., p. 12 (fig. 4). Shown on columnar section of Pleistocene deposits in Dixon-Oregon area above Minooka drift and below Manhattan drift.

Named for village of Rockdale, 2 miles southwest of Joliet, Will County.

Rockdale Formation (in Wilcox Group)[1]

Eocene: Eastern Texas.

Original reference: F. B. Plummer, 1933, Texas Univ. Bull. 3232, p. 530, 583.

W. M. Beckman 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, Solomon Creek clays, and Caldwell Knob sands, are redefined so that base of Wilcox is placed at disconformity marking top of Solomon Creek clays and base of Caldwell Knob sands. Where it is possible to recognize the divisions as redefined, Caldwell Knob beds should be regarded as basal member of Rockdale formation and Solomon Creek member should be regarded as member of Wills Point formation.

R. L. Folk, leader, 1960, Texas Univ. Geol. Soc. Tertiary Field Trip, Dec. 10 strat. section. Includes (ascending) Hooper clay, Simsboro sand, Butler clay, and Calvert Bluff members. Overlies Seguin formation; underlies Sabinetown. Wilcox group.

Type locality: Exposures in central Milam County, in vicinity of Rockdale.

**Rockdale Run Formation** (in Beekmantown Group)

Lower Ordovician: Western Maryland.

R. H. Flower, 1956, Jour. Paleontology, v. 30, no. 1, p. 77, 78. Incidental mention in discussion of cephalopods from Canadian of Maryland. Name credited to W. J. Sando.

W. J. Sando, 1956, Geol. Soc. America Bull., v. 67, no. 7, p. 936. Formal proposal of name. Applied to interbedded limestones and dolomites overlying Stonehenge limestone. Lower two-thirds of formation is predominantly limestone; upper third mostly dolomite. Average thickness about 2,450 feet. Underlies Pinesburg Station dolomite (new); top is placed at top of highest limestone bed beneath the dolomite.

W. J. Sando, 1957, Geol. Soc. America Mem. 68, p. 21–28, geol. sections 2, 3, 4, 5, 8, and 10, pl. 1. Includes three lithologic zones: a cryptozoon chert zone confined to lower 100 to 200 feet of formation; a concentration of oolitic limestones about 100 to 200 feet thick about 200 feet above cryptozoon chert zone; dolomite in upper third. Detailed description of type section.

Type section: On Robinson and Seibert Farms just south of Rockdale Run between 1 and 1½ miles west of Hicksville, Washington County. Outcrops constitute 58 square miles.

**Rockdell Limestone**

Middle Ordovician: Southwestern Virginia.

B. N. Cooper, 1945, Virginia Geol. Survey Bull. 66, p. 135 (fig. 11), 137–139, 240 (geol. section 139), pls. 9, 18, 23. Includes the 100 to 300 feet of beds between the Lincolnshire below and Benbolt limestone above; includes Perry and Ward Cove limestones of Tazewell County, and name Rockdell is used where these two formations cannot be differentiated. Consists of coarse-grained light gray high-calcium limestone with a few beds of dark-gray cherty limestone. Along northwest base of Clinch Mountain upper two-thirds of unit is dark-gray granular cherty limestone and lower division coarse grained light-gray and free from chert; in Rosedale belt upper part is nodular-weathering earthy limestone containing *Nidulites* and lower part, generally thicker, is light-gray to pinkish coarse-grained limestone with distinctly clastic texture. Thickness at type locality 248 feet.

Type locality: Near Elk Garden, Russell County. Also crops out in small elliptical area south of Rockdell.

Rock Falls Series[1]

Mississippian: Eastern Michigan.

Original reference: A. C. Lane, 1900, Michigan Geol. Survey, v. 7, pt. 2, p. 252–253.

In Huron County. Derivation of name not stated.

**Rockfish Conglomerate**[1]

Rockfish Member (of Lynchburg Gneiss)

Precambrian: Western Virginia.

Original reference: W. Nelson, 1932, Washington Acad. Sci. Jour., v. 22, no. 15, p. 456–457.

A. I. Jonas and G. W. Stose, 1939, Am. Jour. Sci., v. 237, no. 8, p. 575, 578 (fig. 2), 589, 593. At many places in Catoctin Mountain-Blue Ridge and Mount Rogers anticlinoria, the Rockfish conglomerate, which at type locality and elsewhere contains pebbles and boulders of granite and gneiss derived from the Lovingston granite gneiss and granite of the injection complex, underlies Lynchburg gneiss.

H. B. Cooke, Jr., 1952, (abs.) Virginia Jour. Sci., v. 3, new ser., no. 4, p. 336. Rockfish conglomerate divided into two members: Rockfish conglomerate (restricted) and Mount Jefferson sandstone (new).

R. O. Bloomer and H. J. Werner, 1955, Geol. Soc. America Bull., v. 66, no. 5, p. 583–585, pl. 1. Referred to as Rockfish member of Lynchburg. Occurs in base of Lynchburg in lenticular bodies as much as 2 miles long and 1,000 feet across at outcrop. Grades downward 10 to 100 feet into basement complex with diminution in number of clasts and disappearance of bedding. The granite clasts were doubtlessly derived from the Lovingston and Pedlar formations, and the biotite clasts probably from skialiths of basement complex gneiss.

Type locality: On Rockfish River, Nelson County.

**Rockford Limestone**[1]

Lower Mississippian (Kinderhook Series): Southeastern Indiana.

Original reference: F. B. Meek and A. H. Worthen, 1861, Am. Jour. Sci., 2d, v. 32, p. 167–177.

P. B. Stockdale, 1939, Geol. Soc. America Spec. Paper 22, p. 88–89. Immediately underlies New Providence shale of Borden group and overlies New Albany shale throughout southern Indiana outcrop belt between New Albany on the Ohio River at south and Bartholomew County to north; absent in Kentucky. Thickness 1 to 3 feet, commonly 2 feet.

Guy Campbell, 1946, Geol. Soc. America Bull., v. 57, no. 9, p. 855–856. Overlies Jacobs Chapel shale (new).

Typically exposed in bed of White River at Rockford, Jackson County.

†Rockford Shale[1]

Upper Devonian : Central northern Iowa.

Original reference : S. Calvin, 1878, Am. Jour, Sci., 3d, v. 15, p. 460–462.

Named for Rockford, Floyd County.

Rockfordian series[1]

Upper Devonian : Iowa.

Original reference : C. R. Keyes, 1933, Pan-Am. Geologist, v. 60, no. 3, p. 226.

Rock Grove Member (of Shell Rock Formation)

Rock Grove Substage[1]

Upper Devonian : Central northern Iowa.

Original reference : C. H. Belanski, 1927, Am. Midland Nat., v. 10, no. 10.

M. A. Stainbrook, 1944, Illinois Geol. Survey Bull. 68–A, p. 187. Shellrock formation comprises (ascending) Mason City, Rock Grove, and Nora members.

Named for development in Rock Grove Township, Floyd County.

Rockhill Limestone (in Graford Formation)[1]

Pennsylvanian : Central northern Texas.

Original reference : E. Böse, 1918, Texas Univ. Bull. 1758, p. 14–16.

Forms the flat top of the long, narrow ridge (Rock Hill) that extends southwest from southern end of Lake Bridgeport Dam in Wise County.

**Rockhouse Shale**[1] (in Linden Group)

Rockhouse Limestone Member } (of Ross Formation)
Rockhouse Shale Member }

Lower Devonian : Western and central Tennessee.

Original reference : C. O. Dunbar, 1918, Am. Jour. Sci., 4th, v. 46, p. 736.

G. A. Cooper and others, 1942. Geol. Soc. America Bull., v. 53, no 12, pt. 1, chart 4. Rockhouse shale shown on correlation chart as Silurian.

C. W. Wilson, Jr., 1949, Tennessee Div. Geology Bull. 56, p. 280 (fig. 83), 283–287, 292. Rockhouse shale member and Rockhouse limestone member comprise the basal unit of newly defined Ross formation through its known outcrop belt and unconformably overlie Decatur limestone. Shale member is restricted to south-central Hardin County where its average thickness is about 25 feet; conformably underlies Ross limestone member. Limestone member is widely distributed in northern Hardin and Wayne Counties where its average thickness is about 12 feet; conformably underlies Birdsong shale member; includes basal 8 to 10 feet of Birdsong shale as described by Dunbar (1919, Tennessee Div. Geology Bull. 21). Cooper and others (1942) place Rockhouse shale in Silurian. If Rockhouse shale is Silurian, then entire Ross formation including Ross limestone member and Birdsong shale member are likewise Silurian because they bear a close relationship to the Rockhouse shale member and Rockhouse limestone member.

Named for Rockhouse, a hunters' clubhouse on Horse Creek, 5 miles northwest of Lowryville, Hardin County.

Rockingham Schist[1] or Mica Schist

Paleozoic: East-central and southeastern New Hampshire.

David Modell, 1936, Geol. Soc. America Bull., v. 47, no. 12, p. 1890–1892. On older geological maps, the crystalling schists of Belknap Mountains were divided into two groups, "Rockingham mica schist" and the "Montalban series." Present study has revealed no real difference between schists in different parts of area, and they are here treated as single unit, Rockingham mica schist. Age unknown.

M. P. Billings, 1953, Geology of New Hampshire, pt. 2, Bedrock geology: Concord, New Hampshire State Plan. Devel. Comm., p. 43. Part of unit which lies southeast of the Fitchburg pluton included in Merrimack group of Silurian (?) age.

Widely exposed in Rockingham [County].

Rock Island 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. Assigned to member status in Spoon formation (new). Present at base of formation. Occurs below Seville limestone member. Thickness 2½ to 3 feet in type section of Abbott. 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: Southwest bank of Spoon River, SW¼SW¼ sec. 23, T. 6 N., R. 1 E., Rock Island County.

**Rock Lake Shale Member** (of Stanton Limestone)[1]

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

Original reference: G. E. Condra, 1927, Nebraska Geol. Survey Bull. 1, 2d ser., p. 41, 59, 156, 157.

G. E. Condra and E. C. Reed, 1943, Nebraska Geol. Survey Bull. 14, p. 51 Rock Lake shale was named in Nebraska but was named Victory Junction shale by Newell (1935) from exposures in Kaw Valley area, Kansas. On basis of subsequent studies, it is agreed that original name is valid.

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), 119. Rock Lake shale member of Stanton formation; underlies South Bend limestone member; overlies Stoner 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. 32. Average thickness 6 feet in Nebraska; 3 to 4 feet in northwestern Missouri; 3 to 8 feet in Kansas. Old type locality now badly covered; co-type locality designated.

Type locality: Exposures in vicinity of Rock Lake located in SW sec. 13, T. 12 N., R. 10 E., Sarpy County, Nebr.; co-type locality is in Platte River Bluffs just east of south gate of State Fish Hatcheries across Platte River northeast of South Bend.

**Rockland Formation**[1]

Cambrian or Ordovician : South-central Maine.

Original reference: E. S. Bastin, 1908, U.S. Geol. Survey Geol. Atlas, Folio 158.

H. W. Allen, 1951, Maine State Geologist Rept. 1949–1950, p. 79. Sequence of metamorphosed sedimentary rocks in Rockland quadrangle is (ascending) Ilesboro formation containing Combs 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.

Well developed just west and southwest of Rockland, Knox County.

Rockland Formation[1]

Middle Ordovician (Trentonian): Ontario, Canada, and northern New York.

Original references: P. E. Raymond, 1914, Canada Geol. Survey Summ. Rept. 1912, p. 348: 1916, Harvard Coll. Mus. Comp. Zoology Bull., v. 56, p. 255, 260; 1921, Canada Geol. Survey Mus. Bull. 31, p. 1.

G. M. Kay, 1937, Geol. Soc. America Bull., v. 48, no. 2, p. 251–255. Rockland limestone is lowermost formation in Trenton group. In type section, Rockland has been described as consisting of 40 feet of heavy-bedded limestones, separated from "Lowville" limestone by 18 feet of "Leray beds of the Black River." These "Leray beds" of Ottawa district carry a fauna in which *Doleroides ottawanus* Wilson is abundant; a similar fauna directly overlies Watertown limestone, the top of the Black River group, at Watertown, N.Y. Believed that the "Leray beds" at Rockland are post-Watertown rather than pre-Watertown Leray limestone of New York. Rockland, at its type section, is revised to include these "Leray beds." In southeastern Ontario and northwestern New York, beds characterized by *Doleroides ottawanus* constitute a separable member of the formation herein designated Selby member. Upper part of formation is herein named Napanee member. Thickness at Dexter, N.Y., about 64 feet. Overlies Chaumont formation; underlies Hull formation. Other formations of Rockland age are: Coboconk and Cloche Island limestones (type areas in Ontario), and Amsterdam and Isle la Motte limestones.

G. M. Kay, 1942, Geol. Soc. America Bull., v. 53, no. 4, p. 599. Type section of Rockland is east of Ottawa. It has been described as consisting of the "Leray," comprising 9½ feet of "Leray proper" and 8½ feet of "transition beds," overlain by 40 feet Rockland limestone. The writer [Kay] 1937 stated that the "Leray beds" at Rockland are post-Watertown. Restudy of section shows that only the "transition beds" are post-Watertown, and that the 9½ feet of "Leray proper" is Chaumont. That the Rockland above the "transition beds" is equivalent to the Napanee is strongly suggested by the fauna and the fact that each is overlain by limestones containing Hull crinoid fauna. Lithology, as well as fauna, of "transition beds" resembles that of Selby member of Rockland, which is post-Chaumont.

G. M. Kay, 1943, Am. Jour. Sci., v. 241, no. 10, p. 598, 599. Stratigraphic column of Trenton group on West Canada Creek, N.Y., shows Rockland limestone, 10 feet thick, above Lowville limestone of Black River group and below Kirkfield limestone; both contacts disconformable. Term Kirkfield used in preference to "Hull" of previous reports.

Marshall Kay, 1948, Am. Assoc. Petroleum Geologists Bull., v. 32, no. 8, p. 1411–1412. Summarizes Middle Ordovician bordering Allegheny synclinorium. Lower Trentonian formations of northwestern New York and eastern Ontario, Rockland and Kirkfield limestones, disconformably overlap Black River rocks, lying locally on Canadian and Cambrian along the Mohawk River, and on Precambrian in Ontario; the Rocklandian and Kirkfieldian are considered to be stages.

Type locality: At Rockland, Ontario, 30 miles east of Ottawa.

†Rockland Sandstone[1]

Precambrian (Keweenawan): Northern Michigan.

Original reference: A. C. Lane, 1911, Michigan Geol. and Biol. Survey Pub. 6, geol. ser. 4, p. 610.

Named for occurrence at Rockland, in Ontonagon County.

†Rockland Sandstone[1]

Miocene(?): Eastern Texas.

Original reference: E. T. Dumble, 1901, Geology of Beaumont oil field.

Named for Rockland, Tyler County.

Rocklandian (Rockland) Stage or Substage

Middle Ordovician (Trentonian): Eastern North America.

G. M. Kay, 1936, Geol. Soc. America Proc. 1936, p. 82. Rockland and Hull are earliest stages of Trenton group.

G. M. Kay, 1937, Geol. Soc. America Bull., v. 48, no. 2, p. 251–261, 293, 298. Discussion of stratigraphy of Trenton group and list of formations of Rockland age. Early Trenton was fundamentally a time of advancing seas that progressively submerged margins of lands. In Rockland stage, oldest sediments were limited to more medial parts of Ontario basin, in Thousand Islands region and northwestward into Ottawa Valley. In late Rockland time, the seas overlapped Adirondack arch in narrow strait somewhat north of Mohawk Valley. Hull stage is essentially a continuation of this overlap.

Marshall Kay, 1948, Am. Assoc. Petroleum Geologists Bull., v. 32, no. 8, p. 1411–1412. 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 Precambrian in Ontario; the Rocklandian and Kirkfieldian are considered stages.

Marshall Kay, 1958, Am. Jour. Sci., v. 256, no. 2, p. 86, 91, 94 (table 3). Raymond's (1914, Canada Geol. Survey Summ. Rept. 1912) "formations" in Trenton were zones he thought time-defined by fossils; subsequently the lithologies were distinguished, but Rockland limestone and Rocklandian stage are identical at Rockland, Ontario. Other formations in the stage have lithic differences or were named as an incident to their isolation. Younger than Chaumontian stage of Blackriveran series.

Marshall Kay, 1960, Internat. Geol. Cong., 21st, Copenhagen, pt. 7, p. 30. Rocklandian and Kirkfieldian substages included in Nealmontian stage.

Named derived from Rockland, Ontario, Canada, for which Rockland limestone is named.

**Rockland Valley Basalt**[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. 31, 47–48, pl. 4. Series of even-bedded blue and black basalts about 250 feet thick. Interbedded with them is one bed of clay 15 feet thick. Shown on stratigraphic column above Massacre volcanics and below Raft lake beds.

Named for exposures on north side of Rockland Valley, Power County.

Rockledge Conglomerate (in Woods Corners Group)

Rockledge Limestone Breccia

Upper Cambrian: Northwestern Vermont.

Charles Schuchert, 1937, Geol. Soc. America Bull., v. 48, no. 7, p. 1021, 1045, 1049–1052. Name Rockledge limestone breccia proposed to replace Corliss conglomerate except at its type locality. Described as breccia composed mainly of small pieces of blue slabby limestone and sandy dolomite, cemented by lime or dolomite with abundant sand grains. Thickness 0 to 40 feet. Underlies Georgia formation conformably; overlies Hungerford formation (new) disconformably.

Phillip Fowler, 1950, Vermont Geol. Survey Bull. 2, pl. 1. Incidental reference to Rockledge conglomerate.

A. B. Shaw, 1958, Geol. Soc. America Bull., v. 69, no. 5, p. 523 (table 1), 532 (fig. 5), 542–543, 546, pl. 1. Schuchert's (1937) Rockledge limestone conglomerate has generally been shortened to Rockledge conglomerate. Included in Woods Corners group (new). Schuchert misinterpreted structure and believed Rockledge to overlie Hungerford. Detailed mapping has proved that Rockledge underlies Hungerford. Maximum thickness 100 feet; because of lensing no applicable figure can be given for thickness. Overlies Skeels Corners slate. Regarded as southern equivalent of Saxe Brook dolomite but separate names are retained because of lithologic differences between the two units. Note on type locality.

Type locality: On Rockledge Estate, 4.4 miles north of center of St. Albans, on west side of Highgate Road, in Franklin County. Large bioherm from which estate takes its name is not in Rockledge conglomerate but in top of underlying Skeels Corners slate. Formation extends northward from type locality in unbroken outcrop to point 1¾ miles S. 20° W. of Highgate Falls. Southward, crops out in discontinuous lenses.

Rock Levee Formation

Middle Ordovician: Eastern Missouri.

J. G. Grohskopf, 1948, Am. Assoc. Petroleum Geologists Bull., v. 32, no. 3, p. 360–362. Proposed for those rocks which underlie the basal Plattin oolitic and conglomeratic limestone and overlie a chert zone which occurs in the Joachim dolomite; thus, it restricts the Plattin and Joachim and contains a part of each. Consists of dense gray limestone or buff dolomites with some interbedded shale. Thickness in type area (determined from wells) 270 feet.

E. R. Larson, 1951, Am. Assoc. Petroleum Geologists Bull., v. 35, no. 9, p. 2042 (fig. 1), 2044–2046. Underlies Bloomsdale formation (new) of Plattin group.

Type locality: 0.2 mile east of junction of U.S. Highway 61 and Missouri Highway 74, Cape Girardeau County. Name derived from siding on St. Louis-San Francisco Railway, in NW¼NW¼NW¼ sec. 24, T. 30 N., R. 13 E. Surface distribution is closely allied with the basal Plattin.

Rocklin Granodiorite

[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 given as 131 million years.

Occurs in Rocklin pluton, an elliptical mass of approximately 150 square miles, which crops out in foothill belt of Sierra Nevada in western part of Auburn quadrangle. Pluton intrudes Mariposa formation and is unconformably overlain by marine beds equivalent in age to Campanian stage of Upper Cretaceous. Dated sample obtained from Rocklin quarry in Placer County.

Rockmart Slate[1]

Mississippian: Northwestern Georgia.

Original reference: C. W. Hayes, 1891, Geol. Soc. America Bull., v. 2, p. 143; 1894, Geol. Soc. America Bull., v. 5, p. 469–470, 478.

Charles Butts and Benjamin Gildersleeve, 1948, Georgia Geol. Survey Bull. 54, p. 52–54, geol. map. Succeeds Newala limestone with an erosional unconformity. Predominantly a clay rock which includes thin beds of sandstone and at one horizon a stratum of thinly bedded, slightly fossiliferous chert about 80 feet thick. Estimated thickness 1,200 to 3,000 feet; bedding is most everywhere steeply inclined and cut by slaty cleavage; no recognizable beds or horizons have been detected that would serve as datum planes for measurement. Rockmart has hitherto been regarded as a facies of Stones River group and correlated with the Chickamauga of older usage. It is here considered Mississippian and a correlative facies of the Floyd shale.

Named for Rockmart, Polk County.

Rock Mesa Lava Flow

Rock Mesa Obsidian Flow

Recent: Southwestern Oregon.

E. T. Hodge, 1925, Oregon Univ. Pub., v. 2, no. 10, p. 54 (fig. 34), 55, 57 (fig. 40). Discussion of Mount Multnomah, ancient ancestor of the Three Sisters. Rock Mesa lava flow is term applied to flow that makes up Rock Mesa.

Howel Williams, 1944, California Univ. Pub., Dept. Geol. Sci. Bull. 27, no. 3, p. 53, 54, 58, pl. 12(b). Referred to as Rock Mesa obsidian flow in report on volcanoes of Three Sisters region. May be among youngest rocks of region.

Rock Mesa is southwest of South Sister Mountain and north of Le Conte Crater.

**Rock Point Member** (of Wingate Sandstone)

Upper Triassic: Northeastern Arizona, southwestern Colorado, northwestern New Mexico, and southeastern Utah.

G. A. Kiersch, 1955, Mineral Resources Navajo-Hopi Indian Reservations, Arizona-Utah, v. 2, p. 4 (fig. 1), 5. Consists of reddish-orange, parallel, and thin-bedded siltstone and sandstone. Thickens southward from Kayenta (350 feet) to 700 feet in Hopi Buttes country where it intertongues with upper Lukachukai member (new). Overlies Chinle formation. Name credited to Harshbarger and others (in press).

J. W. Harshbarger, C. A. Repenning, and J. H. Irwin, 1957, U.S. Geol. Survey Prof. Paper 291, p. 3 (fig. 2), 8–10. Type locality designated. Formerly the "A" division of Chinle formation (Gregory, 1917, U.S. Geol. Survey Prof. Paper 93). At type locality, consists of sequence of pale reddish brown beds forming ledges of silty sandstone and slopes of siltstone; thickness 344 feet; underlies Lukachukai member; conformably overlies Chinle formation.

Type locality: The lower, slope-forming unit exposed in Little Round Rock, a prominent butte, 15 miles south of Rock Point School, Ariz.

Rockport formation[1]

Upper Cretaceous: Utah.

Original reference: C. R. Keyes, 1924, Pan-Am. Geologist, v. 41, p. 36, 61–62, 280, 301.

Named from hamlet of Rockport, Summit County.

Rockport Limestone (in Greene Formation)[1]

Permian: Western West Virginia.

Original reference: C. E. Krebs, 1911, West Virginia Geol. Survey Rept. Jackson, Mason, and Putnam Counties, p. 102.

Thomas Arkle, Jr., 1959, Geol. Soc. America Guidebook Pittsburgh Mtg., p. 118 (table 1). Table shows Lower, Middle, and Upper Rockport limestones in Greene series. Lower Rockport is above Nineveh coal and below Nineveh "A" coal; Middle Rockport is below Taylor sandstone; Upper Rockport is below Gilmore limestone.

Named for occurrence at Rockport, Wood County.

Rockport Limestone[1] (in Traverse Group)

Middle Devonian: Northeastern Michigan.

Original reference: R. A. Smith, 1916, Michigan Geol. and Biol. Survey Pub. 21, Geol. Ser. 17, p. 172–175.

B. F. Hake and J. B. Maebus, 1938, Michigan Acad. Sci., Arts, and Letters, Papers, v. 23, p. 447–461. Included in Traverse group in central Michigan.

G. A. Cooper and A. S. Warthin, 1941, Washington Acad. Sci. Jour., v. 31, no. 6, p. 260. Preoccupied Rockport limestone replaced by Rockport Quarry limestone.

Named for exposures at Rockport, Alpena County.

**Rockport Limestone Member** (of Rockland Formation)[1]

Cambrian or Ordovician: South-central Maine.

Original reference: E. S. Bastin, 1908, U.S. Geol. Survey Geol. Atlas, Folio 158, p. 3–4.

H. W. Allen, 1951, Maine State Geologist Rept. 1949–1950, p. 79. Member at top of Rockland. Overlies an unnamed siliceous limestone member.

Named for exposures on eastern shore of Rockport Harbor, Knox County.

Rockport Sandstone[1]

Pennsylvanian: Southwestern Indiana.

Original reference: E. T. Cox, 1871, Indiana Geol. Survey 2d Ann. Rept., p. 169.

Probably named for Rockport, Spencer County.

Rockport Shales[1]

Pennsylvanian: Northwestern Missouri.

Original reference: C. R. Marbut, 1904, The State of Missouri, p. 69.

**Rockport Quarry Limestone** (in Traverse Group)

Middle Devonian: Northeastern Michigan.

G. A. Cooper and A. S. Warthin, 1941, Washington Acad. Sci. Jour., v. 31, no. 6, p. 260. Proposed to replace Rockport limestone of Smith, 1916 (not Bastin, 1908; Krebs, 1911; or Marbut, 1904).

A. S. Warthin, Jr., and G. A. Cooper, 1943, Am. Assoc. Petroleum Geologists Bull., v. 27, no. 5, p. 579 (fig. 3), 580–581. Section at Rockport consists predominantly of gray and brown limestone with minor amounts of shale; thickness about 41 feet. Overlies Bell shale; underlies Ferron Point formation. Included in Traverse group.

Type section: Quarry of Kelly Island Rock and Transport Co. at Rockport in northeast corner Alpena County. Also exposed in Presque Isle County and at some places along shore of Lake Huron.

Rock Prairie Sandstone (in Jackson Group)

Eocene: East-central Texas.

A. A. L. Mathews, 1950, Texas Eng. Expt. Sta. Research Rept. 14, p. 5, geol. map. Basal sandstone of group. Composed of thick and thin beds of medium- to coarse-grained marly fossiliferous dark-red sandstone which weathers to dark brown; many beds are porous, almost cavernous, while others are dark buff, platy, and friable; some thick beds are slightly crossbedded coarse-grained clear quartz sandstone with uniform quartz grains; other beds are made up of irregular and nodular iron sandstone seams which thicken and thin laterally. Approximately 60 feet thick. Underlies Caddell formation; unconformably overlies Cockfield formation.

Type locality: About 2 miles east of the road where pipelines of Humble Oil Co. cross Carter's Creek Road, Brazos County. Name derived from community of Rock Prairie on Highway 6, 3½ miles south of corner of campus of A & M College of Texas. Section is composed of the compilation of the outcrops along the road, and those exposed in the branches on either side of the road.

Rock Riffle limestone member

Pennsylvanian (Conemaugh Series): Southeastern Ohio.

M. T. Sturgeon and others, 1958, Ohio Geol. Survey Bull. 57, p. 95 (table 11), 131–133. Fresh-water limestone in Harlem cyclothem. Lies beneath Harlem underclay member and above Round Knob redbed member. Typically gray, weathering greenish gray; nodular to bedded and enclosed in greenish gray clay shale. Thickness about 4½ feet.

Named for exposures along Rock Riffle Run, a small tributary on south side of Hocking River, Athens Township, Athens County.

Rock River Formation[1] or Dolomite

Upper Cambrian: 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. Lowest formation of Philipsburg series. Thickness about 500 feet.

Exposed from northern part of St. Albans quadrangle, Vermont, across the international border for about 20 miles into Quebec.

Rock Run Limestone[1]

Upper Ordovician (Richmond) : Northeastern Illinois.

Original reference: J. R. C. Evans, 1926, Chicago Univ., Abs. Theses, Sci. ser., v. 2, p. 199–200.

Type locality not stated.

Rock Springs Beds

Miocene and Pliocene : Central Arizona.

C. S. St. Clair, 1957, Plateau, v. 30, no. 2, p. 36, 37, fig. 2. Volcanic flow rocks and tuffaceous and clastic sandstones. Flow rocks are olivine basalt, hornblende basalt, and hornblende andesite. Tuffaceous sandstones made up mostly of fine-grained pumice with small amounts of rounded sand grains of quartz and feldspar and dark minerals. Locally in sequence are boulder conglomerates probably of fluviatile origin. Beds have been extensively eroded but represent Cenozoic rocks that may have been up to 2,000 feet thick. Underlie Pleistocene gravels.

Sequence is east of Bradshaw Mountains near Rock Springs, south-central Yavapai County.

**Rock Springs Formation** (in Mesaverde Group)[1]

Upper Cretaceous : Southwestern Wyoming and northeastern Utah.

Original reference : A. R. Schultz, 1920, U.S. Geol. Survey Bull. 702.

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 underlies Erickson formation and overlies Blair formation. Thickness 1,090 feet in Flaming Gorge area; 100 feet in Clay Basin. Intertongues with Hilliard shale toward east.

W. R. Hansen, 1957, U.S. Geol. Survey Geol. Quad. Map GQ–101. Described in Clay Basin quadrangle, Utah, as interbedded pale-grayish-orange to light-brown fine-grained sandstone and gray Hilliard-like shale becoming punky toward top; capped by massive pale-grayish-orange to white very fine grained cliff-forming sandstone. Contact with underlying Hilliard shale mapped arbitrarily at base of a grayish-orange fine-grained sandstone bed, 24 feet thick, that separates a predominantly shale sequence below from interbedded shale, sandy shale, and sandstone above.

Present in Rock Springs uplift, Sweetwater County, Wyo.

**Rock Stream Siltstone Member** (of Sonyea Formation)

Rock Stream Flagstone Member (of Cashaqua Shale)

Upper Devonian : Western New York.

W. H. Bradley and J. F. Pepper, 1938, U.S. Geol. Survey Bull. 899–A, p. 12–13, pl. 3. Name proposed for flagstone member in upper part of Cashaqua shale. Consists of sequence of alternating flagstones and shale.

Thickness 180 feet. Underlies Parrish limestone lentil; overlies lower unnamed shale with sharply defined contact.

G. W. Colton and Wallace de Witt, Jr., 1958, U.S. Geol. Survey Oil and Gas Inv. Chart OC–54. Redesignated as Rock Stream siltstone member of Sonyea formation. Is eastern lateral equivalent of large part of Cashaqua shale member. Throughout its extent in area studied, the Rock Stream is underlain by Pulteney shale member (new) and overlain by Cashaqua shale member. Not present west of eastern Livingston County. At westernmost exposure, near Hemlock Lake, consists of two beds of siltstone, from 2 to 5 inches thick, separated by 4 feet of silty gray shale. Thickens eastward. About 217 feet thick along Hamilton Creek 2½ miles west of Watkins Glen.

R. G. Sutton, 1960, New York State Mus. Sci. Service Bull. 380, p. 14–17, 54, 55–56. Member of Cashaqua formation. Overlies Sawmill member (new). After submission of this paper for publication, Colton and de Witt (1958) proposed name Pulteney for unit herein named Sawmill Creek; former name thus has priority.

Named from exposures on Rock Stream in northwestern part of Watkins quadrangle, Reading Township, Schuyler County.

**Rocktown Channel Sandstone Member** (of Dakota Sandstone)[1]

Rocktown Sandstone Member (of Ellsworth Formation)

Upper Cretaceous: North-central Kansas.

Original reference: W. W. Rubey and N. W. Bass, 1925, Kansas Geol. Survey Bull. 10, p. 16, 57–65.

R. C. Moore, 1935, Rock formations of Kansas *in* Kansas Geol. Soc.: Wichita [Am. Assoc. Petroleum Geologists 20th Ann. Mtg., Mar. 21–23]. Reallocated to member status in Ellsworth formation (new) of Dakota group. Overlies Terra Cotta shale member (new).

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, contains stratigraphic units formerly called "Rocktown channel sandstone," "Ellsworth formation," "Solomon formation," "Reeder sandstone," "Marquette sandstone," "Spring Creek clay," and others.

Named for exposures at and near the large group of "hoodoos" or houselike blocks of sandstone in NW¼ sec. 4, T. 13 S., R. 11 W., locally known as Rocktown, Russell County.

**Rockvale Sandstone Member** (of Vermejo Formation)[1]

Upper Cretaceous: Eastern Colorado.

Original reference: W. T. Lee, 1917, U.S. Geol. Survey Prof. Paper 101, p. 163–169.

Named for typical development near Rockvale, Fremont County.

Rockville Conglomerate[1]

Tertiary or Quaternary: Northeastern Iowa.

Original reference: W. J. McGee, 1891, U.S. Geol. Survey 11th Ann. Rept., pt. 1, p. 304.

S. D. Tuttle and R. C. Northup, 1955, Iowa Acad. Sci. Proc., v. 62, p. 366–372. Rockville conglomerate should be updated in age to Tertiary-Quaternary and extended to include a new outcrop at Olin, Jones County.

Named for Rockville, Delaware County.

Rockville Granite

Rockville Quartz Monzonite (in Stearns Magma Series)

Precambrian (middle Keweenawan) : Central Minnesota.

Eleanor Tatge, 1939, Am. Mineralogist, v. 24, no. 5, p. 303–316. Unusually coarse-grained granite with abundant microcline phenocrysts and very little secondary alteration. Rockville granite has been used as a trade name for granite quarried near St. Cloud [and Rockville].

M. S. Woyski, 1949, Geol. Soc. America Bull., v. 60, no. 6, p. 1002, 1006. Quartz monzonite and porphyritic quartz monzonite; typically pink, ranges to dark reddish gray. Included in Stearns magma series; grades into St. Cloud red facies of series.

Crops out between St. Cloud and Richmond, Stearns County. Most characteristic exposure is at Rockville.

†Rockville Member (of Skaneateles Formation)[1]

Middle Devonian : Eastern Pennsylvania.

Original reference: Bradford Willard and A. B. Cleaves, 1933, Geol. Soc. America Bull., v. 44, no. 4, p. 768, 781.

Bradford Willard, 1939, Pennsylvania Geol. Survey, 4th ser., Bull. G–19, p. 16, 138. Pre-occupied name Rockville replaced by Fort Hunter sandstone.

First studied at Rockville, on Susquehanna, in Dauphin County.

†Rockville Sandstone[1]

Upper Devonian : Southwestern New York.

Original reference: H. S. Williams, 1887, U.S. Geol. Survey Bull. 41, p. 51, 73.

Exposed at old Rockville, which is 1 mile west of present Rockville, Allegany County.

**Rockwell Formation**[1] (in Pocono Group)

Rockwell Member (of Pocono Formation)

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.

H. E. Vokes, 1957, Maryland Dept. Geology, Mines and Water Resources, p. 91. In PawPaw-Hancock area, the Pocono is considered to have group rank and is divided into five formations; in western Maryland, where the five units cannot be differentiated, the Pocono is treated as a formation and the Rockwell as a member. Consists of greenish to gray crossbedded arkosic sandstone, fine conglomerate, and buff shales with some dark shales that locally contain coal seams. Thickness 540 to 550 feet on Sideling Hill, Washington County, Md. Underlies Purslane member.

Named for exposures in Rockwell Run, Morgan County, W. Va.

**Rockwood Formation**[1]

Lower and Middle Silurian : Eastern Tennessee and northwestern Georgia.

Original reference : C. W. Hayes, 1891, Geol. Soc. America Bull., v. 2, p. 143.

John Rodgers, 1953, Tennessee Div. Geology Bull. 58, pls. 11, 12, 13. At Rockwood, the formation, if the Sequatchie is removed, is entirely lower Silurian, but in other areas middle Silurian and perhaps even higher rocks are present. Clinch sandstone and Rockwood formation are mainly contemporaneous phases of lower and middle Silurian and, in areas intermediate between the two type localities, grade into each other, though in any one section the sandstone lies chiefly below. Underlies Hancock limestone; overlies Sequatchie formation.

Named for Rockwood, Roane County, Tenn.

Rockwood Oolite[1] Member (of Bangor Limestone)

Mississippian: Northwestern Alabama.

Original reference: W. B. Jones, 1928, Alabama Geol. Survey Circ. 8, p. 13–15.

W. B. Jones, 1939, Econ. Geology, v. 34, no. 5, p. 575, 576–577. Thickness at type locality about 55 feet. Overlies Spout Spring oolite member (new).

Type locality: Near Rockwood, Franklin County.

†Rockwood Sandstone[1]

Silurian: Northwestern Georgia.

Original reference: C. W. Hayes, 1894, U.S. Geol. Survey Geol. Atlas, Folio 2.

East of Chattooga Valley.

Rockwood Sandstone (in Chester Group)[1]

Mississippian: Southwestern Illinois.

Original reference: S. Weller, 1913, Illinois Geol. Survey Bull. 22, p. 31.

Probably named for Rockwood, Randolph County.

Rocky Branch bone bed (in Jeffersonville Limestone)

Middle Devonian: Southeastern Indiana.

J. W. Wells, 1944, Geol. Soc. America Bull., v. 55, no. 3, p. 282–283. Name applied to bone bed near top of Jeffersonville limestone.

Crops out on Rocky Branch, northwestern Jennings County.

Rocky Butte Volcanics

Pleistocene: Northern Oregon.

R. C. Treasher, 1940, (abs.) Geol. Soc. America Bull., v. 51, no. 12, pt. 2, p. 2034. Name applied to a series of volcanic flows that capped many hills in Portland area prior to or during early stages of continental glaciation.

Rocky Canyon Granite[1]

Jurassic or Cretaceous: Northwestern Nevada.

Original reference: C. P. Jenney, 1935, Nevada Univ. Bull., v. 29, no. 6, p. 37–42.

Crops out over 6 square miles in lower Rocky and Wright's Canyons and elsewhere in Humboldt Range.

Rocky Cedar Limestone

Rocky Cedar Creek Limestone Lentil (in Kincaid Formation)[1]

Eocene: Northeastern Texas.

R. A. F. Penrose, Jr., 1890, *in* E. T. Dumble, Texas. Geol. Survey 1st Ann. Rept., p. 19–20. At Rocky Cedar Creek, is deposit of shell limestone, composed almost entirely of shells of lower Eocene fossils. It is traceable up and down Rocky Cedar Creek for 7 miles, and underlies divide between Rocky Cedar and Muddy Cedar Creeks, a distance of 4 miles. Section of well on this divide shows: lower shell limestone 3 to 4 feet thick, coarse sand, 1½ to 2 feet, shell limestone, 3 to 4 feet, gray and yellow clay (Basal Clays), 9 feet, gray and buff sand, 3 feet. About 1 mile below point where Texas Pacific Railroad crosses Rocky Cedar, an outcrop 15 feet thick of this limestone is present, and as it still forms bed of the creek, its thickness here must be still greater than that. Village of Elmo is situated on Muddy Cedar, and just beyond is black prairie region showing Cretaceous fossils. Consequently Rocky Cedar limestone is probably lowermost bed of Tertiary series in this part of State.

Lentil typically exposed in Ola quarry, 1 mile south of Ola and along Rocky Cedar Creek between Ola and Wills Point, Kaufman County.

†Rocky Comfort Chalk[1]

Upper Cretaceous (Gulf Series) : Southwestern Arkansas.

Original reference: R. T. Hill, 1888, Arkansas Geol. Survey Ann. Rept. 1888, v. 2, p. 72, 89–95, 188.

Named for exposures at Rocky Comfort, Little River County.

**Rock Flats Alluvium**

Pleistocene (Nebraskan or Aftonian) : Northeastern Colorado.

G. R. Scott, 1960, Geol. Soc. America Bull., v. 71, no. 10, p. 1541, 1542 (table 1). Name applied to oldest widespread alluvium recognized in Denver area. Where typically exposed, occurs as a sheet, 10 to 40 feet thick, of reddish-brown poorly sorted stony coarse sand that unconformably overlies Mesozoic bedrock on a pediment about 1,600 feet below level of a subsummit surface on the Front Range. Occurs 100 feet above next younger alluvium here named Verdos.

Typically exposed in gravel pit at east edge of Rocky Flats in NW¼SW¼ sec. 23, T. 2 S., R. 70 W., Golden quadrangle.

Rockyford Ash Member (of Sharps Formation)

Miocene: Southwestern South Dakota.

J. C. Harksen, 1960, Geology of the Sharps Corner quadrangle, South Dakota (1:62,500) : South Dakota Geol. Survey. Consists of as much as 38 feet of silty volcanic ash and ashy silt layers that are white, buff, tan, and reddish brown. Conformably underlies upper part of formation and conformably overlies Brule formation. Name credited to John Nicknish (unpub. thesis).

Type locality and derivation of name not given.

Rocky Gap Sandstone (in Helderberg Group)[1]

Lower Devonian: West Virginia and southwestern Virginia.

Original reference: F. M. Swartz, 1929, Pennsylvania Acad. Sci. Proc., v. 3, p. 80.

P. H. Price and H. P. Woodward, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 11, p. 1987. Present in vicinity of Bluefield where it has locally been mistaken for Oriskany sandstone.

Well exposed in Rocky Gap, W. Va.

**Rocky Hill Volcanics** (in Honolulu Volcanic Series)

Pleistocene, upper: Oahu Island, Hawaii.

Original reference: C. K. Wentworth, 1926, Bernice P. Bishop Mus. Bull 30, p. 74–75.

G. A. Macdonald and D. A. Davis *in Jacques* Avias and others, 1956, Lexique Strat. Internat., v. 6, Océanie, fasc. 2, p. 130. Thickness of lava probably 40 feet; Rocky Hill cone 130 feet high, base not exposed. Overlain by Sugar Loaf basalt and by sand and coral of the plus 25-foot (Waimanalo) stand of sea. Extent noted.

Named for Rocky Hill, largest of the four cinder cones. Exposed over area of about 0.1 square mile in lower end of Manoa Valley, on south side of Koolau Range about 11 miles west of Makapuu Head.

**Rocky Mound Limestone Member** (of Graham Formation)[1]

Rocky Mound Limestone (in Graham Group)

Upper Pennsylvanian: Central northern Texas.

Original reference: Wallace Lee *in* Wallace Lee and others, 1938, Texas Univ. Bur. Econ. Geology Pub. 3801, p. 40–45.

John Kay, 1956, North Texas Geol. Soc. Field Guidebook, May 25–26, p. [16], [17], fig. 4. Shown on generalized columnar section as Rocky Mound limestone in Graham group; occurs below Wayland shale and above Upper Gunsight limestone. Limestone is possibly a bioherm; consists mainly of crinoid fragments and a few fusulinids bound together with algal filaments.

Well exposed on southwest slope of Rocky Mound, 3 miles northeast of Graham, Young County.

Rocky Point Beds

Rocky Point Formation

Oligocene, upper: Northwestern Oregon.

F. W. Libbey, W. D. Lowry, and R. S. Mason, 1945, Oregon Dept. Geology and Mineral Industries Bull. 29, p. 8–9. Name Rocky Point beds applied to marine sandstones exposed in eastern Washington County, in Portland Hills area in Multnomah County, and along Dixie Mountain Road between Shady Brook School and Wallace School in sec. 18 and SW¼ sec. 5, T. 2 N., R. 2 W., and in numerous cuts along the Rocky Point Road which leads east from Skyline Boulevard to U.S. Highway 30. In most places, sandstones seem to occupy windows in overlying Columbia River basalt. Fossil evidence indicates that beds are upper Oligocene or somewhat younger.

M. L. Steere, 1955, Geol. Soc. Oregon Country News Letter, v. 21, no. 10, p. 85. Name Rocky Point formation proposed for Cowlitz formation in northwest Oregon. Type locality designated. Name credited to R. J. Deacon (unpub. thesis).

Type locality: On Rock Creek in vicinity of Keasey Station, Columbia County.

Rocky Point Conglomerate (in Deese Formation or Group)

Pennsylvanian (Desmoinesian): Southern Oklahoma.

C. W. Tomlinson, 1937, Ardmore Geol. Soc. [Guidebook] Field Trip, March 13, Road log, p. 1, 2, geol. map. Chert conglomerate in upper Deese formation.

Lynn Jacobson, 1959, Oklahoma Geol. Survey Bull. 79, p. 28 (fig. 11), 35. Rocky Point member of Deese group is about 1,400 feet above Arnold limestone. Maximum thickness 70 feet; much of thickness is sandstone. Much of outcrop covered by Lake Murray.

C. W. Tomlinson and William McBee, Jr., 1959, *in* Ardmore Geol. Soc. Petroleum Geology of southern Oklahoma—a symposium, v. 2: Tulsa, Am. Assoc. Petroleum Geologists, p. 6 (fig. 2), 32–33. Rocky Point conglomerate, in Deese group, is about 1,600 feet below Camp Ground member (new). Desmoinesian. Name credited to Guthrey and Milner (unpub. ms.).

Occurs in area south of Ardmore.

**Rocky Ridge Sandstone Member** (of Pierre Shale)[1]

Upper Cretaceous: Central northern Colorado.

Original reference: M. W. Ball, 1924, Am. Assoc. Petroleum Geologists 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; contains large calcareous sandstone concretions that weather dark brown. Thickness 97 feet. Separated from overlying Larimer sandstone member by 163 to 187 feet of soft yellowish-gray sandstone and sandy shale with gray sandstone concretions; separated from older Terry sandstone member by 511 to 604 feet of sandy and nonsandy shale.

Named for exposures on north and east banks of Rocky Ridge Reservoir 6 miles north of Fort Collins, Larimer County. Makes prominent ridge at many places between Round Butte and Berthoud. Forms west escarpment of Fossil Ridge.

**Rocky Ridge Sandstone Member** (of Pottsville Formation)[1]

Pennsylvanian: North-central Alabama.

Original references: C. Butts, 1926, Alabama Geol. Survey Spec. Rept. 14; 1927, U.S. Geol. Survey Geol. Atlas, Folio 221.

Named for fact it forms Rocky Ridge, east and northeast of Chaba pumping station in northwestern part of Vandiver quadrangle.

Rocky Run Conglomerate[1]

Upper Devonian: Northeastern Pennsylvania.

Original reference: J. P. Lesley, 1892, Pennsylvania 2d Geol. Survey Summ. Final Rept., v. 2, p. 1553.

Crops out on Rocky Run, Montour Township, Pike County.

Rocky Woods Conglomerate[1]

Carboniferous: Southeastern Massachusetts.

Original reference: J. B. Woodworth, 1899, U.S. Geol. Survey Mon. 33, p. 134, table.

In the Great Rock area in Rehoboth, extends eastward to Rocky Woods, near Taunton, Bristol County.

Rod Club Sandstone (in Springer Group)

Rod Club Sandstone Member (of Springer Formation)[1]

Pennsylvanian (Springer Series): Central southern Oklahoma.

Original reference: C. W. Tomlinson, 1928, Oklahoma Geol. Survey Bull. 40–Z, p. 12, 13.

M. G. Cheney and others, 1945, Am. Assoc. Petroleum Geologists Bull., v. 29, p. 143. Overlies Goddard shale (new).

M. K. Elias, 1956, *in* Petroleum geology of southern Oklahoma, v. 1: Tulsa, Okla., Am. Assoc. Petroleum Geologists, p. 70 (table 2), 89. Rod Club sandstone overlies Goddard shale. Springer series.

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), 10. Thickness 250 to 400 feet. Consists chiefly of shales; these typically contain several ledges of sandstone, each from 2 to 25 feet thick. Occurs above Goddard shale and 800 to 1,000 feet below Overbrook sandstone. In Springer group which here includes Chesterian and Springeran series. Basal unit of Springeran series as here defined.

Named for outcrops at smaller Rod and Gun Club Lake in NW¼ sec. 7, T. 4 S., R. 2 E., Carter County, on southeast plunging nose of Caddo anticline.

**Rodeo Shale** (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. 35, p. 69 (table 14), 71, pls. Occurs in southern Carquinez and Mare Island quadrangles. Apparently conformable upon Hambre sandstone where it is exposed in band 1,000 feet wide that extends from San Pablo Bay southwestward in Concord quadrangle. Underlies Briones sandstone. Average thickness 670 feet.

G. D. Robinson, 1956, U.S. Geol. Survey Quad. Map GQ–88. Described in Hayward quadrangle as arenaceous shale, locally porcelaneous, and shaly biotitic arkosic sandstone, with thin but persistent beds of siliceous rocks and limestone. Thickness varies irregularly from less than 100 feet to more than 300 feet; in general thickens southeastward. Overlies middle sandstone and shale of Monterey group; disconformably underlies Briones sandstone.

Named for exposures along Rodeo Creek, in northwest part of Concord quadrangle, Contra Costa County.

**Rodessa Formation** (in Trinity Group)

Rodessa Member (of Glen Rose Formation)

Lower Cretaceous (Comanche Series): Subsurface in Louisiana, Arkansas, Mississippi, and Texas.

W. B. Weeks, 1938, Am. Assoc. Petroleum Geologists Bull., v. 22, no. 8, p. 961 (fig. 4), 970. Lower Glen Rose is divided into Pine Island member below and Rodessa member above. Trinity group, Comanche series. Thickness about 500 feet. Name proposed by Shreveport Geological Society.

R. W. Imlay, 1940, Arkansas Geol. Survey Circ. 12, p. 33–35, cross sections. Rodessa formation includes oolitic to coquinoid limestone, calcareous shale, and two anhydrite beds. Overlies James limestone; underlies Ferry Lake anhydrite. Contains number of members, lentils, and tongues.

R. W. Imlay, 1944, U.S. Geol. Survey Oil and Gas Inv. Prelim. Chart 3. Rodessa formation employed as catch-all for beds between James limestone and Ferry Lake anhydrite in subsurface of Arkansas-Louisiana-east Texas area.

J. M. Forgotson, Jr., 1957, Am. Assoc. Petroleum Geologists Bull., v. 41, no. 10, p. 2350–2354. Formation redefined as those rocks between base of Ferry Lake anhydrite and base of Young zone (or its stratigraphic equivalent) as recognized in Rodessa field. Type well designated.

Type well: Union Producing Co.'s Caddo Levee Board No. B–1, sec. 26, T. 23 N., R. 16 W., Caddo Parish, La. Interval on electrical log from 5,320 to 5,805 feet represents Rodessa.

**Rodman Limestone** (in Black River Group)[1]

Rodman Member (of Nealmont Limestone)

Middle Ordovician: Central Pennsylvania.

Original reference: Charles Butts, 1918, Am. Jour. Sci., 4th ser., v. 46, p. 525, 533, 537.

Charles Butts and E. S. Moore, 1936, U.S. Geol. Survey Bull. 855, p. 39–40, pls. 1, 3. In Bellefonte quadrangle, overlies Lowville limestone and underlies Trenton limestone. Thickness 10 to 50 feet. Black River group.

G. M. Kay, 1941, (abs.) Geol. Soc. America Bull., v. 52, no. 12, pt. 2, p. 1969. Type Rodman included in Nealmont limestone of Trenton group.

G. M. Kay, 1943, Econ. Geology, v. 38, no. 3, p. 192. Termed member of Nealmont.

G. M. Kay, 1944, Jour. Geology, v. 52, no. 2, p. 97, 101, 104–105. Further described as uppermost member of Nealmont limestone. Composed of impure, brownish-weathering limestone, darker than rest of Nealmont, and thin beds of white-weathering dense limestone; frequently has nodular chert in lower part. Thickness about 30 feet in type area; 26 feet in section near Tusseyville. Overlies Centre Hall member; underlies cobbly beds below metabentonite 0 of Salona limestone. Lower limit gradational and cannot be defined readily; essential conformity exists between Nealmont and Salona, though angular unconformity found locally. Type section designated.

Type section: Along Highway 322, 1 mile west of Tusseyville, 3 miles south of Centre Hall and 6 miles east of Oak Hall, Centre County. Named at Rodman Station, near Roaring Springs, Blair County.

Rodriquez Tank Sandstone

Ordovician: Western Texas.

W. B. N. Berry, 1960, Texas Univ. Bur. Econ. Geology Pub. 6005, p. 20. White to buff quartzose sandstone 20 to 50 feet thick. Occurs between Marathon limestone and Fort Pena formation. Graptolites characteristic of uppermost part of the Marathon were collected 3 inches below the sandstone, and graptolites diagnostic of basal beds of Fort Pena were collected 1 inch above the sandstone; thus stratigraphic position was determined from paleontological evidence. Alsate shale commonly present between Marathon, and Fort Pena is absent in this area.

Type locality: Northern part of the Solitario, Brewster County. Named for outcrops near Rodriquez Tank. Sandstone is a continuous unit and commonly stands out forming a low ridge in area of Ordovician outcrop in the Solitario and a prominent bench in old Jones Ranch (now Slaughter Ranch) locality. Outlines recumbent anticline below Cretaceous rim in Jones Ranch area.

**Roger Park Basaltic Breccia**

Pliocene(?): Southwest-central Utah.

Eugene Callaghan, 1939, Am. Geophys. Union Trans. 20th Ann. Mtg., pt. 3, p. 439 (fig. 2), 440 (fig. 3), 446–447. Flows near top of formation are dark gray with distinctly basaltic appearance; breccias are various shades of gray or red, and fragments commonly vesicular. Maximum thickness in mapped area as much as 2,000 feet. Position of Roger Park in volcanic sequence of region not clear. Breccia overlain by latite grouped with Dry Hollow latite (new) and underlain by latites and breccia of Bullion Canyon volcanics (new). May be facies of Bullion Canyon volcanics. Tertiary.

The U.S. Geological Survey currently considers the Roger Park to be Pliocene(?) in age. This designation is made on the basis of restudy of Bullion Canyon Volcanics, now considered to be Miocene(?).

Occurs in Marysvale region. Derivation of name not stated.

Rogers Chalk Lens (in Taylor Marl)[1]

Upper Cretaceous (Gulf Series) : Northern central Texas.

Original reference: W. S. Adkins and M. B. Arick, 1930, Texas Univ. Bull. 3016, p. 65.

Type locality: On a small creek from about 1 mile to 1¼ miles south and a little west of Rogers, Bell County.

**Rogers City Limestone** or **Formation**

Middle Devonian: Northeastern Michigan.

G. M. Ehlers and R. E. Radabaugh, 1937, Michigan Acad. Sci., Arts, and Letters, Sec. Geology and Mineralogy [Guidebook] 7th Ann. Field Excursion [p. 8–9]. Name applied to limestone overlying Dundee limestone and disconformably underlying Bell shale of Traverse group. Thickness 69½ to 72½ feet.

G. M. Ehlers and R. E. Radabaugh, 1938, Michigan Acad. Sci., Arts, and Letters, Papers, v. 23, p. 441–445. As proposed, name Rogers City is applied to limestone and dolomite strata formerly considered part of the Dundee which is here restricted to lower 140 feet of section. Lower 8 to 9 feet of Rogers City is dolomite; upper part is limestone. Rogers City fauna is distinctive from that of Dundee.

Type locality: Quarry of Michigan Limestone and Chemical Co., at Rogers City, Presque Isle County.

**Rogers Creek Member** (of Schrader Bluff Formation)

Upper Cretaceous: Northern Alaska (subsurface and surface).

C. L. Whittington, 1956, Am. Assoc. Petroleum Geologists Bull., v. 40, no. 2, p. 249, 250, 251, fig. 5. About two-thirds of member is medium-gray to medium-light-gray clay shale in type section. Listed in order of importance, rocks interbedded with the clay shale are tuff, siltstone, silt shale, sandstone, and bentonite. Thickness about 700 feet in vicinity of Umiat, 585 to 595 feet at type section. Lowest named member of formation. Rogers Creek member and overlying Barrow Trail member (new) defined to include rocks overlying Tuluvak tongue of Prince Creek formation that were formerly included in Tuluga member of Schrader Bluff formation. Very poorly exposed in Umiat area but is expressed as areas of subdued topography enclosed by cuestas formed by Barrow Trail member.

Type section: Gubik test well No. 1 from 295 to 890 feet and Gubik test well No. 2 from 555 to 1,140 feet. Named from upper part of Rogers Creek, about 10 miles S. 80° W. of Umiat Mountain where subdued topography is typically developed.

Rogers Gap (division) Member (of Cynthiana Formation)[1]

Middle Ordovician: Central Kentucky.

Original reference: A. F. Foerste, 1912, Denison Univ. Sci. Lab. Bull. 17, p. 19, 23, 42, 44.

A. C. McFarlan and W. H. White, 1948, Am. Assoc. Petroleum Geologists Bull., v. 32, no. 8, p. 1642. Division of Cynthiana. Thin- to medium-bedded limestone and shale with distinctive fauna. Overlies Nicholas limestone; underlies Fulton shale. Gratz shale division includes Rogers Gap in its upper part. 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 the Cynthiana. This includes 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. 257, 268. Rogers Gap [member of Cynthiana formation] formation, uppermost member of the Mohawkian, and the overlying Fulton shales, lowermost member of the Cincinnatian, are faunally indistinguishable in this area [Ohio Valley around Cincinnati]; they appear to be lithologic facies of same time-rock unit. The Rogers Gap and Fulton rest northwardly on the Nicholas and southwardly on the Greendale; they are not present over top of Jessamine dome; Fulton (shale phase) is absent in some places toward center of dome, and the Million (Eden) rests directly on the Rogers Gap. The faunal and lithologic evidence indicates the advisability of extending the Cincinnatian series downward to embrace the Cynthiana formation, rather than including this formation in Mohawkian as has been the common practice.

Probably named for Rogers Gap, Scott County.

Rogersian series[1]

Precambrian: Montana, and Alberta, Canada.

Original reference: C. R. Keyes, 1925, Pan-Am. Geologist, v. 44.

Derivation of name not stated.

**Rogers Spring Limestone**[1]

Mississippian: Southeastern Nevada.

Original references: C. R. Longwell, 1921, Am. Jour. Sci., 5th ser., v. 1, p. 46; 1928, U.S. Geol. Survey Bull. 798.

C. R. Longwell, 1949, Geol. Soc. America Bull., v. 60, no. 5, p. 930 (table 1). Chiefly gray crystalline limestone with some cherty zones. Thickness about 600 feet. Underlies Bluepoint limestone; overlies Muddy Peak limestone Mississippian.

A. H. McNair, 1951, Am. Assoc. Petroleum Geologists Bull., v. 35, no. 3, p. 518–519. Lower Mississippian. Thickness Virgin Mountain section 577½ feet.

Ben Bowyer, E. H. Pampeyan, and C. R. Longwell, 1958, U.S. Geol. Survey Mineral Inv. Field Studies Map MF–138. Mapped as 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 Virgin Mountains, underlies Illipah formation.

Well exposed along Rogers Spring fault scarp, Clark County.

Rogersville Limestone (in Greene Formation)[1]

Permian: Southwestern Pennsylvania.

Original reference: J. J. Stevenson, 1907, Geol. Soc. America Bull., v. 18, p. 97, 106.

In Greene County.

**Rogersville Shale**[1] (in Conasauga Group)

Middle Cambrian: Northeastern Tennessee, western North Carolina, and southwestern Virginia.

Original reference: M. R. Campbell, 1894, U.S. Geol. Survey Geol. Atlas, Folio 12, 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. Includes Craig limestone member (new). Overlies Rutledge limestone; underlies Maryville shale.

John Rodgers, 1953, Tennessee Div. Geology Bull. 58, pt. 1 (plates); pt. 2, p. 46 (fig. 3), 48–51. In eastern Tennessee, Conasauga varies in lithology and three phases are recognized; in central phase (between Knoxville and Morristown, and north of Clinch Mountain), the Conasauga is considered a group consisting of six formations of which the Rogersville shale is third in sequence (ascending). Underlies Maryville limestone; overlies Rutledge limestone. Thickness 0 to 250 feet.

Named for exposures at and near Rogersville, Hawkins County, Tenn.

**Rogue Formation**

Upper Jurassic: Southwestern Oregon.

F. G. Wells and G. W. Walker, 1953, Geology of the Galice quadrangle, Oregon: U.S. Geol. Survey Geol. Quadrangle Map [GQ–25]. Name given to a sequence of metavolcanic rocks and small related intrusives of Upper Jurassic age. Sequence consists of intimately intermixed fine- to coarse-grained tuffs, agglomerates, flow breccias, and flows and their metamorphic equivalents. These types can be differentiated only in extensive waterworn exposures. Estimate of thickness depends on an assumption as to the thickening due to folding; thickness at type locality probably 15,000 feet. Bounded on west by Dothan formation; both formations dip steeply eastward; evidence indicates that volcanic rocks of the Rogue were deposited on sedimentary rocks of the Dothan prior to deformation; Galice formation lies to the east of the Rogue.

Type section: Along Rogue River, Galice quadrangle. Formation almost continuously exposed along Rogue River from confluence of Whiskey Creek to Almeda mine, along lower 5 miles of Grave Creek and along lower reaches of Reuben Creek.

Rogue River Flows, Pumice Flows

Pleistocene to Recent: Southwestern Oregon.

Howel Williams, 1942, Carnegie Inst. Washington Pub. 540, p. 81, 90–92, pl. 19 (fig. 2). Rogue River flows (pumice flows) were products of glowing avalanche that followed Rogue River and its tributaries. The flows united near confluence with Union Creek, and composite flow continued for 20 miles to point 1½ miles above present site of village of McLeod. End of flow lies 35 miles from former summit of Mount Mazama. Glowing avalanches of pumice were part of final activity of Mount Mazama and followed what is termed main pumice fall.

Rogue River is west of Crater Lake.

Rogue River Group[1]

Cretaceous: Southwestern Oregon.

Original reference: T. Condon, 1902, The two islands.

Named for Rogue River valley.

Rohnerville Formation

Pleistocene, upper (?) : Northwestern California.

B. A. Ogle, 1953, California Div. Mines Bull. 164, p. 13 (fig. 3), 63, pls. 1, 2. Warped terrace deposit, predominantly gravel with lesser amounts of sand, silt, and clay; unfossiliferous. Thickness 10 to 25 feet. Overlies Carlotta formation (new) with angular unconformity. No positive statement regarding age can be made; it is post-Hookton and thus probably upper Pleistocene.

Formation is of limited extent; restricted to surface upon which Rohnerville and Fortuna are built and to isolated surface known as Grizzly Bluff, Humboldt County.

Rolling Fork Limestone Member (of Brodhead Formation)

Lower Mississippian: Central Kentucky.

P. B. Stockdale, 1939, Geol. Soc. America Spec. Paper 22, p. 76, 152, pl. 25. Upper member of Brodhead formation, Athertonville facies (new). Dense and siliceous to crinoidal cherty limestone about 60 to 80 feet thick. Underlies Floyds Knob formation; overlies Ginseng siltstone member (new) of Brodhead formation.

Well exposed along road leading up hill west of old Ginseng post office, southeastern Larue County. Probably named for Rolling Fork of Salt River which forms boundary between Larue and Nelson Counties.

**Rollins Sandstone Member** (of Mesaverde Formation)[1]

**Rollins Sandstone Member** (of Mount Garfield Formation)

Upper Cretaceous: Central western Colorado.

Original reference: W. T. Lee, 1909, U.S. Geol. Survey Bull. 341, p. 320 (table), 322.

C. E. Erdmann, 1934, U.S. Geol. Survey Bull. 851, p. 23 (table), 40, 41, 44. In Book Cliffs coal field, Colorado, Rollings sandstone is basal member of Mount Garfield formation (new). Thickness 71 feet at Book Cliff mine. In Grand Mesa region, the Rollins is basal member of Mesaverde.

E. C. Dapples, 1939, Econ. Geology, v. 34, no. 4, p. 371. In Anthracite-Crested Butte quadrangles, strata near village of Baldwin that Lee identified as Bowie are believed to underlie Rollins sandstone forming part of a new member herein called Baldwin sandstone. Hence, the Rollins overlies the Baldwin sandstone member and underlies Paonia shale member.

J. D. Fisher, C. E. Erdmann, and J. B. Reeside, Jr., 1960, U.S. Geol. Survey Prof. Paper 332, p. 19. Southeast of Colorado River, beds of lower part of Mount Garfield formation below Rollins sandstone member pass into marine shales indistinguishable from Mancos shale, and the Rollins becomes basal member of the Mesaverde. Rollins sandstone member was said by Lee to rest on Mancos shale throughout Grand Mesa area. Paonia member rests, according to Lee, on Rollins sandstone member in western part of Grand Mesa area, but toward east the Bowie member appears and gradually increases in thickness eastward. According to Boyer (written commun.), Lee misidentified his units in Grand Mesa field. Upper member of Sego sandstone of present report was mistaken for Rollins, and strata between the upper Sego and Rollins were referred to Bowie shale member.

Forms conspicuous cliff at Rollins mine, north of Delta, Delta County.

Roll Quarry Limestone[1]

Age(?): West-central Vermont.

Original reference: E. J. Foyles, 1929, Vermont State Geologist 16th Rept., p. 283.

Rolls Ford Shale Member (of McLeansboro Formation)[1]

Pennsylvanian: Central western Illinois.

Original reference: T. E. Savage, 1915, Illinois Geol. Survey Bull. 20, p. 99–107.

H. R. Wanless, 1939, Geol. Soc. America Spec. Paper 17, p. 100. Marine shale and impure limestone in lower McLeansboro, probably above Danville (No. 7) coal.

Exposed at Ralls Ford (Rolls Ford) on Sangamon River, 4 miles northwest of Springfield, Sangamon County.

Roma Sandstone Member or Tongue (of Fayette Formation)[1]

Eocene, upper: Southern Texas, and Tamaulipas, Mexico.

Original reference: W. G. Kane and G. B. Gierhart, 1935, Am. Assoc. Petroleum Geologists Bull., v. 19, no. 9, p. 1376, 1383, 1387.

J. M. Patterson, 1942, Am. Assoc. Petroleum Geologists Bull., v. 26, no. 2, p. 259 (fig. 2), 268. Thickness of tongue (or member) 250 to 300 feet at Roma. Thins northward and wedges out completely near Laredo. Composed almost entirely of massive and crossbedded medium- to fine-grained sandstones which are fossiliferous; large calcareous sand concretions common throughout member. Overlies Resendez shale tongue (new); underlies Gorgora shale member (new).

Exposed at International Bridge, San Pedro de Roma on Mexican side of Rio Grande from Roma, Starr County, Tex.

Romance Arkose[1]

Precambrian: Northwestern Vermont.

Original reference: W. G. Foye, 1919, Vermont State Geologist 11th Rept., p. 84.

Probably named for Romance Mountain, in western part of Rochester quadrangle, in Addison County.

**Rome Formation**[1]

Lower Cambrian: Northwestern Georgia, northern Alabama, western North Carolina, eastern Tennessee, and southwestern Virginia.

Original reference: E. A. Smith, 1890, Alabama Geol. Survey Rept. on Cahaba coal field, p. 149.

G. W. Stose and A. I. Jonas, 1938, Virginia Geol. Survey Bull. 51–A, p. 8. Ivanhoe limestone member of Shady dolomite herein considered basal member of Rome formation.

B. N. Cooper, 1939, Virginia Geol. Survey Bull. 55, p. 8–10, pl. 2. In Draper Mountain area, Virginia, overlies Shady formation; underlies Elbrook formation. Consists of red, green, and yellow shales and siltstones; many intercalations of argillaceous dolomite. Thickness 2,000 feet.

P. B. King and others, 1944, Tennessee Div. Geology Bull. 52, p. 14–16. Described in connection with manganese deposits in northeastern Tennessee. Lower and Middle Cambrian.

John Rodgers and D. F. Kent, 1948, Tennessee Div. Geology Bull. 55, p. 4–7. Underlies Pumpkin Valley shale (new); shale was formerly included in Rome formation. Stratigraphic section at Lee Valley, Hawkins County given; here 513 feet of Rome is exposed.

T. L. Kesler, 1950, U.S. Geol. Survey Prof. Paper 224, p. 12–17, pl. 1. In Cartersville district, Georgia, the Rome overlies Shady formation, or where Shady is absent, the Weisner formation. In extreme western part of the district, formation consists largely of crystalline dolomite and limestone whose maximum thickness is about 1,800 feet. In southeastern part, consists largely of metashale whose thickness is at least 2,000 feet. Carbonate rocks and metashale intergrade. Some dolomite formerly included in the Shady are here included in the Rome. Underlies Conasauga formation.

John Rodgers, 1953, Tennessee Div. Geology Bull. 58, pt. 1 (geol. maps); pt. 2, p. 43–45. Summary discussion of usage of name. [See bibliography entry for Hayes and Keith, this report.] Rome formation as mapped herein [eastern Tennessee] includes Apison shale member but excludes overlying "Rome shale" as used by Hayes and Keith which belongs to Conasauga group. In this usage, Rome corresponds to Safford's (1869, Geology of Tennessee) Knox sandstone. Formation is a heterogeneous and variegated mixture of sandstone, siltstone, shale, dolomite, and limestone; proportions vary greatly. Stratigraphy of the Rome is one of major problems of east Tennessee stratigraphy; Rome occurs chiefly just above major thrust faults, is commonly folded and imbricated, and shows no base; fossils are comparatively rare. Thickness in northeast Tennessee 1,200 feet or more; elsewhere, base is missing, and thickness is unknown but is more than 700 feet in many places. Fossils of both Lower and Middle Cambrian are reported from the formation, but it is believed that the Middle Cambrian fossils come from the "Rome shale" unit; hence, most if not all of the Rome as mapped here is of Lower Cambrian age.

J. L. Stuckey and S. G. Conrad, 1958, North Carolina Div. Mineral Resources Bull. 71, p. 40. Formation conformably overlain by Honaker limestone in Hot Springs area and occurs as single small patch in northernmost part of window.

Named for exposures at Rome, Ga.

†Rome Sandstone[1]

Lower Cambrian: Northwestern Georgia and southeastern Tennessee.

Original reference: C. W. Hayes, 1894, U.S. Geol. Survey Geol. Atlas, Folio 2.

Probably named for exposures south of Rome, Ga.

Romeo Member (of Joliet Formation)

Silurian (Niagaran): Northern Illinois.

D. L. Graf, 1952, Illinois Geol. Survey Rept. Inv. 161, p. 2, 3 (table 1). Very fine grained dolomite; widespread.

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. 27 he [Willman] mentions locality at Romeo but name is not applied to any of his units].

Romero Conglomerate Lentil (in Debris Dam Sandstone)

Upper Cretaceous: 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). 1741. Lenticular conglomerate beds in Debris Dam sandstone (new). Well cemented; pebbles and cobbles are largely siliceous types mostly 2 to 8 inches, with some as much as 14 inches in diameter; matrix is dark arkose, which also occurs as interbeds between gravel layers of member. Although lenticular in detail, conglomerate is persistent in general, where one gravel layer tapers out another begins above or below it. Thickness, if intervening sandstone beds are included, ranges up to 2,000 feet. South of Santa Ynez fault, disconformably (?) underlies Juncal formation (new).

Occurs south of Santa Ynez River, northeast of Santa Barbara, Santa Barbara County.

**Romney Shale**[1]

Middle Devonian: Eastern West Virginia, western Maryland, southern Pennsylvania, and northern Virginia.

Original reference: N. H. Darton, 1892, Am. Geologist, v. 10, p. 13, 17.

Charles Butts, 1940, Virginia Geol. Survey Bull. 52, pt. 1, p. 305–308. Romney shale restricted. Millboro shale, as named and as here used, includes only the Marcellus and Naples (basal Portage) shales of original Romney. In Frederick and Shenandoah Counties, Romney (restricted) includes at base much black and gray fissile shale, which rests normally upon Onondaga shale. This shale is overlain by a commonly fossiliferous mass of rock, the Hamilton, composed largely of compact very fine-grained olive-green argillaceous sandstone. Upper part of Romney (restricted) is dark-colored to black sandy fossiliferous Naples shale with *Paracardium* and *Probeloceras*, extending up to the light-greenish shale of succeeding Brallier.

H. P. Woodward, 1943, West Virginia Geol. Survey, v. 15, p. 245–253. In its reports describing eastern counties (1916–39), the West Virginia Geological Survey abandoned term "Romney," indicating that its several horizons were individually recognizable. Name Romney is without adequate support because it cannot be used for any precise chronological position. Name must either be entirely redefined or abandoned. It is suggested that Romney be hereafter used to designate the black-shale Devonian facies of whatever age. In terms of this proposal, Romney black shale stands for rocks of this facies wherever they occur in geologic column of Appalachian Devonian.

Ernst Cloos. 1951, Maryland Dept. Geology, Mines and Water Resources Washington County [Rept. 14], p. 87–89. Romney shale, in Maryland, comprises (ascending) Onondaga shale, Marcellus black shale, and Hamilton members. Overlies Ridgeley sandstone member of Oriskany formation; underlies Jennings formation.

F. G. Lesure, 1957, Virginia Polytech. Inst. Engineering Expt. Sta. Ser. 118, p. 18 (table 1), 20 (table 2). Described in Clifton Forge iron district where it includes Needmore shale member below and Millboro shale member above. Overlies Ridgeley sandstone; underlies Brallier formation. Thickness 800 to 1,200 feet. Includes most of Middle Devonian and probably includes a little of the Upper Devonian.

Named for exposures at Romney, Hampshire County, W. Va.

**Rondout Limestone**

Rondout Limestone (in Cayuga Group)[1]

Rondout Limestone (in Keyser Group)

Rondout Limestone Member (of Manlius Formation)

Upper Silurian and Lower Devonian: New York and Pennsylvania.

Original reference: J. M. Clarke and C. Schuchert, 1899, Science, new ser., v. 10, p. 874–878.

G. H. Chadwick, 1940, New York Geol. Assoc. 16th Ann. Mtg. Field Guide Leaflets, p. 2. In Catskill area, includes Fuyk sandstone member (new). Thickness 2 to 40 feet. Underlies Manlius (Olney limestone); overlies Normanskill.

C. K. Swartz and F. M. Swartz, 1941, Geol. Soc. America Bull., v. 52, no. 8, p. 1182–1184, 1160. Included in Keyser group. White's (1882) Stormville section reexamined. Rondout limestone includes unit correlated with Stormville hydraulic cement bed. Rondout overlies Decker sandstone. Underlies Manlius. Silurian.

H. P. Woodward, West Virginia Geol. Survey, v. 14, p. 175–176. Beds overlying Williamsport ("Bloomsburg") sandstone and below Tonoloway ("Bossardville") limestone in eastern West Virginia, although previously described as "Rondout," are here identified with Wills Creek limestone of Maryland and are treated under that name.

G. H. Chadwick, 1944, New York State Mus. Bull. 336, p. 44, 45–58 [1946]. Rondout waterlime includes Fuyk sandstone locally, and Glasco limestone lentil (new) near top. Underlies Manlius (Olney); overlies Normanskill. Upper Silurian.

L. V. Rickard, 1955, New York State Geol. Assoc. Guidebook 27th Ann. Mtg., p. 7. Formation included in Helderbergian series. Underlies Thacher member (new) of Manlius formation.

Colgate University staff and students, 1955, New York State Geol. Assoc. Guidebook 27th Ann. Mtg., p. 2 (columnar section), 4, Referred to as member of Manlius formation. Overlies Cobleskill limestone member; underlies Olney limestone member. Columnar section (p. 2) shows Rondout member of Manlius group.

L. V. Rickard, 1956, Dissert. Abs., v. 16, no. 1, p. 102. Base of Devonian system of New York is apparently not at base of Coeymans of eastern part of State where it has been placed for many years. Present information indicates that underlying Rondout and Cobleskill formations are probably also Devonian in age.

D. W. Fisher, 1959, New York State Mus. Sci. Service Geol. Survey Map and Chart Ser. 1. Chart shows upper part of Chrysler (Rondout) waterlime as Devonian; lower part is Upper Silurian.

U.S. Geological Survey currently designates the age of the Rondout Limestone as Upper Silurian and Lower Devonian on the basis of a study now in progress.

Named for development in cement quarries at and near Rondout County, N.Y.

**Ronkonkoma Stade, Drift**

Ronkonkoma Substage[1]

Pleistocene: Southeastern New York.

Original reference: A. C. Veatch, 1903, Jour. Geology, v. 11, p. 766–776.

Occurs on eastern end of Long Island. Probably named for town and lake of Ronkonkoma.

Roodhouse Coal Member (of Carbondale Formation)

Pennsylvanian: Southern Illinois.

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 34, 35, 47 (table 1). Member of Carbondale formation. Lies between Shawneetown coal member and Summum (No. 4) coal member. Recognized only in vicinity of type locality.

Type locality: NW¼ sec. 21, T. 12 N., R. 11 W., Roodhouse quadrangle, Greene County.

Rooney Chert (in Hannan Limestone)

Rooney Chert Member[1] (of Madison Limestone)

Rooney Limestone

Mississippian (Kinderhook and (or) Osage): Northwestern Montana.

Original reference: C. F. Deiss, 1933, Montana Bur. Mines and Geology Mem. 6, p. 14, 47.

J. M. Weller and others, 1948, Geol. Soc. America Bull., v. 59, no. 2, pl. 2 (col. 38). Shown on correlation chart as being in Hannan limestone. Underlies Monitor Mountain limestone and overlies Dean Lake chert, both in Hannan limestone, Osagean.

J. M. Andrichuk, 1955, Billings Geol. Soc. Guidebook 6th Ann. Field Conf., p. 89. Hall (1952, unpub. thesis) proposed that Deiss' Rooney chert be recognized as a formation and be designated Rooney limestone. The Rooney at type section includes about 550 feet of crinoidal limestone, varying to microcrinoidal or sparsely crinoidal in lower part, with interbeds of gray bedded dense fine-grained limestone. Upper boundary is erosional surface, but about 50 miles to southeast, the Rooney is reported by Deiss to be 292 feet thick and overlain by Monitor Mountain limestone. Upper Kinderhook and possibly lower Osage age.

Type locality: On south slope of top of Lone Butte, in SE¼ sec. 23, T. 23 N., R. 13 W., about 15 miles from Pentagon Mountain.

Roop Sandstone Member (of Alhambra Formation)

Eocene, upper: Northwestern California.

C. E. Weaver, 1953, Washington [State] Univ. Pubs. in Geology, v. 7, p. 19 (chart), 54–55, pls. 2F, 3A, 4A. Proposed for 115 feet of brownish-gray medium-grained poorly stratified sandstone with 5 percent of interbedded silty shales; nonfossiliferous. Overlies Castro shale member (new); lies stratigraphically below Pereira shale member (new). May represent a local lens in formation but is well-marked lithologic unit at type locality; term Roop sandstone should be used as a lithologic unit only in type area.

Type section: West limb of Pacheco syncline in cuts along Santa Fe Railway east of east portal of Muir Tunnel, near Martinez, Contra Costa County.

Roosevelt Member (of Apache Group)

Precambrian (Algonkian) : South-central Arizona.

N. E. A. Hinds, 1936, Carnegie Inst. Washington Pub. 463, p. 32. Seventh [upper] member of group. Chert and dark-reddish and purplish siliceous shales. Maximum thickness 30 feet. Underlies Troy quartzite and overlies a vesicular basalt flow south of Roosevelt Dam.

Present locally at and near Roosevelt Dam, Gila County.

Roosville Formation[1]

Roosville Member (of Miller Peak Formation)

Precambrian (Belt Series) : Southeastern British Columbia, Canada.

Original reference: R. A. Daly, 1912. Canada Geol. Survey, Dept. Mines Mem. 38, Map 2, 114°30′ to 115°.

C. L. Fenton and M. A. Fenton, 1937, Geol. Soc. America Bull., v. 48, no. 12, p. 1902. Designated a member of Miller Peak formation in Belt series. Underlies Mount Rowe member (new) ; overlies Kintla member. Type locality given.

Type locality: Three miles east-northeast of Phillips Creek cascade, near Roosville, British Columbia.

**Root Shale** (in Wabaunsee Group)

Pennsylvanian (Virgil Series) : East-central Kansas.

R. C. Moore and M. R. Mudge, 1956, Am. Assoc. Petroleum Geologists Bull., v. 40, no. 9, p. 2274 (fig. 1), 2275. Defined to include strata between Wood Siding formation above and Stotler limestone (new) below. Thickness ranges from about 30 to 90 feet and averages 60 feet. Comprises (ascending) Friedrich shale, Jim Creek limestone, and French Creek shale members.

M. R. Mudge and H. R. Burton, 1959, U.S. Geol. Survey Bull. 1068, p. 15 (table 2), 30–33. Originally, strata comprising Root shale was included in McKissick Grove shale member of Wabaunsee group 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 3, Friedrich shale, Jim Creek limestone, and French Creek shale, are now classified as members of Root shale. Average thickness 38 feet in Wabaunsee County [this report].

Type section: In a roadcut along east-flowing stream near center of N½SE¼ sec. 20, T. 21 S., R. 11 E., Lyon County. Name derived from Root Station on Atchison, Topeka, and Santa Fe Railroad.

Root Valley Member (of Prairie du Chien Formation)

Root Valley Sandstone

Ordovician (Beekmantown) : Southeastern Minnesota and northwestern Iowa.

C. R. Stauffer and G. A. Thiel, 1941, Minnesota Geol. Survey Bull. 29, p. 59–63. Medium- to fine-grained, white to buff, yellow, or brown rather even-bedded sandstone with hard quartzitic masses that have appearance of arenaceous chert. Thickness 35 to 40 feet. Underlies and is interbedded with Shakopee dolomite; overlies Oneota dolomite. In older geologic literature horizon was known as New Richmond beds or sandstone.

L. A. Thomas and C. A. Balster, 1949, Iowa Acad. Sci. Proc., v. 56, p. 236 (table 1). In discussion of micropaleontological zones in Iowa, Root Valley is shown as member of Prairie du Chien formation. Occurs above Oneota member and below Willow River member.

R. L. Heller, 1956, Geol. Soc. America Guidebook for Field Trips Minneapolis Mtg., Field Trip 2, p. 31–33. Detailed studies of the Root Valley sandstone and the New Richmond sandstone indicate that these two units are one and the same. Based on priority of the name New Richmond, the name Root Valley should be suppressed.

Typically exposed along highway above State Fish Hatchery west of Lanesboro, along river bluff at Preston, in Whitewater State Park, where highway descends from St. Charles, Winona County, Minn.

†Rosalie Granite[1]

Precambrian : Central northern Colorado.

Original reference : S. H. Ball, 1906, Am. Jour. Sci., 4th v. 21, p. 383.

Forms ridge between Mount Evans and Mount Rosalie, Georgetown quadrangle.

†Rosamond Series[1]

Miocene : Southern California.

Original reference: O. H. Hershey, 1902, California Univ. Pub., Dept. Geol. Bull., v. 3, pl. 1, map.

T. W. Dibblee, Jr., 1958, Am. Assoc. Petroleum Geologists Bull., v. 42, no. 1, p. 135–136. Since Hershey's description, name Rosamond has been applied by later workers to Tertiary stratified rocks exposed in widely separated areas in Mojave Desert, as far north as Ricardo and as far east as Newberry. Many of these exposed sections called Rosamond were found to be of different ages, with one as old as Paleocene and another as young as Pliocene. Hence, the sequence of rocks exposed in Rosamond Hills and originally described by Hershey as Rosamond series, together with probable correlative rocks of Tertiary age exposed in vicinities of Kramer borate area and in Kramer Hills are here named Tropico group.

Type section : Near Rosamond Station, Kern County.

Rosebud Beds[1]

Rosebud facies

Miocene, lower and middle : Central southern South Dakota.

Original reference: W. D. Matthew and J. W. Gidley, 1904, Am. Mus. Nat. History Bull., v. 20, p. 241–246.

A. L. Lugn, 1939, Geol. Soc. America Bull., v. 50, no. 8, p. 1270–1271. Rosebud is name applied to about 500 feet of pinkish sandstone and silty clay, the "lower Miocene of southern South Dakota," and has been used to some extent for bluff-forming layers of eastern part of the Pine Ridge, mainly in Sheridan County, Nebr. Matthew tentatively correlated the Rosebud with lower Miocene of western Nebraska, that is, with the Harrison. The Rosebud in northern Sheridan County encompasses all that is present of following formations: Gering, Monroe Creek, Harrison (old lower Harrison) and at least lower part of Marsland formation (old upper Harrison). Hence, term Rosebud, as far as Nebraska is concerned, is obsolete. However, Rosebud might be retained in northern Nebraska and South Dakota as an inclusive term for correlative formations where they are too indistinct for differentiation.

J. C. Harksen, 1960, Geology of the Sharps Corner quadrangle, South Dakota (1:62,500) : South Dakota Geol. Survey. Rosebud strata of type locality are traceable southwestward into three (Gering, Monroe Creek, and Harrison) formations of Arikaree group and possibly into part of overlying Marsland formation. However, the "Rosebud" in mapped area is unlike typical Marsland of Nebraska and is here informally called "Rosebud facies" pending further study. In area of report, consists of light-tan to brown interbedded calcareous sands, silts, and clays with large amounts of layered tabular concretions and cemented ledges. At Porcupine Butte, 3 miles east of southern (Manderson) quadrangle, upper contact of the Rosebud with overlying Ash Hollow formation is exposed; in this area, the Rosebud is 235 feet thick.

Well exposed along Little White River in vicinity of Rosebud Agency, Todd County.

Rose Canyon Latite-Andesite Volcanics

Oligocene: Northern Utah.

R. E. Marsell and R. L. Threet, 1960, Geologic map of Salt Lake County, Utah (1:62,500); supplement to Bull. 69 [not yet published]: Utah Geol. and Mineralog. Survey. Named on map legend. Occurs above Butterfield andesite flows (new) and below South Mountain andesite flows (new).

Mapped in southern part of Salt Lake County. Rose Canyon is in unit as mapped.

Rose Canyon Shale[1]

Rose Canyon Shale Member (of La Jolla Formation)

Eocene, lower and middle: Southern California.

Original reference: M. A. Hanna, 1926, California Univ. Pub., Dept. Geol. Sci. Bull., v. 16, no. 7, p. 187–246.

L. G. Hertlein and U.S. Grant 4th, 1939, California Jour. Mines and Geology, v. 35, no. 1, p. 66–67. Uppermost member of La Jolla. Attains maximum thickness of at least 300 feet and is most widely distributed member of formation. Unconformably overlies Torrey sand member or overlaps the sand and rests unconformably on Black Mountain volcanics or Cretaceous sandstones. Underlies Poway formation.

A. M. Keen and Herdis Bentson, 1944, Geol. Soc. America Spec. Paper 56, p. 21 (fig. 4). Shown on chart as shale member of La Jolla formation. Lower and middle Eocene.

G. B. Oakeshott, 1951, Am. Assoc. Petroleum Geologists Bull., v. 35, no. 2, p. 254 (table). Table lists Rose Canyon shale (formation). Overlies Torrey sand; underlies Poway conglomerate.

Named for exposures at big bend in Rose Canyon, La Jolla quadrangle, San Diego County.

Rosefield Formation

Oligocene: Eastern Louisiana.

J. F. L. Connell, 1960, Southeastern Geology, v. 2, no. 2, p. 59, 115. Listed in catalog of type localities of coastal plain stratigraphic units. Name credited to Delaney (unpub. thesis).

H. V. Andersen, 1960, Louisiana Dept. Conserv., Geol. Bull. 34, p. 100–101. Delaney (1958) in an investigation of Louisiana Vicksburg equivalents restudied Mosley Hill type locality. He reported presence of three mappable units (two silty clay units separated by a sand) between the Danville Landing and the Catahoula. He restricted the Mosley Hill to the basal unit; the overlying sand he named Sandel formation; the uppermost fossiliferous clays and siltstones he named Rosefield formation. Rosefield at its type locality carries a Vicksburg fauna.

Type locality: Exposures at Rosefield cemetery, near junction of Louisiana State Highways 112 and 126, northwestern Catahoula Parish.

**Rose Hill Formation**[1]

Rose Hill Formation (in Clinton Group)

Middle Silurian: Maryland, Pennsylvania, and northern Virginia.

Original reference: C. K. Swartz, 1923, Maryland Geol. Survey Silurian vol., see index.

H. P. Woodward, 1941, West Virginia Geol. Survey [Repts.], v. 14, p. 55–91. Geographically extended into West Virginia where it underlies Keefer sandstone and overlies the Tuscarora sandstone. Thickness 200 to 600 feet.

Ernst Cloos and C. H. Broedel, 1943, Geol. Soc. America Bull., v. 54, no. 9, p. 1379 (table 1). Shown on stratigraphic column of Harrisburg, Pa., area as including Keefer sandstone; thickness 700 to 750 feet. Occurs below Bloomsburg red beds and above Tuscarora sandstone.

B. N. Cooper, 1944, Virginia Geol. Survey Bull. 60, p. 112 (fig. 4), 114–119. Described in Burkes Garden quadrangle, Va., where it is 228 feet thick; underlies the Wills Creek sandstone and overlies the Clinch sandstone. Contains no Keefer or Rochester beds. White sandstone, formerly called Keefer in this area, is a part of the Rose Hill.

F. M. Swartz and H. J. Hambleton, 1958, Pennsylvania State Univ. Mineral Industries Expt. Sta. Bull. 71, p. 21. Rose Hill shale and sandstone, in Clinton group, contains Center iron sandstone member (new).

H. H. Arndt and others, 1959, Geol. Soc. America Guidebook Pittsburgh Mtg., p. 6, 20, 23, 30–31, pl. 1. Greenish-gray and grayish-red fossiliferous shale and sandstone. Thickness 650 to 850 feet. Underlies Mifflin formation (new); overlies Tuscarora formation. Includes Burnt Ridge member (new) in middle.

Named for exposures on Rose Hill, Cumberland, Md.

Rose Island Arkose[1]

Carboniferous: Southern Rhode Island.

Original reference: A. F. Foerste, 1899, U.S. Geol. Survey Mon. 33, p. 308, 380.

Occurs on Rose Island, one of Newport Harbor Islands.

**Roseland Anorthosite**

Roseland Anorthosite (in Virginia Blue Ridge Complex)

Precambrian: Central Virginia.

C. S. Ross, 1941, U.S. Geol. Survey Prof. Paper 198, p. 2–6. Name applied to anorthosite in Roseland district. Consists of antiperthitic andesine. It is cut by numerous quartz veins, dikes rich in ferromagnesian minerals, and large lenticular bodies of a rock called nelsonite; intrudes gneissic quartz monzonite that forms dominant country rock of region. Unit has been referred to as pegmatite and syenite by earlier workers.

R. O. Bloomer and H. J. Werner, 1955, Geol. Soc. America Bull., v. 66, no. 5, p. 582, pl. 1. White or green, coarse-grained, locally granulated, granulose, monomineralic rock consisting of oligoclase-andesine. Along margins are large tabular grains and veins of blue quartz and inclusions of basement complex gneiss oriented parallel to regional foliation; nelsonite forms dikelike bodies along contact of Roseland with Marshall formation In Piedmont is surrounded by Marshall formation; in Blue Ridge is surrounded by Pedlar formation.

W. R. Brown, 1958, Virginia Div. Mineral Resources Bull. 74, p. 9. Included in Virginia Blue Ridge complex (new).

Named from exposures near Roseland, Nelson County. Length of mass is about 13 miles, greatest width about 2½ miles, and total area about 22 square miles.

**Rosendale Limestone Member** (of Salina Formation)[1]

Upper Silurian: Eastern New York.

Original reference: J. Hall, 1893, New York State Mus. 46th Ann. Rept., p. 156, 159.

D. W. Fisher, 1959, New York State Mus. Sci. Service Geol. Survey Map and Chart Ser. 1. In southern half of Rosendale quadrangle. Rosendale waterlime overlies Accord shale (new). Upper Silurian.

Named for exposures at Rosendale, Ulster County.

Rosett Bed (in Midway Formation)

Tertiary, lower: Central Texas.

R. H. Cuyler and A. W. Weeks, 1940, *in* Geol. Soc. America [Guidebook] 53d Ann. Mtg., p. 24. Named in road log.

Near Larremore oil field, Caldwell County.

**Rosewood Shale**[1]

Lower Mississippian: Southeastenn Indiana and western and northern Kentucky.

Original reference: Charles Butts, 1915, Kentucky Geol. Survey, 4th ser., v. 3, pt. 2, p. 150.

P. B. Stockdale, 1939, Geol. Soc. America Spec. Paper 22, p. 143–144. Name abandoned. Holtsclaw Hill facies (new) of Brodhead formation (new) comprises the two units "Rosewood shale" and "Holtsclaw sandstone" proposed by Butts (1915).

Type locality: Village of Rosewood, Harrison County, Ind.

**Rosiclare Sandstone Member** (of Ste. Genevieve Limestone)[1]

Rosiclare Member (of Ste. Genevieve Limestone)

Upper Mississippian: Southern Illinois, southern Indiana, and western Kentucky.

Original reference: E. O. Ulrich and W. S. T. Smith, 1905, U.S. Geol. Survey Prof. Paper 36, p. 24, 40.

J. M. Weller and A. H. Sutton, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 5, p. 816. Underlies Levias (formerly Lower Ohara) member; overlies Fredonia member.

T. G. Perry and N. M. Smith, 1958, Indiana Geol. Survey Bull. 12, p. 20–21, pl. 1. Because Rosiclare generally contains more limestone than sandstone and in places consists partly or mostly of shale, Indiana Geological Survey uses name Rosiclare member. Thickness 1 to 15 feet.

Named for Rosiclare, Hardin County, Ill. Typical development in Ohio River bluff just below town.

**Rosita Andesite**[1]

Eocene : Central southern Colorado.

Original reference: W. Cross, 1896, U.S. Geol. Survey 17th Ann. Rept., pt. 2, p. 285.

J. W. Gabelman, 1953, Econ. Geology, v. 48, no. 3, p. 197. In Silver Cliff-Rosita region, the volcanics, in order or decreasing age, consist of Rosita fragmental andesite, Bunker massive andesite. Fairview diorite in dikes cutting earlier andesite, Bald Mountain dacite flows, rhyolite in dikes, eruptive channels and flows, Pringle andesite, trachyte flows, and Bassick agglomerate.

Chief occurrence in beneath and about town of Rosita, from which unit is named, Silver Cliff-Rosita region, Custer County.

**Roslyn Formation**[1]

Roslyn Arkose

Eocene : Central Washington.

Original reference: I. C. Russell, 1900, U.S. Geol. Survey 20th Ann. Rept., pt. 2, p. 100–137, map.

C. E. Weaver, 1937, Washington [State] Pub. in Geology, v. 4, p. 26 (table), 51–52. Massive yellowish-brown sandstone and subordinate quantities of clay shales and carbonaceous shales including coal seams. Thickness 2,000 to 3,500 feet. Overlies Teanaway basalt. Middle to upper Eocene. Areal distribution noted.

R. J. Foster, 1960, Geol. Soc. America Bull., v. 71, no. 2, p. 101 (table 1), 108–110, pl. 1. Roslyn arkose in area of this report [northern parts of Mount Stuart and Snoqualmie quadrangles] concordantly underlies Teanaway basalt and is in contact with two younger rocks, post-Roslyn rhyolite and Yakima basalt; the Yakima overlies Roslyn with angular unconformity. Just south of area of this report the Roslyn is deformed into asymmetrical syncline with steep limb on southwest side; west side of syncline is tightly folded and faulted. C. T. Bressler (1951, unpub. thesis) divided Roslyn into three units: basal beds—200 feet or less of red clastic rocks that grade upward into nearly white clastic rocks; 2,300 feet of largely massive yellowish-gray arkosic medium-grained sandstone with darker interbedded fine-grained sandstone and siltstone; upper 1,500 feet composed of eight major coal beds interbedded with medium- to fine-grained sandstone and siltstone. Considered middle and (or) upper Eocene on basis of one fossil fish and two turtle carapaces, which together with leaves, are only fossils found in Roslyn to date.

Best exposed on northern side of Yakima Valley between Swauk Creek and Lake Cle Elum on eastern side of Cascade Mountains. Largest area is in drainage basin of Teanaway River and southward in vicinity of Cle Elum and Roslyn, Kittitas County.

Ross Formation

Lower Devonian : Central Tennessee.

C. W. Wilson, Jr., 1949, Tennessee Div. Geology Bull. 56, p. 280-302, fig. 2. In this report [Pre-Chattanooga stratigraphy of central Tennessee]. Dunbar's 1919 (Tennessee Div. Geology Bull. 21) classification of the Lower

Devonian is modified. Ross formation is defined to include all beds overlying Decatur limestone and underlying Flat Gap or Harriman formations. As thus defined, includes Birdsong shale member, Bear Branch facies. Ross limestone member, Rockhouse shale member, Rockhouse limestone member. Decaturville zone, and Bryozoan zone. Cooper and others (1942, Geol. Soc. America Bull., v. 53, no. 12, pt. 1 chart 4) placed Rockhouse in the silurian, leaving Ross the oldest unit of Devonian; no reasons were given for this shift in classification, but presumably it resulted from recent analysis of fauna of Rockhouse. However, if Rockhouse is Silurian, then entire Ross formation, including Ross limestone member and Birdsong shale member, are likewise Silurian. In one respect, such a shift would clear up matter of occurrence of unique bulbs of *Camarocrinus* in a Niagaran formation and in a Devonian formation; proposed change would limit range of these fossils to the Silurian.

Type locality not given.

**Ross Limestone Member** (of Olive Hill Formation)[1]

Ross Limestone Member (of Ross Formation)

Lower Devonian: Western Tennessee.

Original reference: A. F. Foerste, 1903, Jour. Geology, v. 11, p. 579, 685.

C. W. Wilson, Jr., 1949, Tennessee Div. Geology Bull. 56, p. 280, 287–290. In this report (Pre-Chattanooga stratigraphy of central Tennessee, Dunbar's 1919 (Tennessee Div. Geology Bull. 21) classification is modified. Ross formation, which is defined to include all beds overlying Decatur limestone and underlying Flat Gap or Harriman formations, includes Birdsong shale member, Bear Branch facies, Ross limestone member, Rockhouse shale and limestone members, Decaturville zone, and Bryozoan zone. It is believed here that original separation of Pyburn from Ross was not justified, nor was separation made by later workers justified; hence, name Pyburn limestone is discontinued, and all limestone formerly classed as Pyburn is included in Ross limestone member of Ross formation. Ross limestone member, as used here, would be represented at all localities mentioned in preceding work of Foerste, Dunbar, Miser, and Jewell. Ross member conformably overlies Rockhouse shale member in areas along Tennessee River and Horse Creek to south and overlies Rockhouse limestone member in outliers in Hardin and Wayne Counties; member (and its local Bear Branch facies) unconformably underlies Flat Gap limestone or Harriman formation; northward Ross member grades into Birdsong shale member. Thickness in northern part of outcrop area 35 to 45 feet; southward thickens to about 60 feet at Chalybeate Spring and 90 feet along Dry Creek.

Named for exposures on Ross Farm, near Sulphur Spring, Hardin County.

**Ross Fork Limestone** (in Thaynes Group)[1]

Lower Triassic: Southeastern Idaho.

Original reference: G. R. Mansfield, 1915, Washington Acad. Sci. Jour., v. 5, p. 492.

G. R. Mansfield, 1952, U.S. Geol Survey Prof. Paper 238, p. 17, 31–32, pl. 1. Mapped in Ammon and Paradise Valley quadrangles where it consists of grayish and yellowish limestone, shale, and sandstone.

Named from Ross Fork Creek, in Fort Hall Indian Reservation, in upper waters of which this limestone is well exposed.

Rossian series[1]

Precambrian: Cordilleran region.

Original reference: C. R. Keyes, 1917, Iowa Acad. Sci. Proc., v. 24, p. 56.

Rossie Dioritic Series

Rossie Intrusive Complex[1]

Precambrian: Northwestern New York.

Original reference: A. F. Buddington, 1929, New York State Mus. Bull. 281, p. 81–86, 89.

A. F. Buddington, 1939, Geol. Soc. America Mem. 7, p. 67–71. Referred to as Rossie dioritic series; varies from augite diorite to biotite-oligoclase quartz diorite, with local variations toward monzodiorite.

Well displayed in town of Rossie, St. Lawrence County.

Rossland Monzonite[1]

Mesozoic; Southern British Columbia, Canada, and northeastern Washington.

Original reference: R. A. Daly. 1912, Canada Geol. Survey Dept. Mines Mem. 38, map 8.

Named for occurrence at Rossland, British Columbia, just north of international boundary.

Rossland Volcanic Group[1] or Formation

Carboniferous(?) to Cretaceous: Southern British Columbia, Canada, and northeastern Washington.

Original references: R. G. McConnell and R. W. Brock, 1904, British Columbia West Kootenay Sheet (1:253,440): Canada Geol. Survey; R. A. Daly, 1912, Canada Geol. Survey Dept. Mines Mem. 38, p. 320–334, maps.

Mapped at and around Rossland Mountains, British Columbia, just north of international boundary.

Ross Mine Formation

Permian (Guadalupe): Southwestern Texas.

C. C. Rix, 1952, Geologic map of Cinati Peak quadrangle, Presidio County, Texas (1:48,000): prelim. ed., Texas Univ. Bur. Econ. Geology; 1953, West Texas Geol. Soc. [Guidebook] Spring Field Trip, May 28–30, p. 1, 5 (chart), 14, 20. Sandstone, shale, chert, and limestone. Occurs above Cibolo formation and below Mina Grande formation (new).

Type locality and derivation of name not stated. Probably named for Ross mine which is in Shafter mining district.

Rossville Shales and Sandstone[1]

Pennsylvanian: Northeastern Kansas.

Original reference: J. W. Beede, 1898, Kansas Acad. Sci. Trans., v. 15, p. 31.

Probably named for Rossville, Shawnee County.

Rota Limestone

Pleistocene or early Holocene: 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, pt. 57, table 4 [English translation in library of U.S. Geol. Survey, p. 68, 69]. Named on correlation chart. Correlated with Chatcha [Chacha] limestone of Saipan, Asuncion [Sonson] limestone of Tinian. Peleliu limestone on Palau and Fais limestone, and Barigata [Barrigada] limestone on Guam. Pleistocene.

S. Hanzawa *in* Jacques Avias and others, 1956, Lexique Strat. Internat., v. 6, Océanie, fasc. 2, p. 54. Raised coral reef limestone; elevated as much as 20 meters above sea level in general and 30 meters on southwest coast. Mostly coralliferous, but *Halimeda*-bearing near Sonson, Taipincot, southwest of island and only geomorphologically distinguished from Mariana limestone. Early Holocene. Name credited to S. Sugawara (unpub. ms.).

Type locality: Rota Island. Developed as belt surrounding island.

Rothwell Shale Member (of Muldraugh Formation)

Lower Mississippian: Central Kentucky.

P. B. Stockdale, 1939, Geol. Soc. America Spec. Paper 22, p. 76, 217–219, pl. 16. Shale, very clayey; dark blue gray, olive gray, green gray, and purple. Forms basal unit of Olive Hill facies (new) of formation. Thickness as much as 30 feet. Overlies Floyds Knob formation; overlain by impure limestone beds which constitute upper part of formation. The combined Rothwell shale and the Indian Fort shale member (new) at the top of the Brodhead formation, Irvine and Morehead facies (both new), constitute the Morris Mountain shaly member of the Logan formation of Butts (1922)

Type section: Along State Highway 40 between Rothwell post office and top of hill 1 mile east-northeast, Menifee County.

Roubaix Group

Precambrian: Southwestern South Dakota.

J. R. Berg, 1946, South Dakota Geol. Survey Rept. Inv. 52, p. 4, 6–7, 14–19, map (on page following title page). Varied in lithology, including more than two lithologically mappable units. Basal part in places a blue-gray quartzite; in other places may be described as gray to brown quartzose schist. Interbedded with upper parts of the quartzose schists and quartzite are black quartzose schists of similar lithology, differing only in color. Where less resistant and more schistose the aluminous sediments show biotite prophyroblasts, or segregations of biotite. Mapped as part of Lead system; group is younger than and overlies rocks of the Lead system.

Mapped in vicinity of Roubaix, Galena-Roubaix district, in the Black Hills. Biotite schist lithology most characteristic northeast and southwest of Hay Creek, east of Roubaix (secs. 33 and 34, T. 4 N., R. 4 E.; and secs. 3, 4, and 5, T. 3 N., R. 4 E.) Biotite porphyroblast type of rock well developed in N½SW¼ sec. 28 and in S center sec. 32, T. 4 N., R. 4 E.

**Roubidoux Formation[1] or Dolomite**

Lower Ordovician: Eastern and central Missouri.

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

E. B. Branson, 1944, Missouri Univ. Studies, v. 19, no. 3, p. 47–50. Interbedded sandstones and dolomites; variable in character; in some places is almost entirely sandstone; whereas in others it is mainly dolomite. Basal sandstone irregular in thickness, ranging from less than 1 foot up to 30 feet; color reddish-brown or sometimes gray. Thickness 160 to 170 feet. Fossiliferous; main fossil zone 60 to 70 feet above base. Overlies Gasconade formation; unconformably underlies Jefferson City formation.

J. S. Cullison, 1944, Missouri Univ. School Mines and Metallurgy Bull., Tech. Ser., v. 15, no. 2. p. 15. Unconformably underlies Rich Fountain formation (new) of Jefferson City group.

R. L. Heller, 1954, Missouri Geol. Survey and Water Resources, 2d ser., v. 35, 118 p. As originally defined, Roubidoux did not have specific type section. Type section is herein designated. Thickness 150 feet at type section. Here formation overlies the Gasconade and underlies Rich Fountain formation of Jefferson City group. May rest unconformably on Gasconade, but there is little field evidence to support this view; Roubidoux-Rich Fountain contact appears to be one of conformity. Systematic description of fauna.

Type section (Heller): Along southeast-facing hillside above Roubidoux Creek in SE¼NW¼SW¼ sec. 10, T. 33 N., R. 12 W., Texas County. Widely distributed throughout most of Ozark uplift in Missouri.

Rough Creek Bed (in Strawn Formation)[1]

Pennsylvanian: Central Texas.

Original reference: N. F. Drake, 1893, Texas Geol. Survey 4th Ann. Rept., pt. 1, p. 374–383.

D. A. Zimmerman and G. D. Glover, 1956, Soc. Econ. Paleontologists and Mineralogists Permian Basin Sec. [Guidebook] Spring Mtg., p. 76. In ascending order, 150 feet sandstone; 50 feet blue sandy clay; 25 to 40 feet sandstone, partly massive. Commonly massive and containing considerable conglomerate, especially at top. Overlies Hamm Valley beds; underlies Buffalo Creek bed.

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.

Named for Rough Creek, Mills County.

†Rough Creek Shale Member (of Tesnus Formation)[1]

Pennsylvanian: Western Texas.

Original reference: J. A. Udden, C. L. Baker, and E. Bose, 1916, Texas Univ. Bur. Econ. Geology and Tech. Bull. 44, p. 45

Named for exposures on Rough Creek in Dove Mountain quadrangle.

Roughlock Siltstone

Middle Ordovician: Western South Dakota.

M. R. McCoy, 1952, Billings Geol. Soc. Guidebook 3d Ann. Field Conf., p. 44, 45, 46. Pale-gray-green to cream siltstone 25 to 30 feet thick. Conformably underlies Whitewood dolomite; conformably overlies Ice Box formation (new).

Type section: In Spearfish Canyon, 2.4 miles above Maurice [Lawrence County], several hundred yards up canyon wall. Name taken from Roughlock Falls.

Rough Mountain Conglomerate Lentil (in Brownwood Shale)

Pennsylvanian: Central Texas.

F. B. Plummer, 1950, Texas Univ. Bur. Econ. Geology Pub. 4329, p. 95, pl. 20. Small lentil that varies in thickness from 6 to 20 feet. At thickest part, on east side of Rough Mountain, made up of alternating beds of gravel exhibiting crossbedding like that found in stream terraces; foreset beds dip at angles ranging from 10° to 30°. Northward from Rough Mountain and northward along base of Adams Branch escarpment, conglomerate thins and grades into a coarse-grained crossbedded sandstone.

Extends from point where Rochelle-Cowboy Road leaves the Rochelle-San Saba Road north a distance of about 3 miles to a water tank on Baker's Ranch, McCulloch County.

Roulet Conglomerate[1]

Upper Devonian: Central northern Pennsylvania.

Original reference: C. A. Ashburner, 1880, Pennsylvania 2d Geol. Survey Rept. $G_3$, p. 97–104.

Probably named for Roulette [Roulet], Potter County.

Round Knob Shale Member or horizon (in Conemaugh Formation)[1]

Round Knob clay shales member

Round Knob redbed member

Pennsylvanian (Conemaugh Series): Eastern Ohio and western Pennsylvania.

Original reference: D.D. Condit, 1912, Ohio Geol. Survey, 4th ser., Bull. 17, p. 35.

D. L. Norling, 1958, Ohio Geol. Survey Bull. 56, p. 49, 50. Clay shales member of Conemaugh series in report on Morgan County. Farm Condit's description, it would appear that Round Knob shale and Saltsburg [Saltzburg] sandstone are contemporary units, or the names are applied to different facies of same unit. The Round Knob member overlies the Saltsburg sandstone in some areas in Morgan County, and in others, occupies same interval between Barton and Harlem coals as does the Saltsburg. Term Round Knob is applied to shaly phase of this interval where strata are highly colored, and term Saltsburg is applied to sandy phase. Round Knob shales are pinkish to red or chocolate red.

M. T. Sturgeon and others, 1958, Ohio Geol. Survey Bull. 57, p. 95 (table 11), 130–131. Redbed member of Harlem cyclothem in report on Athens County. Widespread variegated clays and shales occur at many places in Maryland, Ohio, Pennsylvania, and West Virginia in interval between Portersville (Friendsville) shale and limestone and Ames limestone. Thicknesses range up to 50 or even 100 feet. To these beds in Ohio, Condit gave name Round Knob. Elsewhere in northern Appalachian region, these clays and shales are known as Pittsburgh red shale or redbed, a name given by White (1903, West Virginia Geol. Survey, v. 2) and a name which Condit considered unsatisfactory because of previous and general use of Pittsburgh for the Number 8 coal and its underlying limestone. Average thickness about 17 feet. Conemaugh series.

Named for Round Knob, a hill in Madison Township, Columbiana County, Ohio.

Round Mountain Member (of Little Valley Formation)

Upper Jurassic[?] or Cretaceous[?]: Northern California.

J. E. Lawton, 1956, Dissert. Abs., v. 16, no. 10, p. 1885. Upper member of formation. Overlies Leesville member (new); underlies Baldy Mountain member of Davis Creek formation (both new). The 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.

Round Mountain Silt[1]

Round Mountain Silt Member (of Temblor Formation)

Miocene, middle: Southern California (subsurface and surface).

Original reference: A. Diepenbrock, 1933, California Oil Fields, Div. Oil and Gas, v. 19, no. 2, p. 14, 16, pl. 2.

A. M. Keen, 1943, San Diego Soc. Nat. History Trans., v. 10, no. 2, p. 26 (fig. 1), 28 (fig. 2), 29–35. Mapped as Round Mountain silt in Kern River area near Round Mountain. Considered member of Temblor. Thickness about 90 feet. Underlies Santa Margarita; overlies Olcese sand member of Temblor.

Otto Hackel and K. F. Krammes, 1958, San Joaquin Geol. Soc. [Guidebook] Spring Field Trip May 17, p. 3, 4. Overlies Olcese sand; underlies Mon Bluff formation (new); north of Poso Creek underlies Kern River formation. Mainly brown, somewhat bedded organic siltstone. Diatomite member present about 100 feet below top in outcrop. Middle Miocene.

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.

Round Prairie Formation

Pennsylvanian (Morrow): Southern Oklahoma.

B. H. Harlton, 1938, Am. Assoc. Petroleum Geologists Bull., v. 22, no. 7, p. 854 (fig. 1), 895–900. At type locality, section includes lower boulder bed, which overlies Union Valley sandstone, separated from an upper bouldery shale by 2 or 3 beds of sandstones. Some of these sandstones are highly calcareous and fossiliferous and are approximately 25 feet apart. The upper bouldery shale is overlain by 10 to 15 feet of jet black fissile fossiliferous shale, locally siliceous, with seams of chalcedony. Underlies Barnett Hill formation. Thickness 400 to 800 feet. Formation has been described as Johns Valley shale; term Johns Valley is herein abandoned.

B. H. Harlton, 1959, *in* The geology of the Ouachita Mountains, a symposium: Dallas Geol. Soc. and Ardmore Geol. Soc., p. 131 (fig. 1), 137. Formation consists of approximately 425 feet of soft gray bouldery shale generally with two interbeds of dark-gray to black shale and thin sandstone layers. Basal boulder bed, which ranges in thickness up to 275 feet, is succeeded upward by persistent interval, about 50 feet thick, of dark-gray to black shale and intercalated thin-bedded sandstone. This zone is succeeded upward by two bouldery shale beds, separated near middle by zone of dark-gray to black flaky shale with occasional sandstone lentils. Entire thickness of this three-unit zone is a little more than 100 feet. Formation, as thus described, is more restricted term than that defined in 1938. Underlies Barnett Hill; overlies Johns Valley shale of published reports.

L. M. Cline, 1960, Oklahoma Geol. Survey Bull. 85, p. 62–63. Because of uncertainties concerning use of terms Caney, Mississippian Caney, Pennsylvanian Caney, Ouachita Caney, and Johns Valley, Harlton (1938) proposed that name Johns Valley be abandoned and name Round Prairie be adopted. Subsequent workers have not followed Harlton in use of term Round Prairie, preferring instead the older term Johns Valley.

Type locality: NE¼NE¼SE¼ sec. 2, T. 2 S., R. 12 E., Round Prairie syncline.

**Round Rock Member** (of Esmeralda Formation)[1]

Miocene, upper, and pliocene, lower: Central Nevada.

Original reference: H. G. Ferguson, 1924, U.S. Geol. Survey Bull. 723.

Exposed in vicinity of Round Rock, about 1 mile north of Manhattan, Nye County.

Roundtop Flow, Lava

Pleistocene to Recent: Southwestern Oregon.

Howel Williams, 1942, Carnegie Inst. Washington Pub. 540, p. 32, 62. Bulk of flow consists of porphyritic andesite marked by pronounced slabby jointing parallel to banding. In places, thickness no less than 500 feet. Rests on bouldery till. Summit polished and scratched by glacial action. Lies to east of Palisade flow (new). Was part of main andesitic cone of former Mount Mazama. Wineglass welded tuff may once have been continuous over entire top of Roundtop lava. [Diller and Patton, 1902, U.S. Geol. Survey Prof. Paper 3, described Roundtop andesite area.]

Roundtop is on northeast rim of Crater Lake.

Roundtop 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, 33–34, 44. Consists mostly of shale, mudstone, and thin limestone colored various shades of red, green, and gray. Comprises Division IV of Hartville "formation" (Condra and Reed, 1935, Nebraska Geol. Survey Paper 9). Thickness 149 feet. Underlies Hayden group (new); overlies Reclamation group (new).

Type locality: Roundtop Mountain, sec. 22, T. 27 N., R. 66 W., Platte County, Wyo.

**Round Valley Limestone**

Lower Pennsylvanian: Northeastern Utah and northwestern Colorado.

Walter Sadlick, 1955, Wyoming Geol. Assoc. Guidebook 10th Ann. Field Conf., p. 50 (chart), 52, 56–57. In Uinta Mountains, Morgan formation has been subdivided into two members. Upper member consists mainly of reddish-brown clastics that are overlain by Weber sandstone. In these aspects, the upper member is correlative with type Morgan. Lower member consists of light-gray limestones that have no counterpart in type Morgan as defined by Blackwelder (1910). Name Round Valley is here proposed for essentially Morrowan beds of typically light-gray limestone, in part dolomitic and cherty, having an average thickness of 300 to 350 feet. Thickness 481 feet in Sols Canyon. Underlies Morgan formation (restricted); overlies Manning Canyon formation.

Walter Sadlick, 1957, Intermountain Assoc. Petroleum Geologists Guidebook 8th Field Conf., p. 69–70, pl. 1 (fig. 1). In Uinta Mountains, the Round Valley typically forms resistant ledges of light-gray limestone. Formation can be traced laterally along flanks of Uintas and as far east as Juniper Mountains, Colo. At latter locality, Abrassart and Clough (1955) published detailed section of Morgan (unrestricted). Their middle Morgan member is at least partially equivalent to Round Valley limestone. At type section herein stated, disconformably overlies Great Blue limestone.

Type section: In Round Valley about 3 miles east of Morgan, Morgan County, Utah; measured in NW¼ sec. 29, T. 4 N., R. 3 E. Traced in Wasatch Mountains from Dry Bread Hollow, east of Huntsville, Utah, southward to west of Heber, and from Salt Lake City to northwestern Colorado along flanks of Uinta Mountains. Well exposed approximately 1 mile north of U.S. Route 30S on west side of Round Valley, in approximately sec. 20, T. 4 N., R. 3 S., Morgan County, Utah.

**Rove Slate**[1] (in Animikie Group)

Precambrian: Western Ontario, Canada, and northeastern Minnesota.

Original reference: J. M. Clements, 1903, U.S. Geol. Survey Mon. 45, index.

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.

Named for Rove Lake, just north of international boundary.

Rowe Formation (in Cherokee Group)

Rowe Formation or coal cycle (in Krebs Group)

Pennsylvanian (Des Moines Series): Southwestern Missouri, southeastern Kansas, and northeastern Oklahoma.

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 Rowe formation. Includes Rowe Coal. Underlies Drywood (Dry Wood) formation (new); overlies Warner formation. Included in Krebs group.

C. C. Branson, 1954, Oklahoma Geol. Survey Guide Book 2, p. 6. Referred to as Rowe coal cycle in Savanna formation, Krebs group, in Oklahoma.

W. V. Searight, 1955, Missouri Geol. Survey and Water Resources Rept. Inv. 20, p. 14, 18, 20. Rowe formation exposed in Barton and Vernon Counties, Mo. Thickness as much as 14 feet in Vernon County. Overlies Warner formation; underlies Drywood formation. Krebs group.

W. B. Howe, 1956, Kansas Geol. Survey Bull. 123, p. 35–37, 101. Formation in Krebs subgroup of Cherokee group. Thickness in Kansas as much as 22 feet. Overlies Warner formation; underlies Drywood (Dry Wood) formation. Derivation of name given.

Named from Rowe coal, which has been extensively mined in southeastern Kansas and western Missouri.

**Rowe Schist**[1]

Lower Cambrian(?): Western Massachusetts, eastern New York, and southern Vermont.

Original references: B. K. Emerson, 1898. U.S. Geol. Survey Geol. Atlas, Folio 50; 1898, U.S. Geol. Survey Mon. 29, p. 76–78, 158, pl. 34.

D. M. Larrabee, 1939, Eng. Mining Jour., v. 140, no. 12, p. 49 (fig. 3), 50–51. Area of report is about 10 miles southwest of Rutland, Vt. Rowe schist borders eastern edge of slate belt, from where it extends into Taconic Mountains. In map area, it is nowhere a true schist but is instead a phyllite, locally a phyllitic quartzite, and grades westward into purple and green slates. There is no sharp contact between the slates and phyllites; it is a zone of variable width—usually less than three-fourths mile—in which slates, quartzites, and phyllites are interbedded. Cambrian slates [Mettawee] grade eastward in Rowe schist. Lower Cambrian.

R. V. Cushman, 1950, New York State Water Power and Control Comm. Bull. GW–21, p. 9 (table 2), 10, 11, pl. 2. Crops out in Rensselaer County, N.Y. Thickness not determined. Lower Cambrian(?).

Norman Herz, 1958, U.S. Geol. Survey Geol. Quad. Map GQ–108. Berkshire schist as mapped in this report [Cheshire quadrangle, Massachusetts] includes some rocks mapped as Berkshire, Hoosac, and Greylock by Pumpelly, Wolff, and Dale (1894, U.S. Geol. Survey Mon. 23) and Hoosac, Normanskill, and Rowe by Prindle and Knopf (1932, Am. Jour. Sci., 5th ser., v. 24).

Named for occurrence at town of Rowe, Franklin County, Mass.

Rowes Agglomerate[1]

Devonian or Carboniferous: East-central New Hampshire.

David Modell, 1936, Geol. Soc. America Bull., v. 47, no. 12, p. 1910–1911, pl. 1. Unbedded explosion agglomerate filling a volcanic vent over 1 mile long and almost one-half mile wide. On Hill 1560 are rounded to angular fragments, a few inches to a few feet across, enclosed in a dense dark-gray matrix which is largely fragmental and composed of small grains of feldspar and quartz. Included fragments of Meredith porphyritic granite are most common; a few of Sawyer quartz syenite, Belknap syenite, and Conway granite also present. Assigned to White Mountain magma series; youngest member of series with possible exception of some dikes which do not cut the agglomerate.

Exposed on Rowes Hill in Belknap Mountains. Best exposures are the broad ledges at summit of Hill 1560, 1½ miles slightly northeast of Gilford village, Belknap County.

Rowlandville Granite[1]

Age(?): Northeastern Maryland.

Original reference: G. P. Grimsley, 1894, Cincinnati Soc. Nat. History, v. 17, p. 79, 81, 88.

At Rowlandville, Cecil County.

Rowlesburg Sandstone (in Chemung Formation)[1]

Upper Devonian: Northern West Virginia.

Original reference: R. V. Hennen and D. B. Reger, 1914, West Virginia Geol. Survey Rept. Preston County, p. 97, 194.

At Rowlesburg, Preston County.

Rowley Creek Slate[1]

Precambrian: Central southern Wisconsin.

Original reference: A. Leith, 1935, Kansas Geol. Soc. Rept. 9th Ann. Field Conf., p. 329–330, fig. 216.

Named for small creek that flows through eastern part of Baraboo syncline, Sauk County.

**Row Park Limestone** (in St. Paul Group)

Middle Ordovician: Western Maryland, southern Pennsylvania, and northern West Virginia.

R. B. Neuman, 1951, Geol. Soc. America Bull., v. 62, no. 3, p. 278–284, pls. 1, 2. Proposed for beds forming lower formation of St. Paul group (new). Typical Row Park contains four limestone types: (1) calcarenite, formed of pebbles and sand of limestone and dolomite in light crystalline matrix; (2) dove vaughanite, usually containing some white, crystalline calcite; (3) granular limestone that varies in color from almost white to dark gray; and (4) dolomitic limestone. Thickness at type locality 162 feet. Underlies New Market limestone. Base of Row Park cannot be traced along a line that corresponds exactly to a bedding plane in either underlying Beekmantown dolomite or to one within itself; beds or lenses of dolomitic limestone are interbedded with nonmagnesian limestone through a zone as much as 50 feet thick; the thickest variable zone corresponds to thickest Row Park section, and this zone thins as formation thins to south. Where Row Park is thickest, southwest of Marion and at Welsh Run, Pa., limestones are interbeded with the Beekmantown dolomite 40 to 50 feet below the stratum thought to represent base of Row Park.

G. A. Cooper, 1956, Smithsonian Misc. Colln., v. 127, pt. 1, p. 80. Neuman named an 800-foot sequence of "Stones River" the Row Park formation. Cooper and Cooper had previously identified this sequence as Whistle Creek on the basis of contained fossils. Below the New Market of Cooper and Cooper, Neuman discovered granular limestone containing abundance of *Rostricellula*. It is postulated here that both identifications of the New Market are correct but that the Row Park is a partial facies of the New Market and also the Whistle Creek.

F. M. Swartz and R. R. Thompson, 1958, Pennsylvania State Univ. Mineral Industries Expt. Sta. Bull. 71, p. 5. In Franklin County, Pa., subdivided into Social Island limestone member below and Browns Mills limestone member above. Overlies Beekmantown dolomite.

Type section: In pastures 0.2 mile northwest of Row Park, Washington County, Md. Limestone forms a wedge whose thin edge lies in West Virginia, thickening northward into southern Pennsylvania.

Roxana Silt

Pleistocene (Wisconsinan): Southwestern Illinois.

J. C. Frye and H. B. Willman, 1960, Illinois Geol. Survey Circ. 285, p. 2 (fig. 1), 5, 10, 12. Succession of silts below Peoria loess and above a well-developed buried soil. Basal part locally contains gray noncalcareous colluvial silts with some sand and rare pebbles; gradationally above this colluvial zone (or in its absence, as basal unit) is gray noncalcareous massive silt, locally containing humus streaks in upper part. This gray silt unit is overlain by weakly calcareous pink to pinkish-tan massive silt containing sparse fauna of large snail shells. Pink silt unit grades upward into weakly calcareous massive gray silt, sparsely fossiliferous in lower part, which in turn is overlain by another pink massive silt, noncalcareous in upper part and commonly noncalcareous and nonfossiliferous throughout. Thickness at type section 47 feet. Altonian substage.

M. M. Leighton, 1960, Jour. Geology, v. 68, no. 5, p. 535–536, 538, 546. Roxna silt of Frye and Willman is not single rock unit but a composite of Farmdale and Peorian. In type section of Roxana silt, Frye and Willman included in its basal part 4 feet of Farmdale loess and above it 43 feet of Peorian loess, lower part of which is undoubtedly Iowan. They have 15 feet of Peorian loess at top to be designated as Peorian. Instead, this uppermost unit may posibly be correlative of Bignell loess of Doniphan County, Kans.

Type section: Exposures at Pleasant Grove School, center SE¼ sec. 20, T. 3 N., R. 8 W., southeast of Roxana, Madison County.

**Roxbury Conglomerate**[1] (in Boston Bay Group)

Devonian or Carboniferous: Eastern Massachusetts.

Original reference: Edward Hitchcock, 1861, Am. Jour. Sci., 2d ser., v. 31, p. 377.

M. P. Billings, F. B. Loomis, Jr., and G. W. Stewart, 1939, Geol. Soc. America Bull., v. 50, no. 12, pt. 1, p. 1868, 1869–1870, 1877–1881. Described as a heterogeneous mixture of conglomerate, sandstone, shale, andesitic and basaltic flows, tuffs, and breccias. Minimum total thickness in Hingham area 3,440 feet. Carboniferous; possibly Pennsylvanian, probably Permian.

Named for exposures in Roxbury, Boston area.

Roxbury Granite Gneiss

Pre-Triassic: Western Connecticut.

John Rodgers and others, 1956, Preliminary geological map of Connecticut (1:253,440): Connecticut Geol. Nat. History Survey. Described as white granite gneiss composed of microcline, albite, quartz, and muscovite. Some gneiss layers are aplitic.

R. M. Gates, 1959, U.S. Geol. Survey Geol. Quad. Map GQ–121. Replaced by Mine Hill granite gneiss. Name Roxbury preoccupied.

Named for town of Roxbury, Litchfield County.

†Roxton beds[1]

Upper Cretaceous (Gulf Series): Northeastern Texas and Southwestern Arkansas.

Original reference: R. T. Hill, 1901, U.S. Geol. Survey 21st Ann. Rept., pt. 7, p. 114, 340.

Crops out near Roxton, Lamar County, and Honey Grove, Fannin County, Tex., and at base of White Cliff section on Little River, Ark.

**Roxy Formation** (in Little Butte Volcanic Series)

Oligocene, lower(?): Southwestern Oregon.

F. G. Wells, 1956, U.S. Geol. Survey Geol. Quad. Map GQ–89. Sequence of flows, flow breccias, and coarse agglomerates that comprises lower part of Little Butte volcanic series. Base of formation is irregular and transitional with flows and water-laid pyroclastics in upper part of Colestin formation (new); hence, base is defined as top of uppermost layer of water-laid pyroclastics that is succeeded by at least 100 feet of flows with or without interlayered nonwater-laid pyroclastics. Underlies Wasson formation (new); transitional with underlying Colestin formation.

Named after Rosy Ann, a well-known knob east of Medford, Jackson County.

Royal Formation[1]

Pennsylvanian: Southern West Virginia.

Original references: M. R. Campbell and W. C. Mendenhall, 1896, U.S. Geol. Survey 17th Ann. Rept., pt. 2, p. 487, 490.

Named for Royal, Fayette County.

Royal Shale (in Pocahontas Group)

Royal Shale (in Pottsville Group)[1]

Pennsylvanian (Pottsville Series): Southern West Virginia.

Original reference: C. E. Krebs and D. D. Teets, Jr., 1916, West Virginia Geol. Survey Rept. Raleigh and western Mercer and Summers Counties, p. 366.

H. R. Wanless, 1939, Geol. Soc. America Special Rept. 17, p. 100; P. H. Price and E. T. Heck, 1939, West Virginia Geol. Survey [Rept.] Greenbrier County, p. 217, 244. Included in Pocahontas group, Pottsville series.

Occurs at Royal, Raleigh County.

†Royalton Formation[1]

Mississippian: Northeastern Ohio.

Original reference: C. S. Prosser, 1912, Ohio Geol. Survey, 4th ser., Bull. 15, p. 33, 72, 144, 493.

Named for exposures in Royalton Township, Cuyahoga County.

**Royer Marble**[1] or **Dolomite** (in Arbuckle Group)

Upper Cambrian: Central southern Oklahoma.

Original reference: E. O. Ulrich, 1927, Oklahoma Geol. Survey Bull. 45, p. 28.

C. E. Decker, 1933, Tulsa Geol. Soc. Digest, p. 55. Royer marble (dolomite) included in Arbuckle (here raised to group status). Underlies Signal Mountain limestone; overlies Fort Sill limestone.

W. E. Ham, 1949, Oklahoma Geol. Survey Circ. 26, p. 50–58. Royer dolomite mapped for this report (Mill Creek-Ravia area, Johnston County) consists mostly of massive-bedded coarsely crystalline, nearly pure dolomite about 550 feet thick; apparently conformable contacts with underlying Fort Sill formation and overlying Butterly dolomite.

Type section: SE cor. sec. 36, T.1 S., R. 1 E., Murray County. Named for old Royer Ranch on west side of East Timbered Hills in Arbuckle Mountains.

Royston Formation[1]

Permian: Central northern Texas.

Original reference: M. G. Cheney, 1929, Texas Univ. Bull. 2913, p. 26, pl. 1.

Type locality: Royston, Fisher County.

Roystone Coquinite (in Conewango Group)

Roystone Coquinite Member[1] (of Oswayo Shale or Riceville Formation)

Upper Devonian: Northwestern Pennsylvania and southwestern New York.

Original references: B. K. Emerson, 1898. U.S. Geol. Survey Geol. Atlas, 71, p. 61, 97, table.

Bradford Willard, 1937, Pennsylvania Acad. Sci. Proc., v. 11, p. 32. Generalized succession for marine Upper Devonian of northwestern Pennsylvania and southwestern New York lists Roystone member at base of Riceville formation. Underlies Oswayo member.

C. R. Fettke, 1938, Pennsylvania Geol. Survey, 4th ser., Bull. M–21, p. 33. Report gives section of Oswayo formation near Knapp Creek, N.Y. The bed of limestone 23 feet above base of section probably is limestone which Ashburner (1880) called the Marvin Creek. Caster (1934) renamed this limestone the Roystone, stating that Ashburner was not sufficiently exact in his definition of type locality and that the limestone which Ashburner saw along Marvin Creek is one of calcareous horizons in lower part of Knapp formation. Writer [Fettke] does not accept this interpretation of Ashburner's use of term and states reasons. Term Marvin Creek used in this report.

Bradford Willard, 1939, Pennsylvania Geol. Survey, 4th ser., Bull. G–19, p. 14 (tables 3, 4), 278. Table 3 shows Roystone coquinite in Oswayo shale. Footnote states that Caster (1934, Bulls. Am. Paleontology, v. 21, no. 71) renamed this coquinite Flatiron, but Roystone is in good standing. Table 4 shows Roystone coquinite at base of Riceville formation, below Oswayo shale. Page 278 lists Roystone coquinite in Conewango group, below Oswayo shale and above Cattaraugus red shale.

Named from exposures on Roosevelt Highway between Roystone and Ludlow, McKean County, Pa.

Rubio Diorite or Diorite Gneiss

Rubio Diorite and Metadiorite[1]

Pre-Tertiary (Late Paleozoic? or Precambrian): Southern California.

Original reference: W. J. Miller, 1934, California Univ. at Los Angeles Pub. Math. and Phys. Sci., v. 1, no. 1, p. 7–12, 49–65, 83, map.

G. B. Oakeschott, 1937, California Jour. Mines and Geology, v. 33, no. 3, p. 223–224. Rubio diorite is for the most part a rather dark, medium-grained gneiss containing abundant hornblende, little quartz, and with the composition of diorite. Age not conclusively determined; several considerations suggest late Paleozoic. The Rubio has been intruded by Upper Jurassic(?) granodiorite which, in a number of places, cuts across secondary gneissic banding. Diorite has intruded and metamorphosed Placerita limestone. There can be no doubt of post-Placerita (Carboniferous?) and pre-granodiorite (Upper Jurassic?) age of the Rubio. Improbable that it is Triassic or Lower Jurassic. Assigned to late Paleozoic, possibly Permian or Pennsylvanian.

W. J. Miller, 1946, Geol. Soc. America Bull., v. 57, no. 5, p. 465, table 4. Placerita formation, Rubio diorite, Echo granite, and combinations of all three (San Gabriel complex) are believed to be early Precambrian in age. Rubio diorite is younger than the Placerita.

G. B. Oakeschott, 1948, California Div. Mines Bull. 129, p. 250, 251. Summary of geology of crystalline rocks in western San Gabriel Mountains lists Rubio diorite-gneiss under heading pre-Tertiary, Late Paleozoic(?).

Named for typical occurrence in large area extending from Rubio Canyon into Eaton Canyon, San Gabriel Mountains.

**Rubio Peak 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 for Santa Rita quadrangle. Gravels and pumiceous tuffs with interbedded flows of andesitic basalt. Thickness as much as 600 feet. Underlies Lucky Bill formation (new); unconformably overlies Wimsattville formation (new). Miocene(?).

H. L. Jicha, Jr., 1954, New Mexico Bur. Mines Mineral Resources Bull. 37, p. 39, 40–44. Of late Tertiary age.

W. E. Elston, 1957, New Mexico Bur. Mines Mineral Resources Bull. 38, p. 17 (table 1), 18–23, pl. 1. Purple, brown, gray and green andesite and latite flows, flow breccia, agglomerate, and tuffs in Dwyer quadrangle. Interfingers with Sugarlump rhyolite near Mimbres Peak. Thickness, 600 to about 5,000 feet. Derivation of name given.

Named after prominent butte located in secs. 9, 10, 15, and 16, T. 19 S., R. 10 W., (as shown on pl. 1), Dwyer quadrangle.

Ruby Diorite

Age not stated: Southeastern Arizona.

G. M. Fowler, 1938, Arizona Bur. Mines Bull. 145, Geol. Ser. 12, p. 121, pl. 32. Darker, finer grained, and denser than the younger diorites, Sidewinder and Blue Ribbon. Includes fragments of conglomerate and is cut by dikes of Sidewinder and Blue Ribbon formations.

Named from mine settlement of Ruby, Santa Cruz County. Exposed in and around the Montana mine.

†Ruby Formation[1]

Eocene: Western Colorado.

Original reference: W. Cross, 1892, Am. Jour. Sci., 3d, v. 44, p. 21–33.

G. G. Simpson, 1937, Cambridge Philos. Soc. Biol. Rev., v. 12, no. 1, p. 9 (footnote). Name Plateau Valley has been applied by Patterson to Paleocene part of the Ruby.

Named for Ruby Peak, near Irwin, Gunnison County.

Ruby Limestone and Gneiss[1]

Precambrian: Southwestern Montana.

Original reference: E. Douglass, 1905, Carnegie Mus. Annals. v. 3, p. 407–428.

Exposed in Ruby Canyon, west of Old Baldy, and on east slope of Ruby Mountains, east of Dillon, Beaverhead County.

Rubyan series[1]

Middle Cambrian: Nevada.

Original references: C. R. Keyes, 1923, Pan-Am. Geologist, v. 40, p. 53; 1924, Pan-Am. Geologist, v. 41, p. 38, 78.

Well exposed on Ruby Hill at Eureka, Eureka County.

Ruby Road Formation

Age not stated: Southern Arizona.

B. P. Webb and K. C. Coryell, 1954, U.S. Atomic Energy Comm. RME–2009, p. 7. Gray intermediate(?) lavas and tuffaceous rocks. In places, has appearance of an intrusive rock. Underlies Montana Peak formation (new).

Exposed along Ruby Road on southwest flank of the Atascosa Range, Ruby quadrangle, Santa Cruz County.

**Ruddell Shale**

Upper Mississippian: Northeastern Arkansas.

Mackenzie Gordon, Jr., 1944, Am. Assoc. Petroleum Geologists Bull., v. 28, no. 11, p. 1631–1634. Proposed for the section of fissile clay shales lying between the top siliceous limestone bed of the Moorefield formation (herein restricted) below and the base of the Batesville sandstone above. Typically dark-gray to greenish-gray fissile clay shale that weathers red; lower 30 to 40 feet contain arenaceous and calcareous beds some of which are platy; upper half of this interval contains dark-gray to black limestone concretions which contain a goniatite assemblage; above this interval, shale is very fissile. Thickness at type locality 125 feet, here unit is exposed near the axis of a small anticline close to the Pfeiffer fault; a complete section 165 feet thick is exposed near Batesville.

Type locality: West end of Ruddell Hill, in Ruddell civil township near Ruddell's mill, Independence County. Section is almost completely exposed along the Batesville-Bethesda Road in the NE¼NE¼ sec. 13, T. 7 N., R. 13 W., starting in a gully a few feet below the culvert three-eighths of a mile northwest of Ruddell's mill and continuing east and south to the crown of Ruddell Hill.

Rudolph Quartzite[1]

Precambrian (middle Huronian): Central northern Wisconsin.

Original reference: S. Weidman, 1907, Wisconsin Geol. Nat. History Survey Bull. 16.

Largest area is immediately east of Rudolph, Wood County.

Ruffner Fire Clay (in Allegheny Formation)

Pennsylvanian: Southern West Virginia.

Original reference: C. E. Krebs and D. D. Teets, Jr., 1914, West Virginia Geol. Survey Rept. Kanawha County, p. 202.

H. R. Wanless, 1939, Geol. Soc. America Spec. Paper 17, p. 100. In Allegheny formation below Lower Freeport coal.

Named for Ruffner, 2 miles east of Charleston, Kanawha County.

Rugg Brook Dolomite or Formation

Rugg Brook Dolomite Conglomerate[1] or Dolomite Breccia

Lower or Middle Cambrian: Northwestern Vermont.

Original reference: Charles Schuchert, 1933, Am. Jour. Sci., 5th ser., v. 25, p. 356, 359, 365, 366, 368.

Charles Schuchert, 1937, Geol. Soc. America Bull., v. 48, no. 7, p. 1014, 1021, 1039–1040. Described as a dolomite breccia and conglomerate.

C. E. Resser and B. F. Howell, 1938, Geol. Soc. America Bull., v. 49, no. 2, p. 203. Lower Cambrian.

B. F. Howell, [1939], Vermont State Geologist 21st Rept., p. 97–101. Redefined as a sandy, sometimes conglomeratic, salmon-brown- to buff-brown-weathering gray-to buff-colored dolomite. Maximum thickness about 75 to 100 feet. Lower or Middle Cambrian.

V. H. Booth, 1950, Geol. Soc. America Bull., v. 61, no. 10, p. 1136, 1151–1153. In Oak Hill sequence, Rugg Brook formation, 0 to 40 feet thick, overlies Parker slate and underlies Skeels Corners slate. Lower Cambrian(?).

A. B. Shaw, 1958, Geol. Soc. America Bull., v. 69, no. 5, p. 534–536. Rugg Brook dolomite described in St. Albans area where it is 100 to 300 feet thick. Overlies Parker slate; underlies St. Albans slate. Middle Cambrian. In Milton quadrangle, Cady (1945, Geol. Soc. America Bull., v. 56, no. 5) mapped the Rugg Brook as Winooski dolomite. Term Winooski should be dropped and name Rugg Brook applied in both northwestern and west-central Vermont.

Type locality: On Rugg Brook less than 3 miles southwest of St. Albans, Franklin County.

Rugged Crest Flow

Pleistocene to Recent: Southwestern Oregon.

J. S. Diller and H. B. Patton, 1902, U.S. Geol. Survey Prof. Paper 3, p. 38, 49. Name applied to flow at Rugged Crest. Overlapped by Wineglass dacite flow (new). [See Sun Creek Dacite Flow.]

Rugged Crest is on north rim of Crater Lake.

**Ruin Granite**[1]

Precambrian: Central Arizona.

Original reference: F. L. Ransome, 1903, U.S. Geol. Survey Prof. Paper 12.

N. P. Peterson, 1954, U.S. Geol. Survey Geol. Quad. Map GQ–41. Mapped in Globe quadrangle. Typically a coarse-grained porphyritic quartz monzonite containing large phenocrysts of pale-pink orthoclase 1 to 3 inches long. Outcrops generally light brown and deeply weathered.

D. W. Peterson, 1960, U.S. Geol. Survey Geol. Quad. May GQ–128. Underlies much of northwestern part of Haunted Canyon quadrangle and occurs in scattered outcrops throughout remainder of northern half. Table 1 shows Ruin granite below Scanlan conglomerate of Apache group and above Pinal schist.

Occurs in Ruin Basin, Globe quadrangle.

**Rulo Limestone Member** (of Scranton Shale)[1]

Rulo Limestone (in Wabaunsee Group)

Pennsylvanian (Virgil Series): Southeastern Nebraska and eastern Kansas.

Original reference: G. E. Condra and N. A. Bengston, 1915, Nebraska Acad. Sci. Pub., v. 9, no. 2, p. 8, 14, 25.

R. C. Moore, 1936, Kansas Geol. Survey Bull. 22, p. 49 (fig. 11), 213. Rank raised to formation in Wabaunsee group. Term Scranton abandoned. Underlies Silver Lake shale; overlies Cedar Vale shale. Average thickness about 2 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 status in Scranton shale, here reintroduced as a formation with stratigraphic span as assigned to it by Haworth and Bennett (1908). Underlies Silver Lake shale member; overlies Cedar Vale shale member.

Type locality: Two and one-half miles north of Rulo, Richardson County, Nebr.

†Ruma Formation (in Chester Group)[1]

Ruma Formation (in Homberg Group)

Mississippian (Chester Series): Southwestern Illinois.

Original reference: S. Weller, 1913, Illinois Acad. Sci. Trans., v. 6, p. 120, 126.

J. M. Weller *in* Stuart Weller and 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), 833. In Randolph and Monroe Counties, mostly shale and locally attains thickness of 75 feet. Shales are variegated and contain reddish and purplish beds similar to some of Renault shales. Arenaceous strata, mainly thin-bedded and shaly sandstones, occur in middle part of formation and locally in upper part. Sandstone beds in midst of Ruma are undoubtedly equivalent to Cypress sandstone of standard section. Parts of underlying and overlying shaly strata may be equivalent to upper and lower parts of the Paint Creek and Golconda formations where the intervening Cypress sandstone is more typically developed. Overlies Paint Creek limestone; underlies Okaw limestone. Included in Homberg group (new).

Named for Ruma, Randolph County. Exposed in tributaries of Horse Creek.

Rumsy Ridge Sandstone Member (of Fish Creek Shale)

Rumsy Ridge Shale (in Medina Group)

Lower Silurian: Western New York, and southern Ontario, Canada.

D. W. Fisher, 1954, Am. Assoc. Petroleum Geologists Bull., v. 38, no. 9, p. 1988. Name proposed for fossiliferous light-bluish-gray calcareous sandstone. Occurs 6 feet above base of Fish Creek shale (new) in Niagara Gorge and closer to base at Lockport, N.Y.

D. W. Fisher, 1959, New York State Mus. Sci. Service Geol. Survey Map and Chart Ser. 1. Rank raised to formation to include green shales and thin interbedded gray siltstones lying above Whirlpool sandstone and beneath Cabot Head shale in Niagara Gorge. Locally underlies Grimsby sandstone. Replaces preoccupied name Fish Creek shale.

Named from populated part of Niagara Escarpment which overlooks village of Lewiston, Niagara County, N.Y.

Run Gap Red Sandstone Member (of Juniata Formation)

Ordovician: Central Pennsylvania.

F. M. Swartz, 1948, Pennsylvania Geologists Guidebook 14th Ann. Field Conf., supp., diagram (following p. 4), fig. 3. Incidental mention as red sandstone in upper part of Juniata. Underlies Tuscarora sandstone: overlies red siltstone and sandstone members of Juniata red beds.

F. M. Swartz, 1957, Pennsylvania State Univ., Dept. Geology Contr. 3, 58 p. At top of Juniata formation, in Tyrone Gap area, are thin red sandstones that appear to represent westerly extension of Run Gap red sandstone member that is about 250 feet thick and finely and sparingly conglomeratic at Run Gap. Overlies Plummer Hollow mudstone member (new); eastward from vicinity of Lost Creek Gap, overlies East Waterford red sandstone member (new). [Swartz refers to his 1955 report *in* Pennsylvania Geologists Guidebook 21st Ann. Field Conf. Compiler was unable to locate this reference.]

Extends from area of Jacks Mountain, north of Lewistown in Mifflin County, to area of Shade Mountain at Lost Creek Gap. Run Gap is located in Tuscarora Mountain along boundary of Juniata and Perry Counties.

Runningwater Formation

Miocene: Northeastern Nebraska and eastern Wyoming.

H. J. Cook, 1960, Internat. Geol. Cong. 21st, Copenhagen, pt. 12, p. 204 (section), 205. Name applied to deposits above lower stages of the Marsland (which were originally named Upper Harrison beds) and below Sheep Creek beds of Matthew and Cook. Generalized section shows the Runningwater below Sheep Creek group.

Name derived from local name of river on which deposits occur.

Runnymede Sandstone Member (of Ninnescah Shale)

Permian: South-central Kansas.

G. H. Norton, 1939, Am. Assoc. Petroleum Geologists Bull., v. 23, p. 1773–1774. Blue-green to gray shaly sandstone 7 to 8 feet thick, with intercalated layers of red shale and sandstone. Topmost bed of the Ninnescah at its northernmost outcrop.

Named from Runnymede, Harper County.

Rush Formation[1] (in Susquehanna Group)

Upper Devonian: Central Pennsylvania.

Original reference: Bradford Willard, 1935, Geol. Soc. America Bull., v. 46, no. 8, p. 1199.

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

H. H. Arndt and others, 1959, Geol. Soc. America Guidebook Pittsburgh Mtg., p. 3. Included in Susquehanna group. Comprises Burket shale member and Tully limestone member.

Named for Rush Township, Northumberland County.

Rush Member (of Tully Limestone)[1]

Upper Devonian: Central Pennsylvania.

Original reference: B. Willard, 1934, Pennsylvania Acad. Sci. Proc., v. 8, p. 57–62.

Exposed in roadcut east of small brook one-half mile from railway station at South Danville (Riverside), in Rush Township, Northumberland County.

**Rushford Sandstone[1]**

Rushford Member (of Canadaway Formation)

Rushford Sandstone (in Canadaway Group)

Upper Devonian: West-central New York.

Original reference: D. D. Luther, 1902, New York State Mus. Bull. 52, p. 619.

J. F. Pepper and Wallace de Witt, Jr., 1951, U.S. Geol. Survey Oil and Gas Inv. Chart OC–45. Overlies Caneadea member of Perryburg formation (new).

I. H. Tesmer, 1955, New York State Mus. Sci. Service Circ. 42, p. 10 (fig. 1), 17. Member of Canadaway formation. Overlies Caneadea member;

underlies "Machias" member of Canadaway. Upper boundary not well established.

L. V. Rickard, 1957, New York Geol. Assoc. Guidebook Ann. Mtg., p. 17 (table 2), 18. Listed as Rushford sandstone in Canadaway group. Overlies Caneadea shale; underlies "Machias" shale.

Well exposed in Caneadea Gorge, 3.3 miles east of Rushford, Allegany County.

Rush Run Sandstone (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. 191.

R. L. Nace and P. P. Bieber, 1958, West Virginia Geol. Survey Bull. 14, p. 17 (table 2). Listed in summary of stratigraphic sections of Dunkard group in Harrison County. Thickness about 25 feet. Top of unit about 495 feet above Waynesburg coal.

Thomas Arkle, Jr., 1959, Geol. Soc. America Guidebook Pittsburgh Mtg., p. 118 (table 1). In Greene series.

Named for Rush Run, which empties into Fish Creek, three-fourths mile southeast of Hundred, Wetzel County.

**Rush Springs Sandstone** or **Formation** (in Whitehorse Group)

Rush Springs Member (of Whitehorse Sandstone)[1]

Permian: Southwestern Oklahoma and north-central Texas.

Original reference: R. W. Sawyer, 1929, Oklahoma Geol. Survey Bull, 40-HH.

D. A. Green, 1936, Am. Assoc. Petroleum Geologists Bull., v. 20, no. 11, p. 1454, 1473. Rank raised to formation; unit has unconformity at base and top. Cloud Chief gypsum is grouped with the Quartermaster rather than with Rush Springs in the Whitehorse.

P. B. King, 1942, Am. Assoc. Petroleum Geologists Bull., v. 26, no. 4, pl. 2. Geographically extended into north-central Texas where it is given formational rank in Whitehorse group. Includes Dozier sandstone member (reallocated). Underlies Cloud Chief gypsum; overlies Marlow formation.

L. V. Davis, 1955, Oklahoma Geol. Survey Bull. 73, p. 68–75, pl. 1. In present report, the Rush Springs is classed as a formation in Whitehorse group. Conformably overlies Marlow formation; unconformably underlies Cloud Chief formation. Thickness 136 to 300 feet in Grady and Stephens Counties. Sawyer did not specify a type locality, but stated that his Rush Springs is the Whitehorse sandstone of Reeves (1921, U.S. Geol. Survey Bull. 726). Reeves mentioned a Whitehorse sandstone cliff which forms river bluffs 1 mile north of northeast corner of Tonkawa Township. This description places the locality in sec. 36, T. 7 N., R. 10 W., Caddo County, where almost the full thickness of formation from base upward is exposed and texture and bedding are typical. This location is considered acceptable as a type locality.

Type locality: Cliffs on river bluffs northeast of Tonkawa Township, sec. 36, T. 7 N., R. 10 W., Caddo County, Okla.

Rushville Group[1]

Rushville Shale Member (of Logan Formation)

Lower Mississippian: Central Ohio.

Original reference: E. B. Andrews, 1879, Am. Jour. Sci., 3d, v. 18, p. 137.

F. T. Holden, 1941, Illinois Acad. Sci. Trans., v. 34, no. 2, p. 172; 1942, Jour. Geology, v. 50, no. 1, p. 1, p. 41 (table 2), 60. Rushville shale member included in Pretty Run sandstone facies (new) of Logan formation. Overlies Vinton sandstone member; locally underlies Pennsylvanian sandstone. Lower Mississippian.

Probably named for Rushville near eastern border of Fairfield County.

Rusk Formation (in Trinity Group)

Cretaceous (Comanche Series): Subsurface in northeastern Texas and northern Louisiana.

J. M. Forgotson, Jr., 1956, Gulf Coast Assoc. Geol. Soc. Trans., v. 6, p. 92, 94 (chart); 1957, Am. Assoc. Petroleum Geologists Bull., v. 41, no. 10, p. 2332 (fig. 2), 2355–2357. Defined as those rocks and their stratigraphic equivalents below top of Glen Rose limestone as recognized in subsurface of northeastern Texas and above top of Ferry Lake anhydrite. In type well, occupies interval from 5,785 to 7,265 feet; consists of alternating beds of nonporous dense crystalline limestone, earthy limestone, and gray to black shale; contains thin stringers of anhydrite in basal part. Occupies stratigraphic interval termed upper Glen Rose formation and Paluxy formation. Revision of Trinity nomenclature by Shreveport Geological Society eliminated term "lower Glen Rose" as formational unit; term upper Glen Rose formation became orphaned and reference to it as Glen Rose formation became a misnomer since it was equivalent only to part of Glen Rose as defined on outcrop.

Type well: Skelly Oil Co.'s G. W. Weatherby Well 1, Williams McIlvane Survey, southwest Rusk County, Tex.

Russell Feldspathic Gabbro

Precambrian: Northeastern New York.

A. F. Buddington, 1939, Geol. Soc. America Mem. 7, p. 53–54, 260–267. Name applied to the gabbro in the Russell sheet. In area of this report, only northern half of mass was studied; here the east-northeast half consists of normal gabbro and the west-southwest half of a feldspathic gabbro; junction between the two is sharp.

North end of gabbro sheet lies about 3 miles south-southwest of Russell, Russell quadrangle, St. Lawrence County.

†Russell Formation[1]

Lower and Middle Cambrian: Southwestern Virginia and southeastern Kentucky.

Original reference: M. R. Campbell, 1894, U.S. Geol. Survey Geol. Atlas, Folio 12, p. 2.

Named for Russell County, Va.

†Russell Formation[1]

Upper Cretaceous: Central and western Kansas.

Original reference: F. W. Cragin, 1896, Colorado Coll. Studies, v. 6, p. 49.

Named for exposures at Russell, Russell County.

†Russell Slate

Upper Cambrian: Northwestern Vermont.

Charles Schuchert, 1937, Geol. Soc. America Bull., v. 48, no. 7, p. 1055. Local name; abandoned in favor of Hungerford slate (new).

Rudolf Ruedemann, 1947, Geol. Soc. America Mem. 19, p. 164, 165. Name Russell slate referred to in description of graptolites *Dictyonema schucherti* and *Dictyonema vermontense.*

A. B. Shaw, 1958, Geol. Soc. America Bull., v. 69, no. 5, p. 547. Ruedemann (1947) referred to this formation [Hungerford] as Russell slate, but name is not necessary and is probably not valid, for it was not defined.

Occurrence: Small road-metal quarry 1 mile northwest of Highgate Center, Franklin County.

Russell Creek Limestone Member (of Senora Formation)

Pennsylvanian (Des Moines Series): Northeastern Oklahoma, southeastern Kansas, and southwestern Missouri.

C. C. Branson, 1954, Oklahoma Acad. Sci. Proc., v. 33, p. 191 (table 1). Name applied to limestone that forms cap rock of the Mineral coal; underlies Broken Arrow coal.

C. C. Branson, 1955, The Hopper, v. 15, no. 12, p. 137. Ferruginous clayey carbonaceous gray limestone, 10 inches to 2 feet thick in one bed; contains fusulinids.

Type section: On Leep Farm on east bank of Russell Creek where it is flowing south in NE¼SW¼ sec. 15, T. 29 N., R. 20 E., Craig County, Okla.

Russellville Shale (in Atoka Formation)[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 Russellville, Pope County, Ark.

Russia Limestone Member (of Denmark Formation)

Middle Ordovician: Central New York.

G. M. Kay, 1943, Am. Jour. Sci., v. 241, no. 10, p. 598–601; 1953, New York State Mus. Bull. 347, p. 55–57. Defined at Trenton Falls as extending from top of Poland member (new) through 70 feet of shaly limestone to a local disconformity 2 feet below a ferruginous bed in base of Upper High Falls. Lower 50 feet lithologically similar to the Poland but relatively barren platy calcilutite and shale form upper 20 feet. Underlies Rust member (new) of Cobourg formation. Facies discussed.

Typically developed in Trenton Falls George along west line of Russia Township.

Rust Limestone Member (of Cobourg Formation)

Middle Ordovician (Mohawkian): East-central New York.

G. M. Kay, 1943, Am. Jour. Sci., v. 241, no. 10, p. 598, 601–602, 604. Name proposed for lower member of formation in Utica quadrangle and vicinity. Described as argillaceous and coquinal limestone. Slump breccias at Prospect Bridge occur near top. Thickness 115 feet. Underlies newly defined Steuben member; overlies newly defined Russia member of Denmark formation.

Marshall Kay, 1953, New York State Mus. Bull. 347, p. 59–61. Further described. Includes shaly limestone, conglomerate, calcilutite and shale in type section.

Type section: At Trenton Falls on West Canada Creek near Oneida-Herkimer County line. Named from Rust Farm in Herkimer County 1 mile east of type section.

**Rustler Formation[1] or Limestone[1]**

Permian (Ochoa Series): Western Texas and southeastern New Mexico.

Original reference: G. B. Richardson, 1904, Texas Univ. Min. Survey Bull. 9, p. 44.

L. R. Page and J. E. Adams, 1938, (abs.) Am. Assoc. Petroleum Geologists Bull., v. 22, no. 12, p. 1709; 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 1, p. 62–63. In eastern Midland basin, underlies Dewey Lake formation (new).

J. E. Adams, 1944, Am. Assoc. Petroleum Geologists Bull., v. 28, no. 11, p. 1612–1615. Lang (1938, New Mexico State Engineer 12th and 13th Bien. Rept.) measured section of Rustler in Eddy County, N. Mex. He divided section into 11 members (descending 1–11). Unit 2, a 30-foot gypsiferous dolomite is here named Magenta member; unit 6, a 35-foot dolomite is here named Culebra member. Overlies Salado formation; underlies Dewey Lake formation.

G. E. Hendrickson and R. S. Jones, 1952, New Mexico Bur. Mines Mineral Resources Ground-Water Rept. 3, p. 22–23. Formation described in Eddy County. Unconformably overlies Salado formation in most of area east of Pecos River and Castile formation and Whitehorse group or its equivalents west of Pecos. In northern part of county, overlies Chalk Bluff formation. Underlies red beds (Pierce Canyon red beds) and sandstones of Dockum group. Thickness 200 to 500 feet.

Named for exposures in Rustler Hills, Culberson County, Tex.

Rustler Canyon Basalt

Tertiary: Southwestern New Mexico.

W. E. Elston, 1957, New Mexico Bur. Mines Mineral Resources Bull. 38, p. 17 (table 1). Black vesicular basal or olivine andesite flows and flow breccias. Maximum thickness 50 feet. On west side of Box Canyon, a single amygdaloidal flow about 18 feet thick is separated from Box Canyon rhyolite (new) by covered zone about 55 feet thick. In one place, 15 feet of basalt breccia is exposed beneath flow which is covered by Piloncillo sediments (new). In one locality, occurs between Kneeling Nun and Caballo Blanco rhyolites.

Named after Rustler Canyon in northwest corner of Dwyer quadrangle. Confined to two localities: on west side of Box Canyon, for about one-quarter mile north of Box Well graben, and in secs. 20 and 21, T. 18 S., R. 11 W.

†Rustler Springs Formation[1]

Permian: Western Texas.

Original reference: J. A. Udden, 1915, Am. Jour. Sci., 4th, v. 40, p. 151–155.

Named for Rustler Springs, Culberson County.

Rusty beds[1]

Rusty zone (in Pierre Formation)

Upper Cretaceous: Central and eastern Colorado, central southern Montana, and central and northern Wyoming.

Original reference: C. W. Washburne, 1908, U.S. Geol. Survey Bull. 340, p. 350.

M. O. Griffitts, 1949, Am. Assoc. Petroleum Geologists Bull., v. 33, no. 12, p. 2012, 2014, 2015, 2017. Dane, Pierce, and Reeside (1937, U.S. Geol. Survey Prof. Paper 186–K) subdivided Pierre shale in Colorado and used Sharon Springs member for basal zone and informal terms (ascending) rusty zone, tepee zone, and transition zone for remainder of formation. These zone terms are recognized and used as formal stratigraphic terms in this report. Thickness of zone about 1,200 feet.

Rusty Beds Member (of Thermopolis Shale)

Lower Cretaceous: Central northern Wyoming.

Arthur Mirsky, 1960, Dissert. Abs., v. 21, no. 4, p. 850. Nonmarine section between marine Sundance formation (Late Jurassic) and definitely marine Thermopolis shale (Early Cretaceous) is divisible into four mappable units. Unit 4 (basal Thermopolis) is a black paper-thin shale, interbedded with thin lenticular tan cross-laminated siltstone and fine-grained sandstone. It has been informally known as "Rusty Beds" for a long time, and term is ingrained in the literature. Unit has been placed in uppermost Cloverly or lowermost Thermopolis by previous investigators. It is here proposed that it be formally named Rusty Beds member of the Thermopolis.

Area of report is southern Big Horn Mountains.

†Ruth Limestone[1]

Pennsylvanian: Eastern Nevada.

Original reference: A. C. Lawson, 1906, California Univ. Pub., Bull. Dept. Geology, v. 4, no. 14, p. 292.

Named for Ruth mine, Robinson mining district, Egan Range, White Pine County.

**Rutland Dolomite**[1]

Lower Cambrian: Southwestern and west-central Vermont and northwestern Massachusetts.

Original reference: J. E. Wolff, 1891, Geol. Soc. America Bull., v. 2, p. 331–338.

E. C. Jacobs, [1937], Vermont State Geologist 20th Rept., p. 71, 98–100. Geographically extended into northwestern Massachusetts.

Named for exposures in valley in vicinity of Rutland, Vt.

†Rutledge Limestone (in Midway Group)[1]

Eocene, lower: Southern Alabama.

Original reference: E. A. Smith, 1892, Sketch of geology of Alabama: Birmingham, Ala., Roberts & Son, pamph. of 36 p.

Probably named for exposures at Rutledge, Crenshaw County.

**Rutledge Limestone**[1] or **Dolomite** (in Conasauga Group)

Middle Cambrian: Northeastern Tennessee, western North Carolina, and southwestern Virginia.

Original reference: A. Keith, 1896, U.S. Geol. Survey Geol. Atlas, Folio 27, p. 2.

John Rodgers and D. F. Kent, 1948, Tennessee Div. Geology Bull. 55, p. 7, 9–10. In Lee Valley, Hawkins County, Tenn., Ruthledge Limestone overlies Pumpkin Valley shale (new); underlies Rogersville shale. Thickness 320 feet.

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 Mountain) the Conasauga is considered a group consisting of six formations of which the Rutledge is second in sequence (ascending). Overlies Pumpkin Valley shale; underlies Rogersville shale. Thickness 100 to 500 feet.

Named for exposures in valley of Rutledge, Grainger County, Tenn.

Ryan Formation

Tertiary: Southeastern California.

D. I. Axelrod, 1940, Jour. Geology, v. 48, no. 5, p. 528. Unconformably overlies Furnace Creek formation (new). Furnace Creek is Miocene or Pliocene. Name credited to H. D. Curry.

In Furnace Creek Wash area, central Death Valley region.

Ryan Sandstone[1]

Pennsylvanian: Central southern Oklahoma.

Original reference: J. R. Bunn, 1930, Oklahoma Geol. Survey Bull. 40PP, p. 10.

Typically exposed in scarps southeast and northwest of Ryan, Jefferson County.

Ryans Ford Limestone (in McLeansboro Formation)[1]

Pennsylvanian: Central eastern Illinois.

Original reference: J. E. Lamar and H. B. Willman, 1934, Illinois Geol. Survey Bull. 61, p. 129–138.

Coles and Cumberland Counties.

**Rye Formation**

Rye Gneiss[1]

Probably Ordovician and Silurian: Southeastern New Hampshire and southwestern Maine.

Original reference: Alfred Wandke, 1922, Am. Jour. Sci., 5th ser., v. 4, p. 141, 143–144.

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. 23, 24, 29, 44. Includes an upper metavolcanic member, fine-grained biotite gneiss and amphibolite, and a lower metasedimentary member, feldspathic mica schist. Latter represents several metamorphic zones. Thickness about 4,000 feet. Conformably underlies Merrimack group. Paleozoic, probably Silurian and perhaps Ordovician also.

M. P. Billings, 1956, Geology of New Hampshire, pt. 2, Bedrock geology: Concord, New Hampshire State, Plan. Devel. Comm., p. 38–39. Ordovician(?).

U.S. Geological Survey currently designates the age of the Rye Formation as probably Ordovician and Silurian on the basis of a study now in progress.

Named for development in Rye Township, Rockingham County, N.H.

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Ryegate Granite[1] or Granodiorite

Upper Devonian(?): Northeastern Vermont.

Original reference: E. J. Foyles and C. H. Richardson, 1929, Vermont State Geologist 16th Rept., table facing p. 288.

W. S. White and M. P. Billings, 1951, Geol. Soc. America Bull., v. 62, no. 6, p. 662, 665–667, pl. 1. Medium- to coarse-grained light-gray quartz monzonite, granodiorite, and quartz diorite. Granodiorite most abundant type; porphyritic in vicinity of Blue Mountain. Some foliation present. Forms complex of small plutons. Assigned to New Hampshire magma series.

Named for quarry in northeastern part of Ryegate Township, Caledonia County. Occurs in two general areas, Blue Mountain and Groton, in vicinity of Ryegate in Vermont part of Woodsville quadrangle, Vermont-New Hampshire.

Rye Point Member (of Cashaqua Formation)

Upper Devonian: Western New York.

R. G. Sutton, 1960, New York State Mus. Sci. Service Bull. 380, p. 17–18, 53, 55, figs. 2, 5. Proposed for fossiliferous gray calcareous shales that overlie Rock Stream member. Includes red and green nodular limestone bed known as Parrish limestone lentil (Clarke and Luther, 1904). Thickness 15 to 113 feet; thins eastward and disappears in Ithaca region. Underlies Rhinestreet black shale.

Type locality: Small stream on east side Keuka Lake, 3 miles northeast of Hammondsport and 1½ miles northeast of Rye Point, Steuben County.

Rykert Granite[1]

Jurassic(?): Northern Idaho and Washington, and British Columbia, Canada.

Original reference: R. A. Daly, 1912, Canada Dept. Mines Mus. Mem. 38, p. 284.

**Rysedorph Conglomerate**[1]

Middle Ordovician: Eastern New York.

Original reference: R. Ruedemann, 1901, New York State Mus. Bull. 42; 1901, New York State Mus. Bull. 49.

G. M. Kay, 1937, Geol. Soc. America Bull., v. 48, no. 2, p. 276–277. Discussed under heading of formations of Sherman Fall age, Trenton group.

P. H. Osberg, 1952, Vermont Geol. Survey Bull. 5, p. 116 (fig. 16), 119. Correlation chart for Vermont shows Rysedorph conglomerate in Taconic sequence below Tackawasick limestone and above Normanskill formation. May represent the horizon of Middle Ordovician unconformity.

Also referred to as Rysedorph Hill Conglomerate.

Named for occurrence in Rysedorph [Rysedorf] Hill (locally called Pinnacle or Sugar Loaf Hill), 2 miles southeast of Rensselaer, across river from Albany.

Saanich Formation[1] or glacial deposits

Pleistocene: Western Oregon and northwestern Washington, and British Columbia, Canada.

Original reference: R. Arnold and H. Hannibal, 1913, Am. Phil. Soc. Proc., v. 52, p. 565–595.

C. E. Weaver, 1937, Washington [State] Univ. Pubs. in Geology, v. 4, p. 24 (table). Described as formation consisting of post-glacial marine terrace deposits exposed in Puget Sound area together with poorly consolidated clays, sands, and gravels along the coast of Oregon and Washington.

Probably named for occurrences north of Victoria and Saanich Peninsula, Vancouver Island.

Saavedra Member (of Lowell Formation)

Lower Cretaceous: Southeastern Arizona.

A. A. Stoyanow, 1949, Geol. Soc. America Mem. 38, p. 11, 15–16, pl. 27. Consists of following units (ascending): detritus, white sandstone, light-brown sandstone, gray arenaceous limestone, Barata limestone (new), buff sandstone, Arkill limestone (new), soft white sandstone, yellow limestone, Chapparal sandstone (new), light-colored shales and sandstones, dense gray limestone, green shale, argillaceous limsetone, shale, light-brown sandstone, and calcareous sandstone. Thickness 218 feet. Underlies unnamed limestone and sandstone division; overlies Joserita member (new).

In standard section of Lowell formation in the 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.

Sabana Grande Andesite (in Mayagüez Group)

Sabana Grande Formation

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. 329, 330, 338–339, pl. 1. Sabana Grande andesite was defined by Slodowski (unpub. thesis) as Sabana Grande formation. The mudstone in Sabana Grande of Slodowski is correlated with the Yauco mudstone in area of this report [Mayagüez]. Unit is composed of andesite breccia, flow breccia, and tuff, with minor basalt lava; lateral changes of texture and lithology common. No fossils identified; from its position between Parguera (new) and Yauco formation, the Sabana Grande can be dated as Turonian to Campanian.

T. R. Slodowski, 1958, Dissert. Abs., v. 18, no. 1, p. 200. In Yauco area, a complex, more than 9,000 meters thick, of volcanic flows with interbedded marine limestones, mudstones, tuffs, and sedimentary rocks derived from the volcanic rocks, is divided into eight formations: Sabana Grande, El Rayo (new), Ensenada, Río Yauco, Río Loco, Río Blanco, San Germán, and Jicara (new). Sabana Grande and El Rayo formations unconformably underlie Ensenada and Río Yauco formations. Complex ranges in age from Senonian to late Paleocene, possible Eocene.

Largest exposures are on routes 348 and 119 connecting Mayagüez, Rosario, and San Germán.

Sabanita (Sabanitas) Formation

(?) Miocene, middle: Panamá.

[T. F. Thompson], 1943, Panama Canal Spec. Eng. Div., 3d Locks Proj., pt. 2, chap. 5, p. 7. Continental gravels, tuffs, and clays. Masks the contact of Gatún formation with basement complex.

S. M. Jones, 1950, Geol. Soc. America Bull., v. 61, no. 9, p. 906, 920. Considered middle Miocene(?) continental facies of basal part of Gatún formation. Typically a tuff-conglomerate unconformably overlying pre-Tertiary basement complex. Over wide exposures, weathering has altered it to a weathered ash and gravel. Unsorted and massive in type exposure.

Type exposure: Along Boyd-Roosevelt Highway northeast of Sabanitas, vicinity of Gatún Lake.

Sabattus Formation

Sabattus Garnet Schist (in Tacoma Series)

Sabattus Shale

Silurian: Southwestern Maine.

L. W. Fisher, 1936, Am. Mineralogist, v. 21, no. 5, p. 323. Listed in table of formations as garnet schist. Uppermost unit in Tacoma series (new). Older than post-Silurian pegmatites, aplites, and granites; younger than Minwah limy gneiss (new).

L. W. Fisher, 1937, (abs.) Geol. Soc. America Proc. 1936, p. 71. In Lewiston area are seven formations (ascending): Danville injection gneiss (new), Androscoggin gneiss, Bates crystalline limestone, Deer Rips lime-silicate gneiss (new), Thorncrag biotite-sillimanite gneiss, Tacoma lime-silicate series, and Sabbatus quartz-sillimanite-biotite schist.

L. W. Fisher, 1941, Geol. Soc. America Bull., v. 52, no. 1, p. 125–130, pl. 1, table 1 (facing p. 112). Described as a formation consisting of quartz-mica schist with garnet and sillimanite and marble lenses. Only quartz-muscovite-sillimanite schist can be traced for considerable distance. Thickness 3,000 feet. Conformably overlies Androscoggin formation. Silurian. Type locality described.

R. L. Miller, 1945, Maine Geol. Survey Bull. 2, p. 9. Referred to as shale.

Type locality: Outcrops on or near Sabattus Mountain for which it is named. Crops out in area extending from Lewiston to Waterville.

Sabetha 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. 232, 234.

Named for exposures on Omaha-Tulsa Highway, 1 mile north of Sabetha, Nemaha County, Kans.

†Sabine Formation[1] or Group

Sabine Stage

Eocene, lower: Eastern Texas, Alabama, Arkansas, and Louisiana.

Original references: A. C. Veatch, 1905, Louisiana Geol. Survey Bull. 1. pt. 2, Rept. 1905, p. 84, 85, 88, Letter of transmittal of Louisiana Director to Governor dated Dec. 9, 1904; U.S. Geol. Survey Water-Supply Paper 114, on Louisiana and southern Arkansas, p. 180, 184–185, ms. sent to Govt. Ptg. Office, Aug. 2, 1904.

W. D. Chawner, 1936, Louisiana Dept. Conserv., Geol. Bull. 9, p. 54–64. Sabine group in Louisiana crops out over broad area in northwestern part of State where it is brought to surface by Sabine uplift. History of usage of term discussed. [Most of usage of term Sabine group in Louisiana is in reports dealing with subsurface stratigraphy.]

G. E. Murray, 1955, Am. Assoc. Petroleum Geologists Bull., v. 39, no. 5, p. 687. Term Sabine stage recommended as time-rock term for post-Midwayan and pre-Claibornian deposits of Coastal Plain province. This is similar to original usage of Veatch (1905, 1906). As such, it is synonymous with Wilcox group used as a time-rock term. Stage includes all deposits in Gulf and Atlantic Coast province formed during the stand of early Eocene sea, beginning with initial deposition of widespread *Ostrea thirsae-Ostrea multilirata*-containing beds of East Texas, Louisiana, Mississippi, and Alabama, and their equivalents, and ending up with initial invasion of Claibornian sea. Sabine age includes all time involved in deposition of these deposits. Includes at least two substages based on cyclic alternations of regional nature.

G. G. Varvaro, 1957, Louisiana Dept. Conserv., Geol. Bull. 31, p. 63–64, pl. 4. Term Sabine stage used in discussion of subsurface stratigraphy in Evangeline and St. Landry Parishes. Includes Wilcox group.

Formation named for typical fossiliferous development on Sabine River in Sabine County, Tex., and Sabine Parish, La., and from exposures at Sabinetown Bluff.

†Sabine River Beds[1]

Eocene: Eastern Texas.

Original reference: E. T. Dumble and R. A. F. Penrose, Jr., 1890, Texas Geol. Survey 1st Ann. Rept., p. xxxvi, 17, 22, pl. 3.

Named for Sabine River.

Sabinetown Formation (in Wilcox Group)[1]

Eocene, lower: Eastern Texas.

Original reference: F. B. Plummer, 1933, Texas Univ. Bull. 3232, p. 530, 574, 601, 634.

W. M. Cowan, 1942, Texas Univ. Bur. Econ. Geology Mineral Resources Survey Circ. 51, p. 2. In Wilson County, overlies Rockdale formation and underlies Carrizo sand.

G. E. Murray, Jr., and E. P. Thomas, 1945, Am. Assoc. Petroleum Geologists Bull., v. 29, no. 1, p. 47 (fig. 1), 56, 63–64. In original definition, Plummer included both the beds at Pendleton Ferry and those at Sabinetown in Sabinetown formation. Term Sabinetown is herein restricted to those beds lying above High Bluff member of Pendleton formation and below Carrizo sand. Includes Pearson glauconite member at base, and an upper member that consists of silty, laminated, lignitic shale with glauconitic crossbedded fine-grained sand. Thickness about 52 feet. Note on type locality.

Type locality: Bluff on Texas side of Sabine River about one-fourth mile below old ferry landing. Named from village of Sabinetown, Sabine County, Tex.

Sabula dolomite[1]

Silurian (Niagaran): Central eastern Iowa.

Original reference: C. R. Keyes, 1912, Iowa Acad. Sci. Proc., v. 19, p. 149, 150.

Named for Sabula, or Sabula Junction, Jackson County.

Sac Limestone[1]

Lower Ordovician (Beekmantown): Southwestern Missouri.

Original reference: E. M. Shepard, 1898, Missouri Geol. Survey, v. 12, pt. 1, p. 49, 74–77.

Named for outcrops on Sac River, Greene County.

Sacajawea Formation[1] (in Montchauve Group)

Mississippian: Wyoming and Montana.

Original reference: C. C. Branson, 1936, Geol. Soc. America Proc. 1935, p. 391.

C. C. Branson, 1937, Jour. Paleontology, v. 11, no. 8, p. 650–660. Lower part of Amsden is Mississippian in age and is here described and named Sacajawea formation to separate it from upper part of Amsden (Pennsylvanian). At type section, formation (units 14 and 15 of measured section) consists of basal unit, 2 to 11 feet thick, of red and buff sandstone and shaly sandstone, breccia in places, shale cave filling in places; and upper unit, 43 feet thick, of massive crystalline light-gray cherty limestone, with Ste. Genevieve fauna in lower 20 feet. Beds 10 to 13 (possibly Chester in age) in section are set off by unconformity above and are possibly separated from Sacajawea by unconformity below; these beds may be added to the Sacajawea if favoring evidence appears. Disconformable on Madison limestone. Fauna described.

C. C. Branson, 1939, Geol. Soc. America Bull., v. 50 no. 1, p. 1203, 1204, 1211, 1212. Measured sections show Sacajawea formation underlies Tensleep formation (redefined); locally separated from the Tensleep by limestone interval referred to as beds of Chester(?) age.

E. B. Branson and C. C. Branson, 1941, Am. Assoc. Petroleum Geologists Bull., v. 25, no. 1, p. 126 (fig. 2), 130–131. Columnar section of formations exposed in and near Wind River Mountains shows Sacajawea formation, 100 to 200 feet thick, above Madison formation and below the Tensleep. Text states that on Bull Lake Creek 60 feet of laminated limestone without fossils lies with irregular contact on the Sacajawea and is overlain disconformably above. This sequence may constitute another formation, possibly of Chester age. Term Amsden not used in area of this report.

W. F. Scott and P. C. Wilson, 1953, (abs.) Geol. Soc. America Bull., v. 64, no. 12, pt. 2, p. 1554. Distinctive red-bed sequence, usually considered basal part of Amsden formation, constitutes persistent lithostratigraphic unit over much of Montana and Wyoming. In most areas, this unit rests disconformably upon Madison limestone. In central Montana, it overlies Heath formation of Big Snowy group. Underlies typical Amsden carbonates except in western Montana, where Amsden is absent and unit underlies Quadrant quartzite, and in eastern Wyoming, where Amsden lithologies have not been separated from the Hartville and Minnelusa. Thicknesses vary, without apparent pattern, from 5 feet in central Wyoming to 230 feet in Big Snowy Mountains. Name Sacajawea, which has been applied to Mississippian part of the Amsden in northwestern Wyoming, should be restricted vertically to include only the red beds, and extended laterally throughout area where these beds are recognizable. Term Amsden should be retained for the limestone and dolomites between the Sacajawea (restricted) and the typical sandstones of the Tensleep or its equivalents.

J. D. Love, 1954, Tentative diagrammatic correlation of Tensleep, Amsden, Casper, and Hartville formations in Wyoming *in* Wyoming Geol. Assoc. Guidebook 9th Ann. Field Conf. [chart in pocket]. Correlation chart shows that Sacajawea formation at type locality extended upward to base of Darwin sandstone member of Amsden formation.

A. B. Shaw and W. G. Bell, 1955, Am. Assoc. Petroleum Geologists Bull., v. 39, no. 3, p. 333–337. Discussion of age of Amsden formation on basis of new collection of fossils made at Cherry Creek, Wind River Mountains, Wyo. Use of name Sacajawea formation at Cherry Creek is not justifiable because Mississippian beds in this area do not constitute a mappable unit under present standards; in this the writers [Shaw and Bell] disagree with Branson (1937). Possibly such terms as Sacajawea fauna or Sacajawea beds used in colloquial sense, may be applicable.

A. B. Shaw, 1955, Wyoming Geol. Assoc. Guidebook 10th Ann. Field Conf., p. 60, 61 (fig. 1), 62. As originally defined the Sacajawea did not include all of the Amsden below the Darwin sandstone, but only the *Spirifer welleri* zone. Love (1954) extended type section upward to include all post-Madison and pre-Darwin rocks; this makes the Sacajawea an objectively recognizable lithologic unit rather than a named faunal zone, but it may not serve the original purpose of separating the *Spirifer welleri* zone from overlying Pennsylvanian rocks. Whichever designation of the Sacajawea is used, the beds so designated contain in their lower part a large and distinctive fauna which Shaw and Bell (1955) regarded as Chesteran.

J. W. Strickland, 1956, Wyoming Geol. Assoc. Guidebook 11th Ann. Field Conf., p. 51, 53. Term Sacajawea should be adopted throughout western Wyoming for strata of Chester age below the Darwin and above top of Madison group.

C. A. Burk, 1956, Stratigraphic summary of the pre-Niobrara formations of Wyoming, *in* Wyoming stratigraphy, pt. 1, Subsurface stratigraphy of the pre-Niobrara formations in Wyoming, Casper, Wyoming: Wyoming Geol. Assoc., p. 92. Suggests name be abandoned.

J. W. Strickland, 1957, Wyoming Geol. Assoc. Guidebook 12th Ann. Field Conf., p. 20, 21, 23–25. Sacajawea problem discussed. Confusion in interpretation and usage of term Sacajawea believed to have arisen largely as a result of original miscorrelation of type Sacajawea with Cherry Creek section and failure of most workers, including writer [Strickland], to recognize it. Believed that term Sacajawea should be used only for upper member of Upper Madison but should include the thin-bedded limestone and dolomites directly underlying Darwin sandstone and above the "massive crystalline limestone" of Branson (1937). This conclusion seems warranted on the basis of lithologic similarity with beds in unquestionable Madison strata and comment by Branson that beds referred to as Lower Amsden formation may be added to the Sacajawea if favoring evidence appears. This conclusion differs from those of earlier workers including the writer's (Strickland, 1956) who considered the term Sacajawea interchangeable with beds referred to as Lower Amsden. Type section described. Type Sacajawea as originally defined embraces only lower 50 feet or so of an 80- to 100-foot sequence of strata between the Darwin sandstone and typical looking Madison limestone.

T. W. Todd, 1959, Dissert. Abs., v. 20, no. 6, p. 2230–2231. Sacajawea formation, Amsden formation, and Tensleep sandstone are products of marine transgressive-regressive cycle that took place on Wyoming cratonic shelf during Pennsylvanian period as one phase in development of eastern Cordilleran geosyncline. Name Montchauve group is suggested for these formations.

D. O. Peterson, 1960, Dissert. Abs., v. 20, no. 7, p. 2757. Discussion of stratigraphy of Pennsylvanian in northeastern Utah, western Wyoming, northwestern Colorado, and southeastern Idaho. Suggested that Quadrant and Casper formational names be abandoned and the Tensleep-Amsden-Sacajawea terminology be extended to include strata formerly referred to by these names and that term Sacajawea be accepted as formational name applicable to the red clastic sequence between Madison limestone or equivalent and Amsden carbonates.

Type locality (Strickland, 1957): In SE¼NW¼NE¼ sec. 11, T. 2 N., R. 4 W., along hogbacks in middle of valley above Bull Lake, Wind River Mountains, Wyo. Name derived from Mount Sacajawea at head of Bull Lake Creek. A store and inn of that name are on Yellowstone Park Highway near mouth of Bull Lake Creek. Word is Shoshone name of Bird Woman, guide of the Lewis and Clark expedition.

Sacandaga Quartzite[1]

Precambrian: Northern New York.

Original reference: H. L. Alling, 1918, New York State Mus. Bull. 199, p. 94, 121.

Type locality: Sacandaga River, Sacandaga mine, Day Township, Saratoga County.

Sacator Quartz Diorite

Paleozoic(?) or Mesozoic(?): Southern California.

W. J. Miller and R. W. Webb, 1940, California Jour. Mines and Geology, v. 36, p. 354–355, 356, 378 (fig. 31), pl. 2. Quartz-diorite varying to diorite, dark-colored and even-grained. Intrudes the Summit gabbro.

W. J. Miller, 1946, Geol. Soc. America Bull., v. 57, no. 5, p. 512. Noted as cutting both Kernville series and Summit gabbro.

Named from exposures in Sacatar Canyon in northeastern part of Kernville quadrangle, Kern County.

Sacate Formation

Eocene, middle or upper: Southern California.

F. R. Kelley, 1943, Am. Assoc. Petroleum Geologists Bull., v. 27, no. 1, p. 3 (fig. 2), 4 (fig. 3), 10–11. Succession of sandstones and interbedded silty and shaly strata. Thickness about 875 feet. Formation varies laterally. In Sacate Canyon, three well-defined massive sandstones crop out and are separated by sandy shales. These sandstones lose their identity toward the east and west. Conformably underlies Gaviota formation; conformably overlies Cozy Dell formation. Sandstone has been called "Coldwater" since evidence indicated it to be the probable equivalent of the Coldwater sandstone of the Ventura region.

T. W. Dibblee, Jr., 1950, California Div. Mines Bull. 150, p. 28–29, 38 (fig. 2). Thickness given as 1,000 to 1,500 feet. Overlies Cozy Dell; underlies Gaviota; upper and lower contacts gradational. Upper Eocene.

Type locality: Sacate Canyon, western Santa Ynez Mountains, Santa Barbara County.

Sacchi Beach Beds

*See* **McIntosh Formation.**

Sacfox Subgroup[1] (of Wabaunsee Group)

Pennsylvanian (Virgil Series) : Southeastern Nebraska, southwestern Iowa, eastern Kansas, and northwestern Missouri.

Original reference: G. E. Condra, 1935, Nebraska Geol. Survey Paper 8, p. 4, 5, 10–11.

R. C. Moore, 1948, Am. Assoc. Petroleum Geologists Bull., v. 32, no. 8, p. 2036, 2037 (fig. 6) ; Kansas Geol. Survey Bull. 83, p. 169–171; G. E. Condra, 1949, Nebraska Geol. Survey Bull. 16, p. 18–20; F. C. Greene and W. V. Searight, 1949, Missouri Geol. Survey and Water Resources Rept. Inv. 11, p. 19–20. The subgroups named (ascending) Sacfox, Nemaha, and Richardson by Condra (1935) have been included in the interstate classification agreed to by the Geological Surveys of Iowa, Kansas, Missouri, Nebraska, and Oklahoma. As thus defined, the Sacfox subgroup in standard section includes (ascending) Severy shale, Howard formation, White Cloud shale, Happy Hollow limestone, Cedar Vale shale, Rulo limestone, and Silver Lake shale. Nomenclature in the several States may deviate from this by combination or omission of terms where certain named rock units are not recognizable.

Type locality: In Missouri River bluffs in southeastern Richardson County, Nebr., and adjacent part of northeastern Kansas, that is, between southeast of Rulo, Nebr., and White Cloud, Kans. Name derived from the Iowa-Sac-Fox Indian Reservation in northeastern Kansas and southeastern Nebraska.

Sachuest Arkose[1]

Carboniferous: Southeastern Rhode Island.

Original reference: A. F. Foerste, 1899, U.S. Geol. Survey Mon. 33, p. 284–288, 379.

Composes west and south shores of Sachuest Neck, north shore at Flint Point, and a small exposure offshore at a headland one-fourth mile south of Flint Point, Newport County.

†Sacramento Formation[1]

Middle Devonian: Northern California.

Original reference: J. P. Smith, 1894, Jour. Geology, v. 2, p. 591, 592.

In Sacramento Canyon, Redding region.

**Sacramento Porphyry** or **Porphyrite**[1] (in Gray Porphyry Group)

Tertiary, lower: 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, cross-section sheet; 1886, U.S. Geol. Survey Mon. 12, p. 81.

C. H. Behre, Jr., 1953, U.S. Geol. Survey Prof. Paper 235, p. 50–52, 57, pl. 1. Distinguished from similar rocks of Gray porphyry group by following megascopic features: coarser and less equigranular than Evans Gulch porphyry; lacks large orthoclase phenocrysts such as are common in Johnson Gulch porphyry; relative abundance of ferromagnesian minerals and relatively small proportion of orthoclase phenocrysts and euhedral quartz distinguish it from typical Lincoln porphyry. 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, 1956, U.S. Geol. Survey Mineral Inv. Field Studies Map MF–34. Mapped as early Tertiary in Tennessee Pass area, Eagle and Lake Counties, where it consists of gray, greenish-gray, or dark-orange-buff quartz monzonite porphyry characterized by abundant stout feldspar phenocrysts, predominantly plagioclase in most bodies but mostly orthoclase in some, and by abundant biotite flakes. Considered younger than Elk Mountain porphyry because some faults that offset bodies of Elk Mountain do not appear to run through the Sacramento.

Named for occurrence under Gemini Peaks, between heads of Big and Little Sacramento Gulches, vicinity of Leadville, Lake County.

Sacramento Tuff and Sand 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 is subdivided into five members. Sacramento tuff and sand is youngest in sequence. Overlies Iron Canyon agglomerate member.

Occurs at Iron Canyon dam site near Red Bluff, Tehama County.

Sacramento Hill Porphyry

Lower Cretaceous: Southeastern Arizona.

W. G. Hogue and E. D. Wilson, 1950, Arizona Bur. Mines Bull. 156, Geol. Ser. 18, p. 21. Porphyry, ranging from granitic to monzonitic in composition. Forms numerous dikes and sills and Sacramento Hill stock. Intruded Paleozoic and older rocks.

G. W. Bain, 1952, Econ. Geology, v. 47, no. 3, p. 305, 306, 308. Described as quartz porphyry. Appears to have been intruded before deposition of Lower Cretaceous strata. If porphyry is later than Dividend fault and older than Glance conglomerate, then it is of very early Lower Cretaceous age.

Forms the stock of Sacramento Hill in Bisbee or Warren district, Cochise County.

Sacred Heart Granite (in Minnesota Valley Granite Series)

Precambrian: Southwestern Minnesota.

E. H. Lund, 1956, Geol. Soc. America Bull., v. 67, no. 11, p. 1482, 1483–1484. Massive, medium-grained, pinkish-gray to red granite. Inclusions common but concentrated in swarms, rather than being everywhere present as in Morton gneiss. Inclusions commonly a few feet or less across but some measure more than 100 feet across. Appears to be younger than nearby Morton gneiss but age relationship not certain. May represent younger phase of magma that produced Morton gneiss and Fort Ridgely granite (new).

Crops out in vicinity of Sacred Heart, Renville County.

**Saddle Gneiss**

Precambrian: Southwestern Virginia.

A. J. Stose and G. W. Stose, 1946, Maryland Dept. Geology, Mines and Water Resources Carrol and Frederick Counties Rept., p. 17, 18. Oldest rock of the injection complex, a highly metamorphosed biotite gneiss with layers of biotite schist and quartzite. Intruded by Cattron diorite (new).

A. J. Stose and G. W. Stose, 1957, Virginia Geol. Survey Bull. 72, p. 22–25, pl. 1. Comprises quartzite, biotite, schist, gneiss and garnetiferous facies with and without sillimanite. Quartzite in places contains graphite. Individual layers of these rocks, nowhere more than few feet thick, alternate with each other in every outcrop to such an extent that different kinds of rock could not be mapped separately. No sequence in the rock determined. Garnetiferous biotite gneiss is medium-to fine-grained banded rock composed of fine quartz grains, grayish-green feldspar, and bronze biotite flakes. Highly garnetiferous variety occurs 1 mile east of Cattrons Mill. Quartzite abundant in Saddle gneiss in several narrow zones which lie north of and along U.S. Route 58 from Baxter Ferry on New River southwestward to Independence. Quartzite that is interlayered with biotite gneiss is found chiefly in belt northwest of Fries overthrust and south of Striped Rock granite and north of Elk Creek village. Oldest known rocks of district. Derivation of name given.

Named from Saddle Creek in southwestern part of Gossan Lead district, Grayson County. Well exposed at intersection of Saddle Creek and U.S. Route 58. Best exposures at several places along U.S. Route 58 on State Highway 95, and on U.S. Route 21 south of its junction with State Highway 95.

**Saddleback Basalt** (in Tropico Group)

Saddleback Basalt (in Ricardo Formation)

Pliocene(?): Southern California.

H. S. Gale, 1946, California Jour. Mines and Geology, v. 42, no. 4, p. 326, 339, 346–350. Name applied to basaltic lavas which form base on which borate-bearing lake beds (Kramer Lake beds) rest. They rise in dip slope outcrops around northern borders of basin where borates occur. Flows vary in thickness from 600 feet maximum to where they pinch out and disappear in an area along the southern border of the basin. Present in Ricardo formation only in Kramer borate district.

T. W. Dibblee, Jr., 1958, Am. Assoc. Petroleum Geologists Bull., v. 42, no. 1, p. 137 (fig. 1), 138 (fig. 2), 142. Redefined as local formation in Tropico group (new). At type section, rests on quartz monzonite but elsewhere rests with probable slight unconformity on lower part of Tropico group. In Kramer borate district, these underlying rocks were referred to as Rosamond formation by Gale (1946). The Saddleback is overlain unconformably by the borate-bearing shale of upper part of Tropico in Kramer district in the borate mines and unconformably by fanglomerate of probable Pleistocene age at the surface. Pliocene(?). Type locality designated.

Type locality: Saddleback Mountain in S¼ sec. 9, T. 11 N., R. 7 W., 4 miles north of Boron, Boron quadrangle, San Bernardino County. From Saddleback Mountain, basalt crops out as scattered exposures in low isolated hills toward northwest for 6 miles, and west about 10 miles.

Saddlebag 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. 1033–1034. Basal conglomerate composed almost entirely of greenstone fragments in a schistose matrix of greenstone debris. Unconformably underlies Dike Lake slate (new); unconformably overlies Ely greenstone. Name credited to V. G. Sleight. [Fig. 4 shows Moose Lake conglomerate occupying stratigraphic position assigned to Saddlebag Lake conglomerate in text.]

Named for exposure on shores of Saddlebag Lake in sec. 13, T. 65 N., R. 6 W., in Vermilion district.

Saddle Bayou Lentil (in Verda Member of Yazoo Clay)

Eocene (Jackson): Central Louisiana.

H. N. Fisk, 1938, Louisiana Dept. Conserv., Geol. Bull. 10, p. 78 (fig. 6), 102–103. Series of massive fossiliferous sands averaging 20 feet in thickness. Sands are medium grained, well rounded, poorly indurated, and locally cemented by limonite. Lentil grades downward and interfingers laterally with typical Verda lignitic clays; grades laterally, eastward, into a series of unnamed sandy shales.

Exposed in cuts along a secondary road crossing a tributary of Saddle Bayou in the NW¼ sec. 20, T. 9 N., R. 2 W., Grant Parish.

**Saddle Creek Limestone Member** (of Pueblo Formation)

Saddle Creek Formation (in Pueblo Group)

Saddle Creek Limestone Member (of Harpersville Formation) [1]

Permian: Central and central northern Texas.

Original reference: N. F. Drake, 1893, Texas Geol. Survey 4th Ann. Rept., pt. 1, p. 387, 416.

M. G. Cheney, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 1, p. 66 (fig. 1), 91. Rank raised to formation and reallocated to the Pueblo here redefined, given group status and assigned to the Permian. Underlies Stockwether formation. Redefined Pennsylvanian-Permian boundary is placed at disconformity in Harpersville formation above Waldrip-Newcastle coal zone about 40 to 150 feet below Saddle Creek limestone.

R. C. Moore, 1949, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 80, sheet 2. Described in Colorado River valley as limestone member of Pueblo formation. Consists of thin irregular layers of brittle fine-grained blue-gray limestone 4 to 5 feet thick. Underlies Camp Creek shale member; overlies Waldrip shale member.

Well exposed 1 to 2 miles south of mouth of Saddle Creek, south of Colorado River, McCulloch County.

**Saddlehorse Gypsum Lentil** (in Quartermaster Formation)[1]

Permian: Texas.

Original reference: C. N. Gould, 1907, U.S. Geol. Survey Water-Supply Paper 191, p. 16–20.

Saddle Mountain Lavas

Age not stated: Northern California.

Howell Williams, 1932, California Univ. Pub. Bull. Dept. Geol. Sci., v. 21, no. 8, p. 274. Flat-lying lavas older than Harkness lavas.

Saddle Mountain shown on map in Shasta and Plumas Counties, Lassen Volcanic National Park.

Saddle Mountain Porphyry[1]

Saddle Mountain Rhyolite

Precambrian: Southwestern Oklahoma.

Original reference: H. F. Bain, 1900, Geol. Soc. America Bull., v. 11, p. 135, 136.

R. E. Denison, 1959, (abs.) Oklahoma Acad. Sci. Proc. 1958, p. 124. Saddle Mountain rhyolite is typically granophyric, and recent investigation indicates that it is gradational phase of Lugert granite.

Occurs near Saddle Mountain, in and around sec. 36, T. 5 N., R. 15 W., Wichita Mountains.

**Sadlerochit Formation**

Sadlerochit Sandstone[1]

Permian and Lower Triassic: Northern Alaska.

Original reference: E. D. Leffingwell, 1919, U.S. Geol. Survey Prof. Paper 109, p. 103, 113, map.

J. T. Dutro, Jr., and T. G. Payne, 1957, Geologic map of Alaska (1:2,500,000): U.S. Geol. Survey. Cited as formation on map legend.

In Sadlerochit Mountains, Canning River region.

Saegerstown Member (of Cattaraugus Formation)

Saegerstown Shale[1]

Upper Devonian: Northwestern Pennsylvania and southwestern New York.

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, chart 4. Saegerstown [shale] shown on correlation chart above Salamanca and below Woodcock. Upper Devonian.

I. H. Tesmer, 1954, Hobbies, v. 35, no. 2, p. 30, 33. Extended into Chautauqua County, N.Y., where it is considered member at top of Cattaraugus formation. Consists of shales and siltstones. Thickness about 100 feet. Overlies Salamanca member; underlies Oswayo formation. Upper Devonian.

Named for exposures along French Creek, in village of Saegerstown, Crawford County, Pa.

Safford Dacite

Tertiary: Southeastern Arizona.

W. H. Brown, 1939, Geol. Soc. America Bull., v. 50, no. 5, p. 739–740, pl. 1. Consists of three varieties of rock: fresh porphyritic dacite with groundmass of minute spherulites; porphyritic border facies with clear glass groundmass; and chalky porphyritic dacite. Chalky white to light gray when fresh and gray to light drab on weathered surfaces. Flow structure nearly vertical and parallel to its borders. The dacite pierces the Rillito andesite (new) and the Safford tuff (new). The mass is regarded as an eroded volcanic neck.

Largely confined to core of Safford Peak, Tucson Mountains, Pima County. Area of peak is elliptical, the long axis of which is 2,800 feet and short axis is 1,500 feet.

Safford Tuff

Tertiary: Southeastern Arizona.

W. H. Brown, 1939, Geol. Soc. America Bull., v. 50, no. 5, p. 731–733, fig. 2, pl. 1. Consists of a coarse stratified but poorly sorted volcanic breccia or tuff near Safford Peak. Farther south it is usually fine grained and well stratified to thin bedded. Its materials range from sand to boulders 3 feet in diameter. Ranges through various shades of red and brown and is chalky white where altered. Thickness at least 340 feet. Rests concordantly on Rillito andesite (new) near Safford Peak, but to the southeast rests directly on Cretaceous volcanics with marked angular unconformity and is overlain by later basalts with another angular unconformity.

Named from exposures in cliffs near Safford Peak. Occurs throughout Tucson Mountain Range, Pima County.

Safford Canyon Formation

Oligocene, upper, and Miocene, lower(?): Northeastern Nevada.

Jerome Regnier, 1960, Geol. Soc. America Bull., v. 71, no. 8, p. 1191, 1193–1195, pl. 1. Consists of 700 feet of water-laid vitric tuffs and tuffaceous volcanic sandstones and conglomerates which form an open north-plunging syncline in northern end of Pine Valley. Lower part is 50-foot bed of coarse volcanic-pebble conglomerate which rests in sedimentary contact (slight angular unconformity) on volcanic rocks of Cortez Mountains; remainder of formation is interbedded tuffs, conglomerates, and a 20-foot bed of limestone. Occupies same stratigraphic position as Rand Ranch formation (new), between the volcanic rocks and upper Miocene Raine Ranch formation (new): not considered facies of Rand Ranch but believed to be younger than that formation. Nonfossiliferous.

Named for tributary of Humboldt River southwest of Palisade, vicinity of Carlin. Section measured from NE¼ sec. 11, T. 31 N., R. 51 E., toward center of sec. 1, same township.

**Sagamore Siltstone Member** (of Bedford Shale)

Sagamore Sandstone Lentil (in Bedford Shale)[1]

Mississippian: Northeastern Ohio.

Original reference: C. S. Prosser, 1912, Ohio Geol. Survey, 4th ser., Bull. 15, p. 26, 86, 88.

Wallace de Witt, Jr., 1951, Geol. Soc. America Bull., v. 62, no. 11, p. 1354–1356. Here termed Sagamore siltstone member; unit is of unknown areal extent and is made up predominantly of quartzose siltstone containing a small amount of very fine sand; contains thin to massively bedded gray siltstones from 4 to 20 inches thick. Maximum thickness 20 feet. Occurs 30 feet above base of Bedford; underlain by silty gray shale containing many ripple-marked siltstones; stratigraphically above Euclid siltstone member.

Named for Sagamore Creek, Bedford Township, Cuyahoga County. Crops out along Cuyahoga River valley south of Bedford.

**Saganaga Granite**[1]

Precambrian: Northeastern Minnesota.

Original reference: A Winchell, 1888, Minnesota Geol. Nat. History Survey 16th Ann. Rept.

J. T. Stark and V. G. Sleight, 1939, Geol. Soc. America Bull., v. 50, no. 7, p. 1032 (table 2), 1033. Townline Lake granodiorite (new) which cuts Ely greenstone, may be offshoot of Saganaga granite.

J. W. Gruner, 1941, Geol. Soc. America Bull., v. 52, no. 10, p. 1583 (table 2), 1590, 1613, pl. 1. In Knife Lake area, contacts of granite with overlying Knife Lake sediments dips to west at angles of 60° to 70° in many places at western edge of batholith. Crooked Lake granite pebble conglomerates (new) were deposited on arkosites and graywacke which rest directly on Saganaga granite.

F. F. Grout and others, 1951, Geol. Soc. America Bull., v. 62, no. 9, p. 1041. Underlies Animikie rocks (Gunflint formation) in hills east of Gunflint Trail (road) between Gunflint and Saganaga Lake, secs. 22 and 23, T. 65 N., R. 4 W. Intrudes Ely greenstone.

First described on shores and islands of Saganaga Lake, Cook County.

Saganaga Syenite[1]

Precambrian (Keewatin): Northeastern Minnesota.

Original reference: A. Winchell, 1891, Am. Jour. Sci., 3d, v. 41, p. 386.

**Sagavanirktok Formation**

Paleocene to Oligocene(?): Northern Alaska.

George Gryc, W. W. Patton, Jr., and T. G. Payne, 1951, Washington Acad. Sci. Jour., v. 41, no. 5, p. 167, fig. 2. Mainly of red-bed-type poorly consolidated siltstone, sandstone, conglomerate, and lignite. Structurally conformable with underlying Colville group and no large erosional break indicated. Unconformably underlies Gubik formation. Contains early Tertiary flora.

T. G. Payne, 1956, U.S. Geol. Survey Misc. Geol. Inv. Map I–84. Nonmarine. Contains bentonite, tuff. Maximum thickness 2,000 feet. Tertiary Paleocene(?).

Type locality: In Franklin Bluffs along lower part of Sagavanirktok River. Also well exposed in White Hills area.

**Sagavanirktok River Glaciation**

Pleistocene: Central northern Alaska.

R. L. Detterman, 1953, *in* T. L. Péwé and others, U.S. Geol. Survey Circ. 289, p. 11, 13 (table 1). Four Quaternary glacial advances recognized in Sagavanirktok-Anaktuvuk district. Sagavanirktok, the oldest well-defined advance, succeeded Anaktuvuk glaciation (new); preceded Itkillik glaciation (new). Morainal remnants cover area of 230 square miles. Piedmont lobe probably was formed with maximum extension 30 miles north of mountains.

Renamed Sagavanirktok River Glaciation in order to retain name Sagavanirktok for formation.

Morainal remnants along Sagavanirktok River, 60 miles east of Anaktuvuk.

Sage Limestone (in Gallatin Group)

Sage Limestone Member (of Gallatin Formation)

Sage Limestone Member (of Red Lion Formation)

Sage Pebble-Conglomerate Member (of Snowy Range Formation)

Upper Cambrian: Central, southern, and southwestern Montana and northwestern Wyoming.

Christina Lochman, 1950, Am. Assoc. Petroleum Geologists Bull., v. 34, no. 11, p. 2212. Proposed for upper member of Snowy Range formation. Intercalated shales and limestone pebble conglomerates with dense columnar limestone near base. Thickness 150 to 175 feet in southern Montana where entire member is preserved. Overlies Dry Creek shale member. Upper Sage members is lithic unit called "Pebbly limestone" by Peale (1893, U.S. Geol. Survey Bull. 110).

A. M. Hanson, 1952, Montana Bur. Mines and Geology Mem. 33, p. 18. In southwestern Montana, considered member of Red Lion formation.

A. B. Shaw and P. O. McGrew, 1954, Wyoming Geol. Assoc. Guidebook 9th Ann. Field Conf., chart 2. Lochman (1950) revised and redescribed the Dry Creek shale and named what in Wyoming is called "upper Gallatin limestone" the Sage pebble conglomerates. This name seems applicable in Wyoming, but because of lithic changes, term Sage limestone is preferred. Dry Creek shale is thin and rarely mappable and most commonly should be regarded as member of Sage limestone. Gallatin formation is herein raised to rank of group and includes Sage limestone.

C. R. DeLand, 1954, (abs.) Geol. Soc. America Bull., v. 65, no. 12. pt. 2, p. 1374. Sage limestone considered upper member of Gallatin formation in Wind River Mountains, Wyo.

Type locality: On south slope of Castle Rock, at junction of the East Fork with Mill Creek, N¼SE¼ sec. 13, T. 6 S., R. 9 E., Livingston quadrangle, Montana. Name derived from Lower Sage Creek which enters East Fork of Mill Creek 1½ miles up stream from type locality.

**Sage Breaks Shale Member** (of Carlile Shale)

Sage Breaks Shale Member (of Niobrara Formation)[1]

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

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

H. D. Thomas, 1936, Am. Assoc. Petroleum Geologists Bull., v. 20, no. 9, p. 1190 (table 1), 1194 (fig. 1), 1195. Term Sage Breaks member of Niobrara extended into Laramie basin, southeastern Wyoming. Replaces term "Carlile" as used in this area.

W. A. Cobban, 1951, Am. Assoc. Petroleum Geologists Bull., v. 35, no. 10, p. 2187. Reallocated to member status in Carlile formation.

W. A. Cobban and J. B. Reeside, Jr., 1952, Am. Assoc. Petroleum Geologists Bull., v. 36, no. 10, p. 1948–1949. South-southeast of Rapid City, S. Dak., 70 feet thick; at Belle Fourche, S. Dak., 200 feet; and in Carter County, Mont., 300 feet. In all these areas, the Sage Breaks is conformable with Turner sandy member of Carlile and disconformable with Niobrara. Member is absent over much of central Great Plains. Reasons for reallocation discussed.

Named for exposures in the Sage Breaks, in T. 56 N., R. 63 W., Weston County, Wyo.

Sage Creek Basalts

Eocene: Southwestern Montana.

Robert Scholten, K. A. Keenmon, and W. O. Kupsch, 1955, Geol. Soc. America Bull., v. 66, no. 4, p. 373, pl. 1. Named for several small basalt flows that occur at base of Sage Creek formation in T. 12 S., R. 8 W., north of Sage Creek. Similar flows crop out 2 miles to northwest and on southwest side of Blacktail Range, secs. 2 and 11, T. 10 S., R. 9 W., where they are overlain by Cook Ranch formation (new). Rocks are all badly weathered.

Described in T. 12 S., R. 8 W., Beaverhead County.

Sage Creek Formation[1]

Eocene, upper, and Oligocene: Southwestern Montana.

Original reference: E. Douglass, 1903, Carnegie Mus. Annals, v. 2, p. 145–146.

Jean Hough, 1955, Jour. Paleontology, v. 29, no. 1, p. 22–36. Sage Creek problem discussed. Formation redefined to include 200 feet of higher breccias and tuffs at its type locality and in adjoining areas. As redefined includes Cook Ranch formation of Wood (1933).

Robert Scholten, K. A. Keenmon, and W. O. Kupsch, 1955, Geol. Soc. America Bull., v. 66, no. 4, p. 373, pl. 1. Basalt flows occurring at base and top of formation are here named Sage Creek basalts.

Named for occurrences north of Sage Creek, about 7 miles northeast of Lima, Beaverhead County.

Sage Hen Limestone Member (of Colorado Shale)[1]

Upper Cretaceous: Central northern Montana.

Original reference: C. T. Lupton and Wallace Lee, 1921, Am. Assoc. Petroleum Geologists Bull., v. 5, p. 264, 266.

Named for exposures in Sage Hen Creek, Little Rocky Mountains region.

Sage Valley Limestone Member (of Goldens Ranch Formation)

Eocene, middle or upper: Central Utah.

Siegfried Muessig, 1951, Science, v. 114, no. 2957, p. 234. Relatively pure limestone with abundant plant remains. Occurs 820 feet above base of formation. Age considered middle or upper Eocene on basis of plant fossils.

Occurs in Long Ridge area, southwest of Levan, Juab County. Derivation of name not stated.

**Saginaw Formation[1]**

Saginaw Group

Pennsylvanian: Southern Michigan.

Original reference: A. C. Lane, 1901, Michigan Miner, v. 3, no. 1, p. 9.

W. A. Kelly, 1936, Michigan Dept. Conserv., Geol. Div. Pub. 40, Geol. Ser. 34, p. 158 (table 1), 159, 165–205. Saginaw group is composed of material of fresh water, brackish water, and marine origin, and consists of sandstones, shales, coal, and limestones. Comprises many cyclical formations, one which, herein named Verne, contains a persistent shaly marine limestone member that makes it convenient to divide the group into pre- and post-Verne cyclical formations. Thickness 400 feet. Group directly overlies Parma sandstone wherever that formation is present; in some areas, directly overlies Bayport formation, as in area immediately north of Jackson; in several localities, may rest directly on Napolean sandstone. Underlies Grand River group herein proposed to include all strata younger than Saginaw. Type section given.

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 be considered members of Saginaw formation and that Woodville be restricted to a sandstone member in 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. Includes Verne limestone member. Seven cyclothems, of which Grand Ledge is typical, are recognized in vicinity of Grand Ledge, Eaton County.

Type section: Near Grand Ledge, Eaton County. Name derived from Saginaw Valley and Saginaw County.

**Sailor Canyon Formation**[1]

Lower and Middle Jurassic: Northern California.

Original reference: H. W. Turner, 1894, Am. Geologist, v. 13, p. 232.

N. L. Taliaferro, 1942, Geol. Soc. America Bull., v. 52, no. 1, p. 99–100. Near northern end of 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 Sierra Nevada, south of Taylorsville.

E. D. McKee and others, 1959, U.S. Geol. Survey Misc. Geol. Inv. Map I–300. Correlation chart (table 1) shows lowermost part of Sailor Canyon formation in Upper Triassic.

Named for exposures in Sailor Canyon, which drains into American River about 6 miles south-east of Cisco, Placer County.

**St. Albans Slate**[1]

St. Albans Slate (in Woods Corners Group)

Middle Cambrian: Northwestern Vermont.

Original reference: J. Marcou, 1862, Boston Soc. Nat. History Proc., v. 8, p. 239–253.

Charles Schuchert, 1937, Geol. Soc. America Bull., v. 48, no. 7, p. 1021, 1039–1041. Type locality cited.

B. F. Howell and others, 1944, Geol. Soc. America Bull., v. 55, no. 8, chart 1 (column 70). Listed as St. Albans shale.

A. B. Shaw, 1958, Geol. Soc. America Bull., v. 69, no. 5, p. 532 (fig. 5), 536–537, pl. 1. St. Albans slate is commonly black, gray-black, or tan and is micaceous. At type locality, top of formation is soft tan to golden brown micaceous slate, highly cleaved and contorted. Locally contains thick conglomerate of large blocks of arenaceous dolomite. Near Swantown Junction, a mass of limestone conglomerate is tentatively assigned to the St. Albans. Estimated thickness about 200 feet ± 50 percent. Belt of outcrop widens northward from type locality, but structure exposed in bed of Stevens Brook suggests that beds have flattened out and that formation has not thickened in that direction. Elsewhere than at type locality, formation is commonly less than 100 feet thick. Overlies Rugg Brook dolomite underlies Mill River conglomerate and Skeels Corners slate. Basal formation of Woods Corners group (new). Middle Cambrian.

Type locality: Adams pasture, at western edge of St. Albans, north of road from St. Albans to St. Albans Bay, Franklin County.

St. Charles Intraglacial Substage

Pleistocene (Wisconsin): North-central United States.

M. M. Leighton, 1960, Jour. Geology, v. 68, no. 5, p. 549, 550. Name applied to Tazewell-Cary intraglacial substage. Represented by cutting of Fox River valley.

Named for St. Charles, the locality where Minooka moraine of Cary substage descends into the valley. Later West Chicago moraine of Cary substage also descends into this valley near town of Cary.

**St. Charles Limestone**[1]

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. 1108–1109, 1117 (fig. 4), 1123–1124. Walcott gave thickness of St. Charles as 1,227 feet in Blacksmith Fork section, Utah. Section is herein emended to exclude upper 777 feet which were found to contain Ordovician fossils. As emended, formation is about 400 feet thick; consists of basal dolomite zone about 148 feet thick and an upper limestone zone about 258 feet thick. Worm Creek quartzite member only questionably present here. Overlies Nounan dolomite.

G. B. Richardson, 1941, U.S. Geol. Survey Bull. 923, p. 13, 14, pl. 1. Described in Randolph quadrangle, Utah, where it crops out on both limbs of Fish Haven syncline, on flanks of Bear River Range west of Garden City. Consists of basal Worm Creek quartzite and overlying limestone. Thickness approximately 400 feet. Overlies Nounan limestone. Restricted to lower 400 feet (approximately) of formation as defined by Walcott; upper 900 feet (approximately) now considered Lower Ordovician and assigned to Garden City limestone.

J. S. Williams, 1948, Geol. Soc. America Bull., v. 59, no. 11, p. 1134–1135, pl. 1. Described in Logan quadrangle, Utah. Overlies Nounan formation; underlies Garden City limestone. Consists of basal quartzite member (Worm Creek), middle member of thin-bedded limestone, and upper member of massive dark-gray dolomites. Deiss (1938) erred in redefinition of St. Charles in Blacksmith Fork section, because he failed to locate the Worm Creek which is distinctly present here. The 258 feet of limestone and intercalated intraformational conglomerates which he included at top of formation are basal Garden City.

H. W. Coulter, 1956, Idaho Bur. Mines and Geology Pamph. 107, p. 17–19, geol. map. Thickness east of Willow Flat, Idaho, 771 feet; Worm Creek 170 feet. Overlies Nounan formation; underlies Garden City formation.

Type locality: West of St. Charles, Bear Lake County, Idaho.

St. Clair facies (of Murfreesboro Limestone)

Middle Ordovician: Southwestern Virginia.

Charles Butts, 1940, Virginia Geol. Survey Bull. 52, pt. 1, p. 126, 132, 133. Name given to a purely limestone facies in the Murfreesboro. Thickness varies from 271 feet in Lee County to as much as 1,142 feet near Bluefield, Tazewell County. The St. Clair is confined to the northwest belt of the Murfreesboro and the Blackford facies (new) to the southeast side.

G. A. Cooper, 1956, Smithsonian Misc. Colln., v. 127, pt. 1, p. 88–89. Limestone referred to by Butts (1940) as Murfreesboro is now known not to be Murfreesboro, and the limestones have been placed in other formations.

Well exposed just south of St. Clair Railroad station, 2½ miles west of Bluefield, Tazewell County.

**St. Clair Limestone**[1]

St. Clair Formation (in Bainbridge Group)

Silurian: Northern Arkansas, southern Illinois, and central eastern Oklahoma.

Original reference: R. A. F. Penrose, Jr., 1891, Arkansas Geol. Survey Ann. Rept. 1890, v. 1, p. 102–103, 112–114, 124–128, 166–174.

H. A. Lowenstam, 1949, Illinois Geol. Survey Rept. Inv. 145, p. 12, 13. Lower formation of Bainbridge group. Name is here applied regionally to the pink crinoidal limestone of early Niagaran age throughout its distribution in midwestern States except where local names are applicable to separate tongues in marginal areas, as the Lego and Laurel tongues in Tennessee and a tongue in base of Joliet formation in Illinois and Wisconsin. Underlies Moccasin Springs formation (new). Thickens progressively east and northeast from 20 to 25 feet in outcrop area along Ozark border to about 80 feet near Illinois-Indiana boundary; maximum Illinois thickness 80 to 150 feet over area beneath and just beyond wedge edge of overlying Moccasin Springs formation; locally reaches thickness of 200 feet; thins nortnwestward from area of greatest development by interfingering and gradation of upper beds into rocks typical of Chicago area with only basal member maintaining its identity. Formation occupies belt about 100 miles wide, lying on east and southsides of Ozark highland, and extending discontinuously from western Oklahoma and west-central Texas through Arkansas, western Tennessee, western Kentucky, Illinois, and Indiana to central part of Michigan basin. [Discussion of Niagaran reefs in Illinois and their relation to oil accumulation; much data relative to thickness and distribution of unit are based on subsurface studies].

H. D. Miser and others, 1954, Geologic map of Oklahoma (1:500,000): U.S. Geol. Survey. Mapped as St. Clair limestone.

G. G. Huffman and others, 1958, Oklahoma Geol. Survey Bull. 77, p. 29–33, pl. 4. Described as St. Clair formation in northeastern Oklahoma on south and west flanks of Ozark uplift, where it is best exposed in Marble City area on southern and eastern sides of Quarry Mountain. Characteristically white to pink medium to coarsely crystalline massive-bedded limestone; locally has bluish tint. Because of lack of impurities and coarse texture has been called "marble" by quarry industry. Thickness 95 to 165 feet; maximum thickness not determined as base and top are not exposed near areas of greatest development. Near Qualls unconformably overlies lower beds of the Sylvan; succeeded unconformably by Frisco limestone, Sallisaw sandstone, or Sylamore member of Chattanooga formation.

Named for St. Clair Springs, 8 miles northeast of Batesville, Independence County, Ark.

†St. Claire Shale[1]

Upper Devonian: 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 along St. Clair River, St. Clair County.

St. Cloud Granite[1]

Precambrian: Wisconsin.

Original reference: C. C. Wang, 1932, Geol. Soc. China Bull., v. 11, no. 4, p. 426–428.

St. Cloud Gray Grandodiorite

Precambrian (late Algoman): Central Minnesota.

M. S. Woyski, 1949, Geol. Soc. America Bull., v. 60, no. 6, 1002, 1009, 1012–1013, pl. 1. Massive but not homogeneous; exposures are dotted with small dark inclusions and schlieren, cut by numerous dikes and veins, and irregularly altered to a lighter pinker rock; this pink facies appears to be grandodiorite that was granitized by St. Cloud red granite, dikes and apophyses of which twist and branch irregularly and in some places form a network in the St. Cloud gray granodiorite. 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 intrusives, St. Cloud gray granodiorite, Freedhem tonalite, Hillman tonalite, and Warman quartz monzonite, are indeterminate because no contacts are exposed.

Named for the fact that it occurs in vicinity of St. Cloud, Stearns County.

St. Cloud Red Granite (in Stearns Magma Series)

Precambrian (middle Keweenawan): Central Minnesota.

M. S. Woyski, 1949, Geol. Soc. America Bull., v. 60. no. 6, p. 1002, 1005–1006, pl. 1. Pink to red augite-hornblende granite. Cuts and contains inclusions of St. Cloud gray granodiorite, Freedhem tonalite, Hillman tonalite, and Thomson formation; cuts the quartz latite porphyry of the Stearns magma series and grades into the Rockville facies and porphyritic granite facies.

Crops out near St. Cloud, Stearns County; also in Benton, Mille Lacs, and Morrison Counties. Quarried extensively near St. Cloud.

St. Cloud Sandstone (in Greene Formation)[1]

Permian: Northern West Virginia.

Original reference: R. V. Hennen and D. B. Reger, 1913, West Virginia Geol. Survey Rept. Marion, Monongalia, and Taylor Counties, p. 171.

Named for St. Cloud post office, Monongalia County.

†St. Croix Formation[1], Sandstone[1], Series[1], or Shales[1]

St. Croixan Formation

Upper Cambrian: Eastern Minnesota and western Wisconsin.

Original references: N. H. Winchell, 1873, Minnesota Geol. and Nat. History Survey 1st Ann. Rept. for 1872; 1874, Minnesota Geol. Nat. History Survey 2d Ann. Rept.; 1886, Minnesota Geol. Nat. History Survey 14th Ann. Rept., p. 334–337; C. W. Hall, 1889, Minnesota Acad. Nat. Sci. Bull., v. 3, p. 125–136; N. H. Winchell, 1900, Geol. map of Minnesota.

S. G. Bergquist, 1937, Michigan Acad Sci., Arts and Letters, Papers, v. 22, p. 421-435. Discussion of part of Alger County in which St. Croixan series of the Cambrian system come in contact with younger Hermansville calcareous formation, which, in Delta County, Ulrich and Hussey have tentatively assigned to Ozarkian system. Ulrich (personal commun.) gives evidence to support view that St. Croixan formation of Wisconsin area extends into Superior region of Alger County. The so-called Lake Superior sandstone would thus be included as a member of that formation. The Pictured Rocks, which rise out of Lake Superior as range of cliffs 100 to 150 feet high, are sculptured in St. Croixan formation.

Named for occurrence in St. Croix Valley, Minn.

**St. Croixan Series**[1]

St. Croixan Epoch[1]

Upper Cambrian: North America.

Original reference: C. D. Walcott, 1912, Smithsonian Misc. Colln., v. 57, no. 10, p. 306–307.

G. O. Raasch, 1935, Kansas Geol. Soc. Guidebook 9th Ann. Field Conf., p. 302–315. St. Croixan series crops out in more or less crescentric belt having its base in central southern Wisconsin and its extremities in east-central Minnesota and in northern peninsula of Michigan. Belt includes northwest corner of Iowa and isolated inlier in northern Illinois. In area of outcrop, series is considerably less than 1,000 feet thick, but in subsurface reaches maximum of more than 2,000 feet. Supposed thickening takes place at base of series. Series embraces all beds from base of Mount Simon member of Dresbach to top of Madison formation. Excludes Bayfield sandstone of the Keweenawan and all older rocks; and Oneota formation of Ordovician and all younger deposits. Both lower and upper boundary coincident with major unconformities. Comprises (ascending) Dresbach formation with Mount Simon, Eau Claire, and Galesville members; Franconia formation with Ironton, Goodenough, Hudson, and Bad Axe members; Trempealeau formation with St. Lawrence, Lodi, and Jordan members; and Madison formation.

W. H. Twenhofel, G. O. Raasch, and F. T. Thwaites, 1935, Geol. Soc. America Bull., v. 46, no. 11, p. 1687–1744. Croixian series, Upper Cambrian of Upper Mississippi Valley, comprises (ascending) Dresbach formation with Mount Simon, Eau Claire, and Galesville members; Franconia formation with Ironton, Goodenough, Hudson, and Bad Axe members; and Trempealeau formation with basal greensand and conglomerate member, and St. Lawrence, Lodi, Jordan, and Madison members.

C. R. Stauffer, G. M. Schwartz, and G. A. Thiel, 1939, Geol. Soc. America Bull., v. 50, no. 8, p. 1227-1244. St. Croixian series in Minnesota comprises (ascending) Dresbach formation with Mount Simon, Eau Claire, and Galesville members; Franconia formation with Ironton, Taylors Falls, Hudson, and Bad Axe members; St. Lawrence formation with Nicollet Creek (new) and Lodi members; Jordan formation with Norwalk and Van Oser members. Minnesota classification differs from Wisconsin classification (Twenhofel, Raash, and Thwaites, 1935) or Conference classification (Bridge, 1937, U.S. Geol. Survey Prof. Paper 186–L) in that their Trempealeau is equivalent to the two topmost formations of Minnesota classification. Hinckley sandstone not included in St. Croixian series by Minnesota Geological Survey.

C. R. Stauffer and G. A. Thiel, 1941, Minnesota Geol. Survey Bull. 29, p. 9 (geol. column), 24–49. As shown on geologic column, St. Croixian series occurs above Lake Superior series with Hinckley sandstone at top and below Beekmantownian series with Kasota sandstone at base.

C. A. Nelson, 1956, Geol. Soc. America Bull., v. 67, no. 2, p. 165–184. In Upper Mississippi Valley, Croixan strata above Franconia formation consist of dolomite and dolomitic siltstone and sandstone overlain by massive nondolomitic sandstone. Previous classifications of this successions have employed both faunal and lithologic criteria for discrimination of formations and members. Strata can be divided on lithologic characters alone. Terms St. Lawrence and Jordan formations are applied to the dolomitic strata and massive sandstone respectively. Strata with which present report is concerned have in past been called St. Lawrence, Mendota, Trempealeau, Black Earth, Nicollet Creek, and Lodi. Trempealeau should be abandoned as formational term and its usage restricted to Trempealeauan stage.

W. C. Bell, R. R. Berg, and C. A. Nelson, 1956, Internat. Geol. Cong., 20th, Mexico City, Cambrian Symposium, pt. 2, p. 415–446. Discussion of Croixan type area, Upper Mississippi Valley. By usual definition, the Croixan is said to constitute those rocks that originated during Late Cambrian epoch of geologic time, but in practice the Croixan is defined by those faunal assemblages that by common agreement among paleontologists are assigned to the Croixan. In North America, lowest Ordovician faunas are characterized by trilobites *Symphysurina*, *Bellefontia*, and *Hystrictus*, among others, and lowest and highest Croixan faunas are characterized, respectively, by *Cedaria* and *Plethopeltis*. Only in central Texas have trilobite faunas on both sides of this commonly accepted systemic boundary received critical attention, and this study has not been published; the boundary lies within conformable strata of San Saba member of Wilberns formation. A similar situation is reported in Montana (Lochman and Duncan, 1944, Geol. Soc. America Spec. Paper 54). Neither lowest or highest strata of type Croixan series have received critical lithostratigraphic and biostratigraphic attention, nor have Raasch's biostratigraphic studies been properly documented. Apparently there has been unanimous agreement among previous workers that Croixan series consists of several formations—variously named—and that highest formation is topped by unconformity at Cambrian-Ordovician boundary. This connection is so deeply rooted that Kasota sandstone is defined as reworked Jordan sand continuing Ordovician fauna and overlying Jordan unconformably. It is herein contended that the commonly accepted Cambrian-Ordovician faunal change occurred at Kasota and St. Peter during deposition of sand that today is part of lithogenetic unit that bears formational name Jordan sandstone. In other words, to Croixan series are assigned fossiliferous strata (and their presumed unfossiliferous temporal equivalents) that contain fossil faunas that by consensus are called Croixan and to rock units such as Jordan sandstone are assigned strata on basis of petrologic criteria. In type area, Croixan series consists of two transgressive-regressive sedimentary cycles of marine deposition. Lower cycle, comprising Dresbach formation, is underlain and overlain by unconformities. Upper cycle comprising Franconia, St. Lawrence, and Jordan formations reached maximum transgressive extension during deposition of Black Earth wedge and has unconformity at its top by implication but not thus far by demonstration. Series includes Dresbachian, Franconian, and Trempealeauan stages.

Type area: Upper Mississippi Valley. Name derived from St. Croix River, Minn.

St. David cyclothem (in Carbondale Formation)

St. David cyclothem (in Carbondale Group)[1]

Pennsylvanian: Illinois.

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

H. R. Wanless, 1957, Illinois Geol. Survey Bull. 82, p. 50 (fig. 22), 102-107, 197 (geol. section 21). Includes (ascending) Springfield (No. 5) coal, St. David limestone, and Canton shale. Thickness 18 to 55 feet in localities where upper part is not truncated by Cuba sandstone. Appears to be conformable on Summum cyclothem; contact with overlying Brereton cyclothem is an erosional unconformity along which more than 50 feet of St. David strata are locally eroded. Name St. David was originally applied to the limestone by Savage (1927) and subsequently extended to entire cyclothem. Type locality and derivation of name given.

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 52 (table 2), pl. 1. In Carbondale formation (redefined). Above Summum cyclothem and below Brereton cyclothem in northern, western, and eastern areas and below Briar Hill cyclothem (new) in southwestern and southeastern areas. Presentation of new rock-stratigraphic classification of Pennsylvanian in Illinois; cyclical classification is independent of rock-stratigraphic classification.

Type locality: Ravine sloping southeast to Big Creek, SE¼SE¼ sec. 17, NE¼NE¼ sec. 20, and NW¼NW¼ sec. 21, T. 6 N., R. 4 E., 1 mile west of St. David, Havana quadrangle, Fulton County.

St. David Limestone Member (of Carbondale Formation)

St. David Limestone (in Carbondale Group)

St. David Shale and Limestone (in Carbondale Formation)[1]

Pennsylvanian: Central western Illinois.

Original reference: T. E. Savage, 1927, Am. Jour. Sci., 5th, v. 14, p. 207–316.

H. R. Wanless, 1957, Illinois Geol. Survey Bull. 82, p. 50 (fig. 22), 105–106, 197. St. David limestone included in St. David cyclothem, Carbondale group. Limestone is most typically developed in north half of Havana quadrangle where it is a single bed 10 inches to 2 feet thick, light blue gray, dense, and fossiliferous; weathers to buff or light yellow brown. Overlies and underlies unnamed shale intervals. Stratigraphically below Canton shale.

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 34, 35, 47 (table 1), pl. 1. Rank reduced to member status in Carbondale formation (redefined). In southern area, occurs above Harrisburg (No. 5) coal member and below Briar Hill (No. 5A) coal member. In western and northern area, occurs above Springfield (No. 5) coal member and below Canton shale member. Replaces Absher limestone. Presentation of new rock-stratigraphic classification of Pennsylvanian strata in Illinois.

Type locality: SE¼SE¼ sec. 17, T. 6 N., R. 4 E., Fulton County. Named for exposures near St. David.

St. Edwards Tuff (in Burditt Marl)

Upper Cretaceous: South-central Texas.

C. O. Durham, Jr., 1955, Corpus Christi Geol. Soc. [Guidebook] Ann. Field Trip, March 11–12 [p. 59], pl. 16. Occurs within basal Burditt marl. Younger than Pilot Knob tuff (new).

Exposed near St. Edwards University, south of State Capitol, Austin, Travis County.

St. Elias Schist[1]

Age(?): Southeastern Alaska.

Original reference: I. C. Russell, 1891, Nat. Geog. Mag., v. 3, p. 167–175.

St. Elias Range in St. Elias region.

†St. Elizabeth Formation[1]

Lower Ordovician (Beekmantown) : Central Missouri.

Original reference: S. H. Ball and A. F. Smith, 1903, Missouri Bur. Geology and Mines, v. 1, 2d ser., p. 50.

Named for St. Elizabeth, Miller County.

St. Francis Series or Group

Silurian(?) and Devonian: Quebec, Canada, and Massachusetts and Vermont.

T. H. Clark, 1937, Canada Geol. Survey Mem. 211, p. 37–42. Series made up of two members, a group of lavas and a formation consisting mainly of impure quartzite and graywacke. Thickness of lavas may be in excess of 8,000 feet. Thickness of series may be as much as 10,000 feet. Northern boundary is line drawn from Lac Rocheux in Adstock Township to Elgin Lake in Stratford. Series underlies all of Disraeli map area southeast of this line, except parts underlain by Winslow granite and Lake Aylmer series.

J. G. Dennis, 1956, Vermont Geol. Survey Bull. 8, p. 7. Group extends from Quebec to Massachusetts. In Vermont, includes Waits River formation and Gile Mountain formation. Tentatively assigned to Devonian.

J. H. Eric and J. G. Dennis, 1958, Vermont Geol. Survey Bull. 11, p. 18, pl. 1. Group includes Northfield slate, Waits River formation, Gile Mountain formation, and Meetinghouse slate. Devonian and Silurian(?).

St. Francis Lake and St. Francis River are in Quebec.

†St. Francois Limestone[1]

Upper Cambrian: Eastern Missouri.

Original reference: A. Winslow, 1894, Missouri Geol. Survey, v. 6, p. 331, 346, 349–354.

Named for St. Francois County.

†Ste. Genevieve Group[1]

Mississippian: Missouri, Illinois, and western Kentucky.

Original reference: C. R. Eastman, 1903, Harvard Coll. Mus. Comp. Zoology Bull., v. 39, no. 7, p. 195.

†Ste. Genevieve Group[1]

Mississippian: Missouri, Illinois, and Iowa.

Original reference: H. S. Williams, 1922, Pan-Am. Geologist, v. 37, no. 1, p. 39–40.

Probably named for Ste. Genevieve County, Mo.

**Ste. Genevieve Limestone**

Ste. Genevieve Limestone (in Blue River Group)

Ste. Genevieve Limestone (in Meramec Group)[1]

Upper Mississippian (Meramec Series): Eastern Missouri, northern Alabama, Georgia, southern Illinois, Indiana, Iowa, Kentucky, and Tennessee.

Original reference: B. F. Shumard, 1860, St. Louis Acad. Sci. Trans., v. 1, p. 406.

Stuart Weller and F. F. Krey, 1939, Illinois Geol. Survey Rept. Inv. 60, p. 7–8. Ste. Genevieve limestone, Iowa series, described in Dongola, Vienna, and Brownfield quadrangles where it is as much as 300 feet thick, overlies St. Louis limestone and underlies Renault limestone of Chester series. Fredonia, Rosiclare, and Levias members recognized in Dongola quadrangle but are poorly exposed and cannot be mapped separately. In addition to these members, a variable succession of clastic beds including some limestone overlies the Levias in Union County, and for these name Hoffner member is proposed.

J. M. Weller, 1939, Kansas Geol. Soc. Guidebook 13th Ann. Field Conf., p. 131, 133–134. Ste. Genevieve limestone classified as uppermost formation in Meramec group, Valmeyer series. Overlies St. Louis limestone; underlies Aux Vases sandstone of New Design group (new) Chester series. In southeastern Illinois, consists of three members (ascending): Fredonia limestone, Rosiclare sandstone, and Levias limestone.

Charles Butts, 1940, Virginia Geol. Survey Bull. 52, pt. 1, p. 366–378. Ste. Genevieve limestone occurs in Virginia in two different facies: pure oolitic limestone along Cumberland escarpment and in northwestern margin of Appalachian Valley next to the coal fields and predominant shale with subordinate limestone beds along middle belt of Greendale syncline from Saltville, Smyth County, to Tennessee. Overlies St. Louis limestone; underlies Gasper limestone. Thickness 85 to 1,500 feet.

J. M. Weller and A. H. Sutton, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 5, p. 766 (fig. 1), 815–817. Classified as uppermost formation in Meramec group, Iowa series. This classification follows that of Illinois Geological Survey.

B. N. Cooper, 1944, Virginia Geol. Survey Bull. 60, p. 160–164. In this report [Burkes Garden quadrangle], term Ste. Genevieve is used in tentative sense for beds which possible, though not certainly, are same age as Ste. Genevieve of type region. Thickness 300 to 525 feet. Overlies Hillsdale limestone which name is used to replace St. Louis limestone as used by Butts (1940); underlies "Gasper" limestone of Chester series. Ste. Genevieve of this report may correspond to the lower, or Fredonia member, of the Ste. Genevieve of Ohio Valley. In West Virginia, the same beds are classified with the Sinks Grove and Patton limestones. The "Ste. Genevieve" corresponds to lower part of Newman and Greenbrier limestones of older reports. Meramec series.

F. E. Tippie, 1945, Am. Assoc. Petroleum Geologists Bull., v. 29, no. 11, p. 1654–1667. Formation is overlain by Renault formation in Hardin and Pope Counties, Ill. In southwestern Illinois, the Aux Vases sandstone intervenes between the Ste. Genevieve and Renault, but it is not present east of western Johnson County. Ste. Genevieve consists of (descending) Levias limestone, Rosiclare sandstone, and Fredonia limestone members. Unconformity at top of the Fredonia is more important than the one at top of the Levias limestone. If this condition should be true for all of Illinois basin, it may develop that the base of the Rosiclare sandstone, rather than base of Aux Vases sandstone as now recognized, should be considered base of Chester series.

C. A. Malott, 1946, Jour. Geology, v. 54, no. 5, p. 322–326. Entire Ste. Genevieve is exposed at double falls of Mill Creek near Cataract, Owen

County, Ind. Thickness 75½ feet. Overlies St. Louis limestone; underlies thin representative of Aux Vases sandstone. Comprises (ascending) Fredonia, Rosiclare, and Levias members. Unit referred to as "Cataract Falls sandstone" (Malott, 1945) is correlated with Rosiclare sandstone of southern Illinois.

D. H. Swann and Elwood Atherton, 1948, Jour. Geology, v. 56, no. 4, p. 269–287. Comparison of logs of closely spaced wells and their assembly into cross sections appear to demonstrate a number of inconsistencies in nomenclature that is currently applied to lower part of Chester series and to Ste. Genevieve formation in different parts of Eastern Interior Basin. Evidence indicates that the oil-producing "Aux Vases" sand of central basin area is equivalent to outcropping Rosiclare sandstone member of Ste. Genevieve; the Levias limestone and part of Shetlerville (Renault) together form a continuous limestone sequence which overlies both "Aux Vases" of the basin and Rosiclare sandstone of outcrop area in southeastern Illinois.

Charles Butts and Benjamin Gildersleeve, 1948, Georgia Geol. Survey Bull. 54, p. 46, geol. map. Geographically extended into northwestern Georgia where it is about 90 feet thick. Overlies St. Louis limestone; underlies Gasper limestone.

A. H. Sutton, 1951, Am. Assoc. Petroleum Geologists Bull., v. 35, no. 7, p. 1661–1668. Discussion of Ste. Genevieve-Renault contact and article by Tippie (1945). Evidence presented to show that unconformity between the Levias and Renault is of greater magnitude and much more significant than the one between the Fredonia and Rosiclare and that Renault limestone and shale or Aux Vases sandstone were it is present, and not Rosiclare sandstone, is basal unit of Chester series.

T. G. Perry and N. M. Smith, 1958, Indiana Geol. Survey Bull. 12, p. 18–22, 30–36, pl. 1. Ste. Genevieve limestone (late Meramec) and Chester formations (late Mississippian) crop out in northward-narrowing wedge from Ohio River to west-central Putnam County, in central Indiana. Ste. Genevieve comprises (ascending) Fredonia, Rosiclare, and Levias members. The Fredonia contains Lost River chert, and the Levias contains the Bryantsville breccia. Thickness 70 to 170 feet. Underlies Aux Vases formation; base not exposed in many areas. Field separation of Levias member from younger Paoli limestone is dependent upon recognition of Aux Vases formation if it is present or upon Bryantsville breccia. Where Bryantsville breccia is present and exposed, it is best stratigraphic marker and easiest means of locating the boundary, as currently defined, between Meramec and Chester series.

S. W. Welch, 1958, U.S. Geol. Survey Oil and Gas Inv. Chart OC–58. Alsobrook member of Pride Mountain formation (new) of Colbert County, Ala., and Tishomingo County, Miss., and the *Platycrinites*-bearing beds of the eastern counties are the strata that Butts (1926, Alabama Geol. Survey Spec. Rept. 14) referred to Ste. Genevieve limestone.

H. H. Gray, R. D. Jenkins, and R. M. Weidman, 1960, Indiana Geol. Survey Bull. 20, p. 36 (table 5), 50–51, pl. 1. Included in Blue River group (new). Overlies St. Louis limestone; underlies Paoli limestone. Oldest formation exposed in Huron area [this report]. Only upper 35 feet exposed.

Named for outcrops in Mississippi River bluffs 1 or 2 miles below Ste. Genevieve, St. Genevieve County, Mo.

†Ste. Genevieve Marble[1]

Mississippian: Central eastern Missouri.

Original reference: G. C. Swallow, 1855, Missouri Geol. Survey 2d Ann. Rept., pt. 1, p. 96.

Quarried at St. Genevieve, St. Genevieve County.

†Ste. Genevieve Sandstone (in Chester Group)[1]

Mississippian: Central eastern Missouri.

Original reference: J. A. Gallagher, 1898, Missouri Bur. Geology and Mines Bienn. Rept., p. 37.

Named for exposures at Ste. Genevieve, Ste. Genevieve County.

**St. George Formation**[1]

Pliocene: Northwestern California.

Original reference: J. H. Maxson, 1933, California Jour. Mines and Geology, v. 29, nos. 1–2, p. 135, map.

William Back, 1957, U.S. Geol. Survey Water-Supply Paper 1254, p. 17 (table), 20–23, pl. 5. Principally massive poorly bedded siltstone and shale containing discontinuous irregular lenses and beds of sand and scattered pebbles and carbonized wood fragments. Exposed thickness about 75 feet near Point St. George; maximum thickness estimated about 400 feet. Underlies Battery formation; overlies Jurassic rocks. Pliocene.

Named for exposures in sea cliff at Point St. George, Del Norte County. Crops out for about 1½ miles south from Point St. George along Pebble Beach and for a short distance to north of Point St. George.

**St. Helena Rhyolite Member** (of Sonoma Volcanics)

St. Helena Rhyolite[1]

Pliocene: Northern California.

Original reference: V. C. Osmont, 1904, California Univ. Pub., Dept. Geology Bull., v. 4, p. 59–87.

C. E. Weaver, 1949, Geol. Soc. America Mem. 35, p. 110 (table 24), 122, 123, 128–130, pls. 6, 7, 10. Described and mapped as St. Helena member of Sonoma volcanics. Consists of lava flows, tuffs, and breccias with lentils of sandstone and conglomerate; ranges in thickness from 50 to over 500 feet; in most areas, rests on upper tuffaceous and andesitic units of the Sonoma volcanics. In Mayacmas Mountains, rhyolites appear to transgress the andesites and rest on shales of the Knoxville. Most typical development of the flows and tuffs occurs in higher parts of Howell Mountains east of Napa.

Apparently named for occurrence on Mount St. Helena, Sonoma County.

**St. Ignace Formation**

St. Ignace Dolomite (in Salina Group)

St. Ignace Formation (in Bass Islands Group)

Upper Silurian (Cayugan): Northern 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), 53–73. Proposed for youngest known Upper Silurian in Northern Peninsula. Occupies position between Upper Silurian Pointe aux Chenes formation (new) and Lower Devonian Garden Island formation (new). In some areas, underlies Bois Blanc formation (new); as result of collapse of rocks in region, large segments of St. Ignace are present in Mackinac breccia. Lower part of formation consists of even-bedded very light gray, cream-colored, and light-buff dolomites; upper part consists of thick-bedded buff dolomites overlying thick-bedded light-gray dolomites. Thickness of exposed sections varies from 10 to 76 feet; however, probable order of superposition of the strata exposed in many blocks of the Mackinac breccia indicates that thickness may not be less than 250 feet and not more than 300 feet. Bass Island[s] group.

G. M. Ehlers and R. V. Kesling, 1957, Michigan Geol. Soc. [Guidebook] Ann. Geol. Excursion, p. 2 (table), 24. Most of strata are dolomite; hence, unit is termed St. Ignace dolomite. Assigned to Salina group.

Named for exposures within the Mackinac breccia in St. Ignace area. Also occurs on Mackinac Island. Underlies Round Island, northern part of Bois Blanc Island, and northern part of Garden Island.

St. James 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., figs. 3, 9. Dolomite with weak green shale partings. Thickness about 18 feet. Shown on columnar section as underlying Beecher member (new) and overlying Buckhorn member (new).

In copy of this guidebook used by compiler name Buckhorn had been crossed out and name Red Oak written in with pen. The compiler had no way to determine whether or not this change had been made in all copies of the guidebook.

Occurs in Dixon-Oregon area.

†St. Joe Limestone (in Shawnee Formation)[1]

Pennsylvanian: Northwestern Missouri.

Original reference: J. A. Gallaher, 1898, Missouri Bur. Geology and Mines Bienn. Rept., p. 52–53.

Named for exposures near St. Joseph, Buchanan County.

**St. Joe Limestone Member** (of Boone Formation)[1]

St. Joe **Group**

St. Joe Limestone or **Formation**

Lower Mississippian: Northern Arkansas, eastern Oklahoma, and southwestern Missouri.

Original reference: T. C. Hopkins, 1893, Arkansas Geol. Survey Ann. Rept. 1890, v. 4, p. 10, 212, 253–349, pl. 10.

L. M. Cline, 1934, Am. Assoc. Petroleum Geologists Bull., v. 18, no. 9, p. 1137–1141. Rank raised to formation.

E. B. Branson, 1944, Missouri Univ. Studies, v. 19, no. 3, p. 204–207. Limestone comprises Compton, Northview, and Pierson members.

C. P. Kaiser, 1950, Am. Assoc. Petroleum Geologists Bull., v. 34, no. 11, p. 2157–2161. Formation typically consists of light-gray crinoidal limestone with a red to green silty and shaly zone near middle. Thickness 0 to 75 feet. Rests unconformably on Sedalia, Northview, Sylamore, and Chattanooga formations from north to south and at a few places on Ordovician. Conformably overlain by Reeds Spring limestone. Present only in southern part of area of this report [southwestern Missouri]. Recommended that term Pierson be dropped as a synonym for St. Joe.

T. R. Beveridge and E. L. Clark, 1952, Missouri Geol. Survey and Water Resources Rept. Inv. 13, p. 75. Rank raised to group. Comprises (ascending) Compton, Northview, and Pierson formations. Kinderhook-Osage boundary is considered to be at contact of Northview with Pierson. Hence, St. Joe group straddles series line. In some parts of southwestern Missouri, the Northview, although persistent, is too thin to map. In such cases, the St. Joe group may be mapped as an undifferentiated unit. Overlies Chattanooga; underlies Reeds Spring.

G. G. Huffman and others, 1958, Oklahoma Geol. Survey Bull. 77, p. 14 (fig. 2), 41–43, pls. 1–5. Group described on south and west flanks of Ozark uplift. Three-fold lithic development present. Basal part consists of about 10 feet of gray nodular-weathering limestone which is thin bedded in upper parts; middle part composed of 3 to 5 feet of olive-green soft limy shale; upper part consists of maximum of 25 feet of gray, thick-bedded finely crystalline limestone. Maximum thickness 40 feet. Thins southward by loss of units and by unconformity at top. Unconformably overlies Chattanooga shale; unconformably underlies Reeds Spring formation. Kinderhookian-Osagean.

Named for exposures at St. Joe, Searcy County, Ark.

†St. Joseph Formation[1]

Mississippian: Southeastern Indiana.

Original reference: P. B. Stockdale, 1929, Ohio Jour. Sci., v. 29, no. 4, p. 170.

Probably named for St. Joseph, Clark County.

†St. Joseph Limestone[1]

Upper Cambrian: Eastern Missouri.

Original reference: A. Winslow, 1894, Missouri Geol. Survey, v. 6, p. 331, 347.

Named for mines of St. Joseph Lead Co. near Fredericktown, Madison County.

St. Landry Marble[1]

Cretaceous(?) : Southwestern Louisiana.

Original reference: E. W. Hilgard, Suppl. and Final Rept. Geol. Reconn. Louisiana, 1869, p. 12.

St. Landry and Evangeline Parishes.

**St. Laurent Limestone[1]**

St. Laurent Formation

Middle Devonian: Eastern Missouri and southern Illinois.

Original reference: C. L. Dake, 1918, Missouri Bur. Geology and Mines, v. 15, 2d ser., p. 88, 175.

J. M. Weller *in* J. M. Weller and G. E. Ekblaw, 1940, Illinois Geol. Survey Rept. Inv. 70, p. 16; 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 the black Mountain Glen shale (or the Springville shale where Mountain Glen is absent) have been referred by Savage (1920) to the 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. It might be advisable to apply to them name St. Laurent formation which is used for the Devonian overlying Grand Tower limestone in southeastern Missouri.

G. A. Cooper and others, 1942, Geol. Soc. America Bull. v. 53, no. 12, pt. 1, p. 1778–1779, chart 4. Occurs in two areas not yet satisfactorily correlated: one is in Union and Jackson Counties, Ill., and an adjacent series of outcrops on west side of Mississippi in Altenburg quadrangle, Missouri; other is in Little Saline Valley south of Ste. Genevieve, Mo. St. Laurent limestone is herein regarded as lower Hamilton (Cazenovia stage) and below Lingle limestone. Present position of St. Laurent is tentative but it seems unlikely that formation can be placed above Lingle because no post-Centerfield (Tioughnioga) formations are now known in Midwest.

Named for exposures along St. Laurent Creek, Perry County, 3 miles south of St. Mary's, Ste. Genevieve County, Mo.

**St. Lawrence Formation**[1]

**St. Lawrence Member** (of Trempealeau Formation)

Upper Cambrian: Southern Minnesota, Illinois, Iowa, and southern Wisconsin.

Original reference: N. H. Winchell, 1874, Minnesota Geol. Nat. History Survey 2d Ann. Rept., p. 86, 132, 138–157.

Josiah Bridge, 1937, U.S. Geol. Survey Prof. Paper 186–L, p. 236 (table 2). Chart shows St. Lawrence formation comprises (ascending) unnamed shale, Mendota, and Lodi members. Underlies Jordan sandstone.

C. R. Stauffer, G. M. Schwartz, and G. M. Thiel, 1938, (abs.) Geol. Soc. America Bull., v. 49, no. 12, pt. 2, p. 1902. In suggested revised Cambrian classification for Minnesota, St. Lawrence formation includes Judson (new) and Lodi members.

C. R. Stauffer, G. M. Schwartz, and G. A. Theil, 1939, Geol. Soc. America Bull., v. 50, no. 8, p. 1237–1239. Discussion of St. Croixian classification of Minnesota. St. Lawrence formation comprises (ascending) Nicollet Creek (new) and Lodi members. Overlies Franconia formation; underlies Jordan formation.

C. R. Stauffer and G. A. Thiel, 1941, Minnesota Geol. Survey Bull. 29, p. 9, 30, 42–46, measured sections. Formation discussed in detail. St. Croixian series.

B. F. Howell and others, 1944, Geol. Soc. America Bull., v. 55, no. 8, chart 1. Shown on correlation chart as member of Trempealeau formation.

G. O. Raasch, 1951, Illinois Acad. Sci. Trans., v. 44, p. 147. Member of Trempealeau. Overlies Arcadia member (new); underlies Lodi member.

R. R. Berg, 1954, Geol. Soc. America Bull., v. 65, no. 9, p. 860–861. Above Franconia is a nonglauconitic unit of dolomite, dolomitic siltstone, and very fine- grained sandstone, first named St. Lawrence in Minnesota and later named Trempealeau in Wisconsin. St. Lawrence is used in this report [southern Minnesota and west-central Wisconsin] because of priority.

C. A. Nelson, 1956, Geol. Soc. America Bull., v. 67, no. 2, p. 167–171, 173–177, measured sections. Discussion of upper Croixan stratigraphy in upper Mississippi Valley. Terminology adopted represents return to early lithologic classification in which St. Lawrence and Jordan formations are recognized as the dolomitic strata and the massive sandstone, respectively. St. Lawrence of present study consists of dolomitic sediments between Franconia below and Jordan above. Subdivided into Black Earth member below and Lodi member above. Term Nicollet Creek member abandoned. Thickness 63 feet in typical basinward exposure at Lake City; 15 feet in shoreward areas at Ridgeland and Kingston. Suggests that term Trempealeau, previously used as a formation name to include above strata and also as a stage name, be restricted to Trempealeauan stage.

Named for exposures at St. Lawrence, Scott County, Minn.

†St. Lawrence Limestone or Dolomite Member[1] (of Trempealeau Formation)

Upper Cambrian: Southern Minnesota and southern Wisconsin.

Original reference: F. T. Thwaites, 1923, Jour. Geology, v. 31, p. 547.

Exposed at St. Lawrence, Scott County, Minn.

†St. Louis 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).

Copper district of Keweenaw Point.

**St. Louis Conglomerate**[1] (in Portage Lake Lava Series)

Precambrian (Keweenawan): Northern Michigan.

Original reference: L. L. Hubbard, 1898, Michigan Geol. Survey, v. 6, p. 2, p. 79, 83.

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 on St. Louis property, Houghton County.

†St. Louis 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.

†St. Louis Group[1]

Mississippian: Missouri, Tennessee, Illinois, Iowa, and western Kentucky.

Original reference: A. H. Worthen, 1866, Illinois Geol. Survey, v. 1, p. 41–43, 83–89.

Named for St. Louis, Mo.

**St. Louis Limestone**

St. Louis Limestone (in Blue River Group)

St. Louis Limestone (in Meramec Group)[1]

Upper Mississippian (Meramec Series): Missouri, Alabama, Georgia, Illinois, Indiana, Iowa, Kentucky, Tennessee, and southwestern Virginia.

Original reference: G. Engelmann, 1847, Am. Jour. Sci., 2d, v. 3, p. 119–120.

Charles Butts, 1922, Kentucky Geol. Survey, 6th ser. v. 7, p. 120–136. In northern central Tennessee and southeastern Kentucky, the St. Louis overlies Garrett Mill sandstone member (new) of Warsaw formation. Underlies Ste. Genevieve limestone.

J. M. Weller, 1939, Kansas Geol. Soc. Guidebook 13th Ann. Field Conf., p. 131, 133. Classified as formation in Meramec group, Valmeyer series. Overlies Salem (Spergen) limestone; underlies Ste. Genevieve limestone.

J. M. Weller and A. H. Sutton, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 5, p. 766 (fig. 1), 813–815. Middle formation in Meramec group, Iowa series. Overlies Salem limestone; underlies Ste. Genevieve. This classification follows Illinois Geological Survey. In southeastern Iowa, the St. Louis comprises (ascending) Croton and Verdi members; overlies older Mississippian strata unconformably and overlaps formations as low as the Kinderhook. In western Illinois and northeastern Missouri, the St. Louis has not been separated from overlying beds that may be Ste. Genevieve in age. In Indiana, the St. Louis constitutes lower part of Mitchell limestone up to and including Lost River chert member.

Charles Butts, 1940, Virginia Geol. Survey Bull. 52, pt. 1, p. 359–366. In Virginia, the St. Louis rests upon Fort Payne chert or upon Price formation, as in Cumberland-Big Stone Gap area, and southeast of South Clinchfield, Russell County; upon the Maccrady or possibly upon the Warsaw, as at Bluefield, in the Narrows of New River, 1 mile southeast of Richlands, and 2 miles southeast of Bandy, Tazewell County. Succeeded by Ste. Genevieve limestone everywhere from Ste. Genevieve, Mo., to Appalachian Valley.

Paul Averitt, 1941, Virginia Geol. Survey Bull. 56, p. 14–15, 17. In Scott and Washington Counties, consists of 265 feet of very dark colored thick-bedded crystalline limestone overlain by 50 feet of shale and underlain by 16 feet of argillaceous limestone. Underlies limestones of Gasper and Ste. Genevieve ages; overlies Little Valley limestone (new).

B. N. Cooper, 1944, Virginia Geol. Survey Bull. 60, p. 158. In this report [Burkes Garden quadrangle], term Hillsdale is used to replace St. Louis, name used by Butts (1940) for same succession in southwestern Virginia. There are several objections to continued use of name St. Louis in southwestern Virginia. Beds so named are not areally continuout with the St. Louis of Mississippi Valley. Not definitely established that the so-called St. Louis limestone of southwestern Virginia does not contain correlatives of Salem limestone.

Charles Butts and Benjamin Gildersleeve, 1948, Georgia Geol. Survey Bull. 54, p. 45–46, geol. map. Geographically extended into northwestern Georgia where it is about 100 feet thick. Underlies Ste. Genevieve limestone; contact with Fort Payne not exposed.

H. R. Wanless, 1957, Illinois Geol. Survey Bull. 82, p. 47–49. Youngest Mississippian formation in Beardstown-Glasford-Havana-Vermont area. Maximum thickness about 30 feet in outcrop. Overlies Salem formation; separated from overlying Pennsylvanian strata by erosional unconformity. Meramec group, Valmeyer series.

Charles Collinson and D. H. Swann, 1958, Geol. Soc. America Guidebook St. Louis Mtg., Field Trip 3, p. 4 (fig. 3), 8, 9, 10–17. St. Louis-Ste. Genevieve boundary is in doubt in Alton, Ill., area as it is at many places in midwestern United States. Boundary has been placed at as many as four different positions at Alton Bluff outcrop, Madison County, as high as top of main white bed and as low as base of cycle h of cyclic beds. At other localities in area, boundary has been placed even higher, and possibly even lower. It is not possible to correlate individual beds from this area to Ste. Genevieve, some 80 miles south. Hence, a transition zone containing Ste. Genevieve-like oolites and fragmental limestone as well as St. Louis-like fine-grained light-colored pure limestones is placed in St. Louis limestone. Valmeyer series.

H. H. Gray, R. D. Jenkins, and R. M. Weidman, 1960, Indiana Geol. Survey Bull. 20, p. 36 (table 5), 48, 52. Included in Blue River group (new). Underlies Ste. Genevieve limestone. Not exposed in Huron area [this report].

J. W. Baxter, 1960, Illinois Geol. Survey Circ. 284, p. 2–4, pl. 1. Overlies Rocher member (new) of Salem limestone in southwestern Illinois.

Named for exposures in St. Louis, Mo.

†St. Louis Marls[1]

Mississippian: Iowa.

Original reference: H. Hinds, 1909, Iowa Geol. Survey, v. 19, p. 339.

Des Moines County.

†St. Louis Slate[1]

Precambrian: Northeastern Minnesota.

Original reference: R. D. Irving, 1888, U.S. Geol. Survey 7th Ann. Rept., p. 440–441.

†St. Louis River Gabbro[1]

Precambrian (Keweenawan): Northeastern Minnesota.

Original references: R. D. Irving, 1883, U.S. Geol. Survey 3d Ann. Rept. p. 143–146, pl. 14; 1883, U.S. Geol. Survey Mon. 5.

Exposed along north of St. Louis River to Duluth, St. Louis County.

†St. Louis River Slate[1]

Precambrian (upper Huronian): Northeastern Minnesota.

Original reference: R. D. Irving, 1883, U.S. Geol. Survey Mon. 5, p. 384.

Named for exposures on St. Louis River, St. Louis and Carlton Counties.

St. Luke Limestone Member (of Edinburg Formation)

Middle Ordovician: Western Virginia.

B. N. Cooper and G. A. Cooper, 1946, Geol. Soc. America Bull., v. 57, no. 1, p. 81, 82. Proposed for the beds which form the topmost division of the Edinburg in Shenandoah Valley. Consists of rather pure, dove-gray limestone above the *Nidulites-Lambeophyllum* zone and below the *Reuschella "edsoni"* beds that characterize the basal Oranda formation (new). Thickness at type locality 90 feet.

Type locality: One mile S. 60° E. of St. Luke, Shenandoah County. Exposed west of U.S. Route 11, between Forestville and Saumsville.

St. Marks facies (of Tampa Stage)

Miocene, lower: Florida.

H. S. Puri, 1953, Florida Geol. Survey Bull. 36, p. 16 (table 1), 20–21. Name St. Marks limestone (type locality, Wakulla County) was originally used by Finch (1823, Am. Jour. Sci., v. 7, p. 31–43) in describing the occurrence of large oysters. Name St. Marks revived to include calcareous downdip facies of Tampa stage. Near Tampa, facies consists of basal light-gray to yellow limestone of which "Silex bed" is a part. Upper part consists of greenish clay with calcareous nodules. Estimated thickness in subsurface 65 feet. Updip facies named Chattahoochee facies. [Finch, 1823 [1824], described a limestone at St. Marks, Fla., but did not use term St. Marks limestone.]

Ste. Marie Sandstone[1]

Upper Cambrian: Northern Michigan.

Original reference: W. E. Logan, 1863, Canada Geol. Survey Rept. Prog. to 1863, p. 196.

Sault Ste. Marie region.

**St. Mary River Formation**[1]

Upper Cretaceous: Southwestern Alberta, Canada, and northwestern Montana.

Original reference: G. M. Dawson, 1883, Canada Geol. Survey Rept. 1880–1882, p. 3B–6B.

W. A. Cobban, 1955, Billings Geol. Soc. Guidebook 6th Ann. Field Conf., p. 108 (fig. 1), 118. Overlies Horsethief sandstone and underlies Willow Creek formation on northwest flank of Sweetgrass arch, Montana. Thickness about 980 feet.

G. W. Viele, 1960, Dissert. Abs., v. 21, no. 4, p. 853. Overlies Hogan formation (new) in Flat Creek area, Lewis and Clark County, Mont.

Named for exposures on banks of St. Mary River, Alberta, a few miles north of Blackfeet Indian Reservation.

†St. Marys Epidote[1]

Precambrian (Keweenawan): Northern Michigan.

Original reference: A. R. Marvine, 1873, Michigan Geol. Survey, v. 1, pt. 2, p. 25.

In St. Mary's mine, sec. 18, T. 55, R. 33, Houghton County.

**St. Marys Formation**[1] (in Chesapeake Group)

Miocene, middle and upper: Eastern Maryland, Delaware, and eastern Virginia.

Original reference: G. B. Shattuck, 1902, Science, new ser., v. 15, p. 906.

C. W. Cooke, Julia Gardner, and W. P. Woodring, 1943, Geol. Soc. America Bull., v. 54, no. 11, chart 12. Age shown on correlation chart as middle and upper Miocene.

W. B. Spangler and J. J. Peterson, 1950, Am. Assoc. Petroleum Geologists Bull., v. 34, no. 1, p. 78. Present in Delaware. Middle Miocene.

L. W. Stephenson and F. S. MacNeil, 1954, Geol. Soc. America Bull., v. 65, no. 8, p. 733–738. Underlies Yorktown formation in both Maryland and Virginia.

Named for development in St. Marys County and on St. Marys River, Md.

St. Marys Sandstone[1]

Upper Cambrian: Michigan and northeastern Wisconsin.

Original reference: C. Rominger, R. Pumpelly, and T. B. Brooks, 1873, Michigan Geol. Survey Atlas, map of Upper Peninsula.

Named for exposures on St. Mary's River, east end of Upper Peninsula of Michigan.

St. Marysan Substage

Miocene, middle: Maryland, New Jersey, and Virginia.

D. S. Malkin, 1953, Jour. Paleontology, v. 27, no. 6, p. 767, 768. Substage based on microfaunal assemblages; includes all sediments deposited in central Atlantic Coastal Plain province during time of accumulation of St. Marys formation, type exposure of which is considered exemplary of the substage. In sequence the St. Marysan succeeds Choptankian substage and is followed by Yorktownian substage.

†St. Maurice Formation[1]

Eocene, middle: Northwestern Louisiana.

Original references: W. C. Spooner, 1926, Am. Assoc. Petroleum Geologists Bull., v. 10, no. 1, p. 7; no. 3, p. 234–237.

†St. Maurice Formation (in Claiborne Group)[1]

Eocene, middle: Northwestern Louisiana and southwestern Arkansas.

Original reference: G. D. Harris, 1910, Science, new ser., v. 31, p. 502.

Named for exposures at St. Maurice, Winn Parish, La.

**St. Paul Group**

Middle Ordovician: Maryland, Pennsylvania, Virginia, and West Virginia.

R. B. Neuman, 1951, Geol. Soc. America Bull., v. 62, no. 3, p. 267–324, pls. 1, 2. Proposed as a substitute for "Stones River" group as mapped through West Virginia, Maryland, and the Mercersburg-Chambersburg quadrangles in Pennsylvania. Need for such substitution has been apparent since Cooper and Prouty (1943, Geol. Soc. America Bull., v. 54, no. 6) demonstrated that central Tennessee Stones River was definitely younger than Appalachian "Stones River." As proposed, the group is bounded above by Chambersburg limestone, or by Lincolnshire where it is present, and is underlain by Beekmantown group. Type section. 485 feet thick, contains two formations, a lower Row Park (new) and overlying New Market limestone. South of Bessemer, W. Va., group contains only New Market limestone.

F. M. Swartz and R. B. Thompson, 1958, Pennsylvania State Univ. Mineral Industries Exp. Sta. Bull. 71, p. 1–14. Row Park and New Market limestones of Middle Ordovician St. Paul group occur in Franklin County, Pa., as lower and upper parts respectively of rock mapped by Stose (1909, U.S. Geol. Survey Geol. Atlas, Folio 170) under name Stones River limestone in report on Mercersburg and Chambersburg quadrangles. Thickness 800 to 1,300 feet. Underlies Chambersburg limestone; overlies Beekmantown dolomite.

Carlyle Gray and others, 1960, Geologic map of Pennsylvanian (1:250,000): Pennsylvania Geol. Survey, 4th ser. As mapped, includes Annville formation.

Type section: On Boward Farm, south of U.S. Highway 40, about 500 yards southwest of St. Paul's church and junction of Maryland Highway 57 with U.S. Highway 40, 9 miles south of center of Hagerstown, Washington County, Md.

†St. Peter Group[1]

Lower Ordovician: Missouri.

Original reference: C. L. Dake, 1921, Missouri Univ. School Mines and Metallurgy, v. 6, no. 1.

**St. Peter Sandstone[1]**

Middle Ordovician: Minnesota, Arkansas, Illinois, Indiana, Iowa, Kansas, Kentucky, Michigan, Missouri, Ohio, Oklahoma, and Wisconsin.

Original reference: D. D. Owen, 1847, Prelim, rept. of the Geological Survey of Wisconsin and Iowa: U.S. Gen. Land Office Rept. 1847 (U.S. 30th Cong., 1st sess. S. Ex. Doc. 2), p. 169. 170.

H. S. McQueen, 1937, Missouri Geol. Survey and Water Resources 59th Bienn. Rept., app. 1, p. 10–11, 12, 22–23. In southeastern Missouri, the St. Peter overlies Everton formation and underlies Dutchtown formation (new); where Dutchtown is absent, the St. Peter underlies the Joachim formation.

C. R. Stauffer and G. A. Thiel, 1941, Minnesotota Geol. Survey Bull. 29, p. 66–69. Thickness at type section 155 feet. Overlies Shakopee dolomite; underlies Platteville formation. Chazyan series.

J. S. Templeton and H. B. Willman, 1952, Tri-State Geol. Soc. Guidebook 16th Ann. Field Conf., p. [11], fig. 3, [22], fig. 12. In Dixon-Oregon area, St. Peter sandstone underlies Kingdom formation (new) of Glenwood subgroup of Ancell group (new).

A. F. Agnew and others, 1956, U.S. Geol. Survey Prof. Paper 274–K, p. 255 (fig. 32), 273–274, 275. St. Peter sandstone, in lead-zinc district, is about 40 feet thick, overlies Prairie du Chien group [undifferentiated] and underlies Glenwood shale member of Platteville formation. Middle Ordovician.

Type section: At Fort Snelling, Hennepin County. Named for exposures on St. Peter River, now called Minnesota River, southern Minnesota.

**St. Regis Formation** (in Ravalli Group)[1]

Precambrian (Belt Series): Northeastern Idaho and northwestern Montana.

Original reference: F. L. Ransome, 1905, U.S. Geol. Survey Bull. 260, p. 277–285.

F. L. Ransome and F. C. Calkins, 1908, U.S. Geol. Survey Prof. Paper 62, p. 37–39, pl. 11. Indurated shales and more or less flaggy sandstones; colors mostly green and purple; characterized by shallow-water features. Thickness about 1,000 feet. Overlies Revett quartzite; underlies Wallace formation.

F. C. Calkins, 1909, U.S. Geol. Survey Bull. 384, p. 38. Top formation of Ravalli group.

R. E. Wallace and J. W. Hosterman, 1956, U.S. Geol. Survey Bull. 1027–M, p. 582–584, pl. 48. Underlies Wallace formation; overlies Revett quartzite. In Idaho, typically gray to purplish-gray argillite, about 1,200 to 1,400 feet thick, and has an upper member of thinly laminated greenish argillite, 150 to 450 feet thick. In Mineral County, Mont., exhibits marked facies changes and thicknesses of as much as 3,000 to 5,000 feet.

Named for exposures in vicinity of St. Regis Pass, southeastern part of Coeur d'Alene district, Idaho.

St. Regis Granite

Precambrian: Northern New York.

A. F. Buddington, 1937, New York State Mus. Bull. 309, p. 8, 34–35, 38, 45–46; 1939, Geol. Soc. America Mem. 7, p. 136, 137. Pink hornblende granite; commonly contains narrow bands or small shreds of black amphibolite. In some areas, intrusive into Santa Clara complex (new) and in others adjacent to it.

Named for town of St. Regis Falls, Nicholville quadrangle, Franklin County.

†St. Stephens division,[1] Formation,[1], Group,[1] or Limestone[1]

Eocene, upper, and Oligocene: Southern Alabama.

Original reference: T. A. Conrad, 1856, Philadelphia Acad. Nat. Sci. Proc., v. 7, p. 257–258.

Named for exposures in bluff at St. Stephens, Washington County.

†St. Thomas Sandstone[1]

Lower Ordovician: Central Missouri.

Original reference: J. A. Gallaher, 1900, Missouri Geol. Survey, v. 13, p. 124.

Named for St. Thomas, Cole County.

St. Wendells Formation

St. Wendell Sandstone[1]

Pennsylvanian: Southwestern Indiana and southeastern Illinois.

Original reference: M. M. Fidlar, 1933, Indiana Acad. Sci. Proc., v. 42, p. 137.

H. R. Wanless, 1939, Geol. Soc. America Spec. Paper 17, p. 103. St. Wendells formation, a division of post-Allegheniau, between Friendsville above and Parker formation. Exposures noted.

F. D. Spencer, 1953, U.S. Geol. Survey Circ. 266, p. 14 (fig. 4). Chart shows St. Wendells sandstone underlying New Haven formation and overlying Parkers formation.

Fidlar appears to have applied this name to the same unit Culbertson (1932) called Claypole Hills Sandstone. Culbertson's St. Wendells Limestone appears to have been included in the Parker Formation by Fidlar.

Exposed near St. Wendells, Robinson Township, Posey County, Ind.

St. Wendells Limestone (in McLeansboro Formation)

Pennsylvanian: 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. Fossiliferous limestone; maximum thickness 4 feet. Separated from underlying Inglefield sandstone by Parker coal and black shale; underlies Claypole Hills sandstone (new).

This does not appear to be same as St. Wendell Sandstone of Fidlar (1933). It was apparently included in Fidlar's Parker Formation; Fidlar's St. Wendell Sandstone may be same as Culbertson's Claypole Hills Sandstone.

Type locality and derivation of name not given.

Sais Quartzite

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. Referred to as Sais quartzite. Older than Blue Springs muscovite schist (new); intruded by Los Pinos granite (new).

J. T. Stark and E. C. Dapples, 1946, Geol. Soc. America Bull., v. 57, no. 12, pt. 1, p. 1127–1129, pl. 1. Rocks of Sais quartzite vary from light to dark gray, with greenish and nearly white facies in a few outcrops. Grain size rarely more than 1 mm. in diameter, and in most outcrops grains cannot be distinguished megascopically. Massive quartzose beds 3 to 5 feet thick alternate with thinner bedded zones, commonly sericitic. Intruded by Priest granite (new) at northernmost outcrop. Greatest thickness about 600 feet, measured at Abo Pass.

Named for Santa Fe Railway Station of Sais near Abo Pass. Excellent exposures in quarries of Atchison, Topeka, and Santa Fe Railroad near pass. Exposed on up-thrown side of thrust fault in belt extending along east flank of Los Pinos Range from Abo Pass southward for about 5 miles. Width of outcrop less than 500 feet in central part; averages 1,000 feet north of pass.

†Sakonnet Sandstone[1]

Pennsylvanian: Southeastern Rhode Island.

Original reference: A. F. Foerste, 1899, U.S. Geol. Survey Mon. 33, p. 357–365, pl. 31, map.

Forms upper part of Aquidneck series on east side of Sakonnet River and also across Portsmouth and Middletown Townships on west side of Sakonnet River, Newport County.

**Salado Formation**

Salado Halite

Permian (Ochoa Series): Western Texas and southeastern New Mexico.

Original reference: W. B. Lang, 1935, Am. Assoc. Petroleum Geologists Bull., v. 19, no. 2, p. 262–270.

W. B. Lang, 1939, Am. Assoc. Petroleum Geologists Bull., v. 23, no. 10, p. 1569–1572. Base of Salado formation redefined to include anhydrite formerly considered part of Castile formation. As redefined, base of Salado is placed at depth of approximately 3,300 feet in Means well (center of Loving County, Tex.) instead of at 2,350 feet as arbitrarily selected when unit was originally defined.

S. C. Giesey and F. F. Fulk, 1941, Am. Assoc. Petroleum Geologists Bull., v. 25, no. 4, p. 598 (fig. 3), 601–604. In North Cowden Field, Ector County, Tex., the Salado underlies Rustler formation and overlies Tansill formation. Includes Cowden anhydrite member (new) in lower part.

W. B. Lang, 1942, Am. Assoc. Petroleum Geologists Bull., v. 26, no. 1, p. 63–79. Discussion of basal beds of Salado in Fletcher potash core test, near Carlsbad, N. Mex. Sequence described extends from above Cowden member of Salado into underlying Carlsbad limestone. Two members of Salado are defined, La Huerta siltstone and Fletcher anhydrite (at base).

P. B. King, 1942, Am. Assoc. Petroleum Geologists Bull., v. 26, no. 4, p. 610–612. Salado formation, which overlies Castile formation, is poorly exposed in Gypsum Plain east of Delaware Mountains, but it may come to surface here and there near west edge of Rustler Hills. However, most of it is cut out in this region by unconformity at base of Rustler and it reaches its full thickness only east of the outcrop. As indicated by wells east of outcrops, maximum thickness of formation in Delaware basin is somewhat more than 2,000 feet, but decreases to 1,000 feet or less in shelf area beyond margins of the basin.

J. E. Adams, 1944, Am. Assoc. Petroleum Geologists Bull., v. 28, no. 11, p. 1608–1612. Includes Vaca Triste member (new) in upper part.

Western Texas and southeastern New Mexico.

**Salamanca Conglomerate Member** (of Conewango Formation)[1]

**Salamanca Conglomerate** or **Sandstone Member** (of Cattaraugus Formation)[1]

Salamanca Member (of Venango Formation)

Devonian: Southwestern New York and northwestern Pennsylvania.

Original reference: J. F. Carll, 1880, Pennsylvania 2d Geol. Survey Rept. $I_3$.

R. M. Leggette. 1936, Pennsylvania Geol. Survey. 4th ser.. Bull. W–3, p. 204. Conewango formation, in Warren County, has thickness of about 550 feet and is divided about in half by Salamanca conglomerate. The Salamanca is persistent throughout county and ranges in thickness from about 10 to 20 feet.

Bradford Willard, 1937, Pennsylvania Acad. Sci. Proc., v. 11, p. 32. Listed as member of Venango formation; underlies Saegerstown member; overlies Panama conglomerate.

S. W. Lohman, 1939, Pennsylvania Geol. Survey, 4th ser., Bull. W–6, p. 40. Member of Cattaraugus. Where exposed in quarry near Lewis Run, McKean County, it is greenish-gray sandstone.

G. A. Cooper and others, 1942, Geol. Soc. America Bull., v. 53, no. 12, pt. 1, chart 4. Upper Devonian. In column, Salamanca occurs above the Amity and below the Saegerstown. Term Conewango group is elevated to rank of stage.

J. G. Woodruff, 1942, New York State Mus. Bull. 326, p. 63. Conglomerate member of Cattaraugus formation described in Wellsville quadrangle. Overlies Wolf Creek conglomerate member; underlies Oswayo formation.

Named for Salamanca "rock city," New York.

Salamanca 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. 85–86.

Typically developed in Olean-Salamanca region, Cattaraugus County, N.Y.

†Salem Breccia[1]

Lower Ordovician (early Chazy): Northern central Alabama.

Original reference: E. A. Smith, 1890, Alabama Geol. Survey Rept. Cahaba coal field, p. 152.

Named for exposures in Salem Hills, southwest of Bessemer, Jefferson County.

**Salem Gabbro-Diorite[1]**

Lower Paleozoic(?): Eastern Massachusetts.

Original reference: C. H. Clapp, 1910, Igneous rocks of Essex County, Massachusetts, p. 5, 7, 8, 11.

N. E. Chute, 1940, Massachusetts Dept. Public Works Bull. 1, p. 4, 9–10, pls. 2–A, 2–B. Ordovician(?) or Silurian(?).

N. E. Chute, 1950, Bedrock geology of the Brockton quadrangle, Massachusetts: U.S. Geol. Survey Geol. Quad. Map [GQ–5]. Extensively intruded by Dedham granodiorite in Brockton quadrangle. Lower Paleozoic(?).

Named for occurrence at Salem, Essex County.

Salem Lavas

Salem Hills Basalt

Miocene, middle: Northwestern Oregon.

R. E. Corcoran and F. W. Libbey, 1956, Oregon Dept. Geology and Mineral Industries Bull. 46, p. 7–8, 12. In Salem Hills area, Eugene formation is overlain unconformably by series of basalts called Salem lavas in Salem quadrangle by Mundorff (1939, unpub. thesis) and Stayton lavas in that general region by Thayer (1939). On west side of Salem Hills, the lavas are at least 410 feet thick and dip northeast approximately 2° to 3°. According to Mundorff, the Salem lavas are typically medium to dark gray, fine grained, and dense, rarely porphyritic. Salem-Stayton lavas are correlated with Columbia River basalt. Also referred to as Salem Hills basalt.

Named for occurrence in Salem quadrangle.

**Salem Limestone**[1]

Salem Formation

Upper Mississippian (Meramec Series): Southern Indiana, southern Illinois, southeastern Iowa, western and central Kentucky, and eastern Missouri.

Original references: E. R. Cumings, 1901, Jour. Geology, v. 9, p. 233; Am. Geologist, v. 27, p. 147.

P. B. Stockdale, 1939, Geol. Soc. America Spec. Paper 22, p. 224, 227, pls. 6, 25, 26. Salem limestone (Spergen of some authors) was traced across Kentucky as far as Cumberland River, southern Pulaski County. Somerset shale member of Warsaw formation (Butts, 1922) has been traced from southern Indiana to type locality at Somerset, Pulaski County, Ky., and is here interpreted as being a basal argillaceous phase of Salem limestone.

J. M. Weller and A. H. Sutton, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 5, p. 766 (fig. 1), 811–813. Names Salem and Spergen, both taken from localities in Washington County, Ind., have been applied to limestone from which the Bedford, Ind., building stone is obtained. Name Salem, which was proposed first and has been used consistently by Indiana Geological Survey is preferable to name Spergen. In standard Mississippian section, the Salem underlies St. Louis limestone and overlies Warsaw limestone. In Indiana, overlies Harrodsburg limestone. In its typical development in Indiana, the Salem is lenticular; attains thickness of 50 to 60 feet near Bedford but locally pinches out; layers of buff to nearly black bituminous calcareous shale are associated with massive limestone, particularly at top and bottom, and, including these beds, formation has maximum thickness of 90 to 100 feet. In Ste. Genevieve County, Mo., 160 feet of gray to white, more or less oolitic limestone have been referred to the Salem, but paleontologic evidence suggests that upper part of these beds is of St. Louis age; central 100 feet is exceptionally pure oolite; northward the Salem becomes progressively less pure and beyond Alton, Ill., consists mainly of earthy limestone with minor shaly beds. At Warsaw, Ill., beds referred to Salem consist of 4 to 8 feet of more or less crossbedded yellowish limestone that grades laterally into calcareous sandstone, which has been termed Sonora sandstone (Keyes, 1895). Apparently equivalent beds in southeastern Iowa attain maximum thickness of nearly 30 feet; name Belfast (Van Tuyl, 1925) has been proposed for Salem formation in Iowa. South of Warsaw, Ill., boundary between Salem and Warsaw is drawn at horizon that separates a lower dominantly shale zone from an upper zone of hard massive- to thin-bedded granular to fine-grained more or less earthy, impure and dolomitic limestone beds separated by layers or partings of shale that are commonly calcareous. This report places the Salem in Meramec group, Iowa series.

J. M. Weller and others, 1948, Geol. Soc. America Bull., v. 59, no. 2, chart 5. Shown on correlation chart in Meramecian series.

H. R. Wanless, 1957, Illinois Geol. Survey Bull. 82, p. 28 (fig. 9), 47. In Illinois, Salem formation is included in Meramec group, Valmeyer series.

J. W. Baxter, 1959, Dissert, Abs., v. 19, p. 2910, 2911. In southwestern Illinois, Salem limestone is subdivided into four members [sequence not indicated]: Kidd, Fults, Chalfin, and Rocher.

J. W. Baxter, 1960, Illinois Geol. Survey Circ. 284, p. 1–32. Salem limestone, in southwestern Illinois, subdivided into (ascending) Kidd, Fults, Chalfin, and Rocher members. Thickness about 200 feet. Overlies Warsaw formation; underlies St. Louis limestone. Valmeyer series.

Named for Salem, Washington County, Ind.

Salem Limestone (in Allegheny Formation)[1]

Pennsylvanian: Northeastern Ohio.

Original reference: Wilber Stout and R. E. Lamborn, 1924, Ohio Geol. Survey, 4th ser., Bull. 28, p. 146–150.

R. E. Lamborn, 1951, Ohio Geol. Survey, 4th ser., Bull. 49, p. 27. Light-bluish- to brownish-gray dense-textured limestone. Thickness about 8 inches. Allegheny series.

Named for exposures at Salem, Columbiana County. Not positively identified outside county.

†Salem Syenite[1]

Carboniferous: Massachusetts.

Original reference: E. Cornelius, 1821, Am. Jour. Sci., v. 3, p. 232.

Named for occurrence in town of Salem, Essex County.

Salem Church Granite[1]

Precambrian: Northwestern Georgia.

Original reference: W. S. Bayley, 1928, Georgia Geol. Survey Bull. 43, p. 103–108, map.

G. W. Stose and A. J. Stose, 1949, Geol. Soc. America Bull., v. 60, no. 2, p. 276–277. Stose and Stose (1944, Am. Jour. Sci., v. 242, p. 411) accepted conclusion of Bayley (1929) that the Salem Church granite intrudes the Hiwassee slate of Ocoee series and the statement of Crickmay (1936, Geol. Soc. America Bull., v. 47, no. 9) that the Corbin granite is intrusive into the Talladega series which the writers [Stose and Stose] include in the Ocoee series. Salem Church granite, exposed in an oval area in western part of Tate quadrangle and adjacent Cartersville quadrangle, is surrounded by a band of Hiwassee slate and several small areas of slate lie within the granite. Relation of the granite to the slate is confused because the granite in places is sheared to mylonite on cross fractures, which also offset the slate. The Salem Church may be part of an injection complex which is older than the Ocoee series. Hiwassee slate as mapped around the granite underlies Great Smoky quartzite and is interpreted as basal formation of Ocoee series equivalent to Hurricane graywacke (new). The Corbin granite is exposed southwest of Salem Church granite and just east of Cartersville overthrust. The Salem Church resembles phases of the Corbin granite and because of this similarity has been called Corbin granite by Furcron and Teague (1946, Geol. Soc. America Bull., v. 57, no. 12, pt. 2 p. 1195). Precambrian.

Well exposed at Salem Church, Tate quadrangle, and west and southwest of church.

**Salem Point Shale Member**[1] (of Grenola Limestone)

Permian: Southeastern Nebraska, eastern Kansas, and northern Oklahoma.

Original reference: G. E. Condra and C. E. Busby, 1933, Nebraska Geol. Survey Paper 1.

N. G. Lane, 1958, Kansas Geol. Survey Bull. 130, pt. 3, p. 134–137, 160. In type area of Grenola limestone, the Salem Point is shale, generally unfossiliferous, interbedded with thin earthy limestone layers. Thickness about 9½ feet. Lower boundary is marked by upper massive osagite bed of Burr limestone member; upper boundary is base of first fusulinid limestone, which is lowest bed of Neva limestone member. Lower Permian, Wolfcamp series.

Type locality: Roadcuts at Salem Point, 1½ miles northwest of Salem, Richardson County, Nebr.

**Salem School Limestone Member** (of Graham Formation)[1]

Salem School Limestone Member (of Gonzales Formation)

Upper Pennsylvanian: Central northern Texas.

Wallace Lee and others, 1938, Texas Univ. Bur. Econ. Geology Pub. 3801, p. 12, 16–18. First marine member of Graham formation. Highly fossiliferous yellowish earthy limestone. Thickness 8 inches to nearly 2 feet. Overlies both the channel deposits (Kisinger channel) at base of the Graham and the older Home Creek limestone member of Caddo Creek formation of Canyon group. Underlies unnamed shale and sandstone unit which in turn underlies Gonzales limestone member.

M. G. Cheney, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 1, p. 66 (fig. 1). Reallocated to member status in the Gonzales here raised to formational status in Graham group. Overlies Kisinger channel and underlies an "upper limestone."

E. L. Thackery, 1951, West Texas Geol. Soc. Guidebook, June 1–2, p. 14–15, chart. Chart shows Salem School limestone near base of Graham group. Occurs below Gonzales limestone in Brazos River section and below North Leon limestone in Colorado River section.

John Kay, 1956, North Texas Geol. Soc. Field Guidebook May 25–26, fig. 4. Generalized columnar section shows Salem School limestone at base of Graham group, stratigraphically below Bunger limestone and above Home Creek limestone in Caddo Creek group.

Well exposed one-half mile southeast of Salem School, in southeastern part of Young County, Brazos River area.

Salesville Formation (in Whitt Group)

Salesville Shale Member (of Mineral Wells Formation)[1]

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. Rank raised to formation in Whitt group (new). Expanded below to include Lake Pinto sandstone member. Underlies Keechi Creek formation; overlies East Mountain shale in Lone Camp group. 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] Salesville is considered a formation although author does not wholly agree with Cheney's redefinition and believes it confusing to expand meaning of a rock name vertically to include a previously named rock body. As defined here, formation includes Lake Pinto sandstone at base and an unnamed shale member above which includes Dog Bend limestone bed in lower parts. Whitt group not used in this report.

Named for small town in Palo Pinto County, north of Mineral Wells.

Salida Schists[1]

Precambrian: Central Colorado.

Original reference: W. Cross, 1893, On a series of peculiar schists near Salida, Colorado: Colorado Sci. Soc. Proc., v. 4.

Chaffee County.

**Salina Formation**[1] or **Group**

Upper Silurian: New York, Michigan, and northern Ohio.

Original reference: J. D. Dana, 1863, Manual of geology, 1st ed., p. 246–251.

T. G. Payne, 1938, Rochester Mus. Arts and Sci Guide Bull. 5, p. 69. In Genesee country, group comprises (ascending) Vernon shale, 300 feet, Camillus shales, 550 feet, Bertie waterlime, 85 feet, and Akron dolomite, 6 feet.

C. K. Swartz and others, 1942, Geol. Soc. America Bull., v. 53, no. 4, chart 3. As shown on correlation chart, Salina group comprises (ascending) Pittsford shale, Vernon shale, Syracuse salt, Camillus shale, and Bertie waterlime. Occurs above Guelph group and below Cobleskill (Akron) dolomite.

L. V. Rickard, 1955, New York Geol. Assoc. Guidebook 27th Ann. Mtg., p. 7. Upper Cayugan series (revised) contains two formations, Salina and Bertie. Salina consists of two facies, Vernon red shales near base, and Camillus gray calcareous shales and dolomites with salt and gypsum beds.

D. W. Fisher, 1959, New York State Mus. Sci. Service Geol. Survey Map and Chart Ser. 1. Shown on correlation chart as Salina group. Includes Camillus shale, Vernon shale, and Syracuse dolomite (salt). Name Pittsford shale discontinued. Overlies Lockport group; underlies Bertie group. In Canastotan stage (new). Cayugan series. Upper Silurian. Note on type locality.

W. P. Leutze, 1960, Dissert. Abs., v. 20, no. 12, p. 4633–4634. In central New York, group attains maximum thickness of about 1,000 feet at outcrop. Divisible into (ascending) Vernon shale, Syracuse formation, Camillus shale, and Bertie formation. In eastern New York, Camillus and Bertie cannot be separated and combined unit is called Brayman shale.

Precise type locality unknown but numerous exposures of Vernon, Syracuse, and Camillus rocks exist in northern part of Onondaga County (Syracuse quadrangle), N.Y. Supplies salt wells at Salina, N.Y.

†Salinas Shale[1]

Eocene, middle: Southern California.

Original reference: W. A. English, 1918, U.S. Geol. Survey Bull. 691, p. 219–250.

Well developed on west side of Salinas Valley.

**Saline Formation** (in Wilcox Group)

Eocene: Central Arkansas.

Mackenzie Gordon, Jr., J. I. Tracey, Jr., and M. W. Ellis, 1958, U.S. Geol. Survey Prof. Paper 299, p. 11 (fig. 4), 46–55, plates. Proposed for section of dark-chocolate-brown laminated clay and silt and interbedded white, tan, orange, and red sand that overlies Berger formation (new) and underlies Detonti sand (new). Thickness 350 feet at type locality; thickness recorded in drill holes 165 to 495 feet. Rests with local unconformity upon the Berger and, in places, unconformably on Wills Point and Kincaid formations and nepheline syenite masses and their included small pendants of metamorphic rocks of Paleozoic age.

Type locality: Roadcut immediately north of Benton pumping station, several hundred feet east of northwest corner SW¼SE¼ sec. 25, T. 2 S., R. 15 W., Saline County. Named for Saline River. Crops out in irregular band as much as 9 miles wide that extends in a northeasterly direction across bauxite region and surrounds or covers a part of every nepheline syenite hill. Mapped from east bank of Saline River in Saline County to west bank of Fourche Bayou near Sweet Home in Pulaski County where formation wedges out beneath Quaternary alluvium of Arkansas River flood plain.

Saline Bayou Member (in Claiborne Group)[1]

Saline Bayou Member (of Cook Mountain Formation)

Eocene: 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, 96–101, pls. 3, 8 (fig. 1). Described in Winn Parish, La., as member of Cook Mountain formation. Thickness 20 to 35 feet. Overlies Milams member (restricted); underlies Little Natches member (new).

Type locality: Saline Bayou at St. Maurice, Winn Parish, La.

Saline Creek (cave) Conglomerate[1]

Pennsylvanian: Central Missouri.

Original reference: S. H. Ball and A. F. Smith, 1903, Missouri Bur. Geology and Mines, v. 1, 2d ser., p. 92–95.

Named for exposures on Saline Creek, Miller County.

Salineno Sandstone Member or Tongue (of Fayette Formation)[1]

Eocene, upper: Southern Texas, and northern Mexico.

Original reference: W. G. Kane and G. B. Gierhart, 1935, Am. Assoc. Petroleum Geologists Bull., v. 19, no. 9, p. 1375, 1383, 1387.

J. M. Patterson, 1942, Am. Assoc. Petroleum Geologists Bull., v. 26, no. 2, p. 259 (fig. 2), 267. Basal member or tongue of Fayette. As sandstone enters Starr County from Mexico, it is about 40 feet thick; northward it becomes extinct in a section of red and green bentonitic shales. Contains oyster and other shells; distinguished in Roma area by abundance of calcareous sandy concretions which are highly fossiliferous; borings of *Halymenites* abundant. Underlies Resendez member (new).

Named from town of Salineno on east bank of Rio Grande, southern part of Falcon quadrangle, Starr County.

Salisbury Granite

Age not stated: Western North Carolina.

Felix Chayes, 1952, Am. Jour. Sci., v. 250, no. 4, p. 282–284. Coarse moderately gneissic granite in which quartz is always either magnificently undulant or entirely granulated.

Salisbury is in Rowan County.

†Salisbury Schist[1]

Pre-Triassic: Northwestern Connecticut.

Original references: J. D. Dana, 1874, Am. Assoc. Adv. Sci. Proc., v. 22, p. 25–27; W. M. Agar, 1932, Am. Jour. Sci., 5th ser., v. 23, p. 31–48.

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

Occurs in Salisbury-Canaan region, Litchfield County.

**Salitral Shale Tongue** (of Chinle Formation)

Salitral Shale Member (of Moenkopi Formation)

Upper Triassic: Northwestern New Mexico.

G. H. Wood and S. A. Northrop, 1946, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 57. Tongue of Chinle formation in and around Nacimiento Mountains and San Pedro Mountains. Consists of variegated shale with limestone concretions. Underlies Poleo sandstone lentil; overlies Agua Zarca sandstone member (new). Cannot be differentiated from main body of Chinle formation south of latitude of Los Pinos Arroyo. Upper Triassic.

J. A. Momper, 1957, Four Corners Geol. Soc. Guidebook 2d Field Conf., p. 91, 92. Considered member of Moenkopi in San Juan Basin. Thickens westward into main body of Moenkopi at expense of underlying Agua Zarca member.

J. A. Momper and W. W. Tyrrell, Jr., 1957, Four Corners Geol. Soc. Guidebook 2d Field Conf., p. 23. Thickness in San Juan Basin 30 to 100 feet. Type locality indicated.

Type locality: Salitral Creek, T. 22 N., Rs. 2 and 3 W., Rio Arriba County.

†Salkehatchie Marl[1] or phase[1]

Miocene: 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.

Named for exposures along Salkehatchie River, Colleton County.

**Sallisaw Formation**

Sallisaw Sandstone[1]

Lower or Middle Devonian: Northeastern Oklahoma.

Original reference: I. H. Cram, 1930, Oklahoma Geol. Survey Bull. 40–QQ, p. 24, map.

G. G. Huffman and others, 1958, Oklahoma Geol. Survey Bull. 77, p. 14 (fig. 2), 35–40, pl. 4. On southwestern flank of Ozark uplift Sallisaw formation is composed of several distinct lithologies; most common is light- to dark-gray fine-grained medium-bedded calcareous sandstone which weathers gray to brown and grades laterally into sandy limestone;

white to light-gray chert is interbedded with the calcareous sandstone or sandy limestone; locally contains large amounts of dark ferromagnesian minerals and some phosphatic material; where Sallisaw fills solution cavities in underlying St. Clair, it is typically a gray dense fine-grained limestone containing fine sand. Reaches maximum thickness of 11 feet in sec. 15, T. 13 N., R. 23 E., thins rapidly northward and is essentially absent north of T. 13 N. Unconformably overlies Frisco or St. Clair; unconformably underlies Chattanooga shale or its basal member, the Sylamore sandstone.

Well exposed along Sallisaw Creek near Marble City, Sequoyah County.

Sallisaw Marble[1]

Silurian: Central eastern Oklahoma.

Original reference: C. Schuchert, 1922, Geol. Soc. America Bull., v. 33, p. 670.

Near Marble City, Sequoyah County.

**Sallyards Limestone 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. Shaly to massive limestone with thin shale breaks. Thickness ½ to 3½ feet. Underlies Legion shale member; overlies Roca shale. Wolfcamp series.

Type locality: South bank of ravine 1 mile northeast of Sallyards, Greenwood County, Kans.

**Salmon Hornblende Schist**[1]

Pre-Silurian: Northern California:

Original reference: O. H. Hershey, 1901, Am. Geologist, v. 27, p. 225–245.

F. G. Wells and F. W. Cater, Jr., 1950, California Div. Mines Bull. 134, pt. 1, p. 81. Within Applegate group is a massif of Precambrian(?) Salmon and Abrams schist that lies between Seiad and Beaver Creeks and extends southward across Kalamath River, Siskiyou County.

Seymour Mack, 1958, U.S. Geol. Survey Water-Supply Paper 1462, p. 15 (table 4), 16–18, pl. 1. In northern and western parts of Scott Valley, Siskiyou County, Abrams and Salmon schists are overlain unconformably by several thousand feet of greenstone and greenstone schist possibly correlative with Devonian(?) Copley greenstone. In southern part of Klamath Mountains, the Chanchelulla(?) formation of Hinds (1931), a series of moderately metamorphosed sedimentary rocks probably of Silurian age, lies unconformably on Abrams and Salmon schists. Thus, evidence indicates only that the Abrams and Salmon schists can be adjudged with certainty to be of pre-Silurian age. Any assignment of these rocks to Precambrian or lower Paleozoic would be extremely tenuous.

W. P. Irwin, 1960, U.S. Geol. Survey Prof. Paper 400–B, p. B315–B316; 1960, California Div. Mines Bull. 179, p. 19–20. Mapping in Weaverville quadrangle indicates that (1) structure of metamorphic rocks included in that quadrangle is synclinorial, with Abrams mica schist overlying Salmon hornblende schist, (2) the Abrams is probably younger rather than older than the Salmon, and (3) the marble lenses are of stratigraphic significance in that they are chiefly in lower part of Abrams.

Abrams occupies trough of synclinorium, and thus structurally overlies the Salmon. Early workers believed that the Salmon overlay the Abrams, but this view, based chiefly on reconnaissance, now seems to be erroneous, and so does the view, tentatively advanced by Diller and Ferguson (unpub. data) that the Salmon represents an intrusive body.

Named for exposures along Salmon River, Trinity and Shasta Counties.

**Salmon Lake Glaciation**

Pleistocene: West-central Alaska.

D. M. Hopkins, 1953, *in* T. L. Péwé and others, U.S. Geol. Survey Circ. 289, p. 10–11, 13 (table 1). Four Quaternary glaciations recognized on Seward Peninsula. Salmon Lake succeeded Nome River glaciation (new); preceded Mount Osborn glaciation (new). Salmon Lake ice extended into upland valleys south of Kigluaik Mountains, and in upper parts of valleys in Bendeleben, Darby, and York Mountains. End moraines consist of arcuate zones of slightly modified knob and kettle topography. Lateral moraines on valley walls breached by gullies and ravines.

D. M. Hopkins, F. S. MacNeil, and E. B. Leopold, 1960, Internat. Geol. Cong., 21st, Copenhagen, pt. 4, p. 46–57. Outwash and gravel of Salmon Lake glaciation described in report on coastal plain at Nome. Believed to be Wisconsin.

Salmon Lake, large lake a few miles southwest of Iron Creek, dammed by moraine marking most advanced position of Salmon Lake glaciation, Seward Peninsula.

†Salmon River Sandstone[1]

Upper Ordovician: Northern New York.

Original reference: T. A. Conrad, 1839, New York Geol. Survey 3d Rept., p. 58, 62–63.

Forms falls of Salmon River in town of Orwell and above Redfield village, Lewis County.

†Salmon River Sandstones and Shales[1]

Upper Ordovician: New York.

Original reference: T. A. Conrad, 1840, New York Geol. Survey 4th Rept., p. 201.

**Salmon Springs Drift, Glaciation**

Pleistocene, middle(?) to upper(?): Northwestern Washington.

D. R. Crandell, D. R. Mullineaux, and H. H. Waldron, 1958, Am. Jour. Sci. v. 256, no. 6, p. 385, 394. Pre-Vashon till and pebble and boulder gravel that overlies Puyallup formation. In most areas, these sediments appear to represent a single glacial drift unit; in exposures near Sumner, presence of nonglacial sediments between post-Puyallup glacial gravels indicate that two glaciations or two advances of a single major glaciation are represented; the Salmon Springs drift is defined as including both of these post-Puyallup-pre-Vashon glacial deposits. At Salmon Springs, the drift is separated into upper and lower drift sheets by 4 feet of peat and volcanic ash. Salmon Springs glaciation is the third in a sequence of four glaciations in Puget Sound lowland. Preceded by Stuck glaciation and followed by Vashon glaciation.

Typically exposed in east valley wall of Stuck River in gully 150 feet east and another gully 400 feet north of SE cor. SW¼ sec. 18, T. 20 N., R. 5 E., in vicinity of Salmon Springs, city water supply about 1 mile northeast of Sumner, Pierce County.

**Salmontrout Limestone**[1]

Middle Devonian: Northeastern Alaska.

Original reference: E. M. Kindle, 1908, Geol. Soc. America Bull., v. 19, p. 262, 325–327.

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

J. T. Dutro, Jr., and T. G. Payne, 1957, Geologic of Alaska (1:2,500,000): U.S. Geol. Survey. Appears on map legend.

Outcrops on both banks of Porcupine River immediately above Salmontrout River.

Salona Formation[1]

Middle Ordovician (Trentonian): Central and south-central Pennsylvania, northwestern Virginia, and eastern West Virginia.

Original reference: R. M. Field, 1919, Am. Jour. Sci., 4th ser., v. 48, p. 404, 420.

R. R. Rosenkrans, 1934, Am. Jour. Sci., 5th ser., v. 27, no. 158, p. 113–134. Six bentonite beds recognized near base of Salona. These are designated in ascending order Nos. 0–5. Overlies Rodman formation.

G. M. Kay, 1944, Jour. Geology, v. 52, no. 2, p. 109–114. Includes about 175 feet of dark argillaceous limestone and calcareous shale in type section. Contains eight metabentonite beds. Overlies Rodman member of Nealmont formation with essential conformity; base of Salona lies 2 feet below metabentonite 0. Underlies Coburn limestone. Geographically extended to West Virginia. Trenton group. Mohawkian.

L. C. Craig, 1949, Geol. Soc. America Bull., v. 60, no. 4, p. 742–745. In south-central Pennsylvania, the Martinsburg shale overlies Oranda formation. Lower part of Martinsburg is equivalent in Blacklog Valley to the part of the Salona succeeding metabentonites 1 and 2 and including metabentonite 6.

Marshall Kay, 1956, Geol. Soc. America Bull., v. 67, no. 1, p. 89–91, 95. Subdivided in West Virginia and Virginia to include Onego member (new), which is believed to correspond approximately to lowermost Salona of Pennsylvania, though it probably extends a little lower. Underlies "Martinsburg" formation in West Virginia and Virginia sections. Trentonian series.

G. A. Cooper, 1956, Smithsonian Misc. Colln., v. 127, pt. 1, p. 89. In Virginia overlies Oranda formation. In Pennsylvania, overlies Rodman member of Nealmont formation.

Named for occurrence at Salona, Clinton County, Pa.

Saltash Formation

Precambrian(?): East-central Vermont.

W. F. Brace. 1953, Vermont Geol. Survey Bull. 6, p. 44–45, tables 2, 3. Consists of grits, phyllite, and quartzite, clearly divisible into three members. Lowest, member A, includes green or white grits, schist and sericite quartzite, and a few conglomerate beds. Member B is a graphitic black phyllite with thin dolomite and limestone beds; it is separated from lower grits by pyritic white sericite schist, quartzite, and dolomitic sandstone. Member C consists of vitreous quartzites; a few beds of dolomite and thin-bedded graphitic quartzite separate it from member B. Total thickness varies from about 1,700 to 2,000 feet. Underlies Tyson formation; overlies Mount Holly complex, both unconformably.

Well exposed in all east-flowing brooks of the Ottauquechee and Black River valleys from Saltash Mountain to West Bridgewater in the Rutland area.

Salt Creek Conglomerate

Upper Cretaceous: Northern California.

N. L. Taliaferro, 1954, *in* Northern California Geol. Soc. [Guidebook] Spring Field Trip, [p. 6, 7, 8], correlation chart, structure sections A, B, and C. Shown on correlation chart and structure sections as underlying Antelope shale (new) and overlying Horsetown group or Lower Cretaceous strata. Beds vertical to overturned. Thickness 1,250 to 2,200 feet. The Salt Creek is stratigraphic marker which indicates a possible disconformity or minor unconformity. Conjectural base of Upper Cretaceous.

Occurs in Rumsey Hills-Capay Valley-Wilbur Springs area on west side of Sacramento Valley.

Salt Creek Fanglomerate[1]

Pleistocene: Eastern Utah.

Original reference: A. J. Eardley, 1933, Michigan Acad. Sci., Arts, and Letters, v. 18, p. 310, 336.

K. D. Johnson, 1959, Brigham Young Univ. Research Studies, Geology Ser., v. 6, no. 6, p. 26, 27–28, pl. 8. Described in Mount Nebo-Salt Creek area where, at mouth of Foote's Canyon, it forms red cap on ridges of Arapien shale and at Left Fork of Foote's Canyon overlies vertical beds of Nugget and Ankareh formations. Pleistocene.

First described in Salt Creek Canyon, southern Wasatch Mountains.

†Salt Creek Gravel Beds[1]

Pleistocene: North-central Kansas.

Original reference: W. N. Logan, 1897, Kansas Univ. Geol. Survey, v. 2, p. 218.

J. C. Frye and A. B. Leonard, 1952, Kansas Geol. Survey Bull. 99, p. 110. Used by Logan (1897) for beds which are now, at least in part, the Sanborn formation.

Named for Salt Creek, Russell County.

Salt Creek Marble (in Blaine Formation)[1]

Permian: Northwestern Oklahoma.

Original reference: G. G. Suffel, 1930, Oklahoma Geol. Survey Bull. 49, p. 69.

In vicinity of Salt and Bitter Creeks, Blaine County.

Salt Creek Member (of Moenkopi Formation)[1]

Lower Triassic: Northeastern Arizona.

Original reference: D. Hager, 1921, Oil possibilities of Holbrook area, northeastern Arizona, private publication.

E. D. McKee, 1954, Geol. Soc. America Mem. 61, p. 19. Lower and middle subdivisions of Moenkopi, in Little Colorado Valley, referred to as the Salt Creek by Hager (1922, Mining and Oil Bull., v. 8, no. 2, p. 73), here called, respectively, Wupatki member and Moqui member.

Occurs at mouth of Salt Creek, mouth of Clear Creek, southeast corner of Winslow, and just south of Holbrook.

**Salt Creek Bend Shale Member** (of Pueblo Formation)

Salt Creek Bend Shale (in Cisco Group)[1]

Permian (Wolfcamp): Central Texas.

Original reference: F. M. Bullard and R. H. Cuyler, 1935, Texas Univ. Bull. 3501, p. 245, 249.

R. C. Moore, 1949, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 80, sheet 2. Described in Colorado River valley as shale member of Pueblo formation. Underlies Camp Colorado limestone member; overlies Stockwether limestone member. Average thickness 45 feet. Upper part of member consists mostly of dark-red to maroon clay; near Colorado River, a sandstone 5 to 15 feet thick is persistent subdivision; in eastern Coleman County, three limestone beds, 1 to 5 feet thick, occur in upper part, and the middle of these limestones is sandy and locally grades to sandstone.

P. T. Stafford, 1960, U.S. Geol. Survey Bull. 1081–G, p. 269. Geographically extended into Brazos River valley where it is 40 to 100 feet thick and consists of variegated shale with minor amounts of sandstone and siltstone. Underlies Camp Colorado limestone member; overlies Stockwether limestone member.

Type locality: A sharp bend on Colorado River, 0.1 mile east of mouth of Salt Creek, McCulloch County

Salt Fork Group (in Cimarron Series)

Salt Fork division (of Cimarron Group)[1]

Permian: Central southern Kansas and western Oklahoma.

Original reference: F. W. Cragin, 1896, Colorado Coll. Studies, v. 6, p. 3, 18.

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 is from subsurface records.

Named for Salt Fork, Comanche and Barber Counties, Kans.

Salt Grass 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. As currently defined, consists of gray clayey shale that contains numerous thin bentonite beds, limestone concretions, and concretionary limonite zones. Thickness 60 feet. Overlies Lake Creek shale member; underlies an unnamed shale 500 to 600 feet thick that in turn underlies Beecher Island shale member.

Named for Salt Grass Canyon, the southern tributary of Goose Creek in secs. 1 and 12, T. 12 S., R. 42 W., Wallace County.

†Saltillo Limestone[1]

Middle Ordovician: Western Tennessee.

Original reference: A. F. Foerste, 1903, Jour. Geology, v. 11, p. 33–35, 44.

Named for Saltillo, Hardin County.

Salt Lake Conglomerate[1]

Quaternary(?): Western Wyoming.

Original reference: A. C. Peale, 1879, U.S. Geog. and Geol. Survey Terr. 11th Ann. Rept., p. 552, 612, 641.

Occurs at various points in lower valley of Salt River, Lincoln County.

**Salt Lake Formation[1]**

Salt Lake Group

Pliocene: Northern Utah, southeastern Idaho, and northern Nevada.

Original reference: F. V. Hayden, 1869, U.S. Geol. and Geog. Survey Terr. Rept. on Colorado and New Mexico, 3d Ann. Rept., p. 92.

A. J. Eardley, 1944, Geol. Soc. America Bull., v. 55, no. 7, p. 845–846. Norwood tuff (new) is recognized as division under Hayden's Salt Lake group. When intermontane valleys west of the Wasatch become better known stratigraphically, Salt Lake group may be found to include several formations, perhaps separated in age by considerable parts of the Tertiary.

J. S. Williams, 1948, Geol. Soc. America Bull., v. 59, no. 11, p. 1130 (table), 1147, pl. 1. Group comprises light-colored tuffs, tuffaceous sandstones, and conglomerates that underlie foothill benches about margins of Cache Valley and extend in irregular patches through passes that connect valley with adjacent valleys to south, east, and north. Thickest section, exposed in Junction Hills horst in sec. 15, T. 13 N., R. 2 W., is 1,140 feet. Unconformable above Paleozoic rocks. Oligocene(?) to Pleistocene(?).

G. R. Mansfield, 1952, U.S. Geol. Survey Prof. Paper 238, p. 44–46, pl. 1. Formation described in Ammon and Paradise quadrangles, Idaho. As mapped, consists of conglomerate, calcareous grit, sandstone, shale, and marl; includes some bedded volcanic ash and tuff and windblown dust of Pleistocene age. Thickness varies from 0 to as much as 800 feet. Unconformably overlies rocks of all earlier formations represented. Pliocene(?).

Neal Smith, 1953, Intermountain Assoc. Petroleum Geologists Guidebook 4th Ann. Field Conf., p. 73–76. Williams (unpub. thesis) subdivided Salt Lake group in Cache Valley into basal Collingston conglomerate, West Spring formation, and Cache Valley formation (all new). Figure 2, this report, shows Norwood tuff as basal unit of group. Group is unconformable above Knight formation of Wasatch group. Oligocene through Pliocene.

C. B. Hunt, H. D. Varnes, and H. E. Thomas, 1953, U.S. Geol. Survey Prof. Paper 257–A, p. 13–14, pl. 1. Formation described and mapped in northern Utah Valley where thickness may exceed 1,000 feet. Unconformable below pre-Lake Bonneville deposits. Pliocene(?).

L. W. Slentz, 1955, Utah Geol. Soc. Guidebook 10, p. 23–36. Group, as described in lower Jordan Valley, Utah, comprises (ascending) Traverse volcanics, Jordan Narrows unit, Camp Williams unit, Harkers fanglomerate, and travertine unit (all new). Maximum aggregate thickness 3,700 feet. Oligocene through Pliocene.

R. D. Adamson, C. T. Hardy, and J. S. Williams, 1955, Utah Geol. Soc. Guidebook 10, p. 1 (table 2), 2 (table 1), 4–22. Group in Cache Valley redefined to include (ascending) Colliston conglomerate, Cache Valley formation (redefined) and Mink Creek conglomerate (new). Underlies pre-Lake Bonneville group. Overlaps unit referred to as "Wasatch" conglomerate and in places overlaps Paleozoic rocks. Miocene-Pliocene.

W. J. Mapel and W. J. Hail, Jr., 1956, Utah Geol. Soc. Guidebook 11, p. 2 (table 1), 4 (fig. 3), 9–16, fig. 2. Formation described and mapped in Goose Creek district, Idaho, Utah, and Nevada. Comprises lower unit, 1,550 feet, mainly white volcanic ash containing a few beds of shale, sandstone, and conglomerate; beds of black to reddish-brown welded tuff in upper half; lenticular beds of carbonaceous shale and lignite in lower half; upper unit, about 700 feet, interbedded white and grayish-orange volcanic ash, with a few lenticular beds of conglomerate; a thick persistent bed of welded tuff at base. Overlies unit referred to as Payette(?).

Named for extensive developments in Weber and Salt Lake Valleys, Utah.

**Salt Lake Tuff**[1] (in Honolulu Volcanic Series)

Pleistocene, upper: Oahu Island, Hawaii.

Original reference: C. K. Wentworth, 1926, Bernice P. Bishop Mus. Bull. 30, p. 64.

G. A. Macdonald and D. A. Davis *in* Jacques Avias and others, 1956, Lexique Strat. Internat., v. 6, Océanie, fasc. 2, p. 130–131. Subaerial gray to brown tuff, partly palagonitized, containing bombs of peridotite and fragments of coral limestone. Maximum thickness about 300 feet. Overlies Aliamanu tuff and eroded gravel terraces graded to plus 95-foot (Keana) stand of sea.

Named for Salt Lake (Aliapaakai) which lies in crater of tuff cone that marks the vent. Together with Makalapa tuff covers about 6 square miles just east of Pearl Harbor, on southwest side of Koolau Range 18 miles west of Makapuu Head.

Saltlick Beds[1]

Salt Lick Limestone (in Breathitt Formation)

Pennsylvanian: Eastern Kentucky.

Original reference: W. C. Morse, 1931, Kentucky Geol. Survey, ser. 6, v. 36, p. 296, 303.

H. R. Wanless, 1939, Geol. Soc. America Spec. Paper 17, p. 100. Thin marine limestone in Breathitt formation between Haddix coal (above) and Magoffin marine horizon.

Well exposed at head of Salt Lick Creek, Knott County, Ky.

**Salt Mountain Limestone**

Salt Mountain Limestone (in Midway Group)

Salt Mountain Limestone (in Wilcox Group)[1]

Paleocene: Southwestern Alabama.

Original references: D. W. Langdon, 1891, Geol. Soc. America Bull., v. 2,

p. 589–605; 1894, Alabama Geol. Survey Rept. Coastal Plain, p. 107–122.

L. D. Toulmin, 1941, Jour. Paleontology, v. 15, no. 6, p. 567–611. Foraminifera indicate that Salt Mountain limestone, at least upper part, is younger than Midway and probably is Wilcox in age.

A. R. Loeblich, Jr., and Helen Tappan, 1957, Jour. Paleontology, v. 31, no. 6, p. 1113 (fig. 2); 1957, U.S. Natl. Mus. Bull. 215, p. 174, 177 (fig. 28). Age discussion. Chart shows Salt Mountain limestone above Naheola formation and below Nanafalia formation in Midway group. Paleocene.

C. W. Cooke, 1959, U.S. Geol. Survey Prof. Paper 321, p. 2 (table 1). Chart shows age of Salt Mountain limestone as Paleocene.

Named for exposures at Salt Mountain, Clarke County.

Saltos Shale Member (of Monterey Shale)

Miocene, lower and middle: Southern California.

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), 2977 (fig. 3), 2989–2990. Lower member of Monterey in Caliente Range. Where best exposed on southwest slope, consists of (1) an upper 1,100 feet of thin-bedded brown clay shale, with minor siliceous shale beds and near its base a 75-foot basalt sill, and (2) a lower 1,000 feet of gray-brown, less well-bedded claystone and siltstone; on northeast flank of range, grades eastward into sandstone of the lower part of Branch Canyon formation (new); can be traced northwestward into a clay shale which occurs on northeast side of La Panza Range and where it was mapped as Sandholdt shale by Bramlette and Daviess (1944, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 24); the Saltos, therefore, is in part equivalent to Sandholt shale of Salinas Valley as defined by Thorup (1953, California Div. Mines Bull. 118). In western Cuyama Valley in vicinity of Taylor Canyon, consists of a basal 150 to 300 feet of siliceous shale overlain by about 500 feet of clay shale; this basal siliceous shale was mapped as Whiterock Bluff member of Santa Margarita formation by English (1916) and included in the Vaqueros by Eaton and others (1941, Am. Assoc. Petroleum Geologists Bull., v. 25, no. 2). Conformably underlies Whiterock Bluff shale herein designated as member of Monterey; conformably overlies Painted Rock sandstone. Age, based on foraminiferal content, ranges from Saucesian through most of Relizian stage. The basalt sill marks boundary between Relizian and Saucesian stages in type section of the Saltos. The Saltos was mapped by English (1916) as Maricopa shale and by Eaton and others (1941) as upper part of the "Temblor."

Type locality: The steeply dipping section exposed in an unnamed canyon in sec. 20, and offset along strike in secs. 18 and 19, T. 11 N., R. 27 W. Caliente Mountain quadrangle.

Salt Plain Formation or Siltstone (in Nippewalla Group)

Salt Plain Shale (in Cimarron Group)[1]

Permian (Leonard Series): Central southern Kansas.

Original reference: F. W. Cragin, 1896, Colorado Coll. Studies, v. 6, p. 3, 20–24.

G. H. Norton, 1939, Am. Assoc. Petroleum Geologists Bull., v. 23, no. 12, p. 1762–1763 (fig. 2), 1764–1765 (fig. 3), 1786–1789. Included in Nippewalla group (new). Overlies Harper sandstone (restricted); underlies Cedar Hills sandstone. Cimarron series, Salt Fork division.

R. C. Moore and others, 1951, Kansas Geol. Survey Bull. 89, p. 39. Formation consists chiefly of red, flaky, silty shale and some siltstone. Includes two prominent coarse siltstone beds, the upper, about 25 feet thick, occurring about 42 feet below top of formation and the lower, Crisfield, about 29 feet thick, occurring about 115 feet below top of formation. Thickness 265 feet. Overlies Harper sandstone; underlies Cedar Hills sandstone. In Kingman County, overlapped by Cenozoic deposits. Leonardian. In Nippewalla group (new).

J. M. Jewett, 1959, Graphic column and classification of rocks in Kansas: Kansas Geol. Survey. Chart shows Salt Plain siltstone with Crisfield sandstone member in upper part.

Named for Great Salt Plain of Cimarron River, Kan.

Saltsburg Formation (in Conemaugh Formation)[1]

Pennsylvanian: Southwestern Pennsylvania.

Original reference: G. H. Ashley, 1926, Pennsylvania Geol. Survey Topog. and Geol. Atlas 65, p. 23–24, pl. 4.

Punxsutawney quadrangle.

Saltsburg Member (in Conemaugh Formation)[1]

Pennsylvanian: Western Pennsylvania.

Original reference: M. E. Johnson, 1929, Pennsylvania Geol. Survey Topog. and Geol. Atlas 27, p. 31.

Pittsburgh quadrangle.

**Saltsburg Sandstone Member** (of Conemaugh Formation)[1]

Saltsburg Sandstone (in Conemaugh Group)

Upper Pennsylvanian: Western Pennsylvania, Maryland, eastern Ohio, and northern West Virginia.

Original reference: J. J. Stevenson, 1878, Pennsylvania 2d Geol. Survey Rept. K₃, p. 22.

D. L. Norling, 1958, Ohio Geol. Survey Bull. 56, p. 10 (fig. 3), 49, 50, geol. map. In this report [Morgan County] the Conemaugh is classified as a series and the included units referred to as members. Cyclothemic classification not used in this report. From Condit's (1912, Ohio Geol. Survey, 4th ser., Bull. 17) description, it seems that Saltsburg sandstone and Round Knob shale are contemporaneous units, or the names are applied to different facies of same unit. In Morgan County, interval between Barton and Harlem coals, both of which are discontinuous, is 15 to 20 feet. The Saltsburg is represented in some parts of county by sandstones or sandy shales, which change facies rapidly, and which may comprise entire interval or may be present only in lower half of interval. Term Round Knob is applied to shaly phase and term Saltsburg to sandy phase. In some areas, the Round Knob overlies the Saltsburg. Two spellings of the name, Saltsburg and Saltzberg, have appeared in literature.

M. T. Sturgeon and others, 1958, Ohio Geol. Survey Bull. 57, p. 95 (table 11), 130. In this report [Athens Conuty], Saltsburg shale and sandstone is classified as lowermost member of Harlem cyclothem, Conemaugh series. Thickness about 10 feet. Underlies Round Knob redbed member of cyclothem.

R. R. Dutcher and others, 1959, Geol. Soc. America Guidebook Pittsburgh Mtg., p. 69 (fig. 4). In this report [western Pennsylvania], the Conemaugh is classified as a group. On columnar section, Saltsburg sandstone occurs above Upper Bakerstown coal and below Pittsburgh redbed.

Named for exposures along Conemaugh and Loyalhanna Rivers near Saltsburg, Indiana County, Pa.

Saltville Chert (in Helderberg Group)[1]

Lower or Middle Devonian: Southwestern Virginia.

Original reference: F. M. Swartz, 1929, Pennsylvania Acad. Sci. Proc., v. 3, p. 80.

G. A. Cooper, 1942, Geol. Soc. America Bull., v. 53, no. 12, pt. 1, chart 4. Age shown on correlation chart as Lower or Middle Devonian.

Name applied from Tumbling Creek, near Saltville, Smyth County, to Gala, Botetourt County.

**Salt Wash Sandstone Member** (of Morrison Formation)[1]

Upper Jurassic: Eastern Utah, northeastern Arizona, southwestern Colorado and northwestern New Mexico.

Original reference: C. T. Lupton, 1914, U.S. Geol. Survey Bull. 541, p. 127.

W. L. Stokes, 1944, Geol. Soc. America Bull., v. 55, no. 8, p. 963. Correlates with lower part of Recapture shale member proposed by Gregory (1938).

L. C. Craig and others, 1955, U.S. Geol. Survey Bull. 1009–E, p. 135–137, 138 (fig. 21). Salt Wash member constitutes lower part of Morrison in eastern Utah, parts of western Colorado, northeastern Arizona, and northwestern New Mexico. It was formed as a large alluvial fan by streams diverging to north and east from an apex in south-central Utah. Blunt apex of fan lies along a northwest-southeast-trending line in south-central Utah and north-central Arizona; this line is limit of preservation; southwest of it, Salt Wash has been removed by erosion. South side of fan is limit of deposition; south of Monticello, Utah, upper part of Salt Wash intertongues with and grades into Recapture member; in northeasternmost Arizona, lower parts of Salt Wash intertongue with Recapture, and farther south a basal tongue of Salt Wash reaches limit of deposition. Western edge of fan is poorly defined limit of deposition trending almost north-south along zero isopach in south-central Utah. Rounded margin of fan is irregular line extending from northwestern to south-central Colorado, beyond which Salt Wash cannot be distinguished from upper part of Morrison. Member arbitrarily divided into four facies: conglomeratic sandstone; sandstone and mudstone; claystone and lenticular sandstone; and claystone and limestone. From maximum thickness of more than 600 feet in south-central Utah, member in general thins radially to north and east. Near Vernal, Utah, 285 feet thick; this thickening is poorly understood but may represent accumulation of sediment from source unrelated to main source of member. In southeastern Utah, a thin area of Salt Wash is related to the thickness of underlying Bluff sandstone because, in general, as Bluff thickens, Salt Wash in this area thins. Extension of Salt Wash as recognizable unit through southeastern Utah and into northeastern Arizona and northwestern New Mexico constitutes restriction of Gregory's original definition of Recapture member.

J. W. Harshbarger, C. A. Repenning, and J. H. Irwin, 1957, U.S. Geol. Survey Prof. Paper 291, p. 52, strat. sections. Stokes (1944) correlates Salt Wash member with parts of Gregory's (1938) Recapture in San Juan County, and this correlation is used in this paper on Navajo country. Present only in northern part of area; to the south, intertongues with and grades into overlying Recapture member; in vicinity of Marsh Pass, there is indication that Salt Wash intertongues with Cow Springs sandstone; at Red Mesa, Ariz., intertongues with upper part of Bluff sandstone. Thicknesses: 616 feet on Navajo Point, Utah, and 125 feet near near Rough Rock, Ariz.

T. E. Mullens and V. L. Freeman, 1957, Geol. Soc. America Bull., v. 68, no. 4, p. 505–526. Detailed discussion of lithofacies of Salt Wash member.

Named for Salt Wash, 30 miles southeast of Green River, Grand County, Utah.

†Salt Wells Group[1]

Upper Cretaceous: Southwestern Wyoming, northwestern Colorado, and northeastern Utah.

Original reference: J. W. Powell, 1876, Geology of eastern portion of Uinta Mountains, p. 40, 49, 154.

Occurs at and around Salt Wells Station, Sweetwater County, Wyo.

**Saluda Limestone** (in Richmond Group)[1]

Saluda Formation (in Richmond Group)

Saluda Limestone Member (of Whitewater Formation)

Upper Ordovician: Southeastern Indiana, north-central Kentucky, and southwestern Ohio.

Original reference: A. F. Foerste, 1902, Am. Geologist, v. 30, p. 369.

Wilber Stout, Karl Ver Steeg, and G. F. Lamb, 1943, Ohio Geol. Survey, 4th ser., Bull. 44, p. 110, 114, chart facing p. 108. In Ohio, listed as member of Whitewater formation. Sequence shown on p. 110 (ascending): Weisburg, Saluda, and Oxford; stratigraphic chart and p. 114 shows sequence (ascending): Lower Whitewater, Saluda, and Upper Whitewater.

James Conkin, 1952, Kansas Acad. Sci. Trans., v. 55, p. 126–130. Liberty formation and Saluda member of Whitewater formation in this part of Kentucky [Oldham County] are separated by 14 feet of Whitewater facies. The Saluda wedges into Whitewater formation of Ohio. Upper Richmond beds thus coincide in their stratigraphic succession with Upper Richmond of Ohio. Heretofore, Kentucky section was given as Liberty, Saluda, and Whitewater (Hitz). Recognition of Whitewater beds permits division of Kentucky Upper Richmond, which is similar to that of Ohio into Liberty formation, Lower Whitewater, Saluda, and Upper Whitewater members of the Whitewater formation of Ohio.

J. B. Patton, T. G. Perry, and W. J. Wayne, 1953, Indiana Geol. Survey Field Conf. Guidebook 6, pl. 1. Shown on stratigraphic chart of Indiana as Saluda formation in Richmond group. Consists of limestone, drab-gray, granular, massive to thin-bedded, impure, dolomitic; weathers to banded buff and salmon surface; coral masses at base. Thickness 40 to 65 feet. Underlies Whitewater; overlies Liberty.

Named for Saluda Creek, 6 miles south of Hanover, Jefferson County, Ind.

Saluda zone[1]

Precambrian: Northwestern 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. 6, 8, 12.

Named for exposures in Saluda Mountain Range.

Salvisa Formation

Salvisa Limestone Member (of Perryville Formation)[1]

Middle Ordovician: North-central Kentucky.

Original reference: A. M. Miller, 1913, Kentucky Geol. Survey, 4th ser., v. 1, pt. 1, p. 329.

A. C. McFarlan, 1938, Geol. Soc. America Bull., v. 49, no. 6, p. 992. An exposure in northern Jessamine County seems to indicate that the Faulconer and Salvisa are not entirely distinct stratigraphic units but are lithologic facies, in part contemporary.

A. C. McFarlan and W. H. White, 1948, Am. Assoc. Petroleum Geologists Bull., v. 32, no. 8, p. 1640. Term Perryville is a synonym of Benson; name Devils Hollow division of the Lexington is proposed for the post-Woodburn "Perryville" of the Frankfort-Versailles area. At its type section, the Devils Hollow includes 15 feet of the "Faulconer" rock and 10 feet of the "Salvisa."

J. A. Stokley and F. H. Walker, 1953, Kentucky Geol. Survey, ser. 9, Rept. Inv. 8, p. 44, 45. At Harrodsburg, Mercer County, Salvisa formation is 10 feet thick; underlies Cornishville formation; overlies Faulconer formation.

Named for Salvisa, Mercer County.

Samaniego Granite

Precambrian: Southeastern Arizona.

R. L. DuBois, 1959, Arizona Geol. Soc. Guidebook 2, p. 113. In composition, rock ranges from granodiorite to quartz monzonite and contains large microcline crystals associated with quartz, plagioclase, and hornblende. In fault contact with late Cenozoic sediments on west and with Pinal schist on east. Name credited to R. M. Wallace (unpub. thesis).

Crops out along western side of northern Santa Catalina Mountains, Pima and Pinal Counties.

**Sam Creek Limestone 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. 51–52, pl. 3. Overlies Spaniard limestone member. In Haskell County, underlies a 20-foot massive sandstone referred to as "Spiro" sandstone member.

Named from exposure in center of W½E½ sec. 15, T. 14 N., R. 18 E., along south bank of Sam Creek, Muskogee County.

Samelias Formation

Precambrian: Western South Dakota.

J. R. Berg, 1946, South Dakota Geol. Survey Rept. Inv. 52, p. 7. Similar to and of apparently same stratigraphic horizons as Roubaix group (new). In Keystone district, overlies rocks tentatively correlated with Lead system. Name credited to R. G. Hamilton (unpub. thesis).

First described in Keystone district, southern Black Hills. Also present in Galena-Roubaix district.

**Sample Sandstone**

Sample Formation (in West Baden Group)

Sample Sandstone Member (of Gasper Oolite)[1]

Upper Mississippian: Western Kentucky and southwestern Indiana.

Original reference: C. Butts, 1917, Mississippian formations of western Kentucky: Kentucky Geol. Survey, p. 67, 70.

R. E. Stouder, 1938, Am. Assoc. Petroleum Geologists Bull., v. 22, no. 3, p. 270 (fig. 2), 273–275. In Meade, Hardin, and Breckinridge Counties, Ky., Sample sandstone occurs below Reelsville limestone and above Beaver Bend limestone.

D. J. McGregor, T. G. Perry, and W. J. Wayne, 1957, Indiana Geol. Survey Field Conf. Guidebook 9, p. 6, pl. 2. Sample formation in Indiana is 24 to 42 feet thick. Consists of thin-bedded fine-grained sandstone and siltstone and olive-gray and red-brown mudstones and shale; locally includes lenses of crossbedded sandstone. Underlies Reelsville limestone; overlies Beaver Bend limestone.

H. H. Gray, R. D. Jenkins, and R. M. Weidman, 1960, Indiana Geol. Survey Bull. 20, p. 36 (table 5), 46, pl. 1. Included in West Baden group (redefined). Thickness 22 to 36 feet. Underlies Reelsville limestone; overlies Beaver Bend limestone.

Typically exposed 1 mile east of Sample, Breckinridge County, Ky.

Sampson Rock Sandstone (in Pottsville Formation)[1]

Pennsylvanian: Western Maryland.

Original reference: C. K. Swartz, W. A. Price, and H. Bassler, 1919, Geol. Soc. America Bull., v. 30, p. 571.

Well exposed at Sampson Rock, west of Frostburg, Allegany County.

Sams Creek Metabasalt

Precambrian: Western Maryland.

A. J. Stose and G. W. Stose, 1946, Maryland Dept. Geology, Mines and Water Resources [Rept. 12] Carroll and Frederick Counties, p. 58, 63–65. Grayish-green schistose to massive rock spotted with light-green, white, or pinkish knots, which are amygdules filled with quartz, calcite, or green epidote. All gradations occur from a massive amygdular rock with inconspicuous schistosity through a schistose variety in which the amygdules are drawn out into elliptical form, to fissile slate without recognizable volcanic characteristics in which amygdules are represented by flattened blebs or stringers. Crops out in a linear belt which extends southwestward from Maryland-Pennsylvania State line, in vicinity of Lineboro, to a point 1 mile northeast of Taylorsville; belt lies 1 mile north of Manchester and passes through Westminster. In this belt, the metabasalt overlies Wakefield marble and underlies albite-chlorite schist of Wissahickon formation. West and southwest of linear belt, the Sams Creek has a curvilinear strike which is common to the Wakefield, is repeated several times across the strike and is overlain by Ijamsville phyllite; in vicinity of Union Bridge, Unionville, Linganore, and Dollyhyde Creek, it is interbedded with Libertytown metarhyolite (new); from New London southward to New Market and Monrovia, it is overlain by Urbana phyllite; west of Parrsville, it is exposed in several narrow upfolds in Marburg schist. The unit was mapped as metabasalt in Glenarm series on geologic map of Frederick County [Maryland Geol. Survey, 1938] and age given as 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 of the members; some of the 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 apparenty equivalent to Harpers formation. Late Precambrian.

Named from village of Sams Creek on Carroll-Frederick County line.

Sams Spring 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 is isolated by surrounding Tertiary volcanic rocks.

Clipper Canyon, Toquima Range, Nye and Lander Counties.

**San Andres Limestone**

San Andres Formation (in Manzano Group)

San Andres Group

San Andres Limestone Member (of Chupadera Formation)[1]

Lower and Upper Permian (Leonard and Guadalupe Series): Central and southeastern New Mexico.

Original reference: W. T. Lee, 1909, U.S. Geol. Survey Bull. 389.

R. I. Dickey, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 1, p. 42–44. Report gives geologic section from Fisher County through Andrews County, Tex., to Eddy County, N. Mex. The "Blaine of Texas" is herein called the San Andres because it is believed that unconformity at top of Dog Creek shale on east side of basin can be tied into top of San Andres on west side of basin by means of well logs. San Andres on east side can be divided into (descending) Dog Creek shale, Blaine gypsum, and Flowerpot shale, a division known in Oklahome for some time. Top of Dog Creek shale is there called top of El Reno group. Term San Andres as used on west side of basin at present time includes beds between base of Whitehorse group and top of Yeso. In Guadalupes, San Andres is about 1,250 feet thick, and in wells in basin is about 1,460 feet. It has been assumed that this entire thickness is San Andres in age. At type locality in San Andres Mountains, formation is 500 feet thick and contains fossils which suggest its correlation with the Leonard of Glass Mountains of Texas. At type locality, base of formation is exposed, but top passes under alluvium of the Jornado del Muerto. There is evidence that the increased thickness of the so-called San Andres in the Guadalupes and in subsurface is due to the fact that additional section is younger than San Andres of type locality. This implies a division within the so-called San Andres dividing that part of section which is Leonard in age and which corresponds to San Andres as originally defined from younger beds which are probably middle Delaware Mountain in age.

F. E. Lewis, 1941, Am. Assoc. Petroleum Geologists Bull., v. 25, no. 1, p. 73–103. San Andres problem discussed. San Andres group believed to be time equivalent of Word formation, lower two divisions of Delaware Mountain group, and El Reno group, each of which is separable into an upper and lower division over wide area in south Permian basin. Evidence indicates San Andres group should be placed in Guadalupe series.

P. B. King, 1942, Am. Assoc. Petroleum Geologists Bull., v. 26, no. 4, p. 542, 687–694, 701–703, pl. 2. Rank raised to formation; term Chupadera abandoned. In northern shelf area, upper part mostly limestone in outcrop; anhydrite and red beds interbedded to northeast; in lower part, sandstone beds replace limestone forming Glorieta sandstone member of northern New Mexico, Hondo sandstone member in Sacramento Mountains. Occurs above Yeso formation. In San Andres and other ranges of central New Mexico, formation is overlain unconformably by Mesozoic rocks, no higher Permian beds exposed; in Pecos Valley, overlain by Chalk Bluff formation. Included in Manzano group. Leonard series.

J. M. Hills *in* R. L. Bates, 1942, New Mexico Bur. Mines Mineral Resources Bull. 18, p. 269–271. In subsurface includes Lovington sandstone member (new).

C. E. Needham and R. L. Bates, 1943, Geol. Soc. America Bull., v. 54, no. 11, p. 1662, 1663 (fig. 2), 1664–1666. Lee (1909) gave no detailed section. At new type section, herein designated, consists mainly of gray limestone with minor amounts of sandstone. Thicknesses 593½ feet at type section; 110 feet, Bluewater Canyon in Zuni Mountains; 15 feet, Glorieta Mesa. Overlies Glorieta sandstone herein given formational status; underlies Permian and other beds.

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, formation consists of (ascending) Glorieta sandstone member (100 to 250 feet); light-gray thick-bedded cavernous-weathering limestone member (1 to 20 feet); and upper member (0 to 80 feet) of light-terra-cotta to orange gypsiferous siltstone and fine-grained sandstone. Overlies Yeso formation; underlies Dockum formation.

G. O. Bachman, 1953, U.S. Geol. Survey Oil and Gas Inv. Map OM–137. In northwest Mora County, restricted to exclude upper clastic member which is here named Bernal formation. Includes Glorieta sandstone member at base. Middle limestone member, recognized in other areas, not present in mapped area of this report. Overlies Yeso formation or Sangre de Cristo formation.

W. F. Tanner, 1956, Jour. Sed. Petrology, v. 26, no. 4, p. 307–308. Group, between Las Vegas and Santa Fe includes (ascending) Glorieta sandstone, Lagunita formation (new), and Bernal formation.

C. H. Dane and G. O. Bachman, 1957, U.S. Geol. Survey Misc. Geol. Inv. Map I–224. As used on this map, Glorieta sandstone is considered separate formation.

G. O. Bachman and P. T. Hayes, 1958, Geol. Soc. America Bull., v. 69, no. 6, p. 690 (fig. 1). Mapped as limestone [limestone seems more appropriate designation since Glorieta sandstone has been removed from formation].

P. T. Hayes and R. L. Koogle, 1958, U.S. Geol. Survey Geol. Quad. Map GQ–112. Formation described in Carlsbad Caverns West quadrangle where it is more than 300 feet thick and consists of dolomite and limestone in even to irregular beds. Underlies Grayburg formation; basal contact not exposed. Upper part grades eastward into sandstone tongue of Cherry Canyon formation.

E. D. McKee and others, 1959, U.S. Geol. Survey Misc. Geol. Inv. Map I–300, p. 2. Age of formation in Zuni uplift is not certain. To southeast, in southeasternmost New Mexico and adjoining parts of Texas, the San Andres is considered, on stratigraphic grounds, to be of Guadalupe age. To west, in Arizona, Kaibab limestone with which it apparently is continuous, is considered, from faunal evidence, to be of Leonard age. Assuming that both ages are correct, the San Andres of northwestern New Mexico must either transgress time planes across the State toward its type locality or represent a lithologic unit distinct from that of type San Andres. An indication that formation transgresses time planes is found north of Guadalupe Mountains where it is reported to include rocks of both Leonard and Guadalupe age.

Type section: South wall of Rhodes Canyon 2 miles west of road fork at top of Rhodes Pass and 14.6 miles by road east of Continental Airlines beacon near Engle. Canyon extends from near middle of north line sec. 29, T. 12 S., R. 2 E. Inquiry established that canyon referred to by Lee is one now known as Rhodes Canyon, San Andres Mountains, Socorro County.

**San Angelo Sandstone**[1] (in Pease River Group)

San Angelo Sandstone or Formation (in El Reno or San Andres Group)

Permian: Central northern Texas.

Original reference: W. F. Cummins and O. Lerch, 1891, Am. Geologist, v. 7, p. 73–77, 321–325.

M. G. Cheney, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 1, p. 66 (fig. 1), 97. Included in El Reno group. Underlies Flower Pot shale; overlies Choza formation of Clear Fork group. On east side of Permian basin, name El Reno group appears to have priority and to be more appropriate on facies basis than term San Andres group which has been suggested for beds of Leonard age.

F. E. Lewis, 1941, Am. Assoc. Petroleum Geologists Bull., v. 25, no. 1, p. 73–103. San Angelo is basal formation in San Andres group as defined in this report.

Robert Roth, 1942, Am. Assoc. Petroleum Geologists Bull., v. 26, no. 8, p. 1412, 1413. Basal formation in Pease River group.

E. C. Olson, 1952, Jour. Geology, v. 60, no. 3, p. 286–288; E. C. Olson and J. R. Beerbower, 1953, Jour. Geology, v. 61, no. 5, p. 389–423. Vertebrate fauna discussed. Evidence indicates post-Leonard age.

Well exposed a few miles west of San Angelo, Tom Green County.

**San Antonio Formation**[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. 1083. Thickness 15 to 120 feet. Overlies Alameda formation; underlies Posey formation (new).

Named for development in San Antonio Township, Alameda County.

San Antonio Canyon Group

Age unknown: Southern California.

K. J. Hsu, 1955, California Univ. Dept. Geol. Sci. Bull., v. 30, no. 4, p. 295–296, geol. map. Gneisses, migmatized metamorphics, and marble. Rocks have been intruded by a fine-grained quartz monzonite which is most probably an equivalent of Stoddard Canyon quartz monzonite (new). Similar to Rainbow Flat group (new), and future work may prove that the two were a continuous unit before they were separated by the strike-slip(?) East San Antonio fault.

Exposed on west side of San Antonio Canyon and west of East San Antonio fault, Cucamonga quadrangle, Los Angeles County.

San Ardo Group

Pliocene: West-central California.

T. A. Baldwin, 1950, Am. Assoc. Petroleum Geologists Bull., v. 34, no. 10, p. 1988. Term suggested for three partly equivalent Pliocene units (ascending) Pancho Rico, Etchegoin, and Paso Robles facies.

Well exposed on slopes of Pancho Rico Canyon and the nearby gulches which drain westward to the Salina River at the town of San Ardo, Monterey County.

Sanastee Sandstone Member (of Mancos Shale)

Cretaceous: Northern New Mexico.

W. B. Hoover, 1951, *in* C. T. Smith and others, New Mexico Geol. Soc. Guidebook 2d Field Conf., p. 13 (chart), 46, 47, 79. Member of Mancos shale; about 450 feet above Dakota sandstone.

Dan Bozanic, 1955, Four Corners Geol. Soc. Guidebook [1st] Field Conf., p. 91. Term Sanastee was apparently applied to unit which had earlier been named Juana Lopez by Rankin (1944).

Named for prominent development around Sanastee Trading Post in vicinity of Grants, Valencia County.

Sanatoga Member (of Brunswick Formation)[1]

Upper Triassic: Southeastern Pennsylvania.

Original reference: D. G. McLaughlin, 1933, Geol. Soc. America Bull., v. 44, no. 1, p. 179.

Named for excellent exposures in a large quarry and in the railroad cut at Sanatoga Station on Schuylkill River, Montgomery County.

Sanatorium Limestone Lentil (in Geuda Springs Shale member of Wellington Formation)

Permian: Central Kansas.

W. A. Ver Wiebe, 1937, Wichita Municipal Univ. Bull., v. 12, no. 5, p. 14. Name applied to limestone in Geuda Springs that caps the hills below the Geuda Springs sanatorium.

Occurs at type locality of Geuda Springs member, sec. 7, T. 34 S., T. 3 E. [Cowley County].

San Augustine Group (in Claiborne Group)[1]

Eocene: Eastern Texas.

Original reference: E. T. Dumble, 1924, Am. Assoc. Petroleum Geologists Bull., v. 8, no. 4, p. 428.

Probably named for San Augustine, San Augustine County.

San Benito Gravels[1]

Pliocene to Pleistocene: Wsetern California.

Original reference: A. C. Lawson, 1893, California Univ. Pub. Dept. Geol. Bull., v. 1, p. 151–153.

I. F. Wilson, 1943, California Jour. Mines and Geology, v. 39, p. 225 (fig. 4), 246–249, 257, pl. 3. In San Benito quadrangle, consists of gravels, sands, and clays, in part consolidated into conglomerate, sandstone, and clay shale. About 1,500 feet thick. Overlies Etchegoin group; overlaps Los Muertos Creek formation (new) and Tres Pinos sandstone.

In San Benito quadrangle, main belt of gravels, lying between San Benito fault zone and Tres Pinos Creek, is folded into a broad, gentle syncline, plunging toward the northwest.

**Sanborn Group**

Sanborn Formation[1]

Pleistocene and Recent: Western Kansas.

Original reference: M. K. Elias, 1931, Kansas Univ. Bull., v. 32, no. 7, p. 163.

A. B. Leonard and J. C. Frye, 1943, Am. Jour. Sci., v. 241, no. 7, p. 453–462. Stratigraphic position of these deposits [Sanborn formation] unconformably above middle Pliocene Ogallala beds, and the snails which they contain conclusively demonstrate a Pleistocene age.

C. W. Hibbard, J. C. Frye, and A. B. Leonard, 1944, Kansas Geol. Survey Bull. 52, p. 3–26. Elias' term Sanborn is used in this paper to refer to essentially the entire Pleistocene section exposed in north-central and northwestern Kansas, although some distinct terrace beds of local extent have not been included within it. Term is used despite the fact that in some localities beds have been studied that are probably stratigraphic equivalents of the Peorian and Loveland as described by Lugn in southern Nebraska. Beds herein assigned to Sanborn formation have been observed from western Jewell County westward for more than 200 miles to Yuma County, Colo. Formation mantles upland of much of north-central part of state. Consists of an upper gray silt bed which is persistent over entire area, and an underlying soil zone that occurs only in north-central Kansas, and pre-soil zone deposits consisting of a wide variety of lithologic types.

J. C. Frye and O. S. Fent, 1947, Kansas Geol. Survey Bull. 70, p. 40–41. Proposed that late Pleistocene loesses, associated deposits, and lateral facies generally occurring in northern and central Kansas, be classed as Sanborn formation and the Loveland silt, Peoria silt, and Bignell silt and their lateral coarse-textured facies be assigned rank as members. Type section designated.

J. C. Frye and A. B. Leonard, 1952, Kansas Geol. Survey Bull. 99, p. 106–110. Sanborn formation, unlike other stratigraphic units of formational rank in Kansas Pleistocene, includes deposits of two stages (Illinoian and Wisconsinan) and the several substages of the Wisconsinan. Includes two unconformities, defined by the Sangamon and Brady buried soils, and represents three distinct cycles of deposiiton. As classified by Kansas Geological Survey, includes (ascending) Crete sand and gravel member; Loveland silt member, commonly containing Sangamon buried soil at top; unnamed early Wisconsinan alluvial deposits; Peoria silt member, commonly containing Brady buried soil; unnamed Wisconsinan alluvial deposits; and Bignell silt member. Thickness 130 feet at type locality. 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 are Kingsdown marl or formation, Odee formation, and Vanhem formation.

C. W. Hibbard, 1958, Am. Jour. Sci., v. 256, no. 1, p. 55 (fig. 1). Rank raised to group. In southwestern Kansas, includes Kingsdown formation below and Vanhem formation above. For other parts of Kansas, includes (ascending) Crete formation, Loveland formation, early Wisconsin terrace deposits, Peoria formation, terrace deposits, and Bignell formation. Overlies Meade group. Classification used in this report is in accord with agreement at Pleistocene conference at Lawrence, Kans., June 28–29, 1956.

Type section: In canyons in NW¼ sec. 20, T. 1 S., R. 41 W., Cheyenne County, Kans. Name derived from Sanborn, Nebr., which is nearest town to a locality of the formation in Cheyenne County.

San Bruno Sandstone (in Franciscan Group)[1]

Jurassic(?): Western California.

Original reference: R. Crandell, 1907, Am. Philos. Soc. Proc., v. 46, p. 3–58.

Named for fact that it forms San Bruno Mountains.

**San Carlos Formation**[1]

Upper Cretaceous (Gulf Series): Western Texas.

Original reference: T. W. Vaughan, 1900, U.S. Geol. Survey Bull. 164, p. 81–82.

Named for San Carlos, Presidio County.

San Carlos Formation[1]

Pleistocene(?): Panamá.

Original reference: O. H. Hershey, 1901, California Univ. Dept. Geol. Bull., v. 2, p. 259.

W. P. Woodring *in* R. Hoffstetter and others, 1960, Lexique Strat. Internat., v. 5, Amérique Latine, fasc. 2a, p. 345. Poorly defined name for surficial deposits. Pleistocene(?).

Present on San Carlos Plain, Panamá Province.

Sanchez Sandstone Member or Tongue (of Fayette Formation)

Eocene, upper: Southwestern Texas and northern Mexico.

Original reference: W. G. Kane and G. B. Gierhart, 1935, Am. Assoc. Petroleum Geologists Bull., v. 19, no. 9, p. 1387.

J. M. Patterson, 1942, Am. Assoc. Petroleum Geologists Bull., v. 26, no. 2, p. 259 (fig. 2), 269. Sanchez member (or tongue) overlies Gorgora shale member (new) and underlies Agua Verde shale member (new). Thickness in Starr County about 100 feet; thins and dies out half way across Zapata County.

Lies 280 feet below top of Fayette in section measured on both sides of Rio Grande between Roma and Rio Grande City, Starr County. Derivation of name not stated.

Sand Bay Agglomerate (in Sand Bay Volcanics)

Tertiary: Southwestern Alaska.

F. S. Simons and D. E. Mathewson, 1947, U.S. Geol. Survey Alaskan Volcano Inv. Rept. 2, pt. 4, p. 61, 63, pls. 4, 5. At Sand Bay, composed of subangular to rounded boulders as much as 3 feet across in tuff matrix. Sorting very poor but bedding fairly well defined. Boulders mainly of two rock types: black glassy highly vesicular lava and reddish vesicular porphyry. At south end of Akuyah Cliffs, on west side of island, 1,000 to 1,500 feet thick and unconformably overlies coarse well-bedded tuffs [Finger Bay volcanics]. Numerous dikes exposed in cliffs. Similar agglomerate forms lower slopes of southern half of island. Further inland, toward the cone, agglomerate contains interbedded thin lava flows and is cut by dikes. Constitutes lower part of Sand Bay volcanics (new); underlies Sand Bay lava flows (new) and Great Sitkin volcanics (new).

F. S. Simons and D. E. Mathewson, 1955, U.S. Geol. Survey Bull. 1028–B, p. 28–29, pl. 5. Unit included in Sand Bay volcanics. Term Sand Bay agglomerate not used in this report.

Sand Bay agglomerate and lava flows combined form most of southern half of Great Sitkin Island, in central part of Aleutian Islands.

Sand Bay Lava Flows (in Sand Bay Volcanics)

Tertiary: Southwestern Alaska.

F. S. Simons and D. E. Mathewson, 1947, U.S. Geol. Survey Alaskan Volcano Inv. Rept. 2, pt. 4, p. 61, 63, pls. 4, 5. Lava flows, which are porphyritic, include andesite, olivine andesite, and andesite flow-breccia, and basalt. Colors range from black through purplish gray and reddish gray to light gray. Most flows are medium grained but few are very fine grained. Platy lavas rare, and most rocks show little or no flow structure. Columnar jointing common. Vesicular flows rare. Lavas dip gently south or southeast and thicken toward center of island. Flows cap main ridges in southern part of island and reach aggregate thickness of 400 feet on Triple Divide Peak at head of Middle Yoke Valley. Constitute upper part of Sand Bay volcanics (new). Overlie Sand Bay agglomerate (new); underlies Great Sitkin volcanics (new).

F. S. Simons and D. E. Mathewson, 1947, U.S. Geol. Survey Bull. 1028–B, p. 29, pl. 5. Unit included in Sand Bay volcanics. Term Sand Bay lava flows not used in this report.

Sand Bay lava flows and agglomerate combined form most of southern half of Great Sitkin Island, in central part of Aleutian Islands.

**Sand Bay Volcanics**

Tertiary: Southwestern Alaska.

F. S. Simons and D. E. Mathewson, 1947, U.S. Geol. Survey Alaskan Volcano Inv. Rept. 2, pt. 4, p. 61-63, pls. 4, 5. Comprise a lower pyroclastic sequence containing a few thin lava flows, designated the Sand Bay agglomerate, and an upper sequence of andesite and basalt flows, designated the Sand Bay lava flows. Overlie Finger Bay volcanics unconformably; older than Great Sitkin volcanics (new). Presumed to be of late Tertiary age.

F. S. Simons and D. E. Mathewson, 1955, U.S. Geol. Survey Bull. 1028-B, p. 28-29, pl. 5. Volcanics comprise a lower pyroclastic sequence consisting of agglomerate and a few thin flows, and an upper sequence composed of andesitic and basaltic lavas. Age not certain. Older than Great Sitkin volcanics, which have been glaciated, and of which at least part are probably of Pleistocene age.

Form most of southern half of Great Sitkin Island in central part of Aleutian Islands. Well exposed in vicinity of Sand Bay.

Sand Beach terrace deposit

Recent: 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 (fig. 8), 1710, 1717 (fig. 16). Quaternary section of Texas Coastal Plain between Brazos River and Rio Grande is divided into 11 terraces and terrace deposits. Name Sand Beach is proposed for the terrace deposits that is younger than and lies about 20 feet below the Riverview (new); a second bench, designated Sand Beach No. 2, lies about 5 feet lower, or about 10 to 15 feet above water level in Colorado River at Austin. Largely sand and silt.

Named for Sand Beach Reserve along north side of Colorado River at Austin, Travis County.

Sand Branch Member (of Caney Shale)

Mississippian (Chesterian): South-central Oklahoma.

M. K. Elias, 1956, *in* Ardmore Geol. Soc., Petroleum geology of southern Oklahoma—a symposium, v. 1: Tulsa, Okla., Am. Assoc. Petroleum Geologists, p. 65-69, 70 (table 2). Composed of dark-gray to black, finely laminated to flaky, noncalcareous bituminous shale, commonly shattered, with abundant crystals of gypsum; phosphatic concretions locally abundant; gray to dark-gray limestone concretions present along some bedding planes; locally concretions are closely spaced and produce concretionary lentils 10 or more feet thick. Consists of an upper and lower part, but in no area have the two parts been observed together; only lower part exposed at type locality. Higher shale of the Caney, with an upper concretionary lentil, is exposed in banks of Sandy Creek south of Wapanucka (SW¼SW¼ sec. 36, T. 2 S., R. 8 E.); if it should be found desirable to segregate the highest Caney shale in the Arbuckle Mountains as still another member, name Sand Branch would be retained for part exposed northwest of Frisco. Thickness about 130 feet. Overlies Delaware Creek member (new); unconformably underlies Pennsylvanian Rhoda Creek formation (new) at type locality of Rhoda Creek.

M. K. Elias and C. C. Branson, 1959, Oklahoma Geol. Survey Circ. 52, p. 7, 15-16. Type section redesignated. Thickness 172½ feet.

Type section: Beds 4 to 37, measured section B, sec. 14, T. 2 S., R. 7 E., Johnston County. Named derived from Sand Branch, a tributary of Clear Boggy Creek.

Sand Canyon Formation

Pleistocene, upper: Eastern New Mexico.

Sheldon Judson, 1950, Geol. Soc. America Bull., v. 61, no. 3, p. 263; 1953, Smithsonian Misc. Colln., v. 121, no. 1, p. 21–22, 24 (fig. 9), 30 (table 2). Reddish to reddish-brown alluvium; alternating beds of sand and clayey-humic material. Thickness 0 to 50 feet. Disconformably underlies Wheatland formation (new); disconformably overlies San Jon formation (new).

Type exposure: Sand Canyon, a dissected depression containing the San Jon site, which is approximately 10 miles south of town of San Jon, Quay County. Occurs in broad channels cut into underlying formations 40 to 50 feet above grade of modern arroyos.

Sand Canyon Member (of Sheep Creek Formation)

Miocene (Hemingford): Northwestern Nebraska.

M. K. Elias, 1942, Geol. Soc. America Spec. Paper 41, p. 128, 129–131. Name applied to middle member of formation. The whole exposed section (type) which is about 145 feet, is made up largely of fine-grained sand, grayish in lower half and greenish in upper half; about 30 feet above base is a 3- to 4-foot bed of dark-gray volcanic ash. The fine sand below the ash bed has several zones of concretionary type of cementation and contains bones of mammals (this is zone of remains of *Merychippus* and *Pronomotherium*). Basal 10 feet is somewhat stratified by development of interbedded streaks of white fine sandy silt and contains a bed of white marl. The fine sand above the bed of the dark-gray volcanic ash is partially cemented into harder ledges, which approach in appearance the "mortar beds" of the Ogallala. Overlies Spottedtail member (new); underlies Box Butte member.

Type locality: Sand Canyon, 13 miles south and 5 miles west of Hay Springs. Type section is on southwest side of canyon at and around junction of secs. 11, 13, and 14, T. 29 N., R. 47 W., Dawes County.

†Sand Coulee Beds[1]

Eocene, lower: Western Wyoming.

Original reference: W. Granger, 1914, Am. Mus. Nat. History Bull., v. 33, p. 202–205.

H. E. Wood 2d and others, 1941, Geol. Soc. America Bull., v. 52, no. 1, p. 30, pl. 1. Not clearly separable as member of either Gray Bull or "Bighorn Wasatch." Shown on correlation chart as local fauna, Wasatchian.

Exposed in vicinity of Big Sand Coulee in Clark Fork Basin, Bighorn basin.

Sand Creek Flows

Pleistocene to Recent: Southwestern Oregon.

Howel Williams, 1942, Carnegie Inst. Washington Pub. 540, p. 89–90. Sand Creek flows were results of glowing avalanches of pumic and scoria that descended southern slope of Mount Mazama through Kerr Notch. Flows emptied into Williamson River near present site of village of Kirk.

Glowing avalanches of pumice were part of final activity of Mount Mazama and followed what is termed main pumice fall.

Sand Creek flows southeastward from Crater Lake.

†Sand Creek Formation[1]

Pennsylvanian: Central northern Oklahoma.

Original reference: C. N. Gould, 1925, Oklahoma Geol. Survey Bull. 35, p. 79.

R. C. Moore, 1937, Kansas Geol. Soc. Guidebook 11th Ann. Field Conf., p. 105. Essentially synonymous with Admire group.

C. C. Branson, 1957, Oklahoma Geology Notes, v. 17, no. 11, p. 102. Abandoned by Oklahoma Geological Survey.

Named for Sand Creek in north part of Osage County.

†Sand Draw Sandstone Lentil (in White River Formation)

Eocene, upper, or Oligocene, lower: Southwestern Wyoming.

F. B. Van Houten, 1954, U.S. Geol. Survey Oil and Gas Inv. Map OM-140. Name applied to deposit in stream channel. Most of channel deposit is soft, pale greenish-gray to yellowish-gray tuffaceous sandstone. In upper part of lentil conglomerate lenses a foot thick contain pebbles as much as an inch in diameter. Across width of channel sediments grade upward into facies of Beaver Divide conglomerate member. At margins of channel cross section the upper part of channel fill interfingers with and is conformably overlain by volcanic facies of Beaver Divide conglomerate member. Thickness about 75 feet. Mammalian fossils suggest either Duchesnean or earliest Chadronian (latest Eocene or earliest Oligocene) age.

Name derived from Sand Draw drainage in Long Creek-Beaver Divide area, Fremont County.

Sandel Formation

Oligocene, lower: Western Louisiana.

H. V. Andersen, 1960, Louisiana Dept. Conserv.. Geol. Bull. 34. p. 102, 103–106. Delaney (1958, unpub. ms.) proposed name Sandel for greenish-yellow or tan fine-grained well-sorted. sometimes crossbedded. silty quartz sand which overlies Mosley Hill formation (restricted) and underlies the Rosefield. Thickness about 15 feet at type locality. As interpreted in this report [Sabine Parish], the Oligocene series consists of basal sand, the Sandel formation. and an upper silty clay, the Nash Creek formation (new). Sandel overlies Mosley Hill, as restricted by Delaney. Roadcuts along U.S. Highway 171, in vicinity of Hodges Gardens have been leveled and sodded in recent highway development program. Delaney's type locality of Sandel including macrofossil bed, and Murray's comparative outcrop for Mosley Hill formation (Nash Creek of this report) have been destroyed. Alternate reference localities for both formations are herein designated.

H. V. Andersen. ed., 1960. Type localities project unit 1: Baton Rouge. La.. Soc. Econ. Paleontologists and Mineralogists, Gulf Coast Sec., p. [46–48]. Age given as lower Oligocene.

Type section (Delaney): Series of roadcuts and ditches on east and west sides of U.S. Highway 171 on north inface slope of Catahoula cuesta, 1.1 miles southeast of Sandel, Sabine Parish, in SW¼NE¼ sec. 31, T. 5 N.,

R. 10 W., just north of main gate of A. J. Hodges experimental gardens. Alternate type locality (Andersen): In gully which heads on west side of U.S. Highway 171, 0.3 mile south of entrance to Hodges Gardens (NW¼SE¼ sec. 31, T. 5 N., R. 10 W.).

**Sanders Basalt**

(?)Tertiary, upper, or Pleistocene(?): West-central Arizona.

C. A. Anderson, E. A. Scholz, and J. D. Strobell, Jr., 1955, U.S. Geol. Survey Prof. Paper 178, p. 1, 27–28, pl. 3. Grayish-black basalt that contains conspicuous laths of plagioclase separated by microscopic crystals of olivine and augite. Individual flows of lava are thin, ranging from 5 to 50 feet in thickness. Thickness 200 feet. Along southern mesas rests directly on rhyolite tuff beds of Gila (?) conglomerate, but to north overlies Wilder formation (new) or Gila(?) conglomerate. Along eastern margin of Bozarth Mesa, flows of Sanders basalt interfinger with lava flows of Wilder formation.

Covers all the mesas and receives its name from Sanders Mesa in south-central part of Bagdad area, Yavapai County. A crescent-shaped belt extends from Nelson Mesa on east to Black Mesa on west. Caps the extensive mesas far to the west, north, and northeast beyond the mapped area.

Sanders Bridge Limestone (in Palo Pinto Formation)[1]

Pennsylvanian: North-central Texas.

Original reference: G. Scott and J. M. Armstong, 1932, Texas Univ. Bull. 3224, p. 24.

Type locality: On Boone Creek, 3¼ miles northwest of Booneville, Wise County. Well exposed at Sanders Bridge over Boone Creek, on Booneville-Willowpoint Road.

Sanderson Formation (in New Albany Shale)

Sanderson Member (of New Albany Shale)

Lower Mississippian (Kinderhookian): Southern Indiana, northern Kentucky, and Ohio.

Guy Campbell, 1946, Geol. Soc. America Bull., v. 57, no. 9, p. 840 (fig. 3), 847–849, 857, 870. Proposed for division of the New Albany shale between the Blackiston and Underwood or Henryville formations (all new). Thickness 10 feet. Contains two beds, each with layers of phosphatic nodules at top; shale is less hard, less brittle, and less black than the upper Blackiston shale but is so similar that under varying conditions of weathering the two cannot be distinguished on lithology; fossiliferous. Includes Falling Run member (new) at top. Uniform in character from Indiana into Kentucky and from Lake Erie to Tennessee. Southwest of Irvine, Ky., Falling Run member is present and is overlain by the New Providence; from Irvine north through Ohio, the Falling Run is absent and the Sanderson is overlain by Bedford shale.

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 "formation." Indiana Geological Survey uses these terms with rank of member.

Type section: In northwest angle of intersection of Klerner and Mount Tabor Roads, 1 mile northwest of Sanderson, 2 miles north of New Albany, Floyd County.

**Sandersville Limestone Member** (of Barnwell Formation)

Eocene, upper: Eastern Georgia.

C. W. Cooke, 1943, U.S. Geol. Survey Bull. 941, p. 62, 63, 65. Limestone referred by Veatch and Stephenson (1911) to McBean formation and by Cooke and Shearer (1918, U.S. Geol. Survey Prof. Paper 120–C) to upper part of Barnwell is herein named Sandersville limestone member. Thickness probably not more than 40 feet; at type locality 19 feet.

P. E. LaMoreaux, 1946, Georgia Geol. Survey Bull. 50, pt. 1, p. 18. Sandersville limestone member is believed to be equivalent in part to the Irwinton sand member (new) but may represent in part a still younger bed of Jackson age.

Type locality: At a sink west of the Tenmile Road, 0.8 mile south of courthouse at Sandersville, Washington County.

**Sandfall 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. Consists mainly of noncalcareous to slightly calcareous olive-gray shale, grading upward to calcareous shale and partly oolitic limestone in upper 30 feet; strata becomes increasingly calcareous eastward, grading completely into limestone in Madison County, Ala. Thickness ranges from 86 feet at type locality to about 65 feet on Cane Creek, Colbert County, Ala. Underlies Mynot sandstone member (new); overlies Wagnon member (new).

Named for exposures in cuts along the road up Sandfall Mountain, a northern spur of Pride Mountain, in SE¼ SE¼ sec. 15, T. 4 S., R. 12 W., Colbert County, Ala.

Sand Gap 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 near Sand Gap about 100 feet; in Cross Mountain section about 5 feet. Underlies a shale interval 40 to 120 feet thick that in turn underlies Newcomb sandstone (new); overlies a shale interval 40 to 170 feet thick that in turn overlies the Petros sandstone (new).

Named for exposures in Sand Gap, a short distance north of Elk Valley, Pioneer quadrangle, Campbell County.

**Sandgrass Andesite**[1]

Tertiary: Central Nevada.

Original reference: J. E. Spurr, 1915, Econ. Geology, v. 10, p. 729.

Exposed in Sandgrass mine, Tonopah Extension mine, and other mines in Tonopah district.

**Sand Hills Formation**[1]

Pleistocene and Recent: Western Nebraska, eastern Colorado, and southern South Dakota.

Original reference: A. L. Lugn, 1934, Nebraska State Mus., v. 1, Bull. 41, p. 321, 322, 326, 331, 350.

D. R. Hill and J. M. Tompkin, 1953, U.S. Geol. Survey Bull. 1001, p. 32–33, pl. 1. Geographically extended into Wray area, Colorado, where it makes up northwestward-trending ridges north of the Republican River. Consists of well-sorted pale-yellowish-brown unconsolidated sand; unfossiliferous. Estimated maximum thickness 100 feet. Overlies Grand Island formation and in some areas covers Pleistocene and Recent sandy silt. Considered late Pleistocene and Recent. Formation probably in part contemporaneous with the valley fill and the Pleistocene and Recent sandy silt and clay.

S. G. Collins, 1959, Geology of the Martin quadrangle (1:62,500): South Dakota Geol. Survey. Geographically extended into southern South Dakota. Covers most of southern third of Martin area. Consists of fine sands derived from underlying Valentine formation, reworked by Pleistocene and Recent wind action into a succession of consolidated dunes. Individual dunes rise as much as 160 feet above their base, and most are 80 to 120 feet in height. Total maximum thickness of material affected by eolian reworking estimated to be about 200 feet.

The Sand Hills occupy about 20,000 square miles of central and northern Nebraska.

Sand Hills[1] (series)

Cretaceous: New Jersey.

Original reference: W. B. Clark and G. B. Shattuck, 1897, Johns Hopkins Univ. Circ. 128, p. 13–16.

**Sandholdt Shale Member** (of Monterey Shale)

Sandholdt Shale

Miocene, lower, middle, and upper: West-central California.

R. R. Thorup, 1941, Geol. Soc. America Bull., v. 52, no. 12, pt. 2, p. 1958. Listed as a formation underlying Monterey shale and overlying Vaqueros formation (restricted). Subdivided into three unnamed members. Thickness about 800 feet.

R. R. Thorup, 1943, California Div. Mines Bull, 118, pt. 3, p. 465 (fig. 192), 466. Clay shale with minor amount of interbedded sandstone in lower part. Thickness about 950 feet. Occurs stratigraphically between sandy Vaqueros and overlying porcellaneous and cherty Monterey.

M. N. Bramlette and S. N. Daviess, 1944, U.S. Geol. Survey Oil and Gas Inv. Prelim, Map. 24. Described as a shale. Thickness as much as 2,100 feet in Horse Canyon, near Arroyo Seco, Salinas Valley.

U.S. Geological Survey currently classifies the Sandholdt as a member of the Monterey Shale on the basis of a study now in progress.

Type locality: N½ and SE¼ sec. 14, NE¼ sec. 15, T. 20 S., R. 6 E., Junipero Serra quadrangle, Monterey County.

Sandia Clay[1]

Quaternary: Central northern New Mexico.

Original reference: E. D. Cope, 1875, Ann. Rept. Chief Engineer, USA, Rept. Secretary War to 44th Cong., v. 2, pt. 2, p. 997.

In Sandia Mountains.

**Sandia Formation** (in Magdalena Group)[1]

Lower Pennsylvanian: Central northern New Mexico and southern Colorado.

Original references: C. L. Herrick, 1900, Jour. Geology, v. 8, p. 112–126; Am. Geologist, v. 25, p. 234–237; New Mexico Univ. Bull., v. 2, pt. 3, p. 1–14.

M. L. Thompson, 1942, New Mexico Bur. Mines Mineral Resources Bull. 17, p. 49–50. In Sandia Mountains, formation, as herein interpreted, corresponds in age to lower part of type section of Armendaris group (new). Fauna in uppermost arenaceous beds corresponds in age almost exactly with fauna in lower part of type section of Elephant Butte formation (new). Thickness about 127 feet.

C. B. Read and D. A. Andrews, 1944, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 8; C. B. Read and G. H. Wood, 1947, Jour. Geology, v. 55, no. 3, pt. 3, p. 224 (fig. 1), 228 (fig. 2), 229, 230 (fig. 4), 231 (fig. 5), 233 (fig. 6). Includes lower limestone member and upper clastic member. Underlies Madera formation; overlies Precambrian.

K. G. Brill, Jr., 1952, Geol. Soc. America Bull., v. 63, no. 8, p. 815. Clastic member of Sandia traced from New Mexico as far north as Huerfano Park, Colo. Thickness about 300 feet in Pecos, Gallinas River, Coyote Creek, and Whiskey Creek Pass sections and probably as much as 700 feet in western Huerfano Park.

A. K. Armstrong, 1955, New Mexico Bur. Mines Mineral Resources Circ. 39, p. 3, 13, 23, 28. In some areas, overlies Arroyo Penasco formation (new) and, in some areas, overlies Log Springs formation (new).

E. H. Baltz, Jr., and G. O. Bachman, 1956, New Mexico Geol. Soc. Guidebook 7th Field Conf., p. 98 (fig. 2), 99. Lower limestone member considered Devonian(?) and Mississippian; remainder of formation Early Pennsylvanian (Morrow).

D. W. Bolyard, 1956, Rocky Mountain Assoc. Geologists Guidebook to geology of the Raton Basin, Colorado, p. 52–53; 1959, Am. Assoc. Petroleum Geologists Bull., v. 43, no. 8, p. 1904–1910. Name Deer Creek formation proposed for beds called Clastic member of Sandia by Brill (1952).

E. H. Baltz and C. B. Read, 1960, Am. Assoc. Petroleum Geologists Bull., v. 44, no. 11, p. 1754 (fig. 5), 1755 (figs. 6, 7), 1756 (fig. 8), 1765, 1766 (fig. 12), 1767, 1769. In much of Sangre de Cristo region, unconformably overlies Cowles member of Tererro formation (both new). Lower Pennsylvanian.

First described in Sandia, Manzano, and San Andres Mountains, N. Mex.

Sandia quartzites[1]

Middle Carboniferous: New Mexico.

Original reference: C. R. Keyes, 1903, Ores and Metals, v. 12, p. 48.

Sandia Mountains.

†Sandia series[1]

Carboniferous: New Mexico.

Original reference: C. R. Keyes, 1903, Rept. of the Governor of New Mexico to the Secretary of the Interior.

San Diego Formation[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. 289; 1933, Geology of Puerto Rico, p. 44.

R. C. Mitchell, 1954, Puerto Rico Univ. Agr. Expt. Sta. Tech. Paper 13, p. 36 (table 2). Thickness about 600 feet. Occurs above Fajardo shale. Upper Cretaceous.

Present in Fajardo district.

**San Diego Formation**[1]

Pliocene: Southern California.

Original reference: W. H. Dall, 1898, U.S. Geol. Survey 18th Ann. Rept., pt. 2, p. 337.

L. G. Hertlein and U.S. Grant 4th, 1939, California Jour. Mines and Geology, v. 35, no. 1, p. 63 (fig. 4), 68–71. Described in San Diego quadrangle as soft yellowish and gray sands, occasionally micaceous or marly, fossiliferous; minor amounts of conglomerate. Thickness 1,250 feet. Rests with angular unconformity upon Rose Canyon shale member of the La Jolla, or on Poway formation, or overlaps them and rests with marked unconformity upon Black Mountain volcanics; unconformably underlies Sweitzer formation.

G. B. Cleveland, 1960, California Div. Mines Spec. Rept. 64, p. 7–9, pl. 1. Middle or late Pliocene.

Well developed in immediate environs of city of San Diego.

San Dimas Formation[1]

Pleistocene, upper: Southern California.

Original reference: R. Eckis, 1928, Jour. Geology, v. 36, p. 228, 235–236.

J. S. Shelton, 1955, Geol. Soc. America Bull., v. 66, no. 1, p. 77, pl. 1. Extensively exposed as remnants of Pleistocene fan deposits along base of San Gabriel Mountains. Unconformably overlies Duarte conglomerate.

Type locality: San Dimas, 5 miles west of Claremont, Los Angeles County.

†Sand Mountain Conglomerate[1]

Pennsylvanian: Northern central Alabama.

Original reference: J. L. Campbell and W. H. Ruffner, 1883, Phys. survey from Atlantic Ga., across Alabama and Mississippi, p. 54–57.

Jefferson and Blount Counties.

Sandoval granite[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, 11.

Magdalena and Sandia Mountains. Derivation of name not given.

Sandpoint Conglomerate[1]

Late Carboniferous(?): Northern Idaho.

Original reference: A. L. Anderson, 1930, Idaho Bur. Mines and Geology Bull. 12.

Occurs in Purcell trench, north of Sandpoint, Bonner County.

†Sand Pond Gneiss[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.

**Sand Springs 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. 80–82, pl. 5. Thickness about 500 feet. Older than Minidoka basalt.

Exposed along borders of Snake River for distance of 32 miles upstream from Sand Springs Creek. Fills a former deep canyon of Snake River from Paul to Sand Springs, Gooding and Jerome Counties.

**Sandstorm Rhyolite**[1]

Tertiary: Southwestern Nevada.

Original reference: F. L. Ransome, 1909, U.S. Geol. Survey Prof. Paper 66, p. 28, 43.

In Sandstorm mine and hills lying west of road from the mine to Columbia, Esmeralda County.

**Sandsuck Formation** (in Walden Creek Group)

Sandsuck Shale[1] (in Chilhowee Group)

Precambrian (Ocoee Series): 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, 1947, Am. Jour. Sci., v. 245, no. 10, p. 626 (table), 629. In Hot Springs Window area, North Carolina, Sandsuck shale is 800 to 1,000 feet thick. Underlies Cochran quartzite; overlies Vann quartzite (new). Chilhowee group. Lower Cambrian. Name substituted for Hiwassee slate of Keith.

G. W. Stose and A. J. Stose, 1949, Geol. Soc. America Bull., v. 60, no. 2, p. 300. In Hot Springs Window, lowest beds exposed in Chilhowee group are soft fine-grained arkose and shale (Sandsuck formation, which has no known counterpart in the Unicoi). Late Precambrian and Lower Cambrian.

P. B. King, 1949, Am. Jour. Sci., v. 247, no. 9, p. 627, 629 (fig. 8), 630 (fig. 9), 631 (table 4), 639. Discussion of base of Cambrian in southern Appalachians. Proposed sequence in northeast part of Great Smoky Mountains shows Sandsuck shale, about 4,000 feet thick, at top of Precambrian Ocoee series. Consists of argillaceous shale, with interbedded layers and lenses of limestone and of conglomerate (latter is Citico conglomerate of Keith's early reports). Underlies Cochran conglomerate; overlies Pigeon siltstone.

S. S. Oriel, 1950, North Carolina Div. Mineral Resources Bull. 60, p. 23–25. Sandsuck formation is used in this report [Hot Springs Window area] for rocks between Unicoi above and Snowbird below. Keith's use of Hiwassee in Hot Springs area considered inappropriate.

John Rogers, 1953, Tennessee Div. Geology Bull. 58, pt. 2, p. 24–30; pt. 1, pls. As mapped Sandsuck shale is uppermost unit of Ocoee series. Southwest of Pigeon River (especially Sevier County) overlies Pigeon siltstone; northeast of Pigeon River overlies Snowbird formation. Sandsuck as mapped northeast of river corresponds roughly to what Keith (1904) mapped as Hiwassee slate in same area. In present usage, Wilhite slate (Keith, 1895), is considered synonym of Sandsuck shale, but Citico conglomerate (Keith, 1895) may be used as member name for conglomerate beds and lenses within Sandsuck shale, especially south of Miller Cove fault. Hayes (1895) named Starr conglomerate lentil in Sandsuck shale. Because of poor base map on which he had to work, he made error in tracing units from Hiwassee River to Ocoee

River; hence, Starr conglomerate is now considered synonym of Cochran conglomerate and should be abandoned.

P. B. King and others, 1958, Geol. Soc. America Bull., v. 69, no. 8, p. 955 (table 1), 962–963. Formation included in Walden Creek group (new). Lies beneath sandstone and conglomerate which Keith (1895) considered to be basal Cochran, but intertongues widely with these coarser rocks. Base of Cochran redefined at higher level, at base of persistent beds of arkose and quartzite, in part maroon; shale, sandstone, and conglomerate beneath is redefined as Sandsuck formation. Best section is not along Sandsuck Branch but on opposite northwest slope of Chilhowee Mountain; there 2,500 feet is exposed, but base is cut off by Great Smoky fault. Formation is lowest unit of sequence on Chilhowee Mountain and occurs in same position on English Mountain farther east; in both places its base is cut off by faults, and it is overlain by Cochran formation of Chilhowee group. These two occurrences are in fault blocks along front of Great Smoky thrust sheet and are not in sequence with main body of Walden Creek group. In section south of English Mountain, about 4,000 feet of beds identified as Sandsuck overlie Wilhite formation; top not preserved.

J. L. Stuckey and S. G. Conrad, 1958, North Carolina Div. Mineral Resources Bull. 71, p. 37; J. L. Stuckey, 1958, Geologic map of North Carolina (1:500,000): North Carolina Div. Mineral Resources. Sandsuck shale (formation) mapped in Madison and Yancey Counties. Thickness about 700 feet in Hot Springs area. Ocoee series.

Named for exposures on Sandsuck Branch of Walden Creek, Sevier County, Tenn.

**Sandtrap Conglomerate**

(?)Pliocene, upper: West-central Arizona.

S. G. Lasky and B. N. Webber, 1949, U.S. Geol. Survey Bull. 961, p. 14 (table 2), 35–38, pls. 1, 2. Largely light-red to dark-red poorly sorted conglomerate with discontinuous bedding. Includes prominent basalt member in northwest part of area (along Sandtrap Wash west of Maggie Canyon). Basalt is dense and partly vesicular. Thickness estimated to range from 300 to possibly 2,000 feet in main part of valley southwest of Artillery Mountains. Rests unconformably upon Cobwebb basalt (new), or, where basalt is absent, upon Chapin Wash formation (new), and extends well beyond limits of both to rest with angular unconformity upon Artillery formation (new) and Precambrian rocks. Referred to upper Pliocene because it is youngest of the three supposedly Pliocene formations in the basin and is separated from other two (Cobwebb and Chapin Wash) by erosional unconformity. Shown on plate 1 as Pliocene(?) and on plate 2 as late Pliocene(?).

Named from Sandtrap Wash, along which it is typically and extensively exposed. Occupies mainly the central part of valley between Artillery and Rawhide Mountains.

Sandusky Limestone[1]

Middle Devonian: Northern and central Ohio.

Original reference: J. S. Newberry, 1873, Ohio Geol. Survey, v. 1, p. 143–144, table opposite p. 89.

Occurs at Sandusky, Erie County, and Delaware, Delaware County.

Sandy Creek Beds[1]

Upper Ordovician: Northern New York.

Original reference: R. Ruedemann, 1925, New York State Mus. Bull. 258, p. 85, 137, 141, 149, 154.

Exposed along upper Sandy Creek, Jefferson County.

Sandy Hook Member (of Redbank Formation)

Upper Cretaceous: Eastern New Jersey.

R. K. Olsson, 1959, Dissert. Abs., v. 19, no. 8, p. 2063. Redbank formation is divided into Shrewsbury and Sandy Hook members.

R. K. Olsson, 1960, Jour. Paleontology, v. 34, no. 1, p. 2, 4 (fig. 2). Consists of clayey micaceous slightly glauconitic quartz sand. Underlies Shewsbury member; overlies Navesink formation.

Occurs in New Jersey Coastal Plain.

Sandy Huff Shale (in New River Group)

Sandy Huff Shale (in Pottsville Group)[1]

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. 193.

P. H. Price and E. T. Heck, 1939, West Virginia Geol. Survey Greenbrier County, p. 216, 226–227. Dark-gray and somewhat sandy; as much as 25 feet thick. Compensates for varying thickness of overlying Harvey sandstone and is locally cut out by it. Separated from underlying Guyandot sandstone by Castle coal. Included in New River group, Pottsville series.

Named for exposure at mouth of Sandy Huff Branch, McDowell County.

San Emedio Series[1]

Precambrian(?): Southern California.

Original reference: O. H. Hershey, 1902, California Univ. Pub., Dept. Geol. Bull., v. 3, pl. 1, map.

Probably named for San Emigdio Mountain in Kern County.

†San Emigdio Formation[1]

Eocene, upper and Oligocene: Southern California.

Original reference: G. C. Gester, 1917, California Acad. Sci. Proc., 4th ser., v. 7, pl. opp. p. 220.

R. M. Kleinpell, 1938, Miocene stratigraphy of California: Tulsa, Okla., Am. Assoc. Petroleum Geologists, p. 160, fig. 14. Included in Refugian stage (Oligocene).

A. M. Keen and Herdis Bentson, 1944, Geol. Soc. America Spec. Paper 56, p. 21 (fig. 4). Age shown as upper Eocene and lower Oligocene.

Exposed on east side of San Emigdio Creek, southwestern part of Kern County.

**Sanford Formation** (in Newark Group)[1]

Upper Triassic: Central North Carolina.

Original reference: M. R. Campbell and K. K. Kimball, 1923, North Carolina Geol. and Econ. Survey Bull. 33, p. 20, 43-45.

J. A. Reinemund, 1955, U.S. Geol. Survey Paper 246, p. 35–39, pl. 1. Formation includes youngest Triassic rocks in Deep River basin. Conformably overlies Cumnock formation in Sanford and Durham basins, but appears to lie unconformably on Pekin formation in Colon cross structure. Thickness 4,000 feet in northeastern part of Sanford basin, southeast of Deep River fault, entire formation is exposed; about 3,000 feet thick northwest of fault. Largely sandstones, claystones, and siltstones; strata are lenticular or laterally gradational; no outcrop gives section that is typical outside a small area.

Named for development around town of Sanford, Lee County. Borders southeast edge of Deep River basin throughout mapped area in a belt that attains a breadth of 10½ miles in eastern part of Sanford basin, narrows to little more than one-half mile in Colon cross structure, and broadens again to a width of 3 or 4 miles in southern part of Durham basin.

Sanford Quartzite

Triassic(?): Eastern California.

G. A. Schroter, 1938, Eng. Mining Jour., v. 139, p. 44. Pure white to cream-colored translucent sugary grained quartzite, locally grading into hornfels. Occurs in Sebrina complex.

Area is on east flank of Sierra Nevada Mountains, southwest of Bishop, Inyo County.

San Francisco Alluvium

Quaternary: Southwestern Utah.

P. J. Barosh, 1960, Utah Geol. and Mineralog. Survey Bull. 68, p. 28, 29. Name applied to alluvium on east-sloping flank of San Francisco Mountains.

Area of report is Beaver County.

†San Francisco Group[1]

Franciscan (Jurassic?) and Tertiary, upper: Western California.

Original reference: J. S. Newberry, 1857, Pacific Railroad Repts., v. 6, pt. 2, p. 10–12.

Forms slopes of the axis lying between San Francisco and the ocean.

†San Francisco Sandstone[1]

Jurassic(?) and Tertiary, upper: Western California.

Original reference: W. P. Blake, 1856, Expl. and Survey for railroad route Mississippi River to Pacific Ocean, v. 5, 33d Cong., 2d sess., S. Ex. Doc. 78, p. 145–156.

Forms greater part of hills and mountains around the San Francisco Bay and, also, a considerable part of mass of Coast Mountains.

San Gabriel Formation[1] or Complex

Precambrian: Southern California.

Original reference: W. J. Miller, 1934, Univ. California at Los Angeles Pub. in Math. and Phys. Sci., v. 1, no. 1, p. 12, 25–65, map.

W. J. Miller, 1946, Geol. Soc. America Bull., v. 57, no. 5, p. 465–469, table 4. Referred to as San Gabriel complex. Older Precambrian.

Named for extensive development in San Gabriel Mountains.

**Sangamon Interglaciation**

Sangamon Interglacial Stage

Sangamon (Sangamonian) Stage, Age

Sangamon stage of deglaciation[1]

Pleistocene: Mississippi Valley.

Original reference: F. Leverett, 1898, Jour. Geology, v. 6, p. 171–181.

Leland Horberg, 1950, Illinois Geol. Survey Bull. 75, p. 29. Sangamon interglacial stage includes Early Sangamon soil and Late Sangamon loess. Footnote states that deposits herein referred to as Late Sangamon loess have been named Farmdale loess by Leighton who regards the Farmdale loess as pro-Wisconsin (pre-Iowan) rather than Late Sangamon age.

J. C. Frye and A. B. Leonard, 1955, Am. Jour. Sci., v. 253, no. 6, p. 358–364. Provincial classification of post-Sangamonian time into Scandian, Bradyan, and Almenan subages, proposed for use in Midcontinent region.

J. C. Frye and H. B. Willman, 1960, Illinois Geol. Survey Circ. 285, p. 3–4, 11. Revision of time-stratigraphic classification of the Wisconsinan. Names Wisconsin, Sangamon, and Yarmouth stages of previous usage are here changed to adjectival endings Wisconsinan, Sangamonian, and Yarmouthian to make them consistent with form long used for Nebraskan, Aftonian, Kansan, and Illinoian stages. In terms of stratigraphic sequence, Wisconsinan stage includes all deposits above Sangamon soil and below Recent alluvium. Sangamonian stage is followed by Altonian substage (new) of Wisconsinan stage.

Name amended to Sangamon Interglaciation to comply with Stratigraphic Code adopted 1961.

Named for exposures of the soil in Sangamon County, Ill.

San Germán Limestone[1] or Formation

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. 253.

R. C. Mitchell, 1954, Puerto Rico Univ. Agr. Expt. Sta. Tech. Paper 13, p. 36 (table 2), 44, 47, 60 (table 7). In Ponce district, overlies Río Yauco shale and underlies Peñuelas shale. Thickness 1,000 feet.

P. H. Mattson, 1958, Dissert. Abs., v. 18, no. 1 p. 196. In Mayagüez area, San Germán formation includes Cotui limestone member (new) near top. Occurs above Mayagüez group (new); underlies Paleocene limestone and tuffs.

T. R. Slodowski, 1958, Dissert. Abs., v. 18, no. 1, p. 200. In Yauco district, a complex, 9,000 meters thick, of volcanic flows with interbedded marine limestone, 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 Blanca, San Germán, and Jicara (new). San Germán and Jicara formations are separated from underlying Ensenada and Río Yauco, at least locally, by unconformities. Age of complex is Senonian to late Paleocene, possibly Eocene.

P. H. Mattson, 1960, Geol. Soc. America Bull., v. 71, no. 3, p. 340–344, pl. 1. Mitchell (1922) used term San Germán to describe massive limestone herein called Cotui limestone. Slodowski (1956, unpub. thesis [1958, Dissert. Abs., v. 18, no. 1]) used name to refer to massive limestone and associated volcanic rocks and conglomerates. Present report [Mayagüez area] slightly expands the latter usage. The San Germán is a thick sequence of andesitic volcanic rock with interbedded conglomerate and lenses of massive limestone. One flow near base is differentiated as Cabo Rojo agglomerate; massive Cotui limestone member occurs commonly near top of volcanic sequence; locally andesitic volcanic rock, shale, and conglomerate overlies the Cotui. Maximum thickness 600 meters. Overlies Mayagüez group, probably unconformably; conformably underlies Jicara formation. Upper Cretaceous.

Type locality: In hills southwest of San Germán, Ponce district.

San Gorgonio Igneous-Metamorphic Complex

Mesozoic and older: Southern California.

C. R. Allen, 1957, Geol. Soc. America Bull., v. 68, no. 3, p. 318–322, pl. 1. Consists of migmatitic gneiss, flaser gneiss, piedmontite-bearing gneiss, and green schist. Complex crops out over most of map area and constitutes a metamorphic terrane of intermediate to basic composition that has been intruded and partially reconstituted by Mesozoic(?) quartz monzonite (the Cactus?).

Occurs in San Gorgonio Pass area, Riverside County.

**Sangre de Cristo Formation**[1]

Pennsylvanian and Permian: Southern Colorado and northern New Mexico.

Original reference: R. C. Hills, 1899, U.S. Geol. Survey Geol. Atlas, Folio 58, p. 1.

C. B. Read and G. H. Wood, 1947, Jour. Geology, v. 55, no. 3, pt. 2, p. 223. For continental arkoses and red beds that rest conformably, disconformably, or unconformably on Magdalena group over large areas in New Mexico, several terms have been used. Throughout most of the State, Abo formation is accepted. In Rowe-Mora basin, where indivisible arkose and red shale range in age from Upper Pennsylvanian to Permian, Sangre de Cristo formation is used. Arkosic member of Madera formation grades laterally and vertically into Sangre de Cristo.

K. G. Brill, 1952, Geol. Soc. America Bull., v. 63, no. 8, p. 821–822. In southern Colorado, contact with underlying Madera is obscure; in this region, term Sangre de Cristo is redefined to include the Permo-Pennsylvanian strata that overlie Whiskey Creek Pass limestone member (new) of Madera limestone or its equivalent. Piedmont cyclothems characterize formation; each cyclothem consists of arkosic conglomerate grading upward into finer-grained clastic strata, and, in some, nodular limestone is present at top. Includes Crestone conglomerate near center of Sangre de Cristo Range. Thicknesses: about 500 feet near Pecos; about 2,400 feet east of Mora; about 9,500 feet east of Whiskey Pass; more than 5,500 feet east of Crestone; and about 8,800 feet in Arkansas River valley. Equivalent to Maroon formation, division between the two units placed arbitrarily at Fremont-Park County line. Assumed that formation is mainly Wolfcampian, although it may be late Pennsylvanian.

G. O. Bachman, 1953, U.S. Geol. Survey Oil and Gas Inv. Map OM–137. In northwestern Mora County, N. Mex., intertongues with Madera and interfingers with Yeso formation; where Yeso is absent, directly underlies Glorieta sandstone member of San Andres formation.

E. H. Baltz, Jr., and G. O. Bachman, 1956, New Mexico Geol. Soc. Guidebook 7th Field Conf., p. 98 (fig. 2), 100–101. Summary article on occurrence of formation in southeastern Sangre de Cristo Mountains, N. Mex. Lower contact generally placed at top of highest marine limestone of underlying Magdalena group (Madera limestone). Underlies Yeso formation. Ranges in age from Middle or Late Pennsylvanian to Early Permian.

D. W. Bolyard, 1959, Am. Assoc. Petroleum Geologists Bull., v. 43, no. 8, p. 1903 (fig. 5), 1904 (fig. 6), 1922–1927. Described in Sangre de Cristo Mountains between La Veta Pass and Westcliffe, Colo. Comprises up to 8,000 feet or more of predominantly fluvial strata; differentiated from underlying units by its redbeds. Two members recognized in northern part of area: lower, characterized by piedmont cyclothems and Crestone conglomerate. In fault contact with Pass Creek sandstone (new); overlies Madera formation and in some areas Minturn formation. Upper Pennsylvanian(?) and Permian (probably Wolfcamp). Type locality designated.

R. B. Johnson and E. H. Baltz, 1960, Am. Assoc. Petroleum Geologists Bull., v. 44, no. 12, p. 1895–1902. Sedimentary rocks of Triassic age generally have been thought to be missing from outcrops in Sangre de Cristo formation of Pennsylvanian and Permian age. Two units of probable Triassic age have been separated from top of the Sangre de Cristo formation; one is herein named Johnson Gap formation. The other correlated with Lykins formation and in this report referred to as Lykins(?) formation.

Type locality: Area east of Crestone townsite, on west flank of central anticline between Crestone Needle on south and Eureka Mountain on north, Saguache County, Colo. Here, both members are well developed and structure is least complex. Continuous type section not designated for entire formation because faulting, topography, and inaccessibility make it difficult to measure such a section.

Sangre de Cristo Granite[1]

Precambrian: Colorado.

Original reference: R. D. George, 1913, Colorado Geol. Survey geol. map of Colorado.

Sangre de Cristo Range.

San Gregorio Sandstone Member (of Purisima Formation)

Pliocene: Northern California.

R. M. Touring, 1959, Dissert. Abs., v. 20, no. 4, p. 1325–1326. Composed of 150 to 350 feet of lithic arenites. Overlies Pomponio member (new); underlies Lobitos mudstone member (new).

Area of report is in Santa Cruz Mountains, 30 to 40 miles south of San Francisco.

San Jacinto Granodiorite

Jurassic or Cretaceous: Southern California.

W. J. Miller, 1944, California Jour. Mines and Geology, v. 40, no. 1, p. 60–61, pl. 1. Varies from quartz diorite to granite. Constitutes main part of San Jacinto batholith. Massive granitic dikes, presumably of San Jacinto granodiorite cut Bradley granodiorite and Palm Canyon complex (both new). Unit was described (but not named) by Fraser (1931, California Div. Mines Rept. 27).

Occurs west and southwest of Palm Springs, Riverside County.

San Jacinto Series[1]

Pliocene and Pleistocene: Southern California.

Original reference: P. H. Dudley, 1932, Geol. Soc. America Bull., v. 43, no. 1, p. 223.

Probably named for San Jacinto, Riverside County.

**San Joaquin Formation**[1]

Pliocene, upper: Southern California.

Original reference: F. M. Anderson, 1905, California Acad. Sci. Proc., 3d ser., v. 2, p. 181.

W. F. Barbat and John Galloway, 1934, Am. Assoc. Petroleum Geologists Bull., v. 18, no. 4, p. 476–499. San Joaquin clay described at type section herein designated. Thickness 1,860 feet. Unconformably underlies Tulare formation; overlies Etchegoin sand.

W. P. Woodring, Ralph Stewart, and R. W. Richards, 1940, U.S. Geol. Survey Prof. Paper 195, p. 27–53, pl. 3. Name San Joaquin formation adopted for greater part of apparently nonmarine and marine strata underlying nonmarine Tulare formation; overlies Etchegoin formation. This usage restricts name Etchegoin as used by Arnold and Anderson (1910, U.S. Geol. Survey Bull. 398). Predominantly fine-grained silty sandstone, silt, and clay. Thickness 1,200 to 1,800 feet. Includes Cascajo conglomerate member (new) at base. Faunal zone mapped.

Type section: Sec. 23, T. 22 S., R. 18 E., north dome of Kettleman Hills, Fresno and Kings Counties, San Joaquin Valley.

San Jon Formation

Pleistocene, upper: Eastern New Mexico.

Sheldon Judson, 1950, Geol. Soc. America Bull., v. 61, no. 3, p. 263; 1953, Smithsonian Misc. Colln., v. 121, no. 1, p. 18–20, 24 (fig. 9), 30 (table 2). Consists chiefly of dark-blue-gray clay grading laterally into greenish clay and into reddish compact sandy alluvium toward borders of basin. Thickness 0 to 50 feet. Disconformably underlies Sand Canyon formation (new). Rests on nearly horizontal but slightly irregular top of unit referred to as basal sand that unconformably overlies Purgatoire formation. Bones of extinct bison and artifacts found in top of blue clay.

Type exposure: San Jon site, approximately 10 miles south of San Jon, Quay County.

San Jose Formation

Eocene, lower: Northern New Mexico and southern Colorado.

G. G. Simpson, 1948, Am. Jour. Sci., v. 246, no. 5, p. 257–282; no. 6, p. 363–385. Name proposed for the "Wasatch" of authors in San Juan Basin. In this region the San Jose is preceded by hiatus representing late Paleocene time. There was gentle regional uplift and probably stronger folding outside present basin between deposition of Nacimiento and that of San Jose, but strong uplift that now defines eastern margin of basin is post-San Jose. In southern Colorado there was nearly continuous deposition through the later Paleocene into the Eocene. As a "specific locality at which the unit is typically developed" the badlands exposures along and near continental divide about 1 mile northwest of Regina in sec. 29, T. 22 N., R. 1 W., are designated. These exposures include only one of several distinguishable facies within formation and do not include either highest or lowest beds assigned to it. Characteristically lithology of formation is highly variable, both vertically and horizontally. There is not any one continuous sequence of exposures where full thickness of all major facies of formation are displayed. It is preferable to speak of type region rather than type locality. Type region herein designated. This enlarged type locality includes good development of lithologic facies considered typical of formation and also includes localities where have been found most of early Eocene mammals which constitute typical, but not only, faunas of formation. In type region, and more generally over much of area of formation, three major facies recognized. These intergrade almost imperceptibly in places but are markedly dissimilar in their typical development. In type region are two distinguishable clay facies, corresponding with Granger's (1914) Almagre and Largo beds. These facies contain mammalian faunas also recognizably different in facies. These faunas are all Wasatchian and probably extend over early and middle parts of that age, rather than middle and later parts as commonly supposed. Total thickness as preserved in type region 1,200 to 1,300 feet. Tiffany fauna of southern Colorado, well known to be of late Paleocene age, is in beds not now separated from the San Jose but probably separable and only tentatively assigned to that formation. Discussion of previous nomenclature, especially term Canyon Largo as used by early workers (Newberry, Holmes, and Keyes) and proposed reinstatement of Canyon Largo by Wood and others (1941, Geol. Soc. America Bull., v. 52, no. 1).

Type region: Exposures extending along eastern edge of basin from Yegua Canyon southward about 25 miles to exposed base of formation northwest of Cuba and westward from this front 10 or 15 miles approximately to meridian of settlement of Lindrith. Name derived from San Jose Valley, northwestern Sandoval County, N. Mex. Valley is followed by San Jose Creek, or Arroyo, an intermittent stream rising mainly on west flank of San Pedro Mountain, above settlement of Regina, in T. 23 N., R. 1 W., and running southward from Regina near western border of T. 22 N., R. 1 W., to junction with the Rito de los Pinos and Rio Puerco near town of Cuba in T. 21 N., R. 1 W. Formation extends into southwestern Colorado.

**San Juan Breccia** or **Formation**

San Juan Tuff[1]

Middle and late Tertiary: Southwestern Colorado.

Original reference: W. Cross, 1896, Colorado Sci. Proc., v. 5, p. 225–228.

E. S. Larsen, Jr., and Whitman Cross, 1956, U.S. Geol. Survey Prof. Paper 258, p. 14, 69–75, pl. 1. Composed almost entirely of fragments of dark rocks. Thickness varies because both upper and lower surfaces are irregular surfaces of erosion. Maximum thickness about 3,000 feet, in southern part of Ouray quadrangle. Overlies Telluride conglomerate without apparent unconformity in Telluride quadrangle, but to the east only remnants of Telluride remain and San Juan directly overlies older pre-Tertiary rocks ranging from Precambrian to Cretaceous in age;

in Uncompahgre quadrangle, overlies Lake Fork quartz latite. Underlies flows and tuffs of Silverton volcanic series. Equivalent to West Elk breccia in Anthracite and Crested Butte areas.

F. B. Van Houten, 1957, Geol. Soc. America Bull., v. 68, no. 3, p. 383–385. Gunnison (tillite) volcanic conglomerate believed to be a volcanic-rich mudflow and stream deposit that is seemingly a basal part of San Juan tuff.

Confined to northwestern part of San Juan Mountains, chiefly to area of about 50 miles across. Extends west of Telluride quadrangle, is widely distributed in Telluride, Silverton, and Montrose quadrangles. Extends to north of Montrose and Uncompahgre quadrangles into West Elk Mountains.

San Juan Formation[1]

Pleistocene: Puerto Rico.

Original reference: C. P. Berkey, 1915, New York Acad. Sci. Annals, v. 26, p. 10, 11.

R. C. Mitchell, 1954, Puerto Rico Univ. Agr. Expt. Sta. Tech. Paper 13, p. 36 (table 2), 62–64. In strictest sense, San Juan formation refers to consolidated resistant crossbedded calcarenites of aeolian origin, generally forming ridges of calcareous sandstone elongated parallel to coastline and showing distinctly disconformable relations to the Tertiary. Composed mostly of somewhat rounded grains of shell and coral fragments, along with quartz, bonded together with calcite cement. Formation may be Pliocene, but until further studies are made it is probably best to retain Pleistocene age.

P. H. Mattson, 1960, Geol. Soc. America Bull., v. 71, no. 3, p. 323 (fig. 2), 348. Pleistocene dune-sand deposit. Caps Ponce formation on Cabo Rojo, in Mayagüez area.

Well developed on site of city of San Juan.

†San Juan Glacial Epoch[1]

Pleistocene: Southwestern Colorado.

Original references: W. W. Atwood and K. F. Mather, 1912, Science, new ser., v. 35, p. 315; 1912, Jour. Geology, v. 20, p. 388; 1912, Geol. Soc. America Bull., v. 23, p. 732.

San Juan Mountains.

San Juan Series[1] or Group

Devonian and Carboniferous: Northwestern Washington.

Original reference: R. D. McLellan, 1924, Am. Jour. Sci., 5th, v. 8, p. 217.

F. T. Etherington, 1951, Am. Assoc. Petroleum Geologists Bull., v. 35, no. 2, p. 191. San Juan group listed on table of formations of western Washington. Argillite, graywacke, schist, and limestone, all metamorphosed by batholithic intrusives. Underlies Nanaimo formation. Jurassic and older.

Named for exposures on San Juan Islands.

San Juan Bautista Formation[1] (in San Lorenzo Group)

Oligocene: Southern California.

Original reference: P. F. Kerr and H. G. Schenck, 1925, Geol. Soc. America Bull., v. 36, p. 470, 471, 472, 493, map.

J. E. Allen, 1946, California Div. Mines Bull. 133, p. 18 (fig. 2), 27, pls. 1, 2, 3. Described in San Juan Bautista quadrangle. Basal formation of San Lorenzo group. Thickness 1,500 to 1,800 feet. Underlies Pinecate formation; overlies granite.

Named for exposures in vicinity of San Juan Bautista, San Benito County.

**Sankakuyama Formation**

Sankakuyama Liparite

Eocene(?): 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]. Liparite is chocolate colored on fresh surfaces and grayish white on weathered surfaces. Feldspar is plagioclase. Lower part is lava, which is almost vertical and forms summit of Sankakuyama; middle part is tuff, extensively exposed on shore opposite Tsukimishima Island. Older than Hagman anesite; relationship not clear because contact of the units not observed.

P. E. Cloud, Jr., R. G. Schmidt, and H. W. Burke, 1956, U.S. Geol. Survey Prof. Paper 280–A, p. 39–46, pl 2. chart 2. Formation consists of dacite flows and pyroclastic rocks of several textural varieties. Includes four principal facies of varied relations and known to be repeated in the general succession: Massive dacite flow rocks; vitrophyric and perlitic dacite breccias; dacite tuffs; mixed dacite pyroclastics. Maximum thickness not known, but incomplete section, estimated to be 1,800 feet, is exposed at Mount Achugau; actual thickness probably of order of few thousand feet. Dacite rocks are oldest outcropping rocks on Saipan; disconformably overlain by andesitic tuffs and flows of Hagman formation, by beds of Densinyama formation, and by Matansa limestone, all of which contain Foraminifera and are late Eocene age. Type section designated.

Type section: Succession that begins in cliffs that form northern flank of Mount Achugau, and continues through its south flank. Complete section nowhere exposed. Named for exposures at Sankakuyama (Mount Achugau) north of Densinyama.

Sankaty Beds[1] or Group[1]

Pleistocene: Southeastern Massachusetts.

Original reference: J. B. Woodworth, 1896, U.S. Geol. Survey 17th Ann. Rept., pt. 1, p. 975–988.

Occurs on Gardners Island, Marthas Vineyard, and Block Island. Named for Sankaty Head, on Nantucket Island.

**Sankaty Sand[1]**

Pleistocene: Southeastern Massachusetts, southeastern New York, and southern Rhode Island.

Original reference: J. B. Woodworth, 1896, U.S. Geol. Survey 17th Ann. Rept., pt. 1, p. 975–988.

C. W. Cooke, Julia Gardner, and W. P. Woodring, 1943, Geol. Soc. America Bull., v. 54, no. 11, p. 1715, chart 12. Pleistocene (Sangamon). Area given as New England Islands and Cape Cod, Mass.

Named for Sankaty Head on Nantucket Island, Mass.

†Sankaty Head Beds[1]

Pleistocene: Massachusetts.

Original references: J. H. Wilson, 1905, Jour. Geology, v. 13, p. 713–734; 1906, Glacial history of Nantucket and Cape Cod, p. 13–30.

Probably named for Sankaty Head on Nantucket Island, Mass.

Sankoty Sand

Pleistocene (pre-Kansan or Nebraskan): Northeastern Illinois (subsurface).

Leland Horberg, 1946, (abs.) Geol. Soc. America Bull., v. 57, no. 12, pt. 2, p. 1204. An extensive fill of sand and gravel up to 300 feet thick within the ancient Mississippi (middle Illinois) bedrock valley.

Leland Horberg, 1950, Illinois Geol. Survey Bull. 75, pt. 1, p. 29, 30 (fig. 5), 34–36; 1953, Illinois Geol. Survey Rept. Inv. 165, p. 12–18. Defined as lowermost sand and gravel deposit which underlies glacial till or related outwash and overlies bedrock along ancient Mississippi Valley. Typically sand is 70 to 90 percent quartz grains, about 25 percent of which are pink, rounded, and polished. Thickness varies owing to topography on which it was deposited; along axis of bedrock valley thickness may be almost 300 feet; average about 100 feet. Underlies Kansan and possibly Nebraskan drift; rests directly on Paleozoic formations.

Named for Sankoty water field, north of Peoria, where numerous wells penetrate the deposit.

**San Lorenzo Formation[1]**

San Lorenzo Group

Oligocene: Southern California.

Original reference: R. Arnold, 1906, U.S. Geol. Survey Prof. Paper 47, p. 16.

J. E. Allen, 1946, California Div. Mines Bull. 133, p. 18 (fig. 2), 27. Referred to as San Lorenzo group in San Juan Bautista quadrangle. Includes San Juan Bautista and Pinecate formations. Thickness about 1,500 feet. Overlies Santa Lucia quartz diorite; underlies Vaqueros group.

R. M. Touring, 1959, Dissert. Abs., v. 20, no. 4, p. 1325. Formation, in La Honda and San Gregorio quadrangles, San Mateo County, includes 1,900 to 3,000 feet of mudstones and sandstones of late Eocene and Oligocene (Refugian and Zemorrian) age. Diabase sills as much as 600 feet thick intrude the lower San Lorenzo and are related to igneous activity which supplied volcanic material in overlying Mindego formation (new).

E. E. Brabb, 1960, Dissert, Abs., v. 21, no. 5, p. 1163. San Lorenzo formation of Eocene and Oligocene age is divided into two members herein named Twobar shale and Rices mudstone. Latter unit is type Oligocene of California, although it probably does not correspond to Oligocene series of Europe. Fossils indicate Twobar is Narizian and Rices is Refugian and Zemorrian. Underlies Butano sandstone of late Eocene (Narizian) age.

Typically exposed along bed of San Lorenzo River about 2 miles above Boulder Creek, Santa Cruz County.

San Lorenzo Quartz Diorite[1]

Age(?): Puerto Rico.

Original reference: C. R. Fettke, 1924, New York Acad. Sci. Scientific survey of Porto Rico and Virgin Islands, v. 2, pt. 2, p. 153.

†San Lorenzo Series[1]

Oligocene: Southern California.

Original reference: B. L. Clark, 1918, California Univ. Pub., Dept. Geol. Bull., v. 11, p. 54–111.

†San Luis Formation[1]

Jurassic(?): Southern California.

Original reference: H. W. Fairbanks, 1904, U.S. Geol. Survey Geol. Atlas, Folio 101.

Named for development in San Luis Valley, San Luis Obispo County.

**San Marcos Gabbro**

San Marcos Mountain Gabbro

Cretaceous: Southern California.

F. S. Miller, 1935, *in* C. S. Hurlburt, Jr., Am. Mineralogist, v. 20, no. 9, p. 609–611. Named San Marcos Mountain gabbro. Medium-grained dark-gray plutonic rock composed essentially of plagioclase feldspar and pyroxene. In the intrusive sequence, San Marcos Mountain gabbro is followed by Bonsall tonalite (new).

F. S. Miller, 1937, Geol. Soc. America Bull., v. 48, no. 10, p. 1398–1408. Described as San Marcos gabbro. Rocks included cover a wide range of composition and texture within the gabbro family. Most abundant rock type is medium-grained dark-gray norite. Derivation of name given.

Richard Merriam, 1946, Geol. Soc. America Bull., v. 57, no. 3, p. 224–225, 227, pl. 1. Gabbro and related rocks were described from eastern edge of Ramona quadrangle by Hudson (1922) under name Cuyamaca basic intrusive. Miller (1937) described similar rocks in San Luis Rey quadrangle, where he called them San Marcos gabbro. Mapping in Ramona area, which lies between the two above-mentioned areas, has shown that the two formations are probably the same. The gabbro is here referred to as the San Marcos. Occurs as numerous small bodies scattered among younger and larger tonalite and granodiorite masses and as irregular patches cutting schist and Stonewall rocks [Stonewall formation]. Middle Cretaceous(?).

W. J. Miller, 1946, Geol. Soc. America Bull., v. 57, no. 5, p. 485, table 4. Suggested Late Mesozoic plutonic sequence: San Marcos gabbro (and Cuyamaca basic intrusive), Green Valley tonalite, Bonsall tonalite, Lakeview tonalite, Stonewall granodiorite, La Posta quartz diorite, and Rattlesnake granite.

E. S. Larsen, Jr., 1948, Geol. Soc. America Mem. 29, p. 41–53, pl. 1. Intrudes Bedford Canyon formation (new) and rocks of overlying Santiago Peak volcanics. Older than Green Valley tonalite and Lakeview Mountain tonalite; appears to be oldest rock in Cretaceous(?) batholith. Cretaceous.

Occurs in San Luis Rey, Elsinore, Corona, Ramona, and Santa Ysabel quadrangles. The norite-type gabbro makes up greater part of San Marcos Mountains, San Luis Rey quadrangle, from which name San Marcos gabbro is derived.

San Martine 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), 383–384. Name proposed for upper member of Boracho limestone. Basal 30 to 40 feet of member consists of nodular to thick-bedded slightly argillaceous, aphanic limestone. Thickness 260 feet. Overlies Levinson limestone member (new); unconformably underlies Buda limestone.

Type section: On northwest face of a hill 1 mile south of San Martine Station on Texas and Pacific Railroad, and 1,500 feet south of the railroad, San Martine quadrangle [Reeves County].

San Mateo Formation[1]

Pliocene(?): Southern California.

Original reference: A. O. Woodford, 1925, California Univ. Pub., Dept. Geol. Sci. Bull., v. 15, no. 7, p. 169, 217–219.

Named for occurrence along San Mateo Creek, in northwest corner of San Diego County.

†San Miguel Cherts[1]

Jurassic(?): Western California.

Original reference: A. C. Lawson, 1902, Science, new ser., v. 15, p. 416.

Type locality: Rocks of San Miguel Hill, San Francisco County.

†San Miguel Conglomerate[1]

Eocene: Southwestern Colorado.

Original reference: W. Cross, 1896, Colorado Sci. Soc. Proc., v. 5, p. 235–241.

Typically exposed on north side of San Miguel River, from Marshall Creek westward for several miles.

**San Miguel Formation[1]**

Upper Cretaceous (Gulf Series): Southern Texas.

Original reference: E. T. Dumble, 1892, Geol. Soc. America Bull.. v. 3, p. 224–230.

L. W. Stephenson and others, 1942, Geol. Soc. America Bull., v. 53, no. 4, chart 9. Shown on correlation chart above Upson clay and below Olmos formation. Upper Cretaceous.

Named from abandoned village of San Miguel, near Eagle Pass, Maverick County.

**San Onofre Breccia[1]**

Miocene, middle: Southern California.

Original reference: A. J. Ellis, 1919, U.S. Geol. Survey Water-Supply Paper 446.

L. E. Redwine and others, 1952, Cenozoic correlation section paralleling north and south margins, western Ventura basin, from Point Conception to Ventura and Channel Island, California: Am. Assoc. Petroleum Geologists, Pacific Section. Shown on stratigraphic column of Santa Cruz Island as about 2,000 feet thick. Underlies Monterey formation; overlies Cozy Dell. However, this breccia may better be designated as a member of Rincon formation.

A. O. Woodford and others, 1954, California Div. Mines Bull. 170, chap. 2, p. 68 (fig. 2), 71, 75 (fig. 5), pl. 1a. Described in Los Angeles Basin. Composed almost exclusively of fragments of glaucophane schist and related rocks of Western bedrock complex (Catalina schist), with numerous blocks 3 to 10 feet in diameter. Interbedded with Monterey shale that contains middle or late Miocene fish scales; overlain by Monterey shale with middle Miocene Foraminifera. Separated from underlying main part of Topanga formation by notable unconformity.

Probably named from fact it forms San Onofre Hills, in San Diego County.

San Pablo Formation

San Pablo phase (of Barbacoas Formation)

Oligocene(?): Panamá.

R. T. Hill, 1898, Harvard Coll. Zoology Bull., v. 28, no. 5, p. 184–185, 206, 236 (table). Brownish rock with fragments of decomposed light-blue eruptive material imbedded in it. Grades upward into Barbacoas formation and is termed San Pablo phase of Barbacoas, 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. 345–346. Listed as formation. Considered informal name. Oligocene(?):

Described near village of San Pablo, west of Barbacoas. Now submerged locality in Canal Zone.

**San Pablo Group[1] or Formation[1]**

Miocene, upper: Western California.

Original reference: J. C. Merriam, 1898, California Univ. Pub., Dept. Geol. Bull., v. 2, p. 109–118.

B. L. Clark and A. S. Campbell, 1942, Geol. Soc. America Spec. Paper 39, p. 5. In Mount Diablo region, formation rests directly on Kellogg shale (new).

A. S. Huey, 1948, California Div. Mines Bull. 140, p. 16 (fig. 2), pls. In Tesla quadrangle, group comprises (ascending) Cierbo and Neroly formations. Thickness as much as 2,700 feet. Overlies Panoche rocks, angular unconformity; underlies Livermore gravels.

C. E. Weaver, 1949, Geol. Soc. America Mem. 35, p. 75–85, pls. San Pablo group, in San Francisco Bay region, comprises (ascending) Briones, Cierbo, and Neroly sandstones.

F. F. Davis and D. W. Carlson, 1952, California Jour. Mines and Geology, v. 48, no. 3, p. 212. Formation, in Merced County, overlies Kreyenhagen formation and underlies Ora Loma formation (new).

C. K. Ham, 1952, California Div. Mines Spec. Rept. 22, p. 6 (fig. 3). In Las Trampas Ridge area, San Pablo group overlies Monterey group and underlies Contra Costa group (new).

L. I. Briggs, Jr., 1953, California Div. Mines Bull. 167, p. 12 (fig. 2), 44–46, pl. 2. Described in Ortigalita Peak quadrangle an San Pablo formation consisting of about 400 feet of bentonitic gravel, sand, and clay. Underlies Oro Loma formation; overlies Kreyenhagen formation.

G. D. Robinson, 1956, U.S. Geol. Survey Geol. Quad. Map GQ–88. Described in Hayward quadrangle as formation consisting of two units:

an upper sequence of poorly consolidated biotitic glauconitic sandstone, clay shale, and pebble conglomerate, and a lower overlapping sequence of biotitic arkosic sandstone with ferruginous nodules. Thickness ranges from 200 feet to as much as 1,700 feet. Overlies Briones sandstone; underlies Orinda formation; contact gradational. For purpose of this report, the Briones sandstone is separated from San Pablo group.

C. A. Hall, Jr., 1958, California Univ. Pubs. Geol. Sci., v. 34, no. 1, p. 20–21. In Pleasanton and several others areas of San Francisco Bay region, confusion might be avoided if term San Pablo formation was redefined and used in place of Cierbo and Neroly formations. Need for restudy of San Pablo formation and group arises from fact that in some localities formational boundaries are difficult to recognize because formations have similar lithology. Formational contacts have been drawn chiefly on faunal evidence and with overemphasis on topographic expression of formations of the group. Terms San Pablo group, Cierbo, and Neroly are used with reluctance in this report.

Named for occurrence on San Pablo Bay, Contra Costa County, near town of Rodeo.

San Pedran Epoch[1]

Pleistocene: Southern California.

Original reference: O. H. Hershey, 1902, California Univ. Pub. Dept. Geol. Bull., v. 3, p. 1–29.

San Pedro Group

San Pedro Series

Pliocene: Southeastern Arizona.

G. G. Simpson, 1933, Am. Mus. Nat. History Bull., v. 67, art. 3, p. 109, fig. 2. A Pliocene series between Benson and Tombstone.

A. A. Stoyanow, 1937, (abs.) Geol. Soc. America Proc. 1936, p. 297 (table). Fossiliferous unit of tuffaceous clays in arkosic gravels and conglomerates.

Between Benson and Tombstone, Cochise County.

**San Pedro Sand**[1] or **Formation**

Pleistocene, lower: Southern California.

Original reference: W. H. Dall, 1898, U.S. Geol. Survey 18th Ann. Rept., pt. 2, 1898—first published in 1897 as House Doc. 5, 55th Cong., 2d sess., p. 335.

T. L. Bailey, 1943, Geol. Soc. America Bull., v. 54, no. 10, p. 1557. Described in Santa Barbara County. San Pedro formation, as defined here, is synonymous with Pressler's (1929) Las Posas except that his so-called Kalorama member (near Ventura) which contains a typical Santa Barbara fauna, is retained in the Santa Barbara; it is also approximately equivalent to the combined Hall Canyon and Saugus formations of Eaton (1928). Saugus, Las Posas, and Hall Canyon are abandoned.

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 in Palos Verdes Hills area as San Pedro sand. Rests directly on the Miocene or Pliocene or overlies the Lomita marl or Timms Point silt. Maximum exposed thickness about 170 feet. Lower Pleistocene. Type region designated.

California State Water Resources Board, 1953 (revised 1956), California State Water Resources Bull. 12, v. 2, p. B–103–B–104, pls. B–1C, B–2. In Ventura County, includes basal Fox Canyon member (new) and Epworth gravel member (new) near top.

T. L. Bailey, 1954, *in* Pacific Petroleum Geologist, v. 8, no. 9, p. 1. South of South Mountain, lower 200 to 500 feet of San Pedro formation is Fox Canyon member. San Pedro conformably overlies Santa Barbara formation and is between 1,000 to 3,500 feet thick.

J. F. Poland and others, 1956, U.S. Geol. Survey Water-Supply Paper 1109, p. 38 (table), 60–86, pl. 3. Described in Long Beach-Santa Ana area as a formation. Expanded to include Timms Point silt and Lomita marl as basal members. Full stratigraphic sequence underlies unnamed upper Pleistocene deposits and overlies the Pico formation. Thickness as much as 1,350 feet.

J. F. Poland, A. A. Garrett, and Allen Sinnott, 1959, U.S. Geol. Survey Water-Supply Paper 1461, p. 39–57, pls. In this report [Torrance-Santa Monica area], the San Pedro is considered to be essentially correlative with (but much thicker and more heterogeneous) the type San Pedro sand, Timms Point silt, and Lomita marl as defined by Woodring and others (1946). However, it doubtless includes some younger strata and may include some which are older than any exposed in type section. Nonlithologic designation San Pedro formation is preferred to term San Pedro sand. Timms Point silt and Lomita marl are treated as basal members of the formation. As here defined, formation embraces all strata of early Pleistocene age. In most of area, formation occurs between unnamed upper Pleistocene deposits above and Pico formation below. Thickness as much as 1,000 feet.

Type region: Localities along San Pedro waterfront, Los Angeles County.

San Pedro Schist Breccia and Sandstone[1]

Miocene or Pliocene: Southern California.

Original reference: A. O. Woodford, 1925, California Univ. Pub., Dept. Geol. Sci. Bull., v. 15, no. 7, p. 210–221.

Probably named for San Pedro, Los Angeles County.

†San Pedro Shales[1]

Eocene(?): Western California.

Original reference: R. Crandall, 1907, Am. Philos. Soc. Proc., v. 46, p. 3–58.

Exposed in cliffs north and south of San Pedro Point, San Francisco region.

San Pedro Valley Formation

Pliocene (Blancan) to Pleistocene: Arizona.

H. E. Wood 2d and others, 1941, Geol. Soc. America Bull., v. 52, no. 1, p. 31, pl. 1. Replaces San Pedro as used by Simpson (1933, Am. Mus. Nat. History Bull. 67, p. 109). Term San Pedro preoccupied.

Cochise County.

**Sanpete Formation** (in Indianola Group)

Upper Cretaceous: Central Utah.

E. M. Spieker, 1946, U.S. Geol. Survey Prof. Paper 205–D, p. 122, 127, 133 (fig. 17). Distinct unit of sandstone and conglomerate, with minor amounts of shale, containing fossils of lower Colorado age. Overlies Morrison(?) and underlies Allen Valley shale (new). Where clearly differentiable, it is set apart as Sanpete formation. Consists of brown, ochre, buff, and gray sandstone, gray to ochre shale, mainly sandy, and gray conglomerate. Thickness in Salina Canyon about 1,350 feet. The lower 335 feet of the formation, as here specified, may belong to the Morrison(?).

Named from Sanpete Valley, on east side of which, south of Manti, the rocks of formation are exposed in hogbacks and low ridges. In Salina Canyon, about 4 miles east of Salina, is a complete and well-exposed section. Also exposed in canyon of Lake Fork about 1½ miles southeast of Thistle.

**Sanpoil Volcanics**

Sanpoil volcanic rocks

Eocene or Oligocene: Northwestern Washington.

Hunting Geophysical Services, Inc., 1960 *in* Washington Div. Mines and Geology Rept. Inv. 20, p. 6. Correspond in part to Umpleby's (1910, Washington Geol. Survey Bull. 1) andesite flows; however, with his flows he included rocks which are here assigned to Klondike Mountain formation (new). Consists of flows and flow breccias ranging in composition from quartz latite to dacite; locally tuffaceous interbeds. Intruded by bodies of Scatter Creek rhyodacite (new). Republic quadrangle and part of Aeneas quadrangle were mapped by Muessig and Quinlan (1959, U.S. Geol. Survey open-file map); Curlew quadrangle mapped by Calkins, Parker, and Disbrow (1959, U.S. Geol. Survey open-file map).

Report discusses parts of Okanogan and Ferry Counties.

**San Rafael Group**[1]

Middle and Upper Jurassic: Eastern Utah, Arizona, western Colorado, and New Mexico.

Original reference: A. A. Baker and others, 1927, Am. Assoc. Petroleum Geologists Bull., v. 11, p. 787.

A. A. Baker, C. H. Dane, and J. B. Reeside, Jr., 1947, Am. Assoc. Petroleum Geologists Bull., v. 31, no. 9, p. 1664–1668. Includes Wanakah formation geographically extended into New Mexico and adjacent parts of northeastern Arizona to include Todilto sandstone as member.

C. T. Snyder, 1952, Utah Geol. Soc. Guidebook 7, p. 12. In section from Cedar City, Utah, to Las Vegas, Nev., group includes (ascending) Carmel, Entrada, Curtis, and Winsor formations.

C. T. Smith, 1954, New Mexico Bur. Mines Mineral Resources Bull. 31, p. 12–14. In Thoreau quadrangle, McKinley and Valencia Counties, San Rafael group comprises (ascending) Entrada sandstone, Todilto limestone, and Thoreau formation (new). Underlies Morrison formation; overlies Glen Canyon group.

F. W. Cater, Jr., 1955, U.S. Geol. Survey Geol. Quad. Map GQ–71. In Davis Mesa quadrangle, Colorado, comprises (ascending) Carmel, Entrada, and Summerville. Overlies Navajo sandstone, Glen Canyon group; underlies Salt Wash sandstone member of Morrison formation. Group crops out in narrow band along canyon walls and on sides of Paradox Valley.

J. W. Harshbarger, C. A. Repenning, and J. H. Irwin, 1957, U.S. Geol. Survey Prof. Paper 291, p. 3 (fig. 2), 32–48. At type locality, includes (ascending) Carmel formation, Entrada sandstone, Curtis formation, and Summerville formation. In area of this report [Navajo country], includes (ascending) Carmel, Entrada, Todilto limestone, Summerville, and Bluff sandstone. Unconformably overlies units of Glen Canyon group; in some areas, Navajo sandstone; and in others, Wingate sandstone (Lukachukai member). In some areas, underlies Morrison formation (Salt Wash or Recapture member); in other areas, underlies Cow Springs sandstone. Middle and Upper Jurassic.

E. B. Ekren and F. N. Houser, 1959, U.S. Geol. Survey Mineral Inv. Field Studies Map MF-221. In Moqui SE quadrangle, Colorado, group comprises (ascending) Entrada sandstone, Summerville formation, and Junction Creek sandstone. Overlies Navajo sandstone; underlies Morrison formation.

Named for exposures in San Rafael Swell, southeastern Utah.

**San Ramon Sandstone**[1]

Oligocene, upper, or Miocene, lower: Western California.

Original reference: B. L. Clark, 1918, California Univ. Pub., Dept. Geol. Bull., v. 11, p. 54–111.

A. M. Keen and Herdis Bentson, 1944, Geol. Soc. America Spec. Paper 56, p. 21 (fig. 4). Upper Oligocene.

C. E. Weaver, 1949, Geol. Soc. America Mem. 35, p. 17 (table 3), 64–65, pl. 7. Described in Coast Ranges north of San Francisco Bay, where it occurs southeast of Martinez in Carquinez quadrangle and on east side of Carneros Valley in Sonoma quadrangle. In Martinez area, approximately 140 feet thick; disconformably overlies Domengine sandstone and is slightly unconformably beneath Sobrante sandstone. Near Carneros Creek, approximately 300 feet thick; lies in fault contact with the Knoxville and disconformably underlies undifferentiated Monterey shale. Type section is 525 feet thick. Refers to Clark (1918) for derivation of name and type section.

C. E. Weaver, 1953, Washington [State] Univ. Pubs. in Geology, v. 7, p. 56–59, pls. Formation in Martinez area is exposed in east and west limbs of Pacheco syncline where it is 130 to 190 feet thick. Overlies Pereira shale member of Alhambra formation (both new); underlies Sobrante sandstone.

U.S. Geological Survey currently designates the age of the San Ramon Sandstone as late Oligocene and early Miocene on the basis of a recent study of marine mollusks.

Type section: Southwest of Walnut Creek, Contra Costa County. Named from San Ramon Creek in Concord quadrangle on west side of Mount Diablo, where it lies in two nearly parallel bands in San Ramon syncline.

**San Saba 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. San Saba member of Wilberns underlies Pedernales member (new) and overlies Point Peak shale 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. 117–121, pls. 1, 2. Name San Saba was originally used as a series by Comstock (1890) who applied it either to these beds or some part of them. Dake and Bridge (1932, Geol. Soc. America Bull., v. 43, p. 729–732) called these beds "Post Wilberns," correlated them with the Fort Sill and Signal Mountain formations, and suggested that Comstock's name San Saba might be revived for a part of them. The name is now applied to entire series of more or less glauconitic limestone overlying Point Peak shale member of Wilberns and underlying Threadgill member of Tanyard formation. Replaced eastward by Pedernales dolomite member. Grades downward into Point Peak shale, boundary being drawn on lithic grounds and not at definite stratigraphic horizon. In areas where stromatolitic bioherms do not occur, San Saba-Point Peak boundary is top of highest significant shale; where bioherms occur, selection of boundary commonly depends on lateral tracing and consensus of varied factors. In type section, the zone of stromatolitic bioherms formerly included in San Saba are now considered to be in Point Peak. Top boundary is Cambrian-Ordovician contact in western part of Llano uplift and contact with Pedernales dolomite member elsewhere. Thickness at type section about 280 feet.

P. E. Cloud, Jr., and V. E. Barnes, 1948, Texas Univ. Bur. Econ. Geology Pub. 4621, p. 145, 156, 188, 193, 226, 255, pls. [1946]. Type section and local stratigraphy described in detail.

Type section: Along both sides of Mason-Brady Highway, beginning at bridge across San Saba River and extending northward for 0.7 mile, McCulloch County. Here it is in collapse contact with Threadgill member of Tanyard.

San Saba 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, 301–306, pl. 3.

Josiah Bridge, V. E. Barnes, and P. E. Cloud, Jr., 1947, Geol. Soc. America Bull., v: 58, no. 1, p. 117. Name San Saba was originally used as series term by Comstock who applied it either to beds here termed San Saba limestone member of Wilberns formation or to some part of them.

Named for San Saba County and San Saba River valley.

**San Sebastián Formation** (in Río Guatemala Group)

San Sebastián Shale[1]

Oligocene: 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. San Sebastián formation, Lares limestone, and Cibao marl (sequence ascending) are facies equivalents that show rapid lateral transition; term Río Guatemala group is introduced for this sedimentary complex. Names are retained to designate predominantly clastic facies, predominantly reef-type limestone, and predominantly marl and chalky limestone respectively. Formation changes upward from predominantly gravel in lower part to predominantly shale, locally interbedded and interfingered with marl and limestone at top. Maximum thickness about 300 meters in vicinity of the Río Guatemala northwest of San Sebastián. About 4 kilometers east of San Sebastián, outcrops of approximately 200 meters of basal part of formation end against a salient of Cretaceous rocks; the upper 80 to 110 meters of the sequence overlap salient and continue in outcrop eastward, finally disappearing against another promontory of Cretaceous rock a short distance east of the Rio Tanama. Farther east, thickness of sediments referred to San Sebastián increases steadily into eastern clastic basin; this increase in thickness is largely at expense of Lares limestone.

K. N. Sachs, Jr., 1959, Bulls. Am. Paleontology, v. 39, no. 183, p. 399–416. Upper Oligocene; age determination made on basis of foraminifera.

Principal outcrop area extends from the Quebrada Collazo (4 kilometers east of San Sebastián), northwestward to within 4 kilometers of Aguadilla, where outcrops disappear under alluvium of Río Culebrinas Valley.

San Simon limestone[1]

Mississippian: Nevada.

Original reference: C. R. Keyes, 1923, Pan-Am. Geologist, v. 40, p. 52.

Derivation of name not stated.

Santa Ana[1] [metamorphic rocks]

*See* Santa Ana Formation (California).

Santa Ana Formation

Santa Ana Limestone[1]

Upper(?) Triassic: Southern California.

Original reference: J. P. Smith, 1898, Jour. Geology, v. 6, p. 779, 780.

E. S. Larsen, Jr., 1948, Geol. Soc. America Mem. 29, p. 19. Replaced by Bedford Canyon formation.

Rene Engel, 1959, California Div. Mines Bull. 146, p. 16–25, pl. 1. In Elsinore quadrangle, metamorphic rocks consist of rocks of undoubted sedimentary origin, correlative with Santa Ana formation of Upper(?) Triassic age, including Bedford Canyon formation (Larsen, 1948), and rocks of igneous origin, extrusive and hypabyssal, including Santiago Peak volcanics (Larsen, 1948). Rocks to which name Santa Ana formation is applied form a band, 2 to 3 miles wide, that traverses northern part of area from Railroad Canyon westward to Clevelin Hills, northwest of Elsinore. Band disappears under alluvium at end of Lake Elsinore but is exposed without interruption from point near Leach Canyon westward toward Los Pinos Peak and Trabuco Canyon. Same band extends westward for about 3 miles into Corona quadrangle where it joins main mass of Triassic rocks in Santa Ana Mountains. North of this band, formation is exposed in a few scattered areas. To the south, a few isolated masses of the formation are enclosed by granodiorite; to the southeast in Santa Rosa region, a few patches of older sedimentary rocks are associated with undifferentiated metamorphic rocks. To the southwest, a band of these sedimentary metamorphic rocks extends northwest from Tenaja Canyon to San Juan Canyon. In the quadrangle, these rocks occupy an area of about 64 square miles. The Triassic rocks were intruded by diorite, andesite, dacite porphyry, or quartz latite porphyry, in the northern part of area, and by quartz diorite and granodiorite. Greatest thickness of undisturbed Triassic sediments measured northeast of Lake Elsinore, between North Elsinore fault and north end of Railroad Canyon where unfaulted beds that dip 50° NE. exceed 28,000 feet in thickness; about 6,000 feet of this extends beyond mapped area; entire Triassic section could not be measured because it extends beneath alluvium of San Jacinto River flood plain. Thickness of formation on west limb of Los Pinos syncline, 19,000 feet or more; on east limb of syncline, 8,600 feet. Smith (1898) used name Santa Ana limestone for the hard black siliceous limestone exposed on west slope of Santa Ana Mountain. Merrill (1915 [1914? or 1916?] California Mining Bur. Rept. 14) used term in broader sense to designate metamorphic rocks of Santa Ana Mountains, including the limestone. Moore (1930, unpub. thesis) used name "Silverado formation" to designate most Triassic rocks of southwest slope of Santa Ana Mountains. These rocks have been correlated with the metamorphosed sediments exposed in Elsinore quadrangle, and name "Silverado formation" conflicts with older name Santa Ana formation. Name "Elsinore formation" proposed by Dudley (1935) for metamorphic rocks in Railroad Canyon is not considered applicable in area of this report. Hence, it is proposed to continue earlier name Santa Ana formation to designate the Upper(?) Triassic metasedimentary rocks.

Named for occurrences on west slope of Santa Ana Mountains, Orange County.

Santa Ana Formation

Upper Cretaceous (Santonian): Puerto Rico.

E. A. Pessagno, Jr., 1960, Caribbean Geol. Conf., 2d, Mayaguez, Puerto Rico, 1959, Trans., p. 83. Consists of 30,000 feet (maximum) of volcanic conglomerates, thin-bedded tuffaceous siltstones, thin-bedded argillaceous limestones, and massive argillaceous limestones. Underlies and interfingers with Toa Vaca formation (new). Footnote states that name Santa Ana no longer used; unit currently called Idlefonso [Ildefoñso].

In Ponce-Coamo area.

Santa Ana 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 lower or middle part of formation.

Named for Cerro Santa Ana located 0.5 kilometer north of Río Cuyon and 3 kilometers northeast of Coamo.

Santa Ana Sandstone[1]

Probably Pliocene, upper, or Quaternary, lower: Southern California.

Original reference: F. E. Vaughan, 1922, California Univ. Pub., Dept. Geol. Sci. Bull., v. 13, no. 9, p. 344, 378–379, map.

Named for Santa Ana River, San Bernardino County, along which it is exposed.

**Santa Anna Shale 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.

R. C. Moore, 1948, *in* M. G. Cheney, 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. Underlies Sedwick limestone member; overlies Gouldbusk limestone member (new).

Named for exposures in buttes at Santa Anna, Coleman County, and at various points north of town.

**Santa Anna Branch Shale Member** (of Putnam Formation)[1]

Santa Anna Branch Formation (in Putnam Group)

Permian (Wolfcamp Series): Central and central northern Texas.

Original reference: N. F. Drake, 1893, Texas Geol. Survey 4th Ann. Rept., pt. 1, p. 387, 420.

M. G. Cheney, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 1, p. 66 (fig. 1). Rank raised to formation in Putnam group.

R. C. Moore, 1949, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 80, sheet 2. Described in Colorado River valley as shale member of Putnam formation where it is about 120 feet thick and consists chiefly of variegated red and gray or light-brown shale; includes fairly prominent, persistent sandstone in upper part and a thin limestone near middle. Underlies Coleman Junction limestone member; overlies Sedwick limestone member of Moran formation.

P. T. Stafford, 1960, U.S. Geol. Survey Bull. 1081–G, p. 271, pls. 11, 12. Geographically extended into Brazos River valley where it is basal member of Putnam formation. Thickness 75 to 205 feet. Underlies Coleman Junction limestone member.

Probably named for exposures along Santa Anna Branch, Coleman County.

**Santa Barbara Formation**

Santa Barbara Beds or Marls[1]

Pleistocene, lower: Southern California.

Original reference: J. P. Smith, 1912, California Acad. Sci. Proc., 4th ser., v. 3, p. 161–182.

W. P. Woodring, Ralph Stewart, and R. W. Richards, 1940, U.S. Geol. Survey Prof. Paper 195, p. 110–111. Name Santa Barbara formation applied to the marine formation exposed in the southwestern part of Santa Barbara and near Rincon Point. At Rincon Point, lies unconformably on vertical beds of Miocene shale. Lower Pleistocene.

J. E. Upson, 1951, U.S. Geol. Survey Water-Supply Paper 1108, p. 18–21, pl. 2. As used in this report, comprises marine sand, silt, and clay; total maximum thickness about 2,000 feet. Underlies alluvium and terrace deposits; unconformably overlies older rocks that range from Monterey shale at least down through the Sespe. In Carpenteria basin, underlies Casitas formation (new).

Type locality: On Santa Barbara "mesa" at Rincon Point near Santa Barbara-Ventura County line.

Santa Catalina Formation[1]

Middle Cambrian: Southeastern Arizona.

Original reference: A. A. Stoyanow, 1936, Geol. Soc. America Bull., v. 47, no. 4, p. 476, 477, 480, 482.

R. L. DuBois, 1959, Arizona Geol. Soc. Guidebook 2, p. 110. Consists of mudstone near base, calcareous mudstone in middle, and sandstone near top. Thickness 300 feet. Overlies Troy quartzite; underlies Southern Belle quartzite.

Type locality: Peppersauce Canyon on north side of Santa Catalina Mountains.

Santa Catalina Gneiss[1]

Precambrian: Southern and central Arizona.

Original reference: W. P. Blake, 1908, Science, new ser., v. 28, p. 379–380.

Well developed on south side of Santa Catalina Mountains near Tucson.

Santa Clara Basalt

Quaternary: North-central New Mexico.

H. T. U. Smith, 1937, (abs.) Geol. Soc. America Proc. 1936, p. 103. Named as seventh (and youngest) in a series of Quaternary formations in area. Santa Clara basalt and Bandelier rhyolite (new) tuff locally overlie Puye formation (new).

Occurs in Abiquiu quadrangle, Rio Arriba County.

Santa Clara Complex

Precambrian: Northern New York.

A. F. Buddington, 1937, New York State Mus. Bull. 309, p. 8, 9, 29–34, 37–38, 42–45; 1939, Geol. Soc. America Mem. 7, p. 111–116. Proposed for a group of igneous rocks which crop out over much of Santa Clara quadrangle and which appear to be genetically related; comprises: medium-grained pyroxene-hornblende quartz syenite interpreted as border chill facies; pyroxene quartzose syenite with coarse lenticular structure; hornblende and biotite granite with coarse lenticular stucture; latter two members form core of complex. Along the northwest border, the pyroxene-hornblende quartz syenite is intrusive into gabbro; here, St. Regis granite (new) appears to cut at a slight angle across banding of the quartz syenite and in Nicholville quadrangle is directly adjacent to the hornblende granite; granite pegmatite veins thought to be related to St. Regis granite occur in the quartz syenite.

Complex extends northwest from Santa Clara quadrangle into Loon Lake quadrangle and southwest across Nicholville area.

**Santa Clara Formation[1]**

Pliocene and Pleistocene: Western California.

Original reference: J. G. Cooper, 1894, California Acad. Sci. Proc., 2d ser., v. 4, p. 171.

C. F. Tolman, and J. F. Poland, 1940, Am. Geophys. Union Trans., no. 21, pt. 1, p. 25, 26–27. Further described in Santa Clara County. Consists of silt-cemented conglomerate, fine silt-cemented sandstone, siltstone, and claystone; evenly and well bedded near base. Near Murphy Dam site on Stevens Creek where formation is folded, exposed thickness is about 2,000 feet. Overlies Purisima formation; underlies alluvium. Crops out in foothills west of the valley from Palo Alto on north to Los Gatos on south.

M. D. Crittenden, Jr., 1951, California Div. Mines Bull. 157, p. 22 (fig. 4), 43–44, pls. 1–2. Described in San Jose-Mount Hamilton area as unconsolidated clay, siltstone, and pebbly sandstone; poorly sorted; obscurely bedded. No diagnostic evidence of age found in area. Considered younger than Packwood gravels (new).

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. In Santa Clara and San Mateo Counties, Santa Clara formation overlaps Searsville and Los Trancos formations (both new).

Appears to have been named for its extensive development in Santa Clara County.

Santa Claran Epoch[1]

Pleistocene: California.

Original reference: O. H. Hershey, 1902, California Univ. Pub., Dept. Geol. Bull., v. 3, p. 1–29.

Area of Santa Clara River valley of the South.

Santa Cruz Group

Upper Cretaceous: Southeastern Arizona.

A. A. Stoyanow, 1937 (abs.) Geol. Soc. America Proc. 1936, p. 297 (table). Named on table. Thin-bedded shaly limestone. Older than Sonoita group (new); younger than Patagonia group (new).

Santa Cruz Island Formation[1]

Pleistocene: Southern California.

Original reference: R. W. Chaney and H. L. Mason, 1934, Carnegie Inst. Washington Pub. 415, p. 4–6, 48 [preprint 1930].

P. C. Orr, 1960, Geol. Soc. America Bull., v. 71, no. 7, p. 1118. Locally Santa Rosa formation (new) because of its location on lowest terrace, its lithology, and its fauna, is probably equivalent, in part at least, to Santa Cruz Island formation (Chaney and Mason, 1934).

Occurs on Santa Cruz Island.

Santa Emigdeo Formation

Probably lapsus for San Emigdio Formation.

**Santa Fe Formation[1] or Group**

Miocene, middle(?) to Pleistocene(?): Northern New Mexico and central southern Colorado.

Original reference: F. V. Hayden, 1869, U.S. Geol. and Geog. Survey Terr. 3d Ann. Rept., p. 66, 90.

H. T. U. Smith, 1937, (abs.) Geol. Soc. America Proc. 1936, p. 103. Formation overlies Abiquiu tuff (new).

H. T. U. Smith, 1938, Jour. Geology, v. 46, no. 7, p. 952–957. Formation described in Abiquiu quadrangle, New Mexico. Thickest and most typical exposures are in western slopes of Black Mesa. Here thickness is 990 feet. Base of exposed section lies undetermined distance (probably several hundred feet) above base of formation, and an unknown thickness has been eroded from top of section. Formation consists of alluvial deposits with some interbedded basalt flows. Where formation overlies Abiquiu tuff, there is a gradational transition extending over vertical range of from 100 to 300 feet.

C. S. Denny, 1938, (abs.) Geol. Soc. America Bull., v. 49, no. 12, pt. 2, p. 1877. Note on type area.

C. S. Denny, 1940, Jour. Geology, v. 48, no. 1, p. 78–79 (fig. 1), 82 (fig. 3), 84–99. Formation in San Acacia area, New Mexico, overlies Popotosa formation (new). Total thickness undetermined; structure section (fig. 3) assumes thickness of about 6.000 feet just east of Loma Pelada fault. Fossils suggest middle to upper Pliocene.

C. E. Stearns, 1943, Jour. Geology, v. 51, no. 5, p. 304 (fig. 2), 316–317. Formation unconformably overlies Espinaso volcanics (new). Along base of Sangre de Cristo Mountains, Sante Fe formation unconformably overlies Precambrian granite gneiss. At north end of Sandia Mountains, formation overlies the Mesaverde with angular unconformity. Map legend shows Santa Fe formation below Cuerbio basalt (new).

E. H. Baltz and others, 1952, New Mexico Geol. Soc. Guidebook 3d Field Conf., p. 12. Surface of Santa Fe Plateau is underlain by strata of late Tertiary or Quaternary age which have been called upper beds of Santa Fe formation, or more recently, the "Ancha formation" by Baldwin, Kottlowski, and Spiegel.

F. E. Kottlowski, 1953, New Mexico Geol. Soc. Guidebook 4th Field Conf., p. 144. Proposed that Santa Fe formation be raised to group status.

W. E. Elston, 1957, New Mexico Bur. Mines Mineral Resources Bull. 38, p. 10, 11–13, 17 (table 1), 36, 37, pl. 1. Santa Fe fanglomerates in Dwyer quadrangle are postvolcanic except for minor interbedded basalts. Name Gila formation may be as applicable to rocks of Dwyer quadrangle as name Santa Fe. Term Santa Fe is used in this report to include all consolidated valley-fill sediments younger than units grouped under informal term of Upper Volcanic series. In northern part of the quadrangle, formation is confined to eastern side of Mimbres fault, but, east and southeast of mouth of Tom Brown Canyon, it covers Mimbres fault zone and all other major structures. Thickness of fanglomerates may be as much as 1,000 feet. Overlies Swartz rhyolite (new) with angular unconformity. Stratigraphically above Pollack rhyolite (new).

A. E. Disbrow and W. C. Stoll, 1957, New Mexico Bur. Mines Mineral Resources Bull. 48, p. 5 (table 1), 26–29, pl. 1. Referred to as Santa Fe group in Cerrillos area. Near city of Santa Fe, strata originally placed in Santa Fe formation have been subdivided into three map units which comprise Santa Fe group. They are (ascending) Tesuque formation (with Bishops Lodge member) and Ancha formation. Terminology has been modified in Cerrillos area, where only strata similar to basal and upper units of group are found. Tuffaceous strata similar to Bishops Lodge member are placed in Abiquiu(?) formation. Name Ancha is used in both areas. Table 1 shows Santa Fe group younger than Cieneguilla limburgite and older than Cuerbio basalt. Age of group middle Miocene(?) to early Pleistocene(?).

D. B. Givens, 1958, New Mexico Bur. Mines Mineral Resources Bull. 58, p. 18–20. Discussion of geology of Dog Springs quadrangle. Santa Fe formation consists of gravels and basalts. Summits of D Cross, Tres Hermanos, Table Mountain, and Blue Mesas are capped with basalt which is considered to be part of Santa Fe formation. The basalt truncates Mesaverde group, Baca formation, and Spears Ranch member of Datil formation. Old channels filled with Santa Fe gravel are present under basalt on Tres Hermanos Mesa and on Table Mountain Mesa. Lens of Santa Fe gravel present within basalt of Tres Hermanos Mesa. Age of formation and basalt not definitely known. Believed to be Pliocene-Pleistocene. Santa Fe beds in other parts of State may or may not be age equivalents of Santa Fe beds in area of this report.

W. J. Powell, 1958, U.S. Geol. Survey Water-Supply Paper 1379, p. 18–19. Discussion of ground-water resources of San Luis Valley, Colo. Several outcrops of formation occur in valley, but they are small and do not fully reveal character of formation. Most reliable data are logs of artesian wells and deep oil tests. Thickness may be more than 5,000 feet. Underlies Alamosa formation. In this report, formation is considered to be largely of Pliocene age but in part of Miocene age.

A. J. Budding, C. W. Pitrat, and C. T. Smith, 1960, New Mexico Geol. Soc. Guidebook 11th Field Conf., p. 83, 84. In Chama basin, formation includes Abiquiu tuff member.

Type area (Denny): Region north of Santa Fe, N. Mex., between Sangre de Cristo and Jamez Mountains.

Santa Fe Granite[1]

Precambrian(?): Central northern Colorado.

Original reference: H. B. Patton, 1909, Colorado Geol. Survey 1st Rept., p. 126–128, map.

Forms highest point of Santa Fe Peak in Clear Creek, Summit, and Park Counties.

Santa Isabel Series[1]

Recent: 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. 166.

J. D. Weaver *in* R. Hoffstetter and others, 1956, Lexique Strat. Internat., v. 5, Amérique Latine, fasc. 2b, p. 344. Name given to recent alluvial deposits in south-central Puerto Rico. Term not employed since, and does not appear to have any stratigraphical value.

Santa Lucia Granite[1] or Quartz Diorite[1]

Santa Lucia Granodiorite

Pre-Cretaceous or Upper Cretaceous: Southern California.

Original reference: A. C. Lawson, 1893, California Univ. Pub. Dept. Geol. Bull., v. 1, p. 6, 9–18, pl. 1.

Philip Andrews, 1936, California Univ. Pubs. Dept. Geol. Sci. Bull., v. 24, no. 1, p. 7–9, geol. map. Term Santa Lucia is applied to granitic rocks of Gavilan [Gabilan] Range, since they are considered to be generally related to the granites of Santa Lucia Range. Pre-Franciscan.

N. L. Taliaferro, 1951, California Div. Mines Bull. 154, p. 118. Several names have been given to the ancient crystalline complex in San Francisco Bay Counties. Originally it was called Santa Lucia series, a name applied to the crystalline complex as a whole. Later, name Sur schists was given to the metamorphosed sedimentary and volcanic rocks, and name Santa Lucia was retained for the plutonic rocks. It has become customary to call all schist the Sur series, all crystalline limestones, marbles, and dolomites, Gabilan limestone, and all plutonic rocks the Santa Lucia granodiorite. These names are essentially petrographic and not formational in usual sense since rocks of very different ages might be included under any one of the names.

G. H. Curtis, J. F. Evernden, and J. Lipson, 1958, California Div. Mines Spec. Rept. 54, p. 9. Potassium-argon age determinations on some granitic rocks given. Sample of Santa Lucia granodiorite gave age 81.6 million years. Dated specimen was collected by Lawson from quarry at Carmel Cove on Carmel Bay.

Forms main ridge of Santa Lucia Range.

Santa Lucia Series[1]

Pre-Franciscan (possibly Precambrian): Southern California.

Original reference: B. Willis, 1900, Sicence, new ser., v. 11, p. 221.

Occurs in Santa Lucia Range, Monterey and San Luis Obispo Counties, and Fremont's Peak of Gavilan Range, San Benito County.

Santa Margarita Granodiorite

[Cretaceous]: Southern California.

G. H. Curtis, J. F. Evernden, and J. Lipson, 1958, California Div. Mines Spec. Rept. 54, p. 10. Discussed in report dealing with potassium-argon age determinations. Age given as 84.1 million years.

Dated specimen collected from outcrop in bottom of creek one-fourth mile north of McKittrick 3.6 miles east of Santa Margarita, sec. 10, T. 29 S., R. 13 E., MD. Approximately 100 square miles of intrusive rocks are exposed east of Santa Margarita. Oldest unmetamorphosed sedimentary rocks lying nonconformably on the mass are Upper Cretaceous in age.

**Santa Margarita Sandstone[1] or Formation**

Miocene, upper: Southern California.

Original reference: H. W. Fairbanks, 1904, U.S. Geol. Survey Geol. Atlas, Folio 101.

R. R. Simonson and M. L. Krueger, 1942, Am. Assoc. Petroleum Geologists Bull., v. 26, no. 10, p. 1611 (fig. 2), 1617–1620. Term Santa Margarita, as used in this report [Crocker Flat landslide area], applies (1) to the punky diatomaceous shales and conglomerates above Antelope shale member of Monterey formation and below Etchegoin (Pliocene) formation, on northeast side of Temblor Range, and (2) to the extremely coarse clastics, conglomerates, sands, and shales containing upper Miocene macrofossils, in summit area and on southwest flank of the range. Term is used with reluctance in this area because uppermost Miocene beds are only in part similar lithologically to type Santa Margarita; also, it is believed that upper part of interval is younger than type section. Thickness about 2,700 feet on northeast side of Temblor Range; about 4,000 feet on southwest side of Range. In Recruit Pass area, unconformably underlies Tulare formation. Upper Miocene.

I. F. Wilson, 1943, California Jour. Mines and Geology, v. 39, no. 2, p. 222–240. Formation, in San Benito quadrangle, consists chiefly of fossiliferous grayish calcareous sandstone, containing "reef" beds and pebbly conglomeratic layers, and occasional interbedded clay-shales. Maximum thickness more than 2,000 feet. Exposed only in narrow belt along southwest flank of San Benito River in southern part of quadrangle. This belt dips uniformly to west below Etchegoin group; on the east side, the Santa Margarita is in fault contact with Etchegoin along Pine Rock fault, and base is nowhere exposed. To the southeast in Priest Valley quadrangle, Santa Margarita rests unconformably on the Franciscan. Upper Miocene.

M. N. Bramlette and S. N. Daviess, 1944, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 24. In southeast part of Salinas Valley, including type area, Santa Margarita sandstone is of upper Miocene age and extends down to about top of middle Miocene. Base of formation is of progressively later age northwestward, so that west of San Ardo and San Lucas it appears to be of lower Pliocene age.

J. E. Kilkenny, 1948, Am. Assoc. Petroleum Geologists Bull., v. 32, no. 12, p. 2259–2260. In Salinas Valley, unconformably overlies Monterey shales;

underlies McLure formation in Northeast fault block; underlies Poncho Rico formation in Central block. Maximum thickness 2,500 feet, east of Salinas River, in Cholame Hills; some of this may be sandy phase of Monterey shales. Upper Miocene (Neroly stage of Clark; Delmontian and part of Mohnian stage of Kleinpell). King City formation is included in uppermost part of Santa Margarita.

W. E. Ver Planck, 1952, California Div. Mines Bull. 163, p. 35–37, pl. 3. In Quatal Canyon, Ventura County, includes Quatal red clay (new) member.

T. W. Dibblee, Jr., 1951, Soc. Econ. Paleontologists and Mineralogists [Guidebook] Pacific Sec., Stop 2, p. 1–2. In Salisbury Canyon, overlies Bitter Creek formation (new).

M. L. Hill, S. A. Carlson, and T. W. Dibblee, Jr., 1958, Am. Assoc. Petroleum Geologists Bull., v. 42, no. 12, p. 2874 (fig. 1), 2978 (fig. 3), 2995–2996. Discussion of Cuyama Valley-Caliente Range area. In Morales Canyon (T. 11 N., R. 8 W.), Santa Margarita sandstone is about 1,000 feet thick and consists of fine- to coarse-grained locally pebbly, granitic white sandstone in gradational contact with underlying Monterey formation. Unconformably overlain by Morales formation. Accordant contact with underlying Branch Canyon sandstone (new). Upper part of sandstone contains at least two calcareous reefs of *Ostrea titan*. This littoral Santa Margarita sandstone unit was mapped as *Ostrea titan* zone of Monterey by Eaton and others (1941, Am. Assoc. Petroleum Geologists Bull., v. 25, no. 2). Northwestward from Morales Canyon, the Santa Margarita extends along northeast flank of La Panza Range and is traceable into Santa Margarita formation as mapped by Bramlette and Daviess. On northeast flank of Caliente Range, the equivalent of the Santa Margarita is Quatal formation. On southside of Cuyama Valley, formation is exposed from Bitter Creek eastward to Salisbury Canyon. At Branch Canyon (sec. 1, T. 9 N., R. 27 W.), it was mapped as Neroly by Eaton and others. Assigned to upper Miocene (Mohnian and (or) Delmontian).

Named for exposures at Santa Margarita, San Luis Obispo County.

†Santa Maria Formation[1]

Pliocene and Pleistocene: Southern California.

Original reference: C. M. Carson, 1925, Pan-Am. Geologist, v. 43, p. 265–270.

In Santa Maria district, Santa Barbara County.

**Santa Monica Slate**[1]

Triassic(?) and Jurassic: Southern California.

Original reference: H. W. Hoots, 1931, U.S. Geol. Survey Prof. Paper 165–C, p. 88–89.

Cordell Durrell, 1954, California Div. Mines Bull. 170, map sheet 8. Consists of metamorphosed black shale and graywacke of unknown thickness. Crops out only in eastern part of Santa Monica Mountains. Triassic(?).

U.S. Geological Survey currently designates the age of the Santa Monica Slate as Triassic(?) and Jurassic on the basis of a study now in progress.

Named for occurrence in Santa Monica Mountains, Los Angeles County.

Santa Paula Formation[1]

Miocene(?) and Pliocene, lower: Southern California.

Original references: J. E. Eaton, 1926, Oil and Gas Jour., p. 72; 1926, Oil Age, p. 16.

Well exposed on great monocline, northwest of Santa Paula, Ventura County.

Santa Rita Granodiorite Porphyry

Upper Cretaceous or later: Southwestern New Mexico.

P. F. Kerr and others, 1950, Geol. Soc. America Bull., v. 61, no. 4, p. 288–289, 302, fig. 3, pl. 1. A single intrusive mass of biotite granodiorite porphyry. Groundmass of equigranular, interlocking grains of quartz and slightly sericitized orthoclase. Lustrous, striated green-gray feldspar phenocrysts common; occasional phenocrysts of hornblende and quartz.

Rounded body about 1 mile across best exposed in copper pits of Santa Rita copper mine, in southeastern corner of Santa Rita quadrangle, about 12 miles east of Silver City, Grant County.

Santa Rita Limestone[1]

Silurian: Southwestern New Mexico.

Original reference: C. R. Keyes, 1908, Am. Inst. Mining Engrs. Bi-Monthly Bull. 19, p. 7–21.

Type locality: Santa Rita, Grant County.

Santa Rita Limestone[1]

Middle(?) Devonian: Southeastern Arizona.

Original reference: C. R. Stauffer, 1927, Geol. Soc. America Bull., v. 38, p. 133.

In Santa Rita Mountains region.

Santa Ritan series[1]

Silurian: Southwestern New Mexico.

Original reference: C. R. Keyes, 1908, Am. Inst. Mining Engrs. Bi-Monthly Bull. 19, p. 7–21.

Probably named from Santa Rita, Grant County.

Santa Rosa Basalt

Pliocene(?): Southern California.

J. F. Mann, Jr., 1955, California Div. Mines Spec. Rept. 43, p. 9–10, pl. 1. Name applied to olivine basalt flows that rest on a nearly horizontal surface that consists partly of Paleocene(?) sediments and partly of basement rocks. Thickness varies; in Temecula region, usually only a few tens of feet; may be as much as 100 feet.

Occurs on Hogback, Vail Mountain, and Mesa de Burro, Temecula region, Riverside County.

Santa Rosa Beds

Eocene(?): Mariana Islands (Guam).

Risaburo Tayama, 1952, Coral reefs in the South Seas: Japan Hydrog. Office Bull., v. 11, p. 47, 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. 56–57. Consist of alternate strata of tuff, shale, and marl, with 1 or 2 layers of limestone; characteristically green. Strata dip at high angles. Discordantly (unconformably) overlie Umatac andesite.

Typically exposed on Mount Santa Rosa, Mount Chachao, and Mount Tenjo, Guam.

**Santa Rosa Sandstone** (in Dockum Group)[1]

Upper Triassic: Northeastern New Mexico.

Original reference: D. Hager and A. E. Robitaille, 1919, Geol. Rept. on oil possibilities in eastern New Mexico, corr. table.

W. B. Lang, 1947, Am. Assoc. Petroleum Geologists Bull., v. 31, no. 9, p. 1674. In Pecos Valley, Santa Rosa sandstone grades into Pierce Canyon redbeds; the two units are in part contemporaneous. Upper(?) Triassic.

G. E. Hendrickson and R. S. Jones, 1952, New Mexico Bur. Mines Mineral Resources Ground-Water Rept. 3, p. 23–24. In Eddy County, overlies Pierce Canyon redbeds and redbeds that possibly represent Chinle formation. Thickness 200 to 300 feet.

G. O. Bachman, 1953, U.S. Geol. Survey Oil and Gas Inv. Map OM–137. Described in northwestern Mora County where it is 425 feet thick and consists mainly of brownish-red shale and sandstone. Underlies Chinle formation; overlies Bernal formation (new). Upper Triassic.

Well exposed at Santa Rosa and Puerto de Luna, Guadalupe County, and along canyon of Pecos for many miles.

Santa Rosa Island Formation

Pleistocene, upper: Santa Rosa Island, California.

P. C. Orr, 1960, Geol. Soc. America Bull., v. 71, no. 7, p. 1113–1119. Proposed for the formation that covers lower terrace on island. Includes three members (ascending): Garanon, Fox, and Tecolote. Each member has two or more facies. Unconformably overlies Rincon shale on northwest coast of island. Lower terrace is less than 300 yards in width and is underlain by three wave-cut platforms.

Type locality: Extends about 4,000 yards along sea cliffs on northwest coast. Also exposed at mouth of Soledad Canyon, Ranch House Canyon, and from San Augustine to Wreck Canyons and between China Camp and Bee Rock on south coast of island.

Santa Susana Formation[1] or Shale

Paleocene-Eocene, lower: Southern California.

Original reference: B. L. Clark, 1924, Pan-Pacific Sci. Cong. Proc. Australia, 1923, p. 874–879.

A. M. Keen and Herdis Bentson, 1944, Geol. Soc. America Spec. Paper 56, p. 21 (fig. 4). Chart shows age Paleocene through lower Eocene.

T. E. Gay, Jr., and S. R. Hoffman, 1954, California Jour. Mines and Geology, v. 50, nos. 3 and 4, pl. 4. Formation mapped in Los Angeles County with marine deposits Tejon, Llajas, and Domengine formations. Eocene.

Named for occurrence in vicinity of Santa Susana, Ventura County.

†Santee Beds[1]

Eocene (Jackson and Claiborne): Eastern and central South Carolina.

Original reference: M. Tuomey, 1848, Geology of South Carolina, p. 156, 190, 211.

Well exposed on the Santee River.

**Santee Limestone[1]**

Eocene, middle: Eastern and central South Carolina and North 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.

C. W. Cooke and F. S. MacNeil, 1952, U.S. Geol. Survey Prof. Paper 243–B, p. 20 (fig. 2), 21, 24–25. Santee limestone, long supposed to be of early

Jackson age, represents the *Ostrea sellaeformis* zone of Claiborne group, equivalent to the restricted McBean formation, of which it is an offshore facies. This determination was made on basis of field profiles and restudy of the molluscan fauna. Older than Castle Hayne limestone. Chart shows occurrence in North Carolina.

Commonly accepted type exposure is at Eutaw Springs, Orangeburg County, S.C., 3½ miles east-northeast of Eutawville. Back water from Lake Marion has partly inundated the old exposure, but some limestone still stands above level of reservoir (Cooke and MacNeil).

Santee River Beds[1]

Eocene: South Carolina.

Original reference: F. S. Holmes, 1870, Phosphate rock of South Carolina, pl. 1.

Exposed along Santee River.

†Santiago Chert[1]

Santiago Formation

Upper Devonian: Southwestern Texas.

Original reference: J. A. Udden, C. L. Baker, and E. Böse, 1916, Texas Univ. Bull. 44, p. 41.

W. B. N. Berry and H. M. Nielsen, 1958, Am. Assoc. Petroleum Geologists Bull., v. 42, no. 9, p. 2254–2259. Because King's (1937) lower two members of Caballos novaculite form one genetic unit, and King's upper three members of Caballos form another genetic unit, it is proposed to revive original terminology of Udden, Baker, and Böse and recognize two distinct formations. Name Caballos novaculite should be restricted to lower formation and name Santiago formation applied to middle chert member, upper novaculite member, and upper chert members of King. Thickness about 225 feet. Upper Devonian. Type exposure noted.

Type exposures are at east base of Santiago Range near Santiago Peak. Brewster County.

**Santiago Formation**

Eocene: Southern California.

W. P. Woodring and W. P. Popenoe, 1945, U.S. Geol. Survey Oil and Gas Inv. Prelim. Chart 12. Name proposed for Eocene deposits of northwestern Santa Ana Mountains. These deposits had been called Tejon by Dickerson (1914, California Univ. Dept. Geol. Bull., v. 8, no. 11) and English (1926, U.S. Geol. Bull. 768). An unnamed basal member 40 to 220 feet thick consists of massive coarse-grained poorly sorted arkosic buff or brownish-gray sandstone and conglomerate, sandstone generally predominating. In some areas, basal member is overlain by soft medium-grained moderately well-sorted arkosic gray or brownish-gray "salt and pepper" sandstone. Uppermost part of formation consists of coarse-grained arkosic gray sandstone and grit. Thickness 650 to 725 feet. Overlies Silverado formation (new) without discordance.

Type locality: North of Santiago Creek, near Irvine Park, Santa Ana Mountains, Orange County.

Santiago Formation[1]

Oligocene, upper: 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, Geol. Sci., p. 234 (chart), 241–242. Beds of sandstones and shales. Chart shows Santiago above Tonosi limestones. Upper Oligocene.

W. P. Woodring *in* R. Hoffstetter and others, 1960, Lexique Strat. Internat., v. 5, Amérique Latine, fasc. 2a, p. 346. Oligocene.

At Santiago and adjoining areas, Veraguas Province.

**Santiago Peak Volcanics**

Upper Jurassic(?) to Lower Cretaceous(?): Southern California.

E. S. Larsen, Jr., 1948, Geol. Soc. America Mem. 29, p. 22–32, pl. 1. Name proposed to replace preoccupied name Black Mountain volcanics. Group of mildly metamorphosed volcanics, mostly agglomerates, that include some sediments; older than quartz diorite of southern California batholith. Thickness undetermined, probably many thousands of feet. Unconformably overlie Bedford Canyon formation (new).

Rene Engel, 1959, California Div. Mines Bull. 146, p. 17. Santa Ana formation includes Santiago Peak volcanics and Bedford Canyon formation of Larsen (1948).

U.S. Geologicl Survey currently designates the age of the Santiago Peak Volcanics as Upper Jurassic(?) to Lower Cretaceous(?) on the basis of a study now in progress.

Outcrops form a strip from south of La Jolla quadrangle, across San Luis Rey quadrangle, northward in Santa Ana Mountains nearly to Santa Ana River; exposed width about 10 miles.

Santiam Basalts or Lavas

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), 1617, 1619, 1625, 1626, 1627; 1939, Oregon Dept. Geology and Mineral Industries Bull. 15, p. 18–19, fig. 2 (geol. map). High Cascade lavas are divided into four groups; in chronological order these are: Outerson basalts, Minto basalts, Santiam basalts, and Olallie lavas. Santiam basalts and Olallie lavas are not in contact hence relative ages unknown, similar degrees of erosion suggest they may have been nearly contemporaneous. Fills North Santiam River valley to known depth of 1,800 feet; valley was cut in Minto and Outerson lavas. Pre-Wisconsin but undoubtedly Pleistocene.

Named for occurrence in North Santiam River valley.

San Timoteo Beds[1] or Formation

Pliocene: Southern California.

Original reference: C. Frick, 1921, California Univ. Pub., Dept. Geol. Bull., v. 12, p. 283–288.

D. I. Axelrod, 1938, Carnegie Inst. Washington Pub. 476, p. 129. Characterized by coarse yellowish sands and cobble beds which are crossbedded and exhibit rapid lateral variation and channeling; interbeds of finer gray-brown sands and clays present throughout formation. Unconformably overlie Mount Eden formation.

Occur in San Timoteo Canyon, San Jacinto quadrangle, Riverside County. Form badlands west of Beaumont.

Santo Limestone (in Millsap Lake Formation)[1]

Santo Limestone Member (of Grindstone Creek Formation)

Pennsylvanian: Central northern Texas.

Original reference: F. B. Plummer, 1929, Geologic map of Palo 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, fig. 3. Correlation of Parker exposures with outcrops in Palo Pinto County is made on basis of similarity of lithology and stratigraphic position. Limestone is gray to brownish gray and fairly pure; bedding irregular to massive. Thickness 2 to 4 feet. Occurs about middle of formation. Report follows classification of Cheney (1940) [also refers to this unit as a limestone bed].

Typically exposed along creek 0.4 mile south of railroad crossing in Santo, Palo Pinto County. Outcrop of limestone is interrupted by Littlefield Bend of Brazos River.

Santos Shale[1] Member (of Temblor Formation)

Miocene, lower: Central California.

Original reference: G. C. Gester and J. Galloway, 1933, Am. Assoc. Petroleum Geologists Bull., v. 17, no. 10, p. 1169.

H. H. Heikkila and G. M. McLeod, 1951, California Div. Mines Spec. Rept. 6, p. 4 (table 1), 5 (table 2), 7–9, pl. 1. Temblor formation, in Bitter Creek area, Kern County, is divided into (ascending) Agua sandstone, Upper Santos shale, Carneros sandstone, Media shale, and "Button bed" sandstone members. Upper Santos consists of tan platy siliceous and calcareous silty to sandy shale with discontinuous thin limestone and sandstone beds. Thickness of Upper Santos 0 to 1,500 feet. Lower Santos not exposed in area of present report.

L. B. McMichael, chm., 1959, San Joaquin Geol. Soc. Guidebook May 9, p. 5–6, 13. Topographic profile of Chico Martinez Creek area shows Santos shale below Carneros sands and separated from underlying Salt Creek shale by *Phacoides* reef. Columnar section shows Lower Santos shale about 200 feet and Upper Santos shale about 100 feet, separated by "Agua sand" interval about 70 feet thick. All in Temblor formation.

First mentioned in McKittrick-Midway-San Emigdio region, San Joaquin Valley. Type area presumed to be at Santos Creek, Kern County.

**Santurce Sand**

Miocene, lower, to Recent: Puerto Rico.

C. A. Kaye, 1959, U.S. Geol. Survey Prof. Paper 317–A, p. 7 (chart), 36–37, pl. 2. Proposed for the widespread deposit of quartz sand and interbedded somewhat clayey quartz sand that forms the surficial deposit of much of the coastal plain. Characteristically white, locally bright red. Foundation borings have penetrated 80 to 100 feet of the deposit; maximum thickness not known. Pliocene(?) and Pleistocene.

U.S. Geological Survey currently designates the age of the Santurce Sand as lower Miocene to Recent on the basis of a study now in progress.

Named for town of Santurce, because deposits are particularly thick under low lying areas near there. Occurs widely as discontinuous surface deposits for a distance of 50 miles west of San Juan both on coastal plain and on broader bottom lands between the haystack hills of middle Tertiary limestone.

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, 90–92. At Meriwitica section, member consists of thick-bedded dark-gray aphanitic limestone with prominent bands of siltstone that weather red brown. Farther west, at Quartermaster Canyon, Rampart Cave, and elsewhere, the same type of lithology prevails, but eastward and southward algal limestone dominates the facies. Thickness moderately uniform across area but becomes progressively thinner near its eastern and southern margins. Average thickness about 25 or 30 feet. Older than Spencer Canyon member (new); younger than Rampart Cave member (new).

Designation, Sanup Plateau, comes from large promontory of that name in western Grand Canyon. Lower of two thin but persistent cliff-forming units that extend through the western two-thirds of Grand Canyon between slope-forming tongues of shale and other weak sediments.

San Xavier Conglomerate Beds

Tertiary: Southeastern Arizona.

L. A. Heindl, 1959, Arizona Geol. Soc. Guidebook 2, p. 154, 155, fig. 29. Light-pinkish-brown alluvial conglomerate made up of fragments of Cretaceous(?) arkose, siltstone, and mudstone, and Tertiary rhyolite and andesite, which are commonly of pebble size but may be as large as small boulders. Individual beds lenticular and contain scour-and-fill structures. Base nowhere exposed, but unit appears to overlie older volcanic rocks on east side of Tucson Mountains and may overlie speckled rhyolite at Black Mountain. Maximum exposed thickness about 450 feet. Underlies unnamed andesite porphyry.

Crops out in discontinuous patches on north side of Black Mountain and on southeast slopes of Tucson Mountains, San Xavier Indian Reservation, central Pima County.

**San Ysidro 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. Thin- to medium-bedded light orange-red to dark-red sandstone and siltstone with a few thin limestone beds. Conformably overlies Meseta Blanca sandstone member (new). In area from San Miguel Canyon north to Senorito Canyon, the San Ysidro member tongues with the underlying Meseta Blanca sandstone member. Underlies Glorieta sandstone member of San Andres formation.

Type sections: Near Canon, in sec. 3, T. 16 N., R. 2 E., Sandoval County, and the area immediately to the north of this section in the Canon de San Diego Grant.

Sapello quartzite[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, 11.

In Solitario Peak region, northwest of Las Vegas, San Miguel County. Derivation of name not given.

**Sappa Formation**

Sappa Member (of Meade Formation)

Pleistocene: Eastern Nebraska, western Iowa, southwestern Kansas, and southeastern South Dakota.

J. C. Frye, Ada Swineford, and A. B. Leonard, 1948, Jour. Geology, v. 56, no. 6, p. 504–505, 520 (fig. 1), 522. Referred to as Sappa member of Meade formation in Kansas and Sappa formation in Nebraska. Name Sappa is used to designate deposits formerly called Upland. In Nebraska, overlies Grand Island formation; in Kansas, overlies Grand Island member of Meade formation. At type locality of Meade formation, Sappa member contains Pearlette volcanic ash of the type area.

G. E. Condra and E. C. Reed, 1950, Nebraska Geol. Survey Bull. 15–A, p. 22, 25. Formation is a gray to greenish silty clay deposit of aqueous-eolian origin. Thickness 2 to 30 feet or more; average 15 feet. Overlies Grand Island sand; underlies Crete sand and gravel (new). Occurs in old valleys of till region in eastern Nebraska, western Iowa, and southeastern South Dakota where it occasionally includes lenticular beds of volcanic ash and is locally overlain by Crete sands and underlain by sand and gravel which Nebraska Geological Survey correlates as Grand Island. However, this sand and gravel and horizons represented by the Upland, Pearllette ash, Crete sand and Loveland formation in exposures northeast of Little Sioux, Iowa, have been correlated by Iowa Geological Survey as Yarmouth age.

J. C. Frye and A. B. Leonard, 1952, Kansas Geol. Survey Bull. 99, p. 87. Derivation of name given.

C. W. Hibbard, 1958, Am. Jour. Sci., v. 256, no. 1, p. 55 (fig. 1). Chart of revised classification of Kansas Pleistocene shows Sappa 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. Overlies Grand Island formation; underlies Pearlette ash. Yarmouthian.

E. C. Reed (1948, Geol. Soc. America Bull., v. 59, no. 12, pt. 2, p. 1346) stated that a new name had been substituted for name Upland (Lugn, 1930). The formation was described and type locality designated in Sappa Township, but no name was applied to unit.

Named from exposures in abandoned volcanic ash mine of Cudahay Packing Co. near Orleans in Sappa Township, Harlan County, Nebr.

**Sappington Sandstone Member** (of Three Forks Shale)

Sappington Sandstone or Formation

Upper Devonian and Lower Mississippian: Southwestern Montana.

G. W. Berry, 1943, Geol. Soc. America Bull., v. 54, no. 1, p. 14–16. Sappington sandstone proposed for 60 feet of yellow sandstone lying above *Cyrtospirifer* zone of Three Forks shale. Contains lower Carboniferous *Syringothyris* fauna (Kinderhook). Underlies Madison formation. Formerly included in Three Forks shale.

L. L. Sloss and W. M. Laird, 1947, Am. Assoc. Petroleum Geologists Bull., v. 31, no. 8, p. 1411. Rank reduced to member status in Three Forks formation.

F. D. Holland, Jr., 1952, Am. Assoc. Petroleum Geologists Bull., v. 36, no. 9, p. 1706–1709. Thickness of Sappington sandstone at type locality is 100 feet. This is much more than thickness (60 feet) measured by Berry. Unconformably underlies Lodgepole limestone of Madison group at Sappington type section. Appears to be Kinderhookian.

M. M. Knechtel, J. E. Smedley, and R. J. Ross, Jr., 1954, Am. Assoc. Petroleum Geologists Bull., v. 38, no. 11, p. 2398 (fig. 2c), 2399. Referred to as sandstone member of Three Forks; underlies Little Chief Canyon member (new) of Lodgepole limestone.

W. J. McMannis, 1955, Geol. Soc. America Bull., v. 66, no. 11, p. 1389 (table 1), 1397–1399. In vicinity of Sacajawea Peak, Mont., formation comprises (ascending) black fissile conodont-bearing shale, 8 to 16 feet; pale-brown to yellow-brown thin- to medium-bedded fine-grained calcareous siltstone and sandstone noticeably more sandy in upper part, 62 feet; dark-brown to black silty shale or siltstone, 2 to 3 feet. Cooper and Sloss (1943, Jour. Paleontology, v. 17) call the upper part basal Lodgepole black shale. Devonian(?).

C. A. Sandberg and C. R. Hammond, 1958, Am. Assoc. Petroleum Geologists Bull., v. 42, no. 10, p. 2322. Considered member of Three Forks formation. Assigned Late Devonian and Early Mississippian age.

C. W. Achauer, 1959, Billings Geol. Soc. [Guidebook] 10th Ann. Field Conf., p. 41–49. Detailed discussion on stratigraphy and microfossils of formation. Mississippian age for Sappington could be questioned on grounds that there is intermingling of Devonian forms with characteristic Mississippian fossils in Sappington middle member. Until more investigation is conducted, precise age of formation will remain in doubt.

Type locality: NW¼ sec. 36, T. 2 N., R. 1 W., near village of Sappington, Gallatin County, Mont.

†Sapulpa Group[1]

Pennsylvanian: Central northern and central Oklahoma.

Original reference: C. N. Gould, D. W. Ohern, and L. L. Hutchison, 1910, Oklahoma State Univ. Research Bull. 3, p. 6, 11.

Named for Sapulpa, Creek County.

Sarac Ridge Group

Age unknown: Southern California.

K. J. Hsu, 1955, California Univ. Dept. Geol. Sci. Bull., v. 30, no. 4, p. 283–292, geol. map. Predominantly dark-gray biotite-hornblende-quartz-plagioclase mylonites; small amounts of amphibolite also present. Rocks are present in an east-northeast-trending belt north of East Ridge belt and south of the El Dorado Ridge-Stoddard Canyon plutons. Alf (1948, Geol. Soc. America Bull., v. 59, no. 11) referred to these rocks as the "Black Belt mylonite." In order to follow practice of adopting geographical names in nomenclature, Alf's term is discarded, and term Sarac Ridge group introduced.

Occurs in Cucamonga quadrangle, San Bernardino County.

Saragossa Quartzite[1]

Probably Carboniferous or pre-Carboniferous(?): Southern California.

Original reference: F. E. Vaughan, 1922, California Univ. Pubs., Dept. Geol. Sci. Bull., v. 13, no. 9, p. 344, 352–363, map.

R. B. Guillou, 1953, California Div. Mines Spec. Rept. 31, p. 5, 7, pl. 1. Redefined and restricted to exclude gneisses and granitic intrusions (here named Baldwin gneiss) and quartzites (here named Chicopee formation) that lie beneath a thrust plate that overrides Baldwin gneiss and parts of Chicopee formation. Term Saragossa quartzite is used for the quartzite of the thrust plate. Thickness of Saragossa may be over 1,000 feet if section is not duplicated by faulting. Considered younger than Baldwin gneiss and older than Chicopee formation. Age given as pre-Carboniferous(?).

Well developed near and named for Saragossa Spring, San Bernardino County. [Considered type locality by Guillou (1953).]

Saranac Formation[1]

Saranac Quartz Syenite Complex

Precambrian: Northeastern New York.

Original reference: H. P. Cushing, 1905, New York State Mus. Bull. 95.

David Gallagher, 1937, New York State Mus. Bull. 311, p. 15. Although it is not specifically mentioned, there is no doubt that Cushing intended to include the country rock around Lyon Mountain under this term. [Saranac formation].

A. F. Buddington, 1939, Geol. Soc. America Mem. 7, p. 116–123. Saranac complex forms a band in Saranac Lake quadrangle, extending west across St. Regis quadrangle on northwest and trending toward Lake Placid quadrangle on east. Its relationships to Santa Clara complex (new) and to syenites of Lake Placid quadrangle as yet to be determined. Most of discussion is of Tupper-Saranac complex.

A. F. Buddington, 1953, New York State Mus. Bull. 346, p. 15 (table 1), 67–71. Saranac quartz syenitic complex described in Saranac quadrangle. Geologic column lists Saranac complex above Loon Lake complex.

Well exposed along Saranac River, Clinton County.

**Saratoga Chalk**[1]

Upper Cretaceous: Southwestern Arkansas.

Original reference: J. C. Brenner, 1898, Am. Inst. Min. Engrs. Trans., v. 27, p. 52–59.

L. W. Stephenson and others, 1942, Geol. Soc. America Bull., v. 53, no. 3, chart 9. Shown on correlation chart as unconformable below the Nacatoch sand and above the Marlbrook marl.

R. G. Drouant, 1960, Dissert, Abs., v. 20, no. 11, p. 4367–4368. Saratoga formation of this paper includes a lower chalk member and an upper argillaceous-arenaceous unit which has previously been considered a part of Nacatoch formation. Base of the Saratoga marks first appearance of abundant sand sized clastics following a long period of deposition of nonarenaceous marls which constitute Marlbrook formation.

Named for typical outcrops just north and also east of Saratoga, Hempstead County.

Saratoga Sand[1]

Pleistocene: Eastern New York.

Original reference: A. Fitch, 1850, Hist., Topog., and Agr. survey of county of Washington, N.Y., pt. 3, p. 878.

Occurs in Kingsbury and Fort Edward, Washington County; also in Saratoga and counties south of it.

Sardine Series

Oligocene or Miocene: Northwestern Oregon.

T. P. Thayer, 1936, Jour. Geology, v. 44, no. 6, p. 703–704, 709 (fig. 2), 713 (fig. 3); 1937, Geol. Soc. America Bull., v. 48, no. 11, p. 1616 (fig. 2), 1623–1624. West of Mill City, andesitic lavas are so abundant in Mehama and Fern Ridge formations that formational identity is lost. and unconformity between Mehama volcanics and Stayton lavas is not traceable. Mehama, Stayton, and Fern Ridge formations are grouped in the Sardine series, which at type locality consists of about 6,000 feet of basaltic to dacitic lavas. Grades downward into Breitenbush series (new). Mineralized by Halls diorite (new).

T. P. Thayer, 1939, Oregon Dept. Geology and Mineral Industries Bull. 15, p. 8–9, fig. 1. Entire series may be Miocene, or lower part may be Oligocene; not intended that any Eocene formations be included.

Type locality: In Sardine Mountains, northwest of Detroit, Marion County.

Sarpy Formation (in Kansas City Group)

Pennsylvanian (Missouri Series): Eastern Nebraska.

G. E. Condra, 1949, Nebraska Geol. Survey Bull. 16, p. 37–38. Underlies Quivira formation; overlies Fontana formation. Thickness about 15 feet. Classed on a cyclothemal basis, formation includes (descending) Westerville limestone, Wea shale, and Block limestone.

Type locality: Platte Valley bluffs at the PWA quarry, 2½ miles south of Richfield. Named for Sarpy County.

**Sarten Sandstone**[1]

Lower Cretaceous: Southwestern New Mexico.

Original reference: N. H. Darton, 1916, U.S. Geol. Survey Bull. 618, p. 19, 43.

H. L. Jicha, Jr., 1954, New Mexico Bur. Mines Mineral Resources Bull. 37, p. 26, 34 (fig. 3). In Lake Valley quadrangle, consists of 300 feet of light-gray massive sandstone, mostly quartzitic or very hard. Underlies Colorado shale; overlies Lobo formation.

C. H. Dane and G. O. Bachman, 1957, Four Corners Geol. Soc. Guidebook 2d Field Conf., p. 98. Sarten is now regarded as of Kiamichi age. Contains fauna originally said to be of Washita age.

Type locality: Sarten Ridge, east of Cooks post office, Deming quadrangle.

Sasakwa Limestone Member (of Holdenville Shale)[1]

Pennsylvanian (Des Moines Series): Central southern Oklahoma.

Original references: G. D. Morgan, 1923, Oklahoma Geol. Survey Circ. 12, p. 9, 10; 1924, Bur. Geology [Oklahoma] Bull. 2, p. 103–105.

W. F. Tanner, 1956, Oklahoma Geol. Survey Bull. 74, p. 45–48, pls. 1, 2. Occurs 30 feet or more below top of formation. Thickness a few inches to about 15 feet. Des Moines series.

Named for exposures in Saskawa, Seminole County.

†Sassafras River Greensand[1]

Upper Cretaceous: Northeastern Maryland.

Original reference: W. J. McGee, 1888, U.S. Geol. Survey 7th Ann. Rept., p. 612.

Occurs only along Sassafras River for short distance above its mouth to Back Creek Neck and on Maudens Mountain and a few neighboring eminences.

**Satan 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. 45. Wedges into Hosta sandstone member of Mesaverde and separates it into an upper and lower part. Thickness 300 feet in northern part of Mount Taylor coal field. Stratigraphically above Mulatto tongue of Mancos.

J. E. Allen and Robert Balk, 1954, New Mexico Bur. Mines Mineral Resources Bull. 36, p. 94. In parts of Fort Defiance-Tohatchi quadrangles, intertongues with Point Lookout sandstone.

Named for exposures in Satan Pass, Gallup region.

**Satanka Shale**[1]

Permian: Southeastern Wyoming and northeastern Colorado.

Original reference: N. H. Darton, 1908, Geol. Soc. America Bull., v. 19, p. 430.

G. E. Condra, E. C. Reed, and O. J. Scherer, 1940, Nebraska Geol. Survey Bull. 13, p. 2. Discussion of correlation of formations of Laramie Range, Hartville uplift, Black Hills, and western Nebraska. Terms Satanka, Lykins, and probably Embar should be abandoned.

T. S. Lovering and E. N. Goddard, 1950, U.S. Geol. Survey Prof. Paper 223, p. 34. North of Ingleside, Colo., conformably overlies Ingleside formation. Thickness about 181 feet just south of Wyoming line at Soldier Canyon.

R. S. Agatston, 1954, Am. Assoc. Petroleum Geologists Bull., v. 38, no. 4, p. 547–548. On west side of Laramie Mountains, directly overlies Casper sandstone and underlies Forelle limestone.

Named for railroad station a few miles south of Laramie, Albany County, Wyo.

†Satilla Formation (of Columbia Group)[1]

Pleistocene: Eastern Georgia.

Original reference: J. O. Veatch and L. W. Stephenson, 1911, Georgia Geol. Survey Bull. 26, p. 60, 424, 434–445.

Named for development along both sides of Satilla River, in Camden and Charlton Counties.

**Satsop Formation**[1]

Pleistocene: Western Washington.

Original references: J. H. Bretz, 1914, Geol. Soc. America Cordilleran section abstract of meeting in May 1914; 1915, Geol. Soc. America Bull., v. 26, p. 131.

W. D. Lowry and E. M. Baldwin, 1952, Geol. Soc. America Bull., v. 63, no. 1, p. 7, 9. Name Troutdale was introduced by Hodge (1933) for gravels and sands deposited by ancestral Columbia River, which are well displayed near Troutdale, Oreg. Williams (1916, Oregon Bur. Mines and Geology Min. Resources, v. 2, no. 3) had referred these gravels to Satsop formation.

Type section: Satsop Valley, a tributary of Chehalis Valley.

**Saturday Mountain Formation**[1]

Upper Ordovician: 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. 18–22, pl. 1. Type area designated.

C. P. Ross, 1947, Geol. Soc. America, v. 58, no. 12, pt. 1, p. 1104–1105, pl. 1. Described in Borah Peak quadrangle where its distribution is similar to that of Kinnikinic quartzite which immediately underlies it. Thickness 500 to 700 feet. Underlies Laketown dolomite. Upper Ordovician.

R. J. Ross, Jr., 1959, U.S. Geol. Survey Prof. Paper 294–L, p. 441–459. Brachiopod fauna described. Most of the fauna shows affinities with Late Ordovician species, but Middle Ordovician elements are present.

Named for Saturday Mountain Ridge, which lies west of lower Squaw Creek, near middle of the western boundary of Bayhorse quadrangle. The formation crops out on both sides of lower Squaw Creek from a point above Red Bird mine to mouth of the creek.

Sauceda Volcanics

Cretaceous: Southwestern Arizona.

E. D. Wilson, R. T. Moore, and R. T. O'Haire, 1960, Geologic map of Pima and Santa Cruz Counties, Arizona (1:375,000): Arizona Bur. Mines. Named on map legend. Includes rhyolite, latite, and andesite; locally contains volcanic glass.

Mapped in Pima County. Type locality and derivation of name not stated.

Saucesian Stage[1]

Miocene, lower: 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. 113–117, figs. 4, 14 (correlation chart). Superjacent to Zemorrian stage and subjacent to Relizian stage. Comprises three zones: *Siphogenerina transversa* and *Plectofrondicularia miocenica* in lower part and *Uvigerinella obesa* in upper part. Systematic catalogue.

Type locality: Los Sauces Creek, Ventura County.

†Saugerties Limy Shale

Saugerties lithofacies (of Leeds facies of Schoharie Formation)

Lower(?) Devonian: Eastern New York.

G. H. Chadwick, 1940, New York State Geol. Assoc. 16th Ann. Mtg. Field Guide Leaflets, p. 2, 3. Limy shale 80 feet thick. Overlies Esopus and underlies Onondaga. Fossils listed.

Winifred Goldring and R. H. Flower, 1942, Am. Jour. Sci., v. 240, no. 10, p. 686. Name Saugerties formation, suggested by Chadwick as possible name for new formation, is considered inadvisable. This unit is considered to be Leeds facies (new) of Schoharie formation. Chadwick's type section for Saugerties stated.

G. H. Chadwick, 1944, New York State Mus. Bull. 336, p. 233 [1946]. Saugerties shaly limestone abandoned in favor of Leeds facies of Schoharie formation.

J. H. Johnson, 1957, Dissert. Abs., v. 17, no. 10, p. 2247. Referred to as lithofacies in upper part of Leeds facies of Schoharie formation. Occurs above Aquetuck lithofacies (new).

Type section: Cut three-eighths mile west of railroad underpass, on western edge of Saugerties, Ulster County.

**Saugus Formation**

Saugus Formation (in Fernando Group)[1]

Pliocene and Pleistocene: Southern California.

Original reference: O. H. Hershey, 1902, Am. Geologist, v. 29, p. 349–372.

R. H. Jahns, 1940, Carnegie Inst. Washington Pub. 514, p. 166. Unconformably overlies Mint Canyon strata and brownish sandstones and shale tentatively correlated with the Modelo.

G. B. Oakeshott, 1950, California Jour. Mines and Geology, v. 46, no. 1, p. 50 (fig. 3), 61–62, pls. 14, 16. Overlies upper Pliocene continental Sunshine Ranch member of Pico formation; overlaps Sunshine Ranch eastward onto Repetto siltstone; underlies (with angular unconformity) oldest terrace deposits.

G. B. Oakeshott, 1958, California Div. Mines Bull. 172, p. 22 (fig. 2), 23 (fig. 3), 83–85, pls. 1–3. Restricted to terrestrial deposits of probable lower Pleistocene age lying with slight unconformity on members of upper Pliocene Pico formation and with great angular discordance below middle(?) and upper Pleistocene Pacoima formation and terrace deposits. Sunshine Ranch member of Pico formation is roughly equivalent of "lower Saugus" of earlier workers. Saugus occupies several square miles of San Fernando quadrangle [this report], both north and south of San Gabriel fault. Maximum thickness 6,400 feet as measured on east side of Lopez Canyon; thins in short distance eastward to 2,000 feet, 2 miles east of Little Tujunga Canyon and disappears by further thinning and minor faulting at Big Tujunga Canyon.

E. L. Winterer and D. L. Durham, 1958, U.S. Geol. Survey Oil and Gas Inv. Map OM–196. Includes Sunshine Ranch member. Thickness as much as 7,000 feet. Overlies Pico formation. Includes beds of both late Pliocene and Pleistocene age.

Named for exposures in Soledad Canyon, near Saugus, Los Angeles County.

†Saugus Granodiorite[1] or Quartz Diorite[1]

Lower Paleozoic: Northeastern Massachusetts.

Original reference: C. H. Clapp, 1910, Igneous rocks of Essex County, Mass.

In Essex County.

Sauk sequence

Precambrian (upper Proterozoic) to Upper Cambrian: 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. 111–115, 116–119. An "operational unit" for use in interregional facies analysis. Name is derived from Sauk County in the Driftless Area of southern Wisconsin. Within the county all the rocks of the sequence are exposed with both bounding horizons, one at the base of the Dresbach sandstones, where they unconformably overlie the Precambrian Baraboo quartzites, and the other at the contact between the St. Peter sandstone and the Oneota dolomite. Formational limits in Illinois, Shakopee dolomite-Mt. Simon sandstone; in Kansas, Arbuckle dolomite-Reagan sandstone; in Wyoming, Grove Creek formation-Flathead sandstone.

Sault St. Mary Sandstones[1]

Upper Cambrian: Northern Michigan, and Ontario, Canada.

Original reference: A. R. C. Selwyn, 1883, Science, v. 1, p. 11.

Sault Ste. Marie region, Michigan-Ontario.

**Saunders Formation**[1] (in Chocolay Group)

Precambrian (Animikie Series): Northern Michigan.

Original reference: R. C. Allen, 1910, Michigan Geol. and Biol. Survey Pub. 3, p. 33, 36.

H. L. James, 1958, U.S. Geol. Survey Prof. Paper 314–C, p. 30 (table 1), 35. Included in newly defined Chocolay group. Considered a partial equivalent of the Randville dolomite.

Named for [exposures east of] village of Saunders, Iron County.

Sauquoit Beds,[1] Shale, or Formation (in Clinton Group)

Middle Silurian: East-central New York.

Original reference: G. H. Chadwick, 1918, Geol. Soc. America Bull., v. 29, p. 333, 341.

Tracy Gillette, 1947, New York State Mus. Bull. 341, p. 13 (fig. 2), 72–79. Shale is dominant lithology; hence, unit is referred to as Sauquoit shale. Overlies Oneida conglomerate and in some areas Wolcott Furnace iron ore; underlies Willowvale shale; at Lakeport, underlies Williamson shale. Middle part of Clinton group. Thickness about 90 feet at Verona Station; pinches out to west.

W. L. Grossman, 1953, *in* Marshall Kay, New York State Mus. Bull. 347, p. 68–69. Formation described in Utica quadrangle. Consists of sandstone and shale. Thickness about 200 feet. Overlies Oneida sandstone and conglomerate; underlies Willowvale shale. Clinton group.

D. W. Fisher, 1959, New York State Mus. Sci. Service Geol. Survey Map and Chart Ser. 1. Clinton group, Ontarian stage. Middle Silurian.

Type section: On Swift Creek, north of Sauquoit village, Oneida County.

**Sausalito Chert Member** (of Franciscan Formation)

Sausalito Chert (in Franciscan Group)[1]

Jurassic and Cretaceous: Western California.

Original reference: A. C. Lawson, 1902, Science, new ser., v. 15, p. 416 (table).

U.S. Geological Survey currently classifies the Sausalito Chert as a member of the Franciscan Formation on the basis of a study now in progress.

Named for exposures west of town of Sausalito, on Marin Peninsula, Marin County.

†Savage Formation[1]

Pennsylvanian: Western Maryland and northeastern West Virginia.

Original reference: N. H. Darton and J. A. Taff, 1896, U.S. Geol. Survey Geol. Atlas, Folio 28.

Savage River region.

**Savanna Sandstone**[1] or **Formation** (in Krebs Group)

Pennsylvanian (Des Moines Series): Eastern and southern Oklahoma and western Arkansas.

Original reference: J. A. Taff, 1899, U.S. Geol. Survey 19th Ann. Rept., pt. 3, p. 437.

S. W. Lowman, 1933, Tulsa Geol. Soc. Digest, p. 31. Includes Spaniard limestone member (new).

C. W. Wilson, Jr., 1935, Am. Assoc. Petroleum Geologists Bull., v. 19, no. 4, p. 508–510. In southern Muskogee County, Okla., includes (ascending) Tamaha sandstone, Keota sandstone, Spiro sandstone (all new), and Bluejacket sandstone members. In northern part of county, includes (ascending) Tamaha sandstone, Keota sandstone, Spaniard limestone (new), and Sam Creek limestone (new) members. Overlies McAlester shale; underlies Boggy shale. Thickness 205 to 332 feet.

C. H. Dane and T. H. Hendricks, 1936, Am. Assoc. Petroleum Geologists Bull., v. 20, no. 3, p. 312–314. Restricted to exclude Bluejacket sandstone which is herein allocated to member status in Boggy shale.

M. C. Oakes and M. M. Knechtel, 1948, Oklahoma Geol. Survey Bull. 67, p. 44–54. Restricted to exclude Tamaha sandstone and Keota sandstone members which are herein allocated to member status in McAlester formation. Thickness 450 to 1,400 feet thick on south side of Haskell County and 100 to 200 feet on north side. Overlies McAlester formation; underlies Boggy formation.

M. C. Oakes, 1953, Am. Assoc. Petroleum Geologists Bull., v. 37, no. 6, p. 1523–1526. Included in Krebs group (new).

C. C. Branson, 1954, Oklahoma Acad. Sci. Proc., v. 33, p. 192, 193 (table 1). In Craig County includes Doneley limestone member (new).

Named for Savanna, Pittsburg County, Okla.

**Saverton Shale**[1]

Saverton Formation (in Champ Clark Group)

Saverton Shale (in Fabius Group)

Lower Mississippian: Northeastern Missouri, western Illinois, and southeastern Iowa.

Original reference: C. R. Keyes, 1912, Iowa Acad. Sci. Proc., v. 19, p. 149, 151, 153–156.

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). Overlies Grassy Creek shale; underlies Louisiana limestone. Mississippian or Devonian.

L. E. Workman and Tracey [Tracy] Gillette, 1956, Illinois Geol. Survey Rept. Inv. 189, p. 8 (fig. 1), 16–18. Reallocated to Champ Clark group (new), proposed to replace Fabius group of Weller and others (1948). Overlies Grassy Creek shale; underlies Louisiana limestone in Macoupin and Montgomery Counties; elsewhere conformably overlain by either the Glen Park or Maple Mill. Thickness 0 to 75 feet.

M. G. Mehl, 1960, Denison Univ. Jour. Sci. Lab., v. 45, art. 5, p. 85–87. Keyes (1913. Am. Jour. Sci., 4th, v. 36) used name Saverton for upper part of the "black and green" shales beneath the Louisiana limestone at Louisiana. He stated that immediately beneath the Louisiana limestone at the original locality are 2 feet of blue shales; this apparently insignificant layer is usually included in the Grassy Creek black shales below. Keyes' proposal has been generally accepted and characteristic features and distribution of Saverton were discussed in detail by Moore (1928). Branson and Mehl (1933, Missouri Univ. Studies, v. 8, no. 3) concluded that the blue shales of the "Saverton" represent the upper weathered part of the Grassy Creek and suggested that name Grassy Creek be used as originally defined by Keyes. Weller (1935) saw no reason to separate the blue and black shales and proposed that together they be known as the Saverton. Neither of these proposals has gained general acceptance and current practice in assembling stratigraphic data generally follows Keyes' proposal of separation. Regardless of fact that Keyes named these shales "Saverton," the original locality described by him (1897, [1898], Iowa Acad. Sci. Proc., v. 5), is as follows: "Immediately beneath the well-defined Louisiana limestone, in the vicinity of Louisiana, there are about 6 feet of black and green shales carrying a characteristically Devonian fish fauna." Therefore, type locality is herein specifically designated. Outcrops of Saverton are essentially coextensive with those of underlying Grassy Creek; in Missouri, confined to northeastern part of State north of Lincoln arch. In Pike County, average thickness probably a little more than 2 feet and somewhat less in vicinity of type locality. Saverton seems to thicken toward northwest; Moore (1928) reported 100 feet in river bluff near Saverton, Ralls County; it is likely that Saverton, as herein defined, is much less. Branson and Mehl (1933) measured 15 to 20 feet of shale between the Louisiana and Mineola (Callaway) on Sees Creek, west of Hannibal, Marion County; this shale, which they designated as Grassy Creek, is now believed to be Saverton. Overlies Grassy Creek shale; underlies Louisiana limestone or where Louisiana is missing, the Hannibal shale. Late Devonian.

Type locality (Mehl, 1960): Missouri River bluff several hundred feet above Champ Clark Bridge, the same as the type locality for the Grassy Creek (SW¼NW¼SE¼ sec. 18, T. 54 N., R. 1 W.), Pike County, Mo.

**Savoy 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. 156–163, 220–221, pl. 34.

Phillip Fowler, 1950, Vermont Geol. Survey Bull. 2, pl. 1. Shown on correlation in east Vermont above Ottauqueechee formation and below Hawley formation.

Named for development in eastern part of Savoy Township, Berkshire County, Mass.

**Sawatch Quartzite**[1]

Upper Cambrian: Western and central Colorado.

Original reference: G. H. Eldridge, 1894, U.S. Geol. Survey Geol. Atlas, Folio 9.

Q. D. Singewald, 1947, Preliminary geologic map and section of the upper Blue River area, Summit County, Colorado (1:31,250): U.S. Geol. Survey Prelim. Map; 1951, U.S. Geol. Survey Bull. 970, p. 9 (table). Thickness 100 to 140 feet. Underlies Peerless formation; unconformably overlies Precambrian.

H. F. Donner, 1949, Geol. Soc. America Bull., v. 60, no. 9, p. 1218–1221. Described in McCoy area where it is 270 feet thick, overlies Precambrian granite, gneiss, and schist and underlies Leadville limestone.

Ogden Tweto, 1949, Colorado Sci. Soc. Proc., v. 15, no. 4, p. 152 (table 1), 158–161. Described in Pando area where it consists of fine-grained thick-bedded to massive white quartzite; pink near base and at top. Thickness 140 to 185 feet. Underlies Peerless formation; unconformably overlies Precambrian.

J. C. Maher, 1950, U.S. Geol. Survey Oil and Gas Inv. Prelim. Chart 39. Described along Front Range where it is about 50 feet thick, underlies Ute Pass dolomite (new) ; overlies Precambrian granite.

N. W. Bass and S. A. Northrop, 1953, Am. Assoc. Petroleum Geologists Bull., v. 37, no. 5, p. 892 (fig. 2), 894, 896, 897. In White River Plateau, underlies Glenwood Canyon member (new) of Dotsero formation (redefined).

C. H. Behre, Jr., 1953, U.S. Geol. Survey Prof. Paper 235, p. 25–27. On west slope of Mosquito Range, Sawatch is limited to the quartzite, generally white and averaging 105 feet in thickness. Underlies Peerless formation; overlies Precambrian.

M. G. Ding and C. S. Robinson, 1957, U.S. Geol. Survey Prof. Paper 289, p. 10–11. In Garfield quadrangle, consists of a lower quartzite member, a middle glauconitic sandstone member, and an upper quartzite member. Thickness 100 feet. Underlies Manitou dolomite; overlies Precambrian gneiss.

R. R. Berg and R. J. Ross, Jr., 1959, Jour. Paleontology, v. 33, no. 1, p. 107 (fig. 1), 108, 110. On basis of faunal correlations, unit called Ute Pass at Williams Canyon by Maher (1950) is restored to lower part of Manitou formation. On bases of lithology and stratigraphic position, the Ute Pass of Missouri Gulch is correlated with Peerless formation; term Ute Pass is abandoned. Hence, in some areas the Sawatch underlies the Manitou and in others the Peerless.

Named for persistent occurrence around flanks of Sawatch Range.

Sawatch 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.

Probably named for Sawatch Range.

†Sawatchan series[1]

Upper Cambrian: Colorado.

Original reference: C. R. Keyes, 1924, Pan-Am. Geologist, v. 41, p. 281, 286.

Encircle Sawatch uplift in Sawatch Range.

Saw Mill Conglomerate (in Almy Conglomerate)

Paleocene: Northern Utah.

A. J. Eardley, 1944, Geol. Soc. America Bull., v. 55, no. 7, p. 824 (table 1), 842, pl. 1. Lower 400 feet, massive red cliff-making conglomerates; middle 500 feet, light-tan and gray conglomerates, grits, sandstones, and shales; upper 300 feet, brownish-tan conglomerates. Overlies Pulpit conglomerate division (new) ; underlies Fowkes formation.

B. E. Lofgren, 1955, Utah Geol. Soc. Guidebook 10, p. 75. Since Eardley's original mapping, he and students have remapped area and now regard Saw Mill conglomerate as Knight conglomerate.

Named from Saw Mill Canyon, 4½ miles up Echo Canyon from the Weber, Morgan County.

Sawmill Stage

Pleistocene: Southwestern Montana.

W. B. Hall, 1960, Billings Geol. Soc. [Guidebook] 11th Ann. Field Conf., p. 192–195. Discussion of multiple glaciation in Madison and Gallatin Ranges. Three stages recognized: Marble Point (oldest), intermediate, and Sawmill. Prominent feature of Sawmill stage is Sawmill moraine which rests at elevation of 7,000 feet up valley floor of Taylor Fork of Gallatin River.

Named for former establishment of Sawmill, built along the moraine in Taylor Fork valley, in Madison Range.

Sawmill Creek Member (of Cashaqua Formation)

Upper Devonian: Western New York.

R. G. Sutton, 1960, New York State Mus. Sci. Service Bull. 380, p. 14–17, 54, 55–56, figs. 2, 5. Proposed for gray and black shales that underlie Rock Stream member and overlie Middlesex black shale. Thickness 19 to 236 feet; thickens eastward. After submission of this paper for publication, Colton and de Witt (1958) proposed name Pulteney for unit herein named Sawmill Creek; former name thus has priority.

Type section: Sawmill Creek, on east side of Seneca Lake, 8 miles north of Watkins, Schuyler County.

**Sawtooth Formation** (in Ellis Group)

Middle Jurassic: North-central and western Montana.

W. A. Cobban, 1945, Am. Assoc. Petroleum Geologists Bull., v. 29, no. 9, p. 1264 (fig. 1), 1270–1277, strat. sections. Consists of basal fine-grained sandstone, a medial dark-gray shale containing a few thin dark limestone layers, and an upper highly calcareous siltstone. Thickness at type section 136 feet; at Swift Reservoir section 198 feet; formation is thickest along Rocky Mountain front and in trough extending slightly south of west from Sweetgrass Hills to Rocky Mountain front; thins over Kevin-Sunburst dome; absent over most of South arch. Basal formation of group; underlies Rierdon formation (new); where Rierdon is absent, underlies Swift formation (new); in Sun River section, overlies Hannan limestone. Bathonian age indicated by fossils. Subsurface data.

R. W. Imlay and others, 1948, U.S. Geol. Survey Oil and Gas Inv. Prelim. Chart 32. Detailed description in discussion of marine Jurassic formations of Montana. In south-central Montana grades eastward into Piper formation (new).

R. W. Imlay, 1952, Geol. Soc. America Bull., v. 63, no. 9, p. 968–969, chart 8C (column 56). Middle Jurassic age of Sawtooth is based on presence of *Defonticeras* near its base and of *Arctocephalities* and *Procerites* in its upper silty beds and on its stratigraphic position beneath beds containing varied ammonite faunas that allow correlation with lower Callovian ammonite zones of northwest Europe. Formation pinches out by overlap on South arch of Sweetgrass uplift and on Big Belt uplift east of Helena but grades eastward into Piper formation in northern and southern Montana.

T. P. Storey, 1958, Alberta Geol. Soc. Petroleum Geologists Jour., v. 6, no. 4, p. 90–104. Discussion of Jurassic of Williston Basin and adjacent areas. On basis of faunal, environmental, and tectonic evidence 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 sections of these formation 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; and (2) Sawtooth is discrete stratigraphic unit which is younger than Piper or Gypsum Spring.

Type section: Rierdon Gulch, W½ sec. 23, T. 24 N., R. 9 W., Teton County. Named for exposures in Sawtooth Range.

**Sawyer Limestone Member** (of Waxahatchee Slate)[1]

Precambrian or Paleozoic: Eastern Alabama.

Original reference: C. Butts, 1926, Alabama Geol. Survey Special Rept. 14, p. 51, map.

Charles Butts, 1940, U.S. Geol. Survey Geol. Atlas, Folio 226, p. 3. Described as member of Waxahatchee slate. Separated from overlying Brewer phyllite by an interval of clay rock of brownish, greenish, or pinkish tint banded with thin yellowish, pinkish, or grayish laminae: Derivation of name given.

Name derived from Sawyer Cove, Shelby County, Columbiana quadrangle.

Sawyer Quartz Syenite[1]

Devonian or Carboniferous: East-central New Hampshire.

David Modell, 1936, Geol. Soc. America Bull., v. 47, no. 12, p. 1904–1905, pl. 1. Pink medium-grained equigranular quartz syenite. Megascopically visible quartz invariably present; hornblende and biotite also visible. Contains xenoliths of schist and angular blocks of Belknap syenite. Patches of a shonkinitic type of syenite surrounded by quartz syenite occur locally. Older than Albany quartz syenite and Conway granite; younger than Gilmanton monzodiorite and Belknap syenite. Assigned to White Mountain magma series.

Named from farm at west base of Gunstock Mountain in Belknap Mountains. Extends northward from the mountain for more than 2 miles.

Saxe Brook Dolomite (in Woods Corners Group)

Saxe Brook Formation

Middle Cambrian: Northwestern Vermont, and Quebec, Canada.

B. F. Howell, 1939, (abs.) Geol. Soc. America Bull., v. 50, no. 12, pt. 2, p. 1964. Sandy dolomite, in part a dolomitic sandstone. Underlies

Hungerford formation; overlies Skeels Corners formation (new) disconformably.

A. B. Shaw, 1958, Geol. Soc. America Bull., v. 69, no. 5, p. 523 (table 1), 532 (fig. 5), 543–546, pl. 1. Dolomites south of Missisquoi River that were originally included in formation are now placed in amended Skeels Corners slate and Saxe Brook dolomite limited to beds that form Carter Hill, a mile west of Highgate Center, and the ridge to north on east side of Saxe Brook valley. Extends into Canada only in much reduced thickness. Regarded as northern equivalent of Rockledge conglomerate, but separate names retained because of lithologic differences between the two units. Contains three main rock types. Most common is highly arenaceous gray dolomite, next is sandstone with dolomitic cement, least common is nonarenaceous dolomite. These types are arbitrary divisions of a continuous, gradational lithic sequence. Thickness 600 to 700 feet; about 350 feet at international boundary. Overlies Skeels Corners slate with slight angular unconformity; contact with Hungerford slate not exposed. Included in Woods Corners group (new). Middle Cambrian.

W. M. Cady, 1960, Geol. Soc. America Bull., v. 71, no. 5, p. 572, pl. 3 (correlation chart). Presumably mappable unit north of boundary into Quebec.

Best exposed on Carter Hill, on eastern side of valley of Saxe Brook, northwest of Highgate Falls, Franklin County. Extends several miles northeastward and southwestward of Highgate.

Saxian Series[1]

Upper Cretaceous: Northwestern Iowa.

Original reference: C. R. Keyes, 1925, Pan-Am. Geologist, v. 43, p. 300.

Occurs a short distance east of Missouri River.

**Saxton Conglomerate Member** (of Chemung Formation)[1]

Upper Devonian: Central Pennsylvania.

Original reference: C. Butts, 1918, Am. Jour. Sci., 4th, v. 46, p. 523, 535.

Charles Butts, 1945, U.S. Geol. Survey Geol. Atlas, Folio 227. Member of Chemung formation. Consists of conglomeratic sandstones and greenish-gray and chocolate-brown shales. Thickness 102 feet.

Exposed in and about Saxton, Huntingdon County.

Saxton Shale (in Catskill Formation)[1]

Upper Devonian: Central southern Pennsylvania and eastern West Virginia.

Original reference: D. B. Reger, 1927, Geol. Soc. America Bull., v. 38, p. 157, 397–410.

Well exposed on north side of deep cut at Riddlesburg, Bedford County, Pa.

Saypo Limestone (in Hannan Limestone)

Saypo Limestone Member[1] (of Madison Limestone)

Mississippian (Kinderhookian): Northwestern Montana.

Original reference: C. F. Deiss, 1933, Montana Bur. Mines and Geology Mem. 6, p. 46.

J. M. Weller and others, 1948, Geol. Soc. America Bull., v. 59, no. 2, pl. 2 (column 38). Shown on correlation chart as the lowermost unit in Hannan limestone. Underlies Dean Lake chert. Kinderhookian.

J. M. Andrichuk, 1955, Billings Geol. Soc. Guidebook 6th Ann. Field Conf., p. 85. Assignment of group status to the Madison of northwestern Montana precludes any need for term Hannan.

Type locality: On south side of upper part of Pentagon Mountain, SW¼ sec. 14, T. 25 N., R. 12 W. [Flathead County]. Named for Saypo quadrangle, over much of which it is well exposed.

**Sayreville Sand Member** (of Raritan Formation)

Upper Cretaceous: East-central New Jersey.

H. C. Barksdale and others, 1953, The ground-water supplies of Middlesex County, New Jersey: New Jersey State Water Policy Comm. [Spec. Rept. 8], p. 101–103. Bed of variable composition composed dominantly of fine- to medium-grained, white, micaceous sand (No. 2 sand of previous reports). Separated from overlying Old Bridge sand member (new) by South Amboy fire clay, and from underlying Farrington sand member (new) by Woodbridge clay. North of Raritan River consists of fine white micaceous sand, crossbedded fine- to coarse-grained white sand, with or without layers of white clay, and beds of arkosic sand; here thickness is 35 to 40 feet. Near Sayreville thickness is 6 to 7 feet. In this report, Woodbridge and South Amboy clays are considered informal economic names.

Named for exposures at several localities in northern part of Borough of Sayreville, Middlesex County.

Scajaquada Limy Shale[1]

Scajaquada 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 and L. V. Rickard, 1953, New York State Mus. Circ. 36, p. 9. Mentioned in discussion of Bertie formation in east-central New York.

D. W. Fisher, 1959, New York State Mus. Sci. Service Geol. Survey Map and Chart Ser. 1. Scajaquada shale or waterlime included in Bertie group. Overlies Falkirk dolomite; underlies Williamsville waterlime. Fieldwork has not demonstrated lateral continuity of Scajaquada and Forge Hollow shale as shown on present chart. Thick glacial deposits conceal units in area where they may merge. Therefore, distinct names are used in western and central New York.

Derivation of name not stated.

**Scales Creek Flow** (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. Persistent lava flow noteworthy for its thickness in Portage Lake lava series. Older than Old Colony sandstone; younger than Copper City flow (new).

Geologic map indicates that Scales Creek transects the strike of the flow in southeastern part of Ahmeek quadrangle.

Scammon Formation (in Cabannis Group)

Scammon 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. The Scammon, eighth in the sequence (ascending), overlies the Pilot and underlies the Mineral. Average thickness 33 feet. Includes a thin coal here designated Scammon. [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 Scammon formation in Cabaniss group. Underlies Mineral formation; overlies Tebo formation.

C. C. Branson, 1954, Oklahoma Geol. Survey Guide Book 2, p. 5. Listed as a coal cycle in Senora formation in Oklahoma. Includes Tiawah black shale, Tiawah limestone, shale, and Chelsea sandstone. Overlies Tebo coal cycle; underlies Mineral coal cycle. Cabaniss group.

W. V. Searight, 1955, Missouri Geol. Survey and Water Resources Rept. Inv. 20, p. 22 (fig. 11). Thickness of formation about 4 feet in Vernon County, Mo. Includes Tiawah limestone and Chelsea sandstone. Overlies Tebo formation. Cabaniss group.

W. B. Howe, 1956, Kansas Geol. Survey Bull. 123, p. 22 (fig. 5), 52–60. Formation in Cabaniss subgroup of Cherokee group. Includes beds above Tebo coal and extends to top of Scammon coal. Complete succession included in formation is exposed at only one Kansas locality (strip-pit highwall in SE¼NE¼ sec. 24, T. 28 S., R. 25 E., Crawford County). Following divisions recognized in Kansas: dark-gray to black fissile shale at base, including single limestone bed (Tiawah); fine-grained sandstone and siltstone; medium- to dark-gray shale; sandstone (Chelsea); underclay; Scammon coal bed. In some areas in Kansas and Missouri, the Chelsea sandstone rests on an erosion surface extending down through the lower beds and locally through the Tiawah limestone and underlying Tebo coal. Thickness of formation 28 to 32 feet in eastern Crawford County; 35 to 45 feet in central and southern Crawford County and northern Cherokee County.

Type locality of Scammon coal is along Cherry Creek, northwest of Scammon, Cherokee County, Kans.

Scandian Sub-Age

Pleistocene: Midcontinent region.

J. C. Frye and A. B. Leonard, 1955, Am. Jour. Sci., v. 253, no. 6, p. 359 (fig. 1), 362. Provincial time-stratigraphic and time term used to designate the interval from the end of Sangamonian to the beginning of Bradyan.

Type locality is the section (NW¼ sec. 5, T. 3 S., R. 4 W.) of fossiliferous silt, 40 feet thick, resting on Sangamon soil developed in thin Loveland silt that overlies the Greenhorn limestone, in the bluff of the Republican River valley north of the town of Scandia, Republic County, Kans.

**Scanlan Conglomerate Bed** (in Pioneer Formation)

Scanlan Conglomerate (in Apache Group)[1]

Precambrian: Central and southeastern Arizona.

Original reference: F. L. Ransome, 1903, U.S. Geol. Survey Prof. Paper 12.

N. P. Peterson, 1954, U.S. Geol. Survey Geol. Quad. Map GQ–41. Thickness 1 to 6 feet in Globe quadrangle. Composed of angular and subrounded fragments of vein quartz, small chips of schist, and a few fragments of the more resistant granitic rocks in a matrix that differs from underlying rock. Where it lies on schist [Pinal], matrix is dark gray to black and is composed of fine grains of schist, mica, and quartz. Where it overlies granite [Ruin], matrix is an arkose composed mainly of orthoclase and quartz. Underlies Pioneer formation.

U.S. Geological Survey currently classifies the Scanlan Conglomerate as a bed in Pioneer Formation on the basis of a study now in progress.

Named for Scanlan Pass, Globe quadrangle, through which the trail passes just east of Barnes Peak.

**Scappoose Formation**

Oligocene, upper, and Miocene, lower: Northwestern Oregon.

W. C. Warren and Hans Norbisrath, 1946, Am. Assoc. Petroleum Geologists Bull., v. 30, no. 2, p. 220 (table 1), 231–233. Gray yellowish-weathering firm fossiliferous sandy tuffaceous shale and shaly sandstone, commonly spotted with pumiceous material; loosely consolidated medium-grained sandstone; in some areas, strata show pebble band, crossbedding, and interbedded carbonaceous material. Thickness and distribution erratic; measured thickness in Buxton-Manning area approximately 1,500 feet. Capped by Columbia River basalt; disconformably overlies Pittsburg Bluff formation, and locally, separated from it by a conglomerate of variable thickness.

Typical exposures occur in valley of South Fork, of Scappoose Creek and along Rocky Point Road a few miles east and southeast of Scappoose on Columbia River Highway, Columbia County.

**Scarboro Phyllite** (in Casco Bay Group)[1]

Pennsylvanian(?): Southwestern Maine.

Original reference: F. J. Katz, 1917, Washington Acad. Sci. Jour., v. 7 p. 198.

Named for exposures in Scarboro, Cumberland County.

**Scatter Creek Rhyodacite** or **Formation**

Eocene or Oligocene: Northeastern Washington.

Hunting Geophysical Services, Inc., 1960, *in* Washington Div. Mines and Geology Rept. Inv. 20, p. 5, 6. Consists of variety of fine- to medium-grained porphyritic rocks ranging in composition from quartz monzonite to quartz diorite; local facies of syenite, diorite, and hornblendite; also quartz monzonite and quartz diorite dikes and irregular intrusive bodies that occur in White Mountain area west of Bacon Creek fault. In Curlew quadrangle, has largely engulfed Permian-Triassic and O'Brien Creek rocks (new) and parts of Sanpoil volcanic rocks (new). Intrudes Covada group. Republic quadrangle and part of Aeneas quadrangle mapped by Muessig and Quinlan (1959, U.S. Geol. Survey open-file map); Curlew quadrangle mapped by Calkins, Parker, and Disbrow (1959, U.S. Geol. Survey open-file map).

Widespread in Republic and Curlew quadrangles. Occurs as dikes, sills, and irregular intrusive bodies that occupy considerable part of Republic graben.

Scenic Member (of Brule Formation)

Oligocene: Southwestern South Dakota.

J. D. Bump, 1956, Am. Jour. Sci., v. 254, no. 7, p. 430–431. Unit formerly known as *Oredon* beds (Wortman, 1893, Am. Mus. Nat. History Bull., v. 5), minus the upper *Oredon* bed, is here designated Scenic member. At standard section, consists of upper nodular zone of light-cream-colored clays and gray clays 123 feet thick and a lower nodular zone of pink-gray clays 36 feet thick. Underlies Poleslide member (new); overlies Chadron formation.

Standard section: SW¼ sec. 23, T. 3 S., R. 13 E., 2.2 miles south of Scenic, Pennington County.

Scenic Point Member (of Appekunny Formation)

Precambrian (Belt Series): Western Montana, and southern Alberta, Canada.

C. L. Fenton and M. A. Fenton, 1937, Geol. Soc. America Bull., v. 48, no. 12, p. 1886–1887, fig. 2. Argillites, sandstones, and gravelly conglomerates; green, purplish, buff, brown, and dull brownish red at type locality. Northward and westward from type locality, member grades into thickly bedded, coarsely mud-cracked argillites, which give way to thick quartzites and subordinate gray and iron-stained argillites. Mud breccias, mud cracks, and ripple marks abundant. Thickness 200 to 700 feet. Overlies Appistoki member of Appekunny formation and underlies Rising Wolf member of Grinnell formation.

Type locality: Scenic Point, overlooking Two Medicine Valley, Glacier National Park, Mont.

**Schaefferstown Formation** (in Conococheague Group)

Schaefferstown 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 Snitz Creek member (new); top is drawn at base of first bed of white to pinkish-gray crystalline limestone of overlying Millbach member (new). Consists of medium-light- to medium-gray limestone with distinct shaly bands and laminae; rock is thick bedded in fresh exposures, but weathered rock appears rare; some pinkish-gray limestone beds near base; shaly bands and laminae are carbonaceous and make member particularly susceptible to flowage. Thickness probably 200 to 300 feet; partial section (type) 68 feet with neither top nor base exposed.

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 small quarry on west side of Schaefferstown just south of Route 897, Lebanon County. No satisfactory type section available in Lebanon County but best partial section has been measured and used as type section.

**Schaghticoke Shale**[1]

Upper Cambrian or Lower Ordovician: Eastern New York and western Vermont.

Original reference: E. Ruedemann, 1903, New York State Mus. Bull. 69, p. 934–966.

P. H. Osberg, 1952, Vermont Geol. Survey Bull. 5, p. 116 (fig. 16). Correlation chart for Vermont shows Schaghticoke shale in Taconic sequence below Deepkill shale. Stratigraphically above Zion Hill quartzite. Lower Ordovician.

Typically exposed along Hoosic River at and in vicinity of Schaghticoke, Rensselaer County, N.Y.

Schell shale[1]

Lower Ordovician: Eastern Nevada.

Original references: C. R. Keyes, 1923, Pan-Am. Geologist, v. 40, p. 53; 1924, Pan-Am. Geologist, v. 41, p. 78.

Named for outcrops in full thickness in a fault block near middle of Schell Creek Range, east of Ely, White Pine County.

**Schenectady Formation**[1]

Middle Ordovician: East-central New York.

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

G. M. Kay, 1937, Geol. Soc. America Bull., v. 48, no. 2, p. 273. Discussed under heading of formations of Sherman age, Trenton group. Composed of interbedded blue-gray calcareous sandstones with intercalated dark-gray arenaceous shale. Underlies Indian Ladder beds; overlies Snake Hill formation.

J. M. Berdan, 1950, New York Water Power and Control Comm. Bull. GW–22, p. 10 (table 2), 14. Formation, in Schoharie County, underlies Brayman shale. Thickness estimated at 2,000 feet but entire thickness not exposed in county. No record of wells that have passed completely through formation. Middle Ordovician.

Type exposures: Dettbarn quarries, at Schenectady, and at Aqueduct and Rexford Flats at Schenectady, Schenectady County.

Schenley Red Beds (in Conemaugh Formation)[1]

Pennsylvanian: Southwest Pennsylvania.

Original reference: M. E. Johnson, 1925, Pennsylvania Geol. Survey, 4th ser., Topog. and Geol. Atlas 37, p. 54, 121.

Occurs just north of Blackburn on Turtle Creek branch of Pennsylvania Railroad. Named because of their execllent exposure in Schenley district, Pittsburgh, Allegheny County.

**Scherrer Formation** (in Naco Group)

Scherrer Formation (in Snyder Hill Group)

Permian: Southeastern Arizona and southwestern New Mexico.

James Gilluly, J. R. Cooper, and J. S. Williams, 1954, U.S. Geol. Survey Prof. Paper 266, p. 1, 27–29. Comprises (ascending) about 65 feet of bright-red siltstone at base; about 30 feet of fine-grained gray limestone; 270 feet of sandstone containing a few beds of limestone in lower part;

165 feet of fine-grained, relatively thin bedded, and in part somewhat dolomitic, gray limestone; and 150 feet of sandstone. Sandstone nearly white on fresh fracture but generally weathers rusty brown. Thickness of type section 687 feet. Overlies Colina limestone (new) with sharp contact; underlies Concha limestone (new) at some localities and disconformably underlies Glance conglomerate at others. In Naco group.

D. L. Bryant, 1955, Dissert. Abs., v. 15, no. 7, p. 1224. Excluded from Naco group because it is not present in type area of original Naco. Reassigned to Snyder Hill group (new). Overlies Andrada formation (new) in western part of southern Arizona.

Elliot Gillerman, 1958, New Mexico Bur. Mines Mineral Resources Bull. 57, p. 39–41, tables 1, 2, pl. 1. In Peloncillo Mountains, N. Mex., about 50 feet of thick-bedded well-cemented dusty-red siltstone forms crest of ridge north from Cienega Peak. Overlies Colina limestone; underlies Chiricahua limstone. Formation thins in easterly direction—687 feet thick in central Cochise County, 150 feet in Chiricahua Mountains, and 30 to 50 feet in western part of Peloncillo Mountains. In Naco group.

Type section: On Scherrer Ridge (from which formation takes its name) and Concha Ridge, Gunnison Hills, central Cochise County, Ariz. Top of section measured along crest of Concha Ridge (SW¼NW¼ sec. 28, T. 15 S., R. 23 E.).

**Schieffelin Granodiorite**

Upper Cretaceous or Tertiary: Southeastern Arizona.

B. S. Butler, E. D. Wilson, and C. A. Rasor, 1938, Arizona Bur. Mines Bull. 143, Geol. Ser. 10, p. 25–26, pls. 3, 4. Has general appearance of a rather fine-grained light-gray granite and locally is referred to by that name. Slightly reddish tint in places and passes into various porphyritic modifications along its contact with the sedimentary rocks into which it is intrusive, including the Naco limestone and beds of the Bisbee group.

James Gilluly, 1956, U.S. Geol. Survey Prof. Paper 281, p. 102–104, pl. 5. Intrusive contacts found with all members of Naco group and with Bisbee formation, Bronco volcanics, and Uncle Sam porphyry. Occupies area of about 3 square miles in Tombstone district and forms Bronco Hill in central Cochise County.

Named from its typical occurrence in vicinity of Schieffelin's monument, about 1 mile northwest of Tombstone, western Cochise County.

**Schodack Formation**[1]

Lower Cambrian: Eastern New York and southwestern Vermont.

Original reference. R. Ruedemann, 1914, New York State Mus. Bull. 169, p. 67–70, map.

C. E. Resser and B. F. Howell, 1938, Geol. Soc. America Bull., v. 49, no. 2, p. 204. Bomoseen grit grades upward into calcareous beds to which Ruedemann (1914) assigned name Schodack and which Dale called "Cambric black shales." It is possible that Ruedemann's Mattawee [Mettawee] slate (Dale's "Cambric roofing slate") which crops out about Greenwich, N.Y., and in a belt extending from Pawlet to Fairhaven, Vt., is also Schodack.

Rudolf Ruedemann, J. H. Cook, and D. H. Newland, 1942, New York State Mus. Bull. 331, p. 64–65. In Catskill quadrangle the following units distinguished (descending): Zion Hill quartzite, Schodack shale and limestone, Burden conglomerate, Bomoseen grit, Burden iron ore, and

Nassau beds. Zion Hill quartzite, Schodack shale and limestone, Burden conglomerate, and Bomoseen grit are intimately connected and interfolded. In conference with Resser, it was found to be more practicable to extend term Schodack formation so as to include as members the beds associated or interbedded with it such as Zion Hill quartzite, Burden conglomerate, and also Troy shale and limestone. Resser would unite Ruedemann's Mettawee slate, Schodack shale and limestone, and Eagle Bridge quartzite (Zion Hill quartzite) into Schodack formation.

Winifred Goldring, 1943, New York State Mus. Bull. 332, p. 64–84. Schodack formation is used here [Coxsackie quadrangle] as extended by Ruedemann to include all members associated or interbedded with it from Bomossen grit through Zion Hill quartzite. In Troy and Cohoes quadrangles, it includes (ascending) Bomoseen grit, Diamond Rock quartzite, Troy shale and limestone, Schodack shale and limestone; in Washington County and Vermont, Bomoseen grit, Mettawee slate, Eddy Hill grit, Schodack shale and limestone, and Zion Hill quartzite; in Catskill quadrangle, Bomoseen grit, Schodack shale and limestone, and Zion Hill quartzite. Zion Hill quartzite not present in area of this report. Bomoseen grit overlies Nassau beds. Underlies Deepkill shale.

B. F. Howell and others, 1944, Geol. Soc. America Bull., v. 55, no. 8, chart 1. Shown on correlation chart above Bomoseen formation.

E. P. Kaiser, 1945, Geol. Soc. America Bull., v. 56, no. 12, pt. 1, p. 1084 (table 1), 1087–1089, 1091, pl. 1. In northern Taconic area, Schodack slate underlies Wallace Ledge slate (new) and overlies Eddy Hill grit. Units called Beebe limestone and Hooker slate by Keith (1932) are herein considered part of Schodack formation.

Phillip Fowler, 1950, Vermont Geol. Survey Bull. 2, p. 50–53, pl. 2. Described in Castleton area. Crops out in several narrow north-trending bands in slate belt west of Taconic Range and south of Castleton River. North of Castleton River Kaiser (1945) mapped outcrops of Schodack both in and west of Taconic Range in townships of Castleton, Hubbardton, and Ira. Some of Schodack mapped by Kaiser on eastern flank of Taconic Range in Pittsford is here called Hortonville slate, which lies beneath Taconic overthrust. Maximum thickness about 200 feet. Underlies Zion Hill quartzite; overlies Mettawee slate; in some areas, Eddy Hill grit lies between the Schodack and Mettawee. There are two current usages of name Schodack formation: one includes the Bomoseen grit, the other does not. This report follows Cushing and Ruedemann's (1914) usage. Also Resser and Howell's (1938) interpretation of Schodack and Mettawee formations is rejected.

D. W. Fisher, 1956, Internat. Geol. Cong., 20th, Mexico, Cambrian Symposium, pt. 2, p. 329, 341–342. Ruedemann (1914) applied name Schodack to "Cambrian black shales" of Dale (1898, U.S. Geol. Survey 19th Ann. Rept., pt. 3B). This is regrettable because it cannot be conclusively demonstrated that fossiliferous limestone exposed near Schodack Landing in Columbia County, where Ford (1885, Am. Jour. Sci., 3d, v. 28) discovered Lower Cambrian fossils, is same lithogenetic unit that Dale had reference to in Washington County. Name Schodack has been used to delimit differing intervals of rock, and this has caused confusion toward understanding relationships of early Cambrian strata in New York. Much of what has been called Schodack in past, both in Columbia and Washington Counties, has proved to be Ordovician Schaghticoke and Deepkill shales, by virtue of discovery of graptolites. Some of Dale's

"Cambrian black shales" (Ruedemann's Schodack) have been found to contain *Dictyonema flabelliforme*, a Schaghticoke graptolite and faunal zone considered as base of Ordovician in North America.

Named for exposures 2 miles south of Schodack Landing, N.Y.

**Schoharie Grit**[1]

Schoharie Formation

Lower and Middle Devonian: Eastern New York, New Jersey, and northern Pennsylvania.

Original reference: L. Vanuxem, 1840, New York Geol. Survey 4th Rept., p. 378.

G. A. Cooper and others, 1942, Geol. Soc. America Bull., v. 53, no. 12, pt. 1, p. 1779, chart 4. Lower or Middle Devonian. Onesquenthaw stage (new).

Winifred Goldring and R. H. Flower, 1942, Am. Jour. Sci., v. 240, no. 10, p. 673–694. Schoharie and Esopus formations restudied. Formations were traced from Schoharie west to Springfield Center, then east to Helderbergs and then south of Pennsylvania border. Esopus formation restricted, and beds formerly classed as upper Esopus are separated into the new Sharon Springs formation, which may be locally separated from overlying [Schoharie] and underlying beds by glauconite bands. Instead of disappearing to south, Schoharie grit changes rapidly to a shaly and cherty facies, here termed Leeds facies, and thickens as it approaches Pennsylvania border. Contacts with overlying Onondaga are transitional.

Rudolf Ruedemann, J. H. Cook, and D. H. Newland, 1942, New York State Mus. Bull. 331, p. 130, 183, geol. map [1946]. Schoharie grit is local development of sandy facies of lower Onondaga limestone.

Winifred Goldring, 1943, New York State Mus. Bull. 332, p. 42, 212–225, geol. map. Schoharie grit and limestone exposed in many areas in Coxsackie quadrangle where it has maximum estimated thickness of between 60 and 70 feet. Overlies Esopus shale; underlies Onondaga limestone. Schoharie formation here is dissimilar to beds outcropping in type area and Helderberg region. Possible that this formation does not properly belong to Schoharie. On geological map, Sharon Springs formation, with thickness in northern part of area of about 35 feet, and in Leeds Gorge of about 75 feet, is largely included in Schoharie formation.

Winifred Goldring and R. H. Flower, 1944, Am. Jour. Sci., v. 242, no. 6, p. 340. Preoccupied name Sharon Springs replaced by new name Carlisle Center.

Theodore Arnow, 1949, New York State Water Power and Control Comm. Bull. GW—20, p. 8 (table 1), 11 (fig. 3), 14, pl. 2. Schoharie grit in Albany County is impure siliceous dark-bluish-gray limestone. In places, merges with underlying Esopus shale and overlying Onondaga limestone. Maximum thickness 20 feet. Lower or Middle Devonian.

J. H. Johnsen, 1957, Dissert. Abs., v. 17, no. 10, p. 2247. Schoharie formation is complex of lithologic facies and faunal zones extending from Herkimer County, N.Y., at least to Monroe County, Pa. Thickens south of Port Jervis, N.Y., and thins again in New Jersey and Pennsylvania. Overlies Esopus formation; underlies Onondaga. Includes Carlisle Center, Rickard (new), and Leeds facies.

Named for exposures at Schoharie, Schoharie County, N.Y.

†Schoharie Stage[1]

Lower Devonian: New York.

Original reference: A. W. Grabau, 1898, Buffalo Soc. Nat. History, v. 6, p. xviii.

School Canyon Granite

Jurassic(?): Southern California.

J. C. Crowell, 1952, California Div. Mines Spec. Rept. 24, p. 8, pls. 1, 2. Buff and orange coarse-grained granite. Resembles Tejon Lookout granite (new) to which it may be closely related, although the relationship has not been established.

Exposed in northwestern corner of Lebec quadrangle, Kern County, within the Pastoria fault zone. Large jagged outcrops and cockscombs occur north of School Canyon, after which the granite is named.

Schoolcraft Dolomite or Formation (in Manistique Group)

Schoolcraft Member[1] (of Manistique Formation)

Middle Silurian: Northern Michigan and eastern Wisconsin, and Ontario, Canada.

Original reference: R. B. Newcombe, 1933, Michigan Geol. Survey Pub. 38, p. 23, 37.

C. K. Swartz, 1942, Geol. Soc. America Bull., v. 53, no. 4, p. 536, chart 3. Schoolcraft dolomite and Cordell dolomite replace term Waukesha in eastern Wisconsin.

G. M. Ehlers and R. V. Kesling, 1957, Michigan Geol. Soc. [Guidebook] Ann. Geol. Excursion, p. 2 (chart), 19, 20–21. Rank raised to formation in Manistique group. Predominantly thin even-bedded finely crystalline gray dolomite. Thickness 40 to 60 feet. Underlies Cordell dolomite; overlies Hendricks dolomite of Burnt Bluff group, probably disconformably.

Exposed in abandoned quarry of White Marble Lime Company on eastern side of Manistique, Schoolcraft County, Mich. Traced from northeastern Wisconsin to region of Owen Sound, Ontario.

Schoolhouse Group

Cretaceous(?) or younger: Southwestern New Mexico.

J. G. Wargo, 1958, abs.) Geol. Soc. America Bull., v. 69, no. 12, pt. 2, p. 1748. Volcanic rocks ranging in composition from basalt to rhyolite. Basal units of two andesite flows which rest on Cretaceous(?) shale. Middle unit of thick sequence of pyroclastics, welded tuffs, and flows largely of rhyolitic composition. Five formations can be distinguished locally. Uppermost unit of thin basalt flows interbedded with consolidated gravels of Gila(?) age. Maximum thickness about 9,000 feet.

In Schoolhouse Mountain area, northern Grant County, approximately 20 miles west of Silver City.

Schoolhouse Sand

Schoolhouse Tongue (of Weber Sandstone)

Middle Permian: Western Colorado.

W. O. Thompson, 1949, Am. Assoc. Petroleum Geologists Bull., v. 33, no. 1, p. 72. The so-called Weber sand of Rangely oil fields thins eastward gradually and disappears among red sediments on west slope of Gore

Range, about 10 miles east of Eagle. This sandstone is referred to as Schoolhouse sand. Middle Permian (Leonardian).

K. G. Brill, Jr., 1952, Geol. Soc. America Bull., v. 63, no. 8, p. 823. Renamed tongue of Weber sandstone. On west side of McCoy area, 59 feet thick and lies between McCoy and State Bridge formation. Thickness 79 feet at South Canyon, near Glenwood Springs; 46 feet, 4 miles north of Eagle; 27 feet, 10 miles east of Eagle.

Named for typical outcrop near schoolhouse east of Meeker, Rio Blanco County.

School Mine Ledge Bed (in Rich Fountain Formation)

Lower Ordovician: Central Missouri.

J. S. Cullison, 1944, Missouri Univ. School Mines and Metallurgy Bull., Tech. Ser., v. 15, no. 2, p. 15–16, pls. 2, 3. Massive medium to coarsely crystalline dolomite that forms a prominent ledge in lower part of formation.

Well exposed at experimental mine of Missouri School of Mines and Metallurgy on east line of SW¼SW¼SE¼ sec. 10, T. 37 N., R. 8 W., Rolla quadrangle, Phelps County.

Schooner Head Series[1]

Precambrian or Cambrian(?): Southeastern Maine.

Original reference: N. S. Shaler, 1889, U.S. Geol. Survey 8th Ann. Rept., pt. 2, p. 1037, 1041, 1060, map.

G. H. Chadwick, 1942, (abs.) Geol. Soc. America Bull., v. 53, no. 12, pt. 2, p. 1797. Abandoned; synonymous with Frenchmans Bay series (new) of Silurian age.

Named for exposures at Schooner Head, east coast of Mount Desert Island, Hancock County.

Schooner 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, 137–143.

J. M. Weller and others, 1948, Geol. Soc. America Bull., v. 59, no. 2, p. 127–128, pl. 1. Facies nomenclature discussed. In north and south direction, Locust Point formation comprises Belmont, Nelson, Hill, Schooner Hill, and Spickert Knob facies.

Name derived from Schooner Hill in Brown County, NE¼ sec. 3 and NW¼NW¼ sec. 2, T. 8 N., R. 2 E., 3½ miles southwest of Nashville.

**Schrader Bluff Formation** (in Colville Group)

Upper Cretaceous: Northern Alaska.

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, 166, fig. 2. Largely marine sandstone to south and shale to north. Contains considerable bentonite and tuff which increases upward through formation. Comprises three members (ascending): Seabee (new), Tuluga (new), and Sentinel Hill (new). Members exposed in over 3,000 feet of continuous outcrop at Schrader Bluff. Thickness at Fish Creek test well No. 1 is 2,600 feet. Overlies Umiat formation (new) in Umiat area and to the south; also overlies Chandler formation (new) to the south. Intertongues with nonmarine Prince Creek formation (new). Underlies Sagavanirktok formation (new).

C. L. Whittington *in* George Gryc and others, 1956, Am. Assoc. Petroleum Geologists Bull., v. 40, no. 2, p. 212 (fig. 2), 249–251. Restricted to predominantly marine rocks lying above and interfingering with Tuluvak and Kogosukruk tongues of Prince Creek formation. Type locality redefined by restricting it to steeply south-dipping marine rocks in Schrader Bluff from top of Tuluvak tongue (800 feet above base) to top of exposure (2,700 feet above base). Divided into three members in outcrop area (ascending): Rogers Creek member (new), Barrow Trail member (new), and Sentinel Hill member. In general, formation represents marine deposits of one great transgression and regression of the sea. Thickness about 2,200 feet along Colville River northeast of Umiat, at least 1,900 feet at Schrader Bluff.

Type locality: In north (northeast) bank of Anaktuvuk River about 5 miles above mouth of Tuluga River. Named for exposures at Schrader Bluff on Anaktuvuk River just south of junction with Tuluga River, identified also in well cores from Umiat, Fish Creek, Sentinel Hill, and Cape Simpson areas.

Schreyfogels Limestone[1]

Mississippian: Northeastern Pennsylvania.

Original reference: F. Platt, 1880, Pennsylvania 2d Geol. Survey Rept. $G_2$, p. 187, 199.

Exposed on hillside south of Schreyfogel's Hotel and 170 feet above level of Loyalsock Creek, Sullivan County.

Schroeppel Shale[1] (in Clinton Formation)

Silurian: Central New York.

Original reference: G. H. Chadwick, 1918, Geol. Soc. America Bull., v. 29, p. 327–368.

Charles Butts, 1939, *in* Rudolf Ruedemann and Robert Balk, eds., Berlin gebrüder Borntraeger, Geologie der Erde, North America: v. 1, p. 368. Section from Lakeport, Madison County, to Wolcott, Wayne County, shows Schroeppel shale in Clinton formation below Irondequoit limestone and above Brewerton shale.

D. W. Fisher, 1959, New York State Mus. Sci. Service Map and Chart Ser. No. 1. Gillette (1947) in his detailed study of Clinton group ignored Chadwick's (1918) Phoenix and Schroeppel shales, probably because they were so loosely defined. Instead he introduced name Willowvale for the green fossiliferous shale beneath the Herkimer and above the Kirkland. Gillette's view is followed in present report.

Type locality: Phoenix, on Oswego River, Oswego County. Phoenix is in Schroeppel Township.

**Schroyer Limestone 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. 33.

D. E. Hattin, 1957, Kansas Geol. Survey Bull. 124, p. 43–49, pls. 1–3. Three units invariably present in Schroyer (ascending): basal cherty limestone, which locally contains some shale in northern Kansas; a shaly unit, which commonly contains a cherty limestone bed; and algal limestone. No exposure examined during this study includes more than 13 feet of what can be called Schroyer. On basis of lithology, much of what has been called Schroyer at type locality should be included in underlying Havensville shale. At several places in Marshall and Pottawatomie Counties, the Havensville includes a molluscan-limestone phase; at first appearance, this molluscan limestone seems to belong to the Schroyer; however, placement of this unit in the Havensville is harmonious with respect both to cycles of sedimentation and to observed thicknesses of shaly exposures of the Havensville. Therefore only 5 feet of cherty limestone at type section should be classified as Schroyer, and at present only 1.6 feet of Schroyer is actually exposed. In this report, boundary between Schroyer limestone and Havensville shale is placed at the contact of chert-bearing limestone on shale or noncherty limestone, the strata above and below the contact thus being lithologically and stratigraphically compatible units. Placed in Wolfcamp series.

Type locality: East side of Big Blue Valley, about 1¼ miles below Schroyer, Marshall County, Kans.

Schubert Creek Limestone[1]

Pennsylvanian: Eastern Kansas and northwestern Missouri.

Original reference: R. C. Moore, 1932, Kansas Geol. Soc. 6th Ann. Field Conf. Guidebook, p. 90, 97.

G. E. Condra, 1949, Nebraska Geol. Survey Bull. 16, p. 41. Name introduced by Moore for lower member of Hertha. Later it was found that this limestone is the one called Hertha at Kansas City. Kansas Geological Survey now uses names Sniabar limestone, Mound City shale, and Critzer limestone as members of the Hertha.

Type locality: On Schubert Creek between Bronson and Uniontown, Kans., on U.S. Highway 54.

**Schuler Formation** (in Cotton Valley Group)

Upper Jurassic: Subsurface in Arkansas, Louisiana, and Texas.

H. K. Shearer, 1938, Am. Assoc. Petroleum Geologists Bull., v. 22, no. 6, p. 724–725. Schuler formation or Schuler facies of Cotton Valley formation applied to formation underlying basal gravel of Travis Peak and overlying Buckner formation (new) or older beds where Buckner is absent in south Arkansas. Includes Morgan sands zone near top and Jones sand at base in Schuler oil field, where thickness is about 2,250 feet. Named by Shreveport Geological Socity.

F. M. Swain, 1944, Am. Assoc. Petroleum Geologists Bull., v. 28, no. 5, p. 594–609. Redefined as formation to include nearshore or nonmarine pastel and red-green shales, sandstones, and basal conglomerates and offshore equivalents of these rocks which are dark-gray fossiliferous shales, limestones, sandstones, and basal conglomerates lying stratigraphically between base of Hosston formation and top of Bossier formation (new). Subdivided into (ascending) Dorcheat and Shongaloo members. In Cotton Valley group. Type section stated.

Type locality: Schuler oil field, Union County, Ark. Type section (near shore facies): Lion Oil Refining Co., and Phillips Petroleum Co.'s Edna Morgan No. 1, C., NE¼SW¼ sec. 18, T. 18 S., R. 17 W., Union County.

**Schultze Granite**[1]

Tertiary(?): Central Arizona.

Original reference: F. L. Ransome, 1903, U.S. Geol. Survey Prof. Paper 12.

M. N. Short and others, 1950, Arizona Bur. Mines Bull. 151, Geol. Ser. 16, p. 50. Tertiary.

In Globe mining district.

Schulz Member (of Williams Formation)

*See* **Schulz Ranch Sandstone Member** (of Williams Formation).

**Schulz Ranch Sandstone Member** (of Williams Formation)

Schulz Member (of Williams Formation)

Upper Cretaceous: Southern California.

W. P. Popenoe, 1937, Jour. Paleontology, v. 11, no. 5, p. 380. Named Schulz member of Williams formation (new). Light-colored coarse arkosic sandstones with numerous beds of well-rounded boulders; unfossiliferous. Average thickness 200 feet. Underlies Pleasants member (new) of Williams formation; overlies Holz member of Ladd formation (both new).

W. P. Popenoe, 1942, Am. Assoc. Petroleum Geologists Bull., v. 26, no. 2, p. 166, 168 (fig. 2), 173–174. Type locality designated.

W. P. Woodring and W. P. Popenoe, 1945, U.S. Geol. Survey Oil and Gas Inv. Prelim. Chart 12. Renamed Schulz Ranch sandstone member. North of Silverado Canyon, underlies Silverado formation (new).

Type locality: Approximately a quarter of a mile upstream from mouth of Williams Canyon, near west boundary of Schulz Ranch, northern Santa Ana Mountains, Orange County.

Schumann Formation[1]

Pliocene(?) and Pleistocene: Southern California.

Original reference: R. D. Reed, 1933, Geology of California, p. 232.

G. F. Worts, Jr., 1951, U.S. Geol. Survey Water-Supply Paper 1000, p. 28 (footnote). Term sometimes applied to Paso Robles formation; Paso Robles used in this report.

Exposed near north end of Schumann cut, where railroad enters Casmalia Hills south of Guadalupe, Guadalupe quadrangle.

Schuyler Soapstone[1]

Precambrian: Central Virginia.

Original reference: A. I. Jonas, 1928, Virginia Geol. Survey prelim. ed. of geol. map of Virginia.

Mapped at and around Schuyler, Nelson County.

**Schuylkill Member** (of Pottsville Formation)

Schuylkill Formation (in Pottsville Group)

Lower Pennsylvanian: Eastern Pennsylvania.

G. H. Wood, Jr., and others, 1956, Am. Assoc. Petroleum Geologists Bull., v. 40, no. 11, p. 2674 (fig. 3), 2675–2676, 2679–2680; 1957, U.S. Geol. Survey Coal Inv. Map C–43, sheet 1. Consists of several beds of fine to coarse pebble conglomerate and quartzose sandstone intercalated with thinner beds of shale and coal. Thickness about 300 feet at type section. Conformably overlies Tumbling Run member (new) with contact sharp where observed in anthracite region; studies in southern and western middle anthracite field indicate that Schuylkill member intertongues on a regional scale with Tumbling Run member; underlies Sharp Mountain member (new).

Carlyle Gray and others, 1960, Geologic map of Pennsylvanian (1:250,000): Pennsylvania Geol. Survey, 4th ser. Mapped as formation in Pottsville group in anthracite region.

Type section: Included in Pottsville formation reference section which is in roadcut on east side of U.S. Highway 122, about 150 feet farther east than original type section of the Pottsville which is on eastern side of Pennsylvania Railroad cut through water gap south of Pottsville, Schuylkill County.

Scio Beds or Formation

Oligocene, upper, or Miocene, lower: Western Oregon.

E. I. Sanborn, 1947, Oregon State Coll. Studies in Geology Mon. 4, p. 1–2, 11–12. Beds consist of a series of sandstones and water-lain tuffs and breccias which dip about 12° N. and 40° E. Character of beds varies from very fine grained white tuffaceous shale through quartz-mica sandstone containing as much as 96 percent quartz; on Franklin Butte, formation is more tuffaceous and about 75 feet of it is a well-defined white sandy shale containing fossil leaves. Beds apparently overlie marine Oligocene (Eugene) formation, but exact relationship is questionable because no contacts were observed; unconformably underlie a series of basic lava flows that are presumably middle Miocene in age. Name credited to W. M. Felts (unpub. thesis).

I. S. Allison and W. M. Felts, 1956, Geology of the Lebanon quadrangle, Oregon (1:62,500): Oregon Dept. Geology and Mineral Industries. Tentative names Scio beds and Berlin volcanics used by Felts (1936, unpub. thesis) are abandonded. Name Mehama volcanics used in area.

Well exposed in eastern part of Lebanon quadrangle, Linn County. Named for town of Scio, 9 miles southeast of Jefferson, on U.S. Highway 99.

Scioto Freestone (in Allegheny Formation)[1]

Pennsylvanian: Central southern Ohio.

Original reference: D. D. Owen, 1859, Rept. Geol. Reconn. State of Indiana in 1838, pt. 2, p. 50.

Probably named for Scioto Valley.

†Scioto Slates and Shales[1]

Upper Devonian: Southern Ohio.

Original reference: D. D. Owen, 1859, Rept. geol. reconn. State of Indiana, in 1838, pt. 2, p. 59.

Probably named for Scioto Valley.

Scioto Valley shale facies[1] (of Cuyahoga Formation)

Scioto Valley shale facies (of Logan Formation)

Mississippian: Southern Ohio.

Original reference: J. E. Hyde, 1915, Jour. Geology, v. 23, p. 657, 757–758.

F. T. Holden, 1941 Illinois Acad. Sci. Trans., v. 34, no. 2, p. 173; 1942 Jour. Geology, v. 50, no. 1, p. 54 (fig. 3), 60–62. Here considered a facies of Logan formation. Includes Portsmouth shale, Buena Vista sandstone, and Vinton sandstone members. Lies between Pretty Run shale facies (new) to the east and Vanceburg siltstone facies to the west.

Crops out to the east along the Scioto River valley.

Sciotoville clay member

Sciotoville Fire Clay (in Pottsville Formation)[1]

Pennsylvanian (Pottsville Series): Southern Ohio.

Original reference: E. B. Andrews, 1871, Ohio Geol. Survey Rept. Prog. 1870, p. 166, pl. opp. p. 242.

N. K. Flint, 1951, Ohio Geol. Survey, 4th ser., Bull. 48, p. 21, 22, table 1. Included in Anthony cyclothem in Perry County. Thickness 1½ to 6 feet. Underlies Anthony coal; overlies basal sandstone or shale member of cyclothem. Throughout most of county, the clay and coal lie only a few feet above Mississippian-Pennsylvanian boundary; locally clay lies directly on Mississippian Vinton sandstone.

R. E. Lamborn, 1954, Ohio Geol. Survey Bull. 53, p. 39–41, geol. map. Position of Sciotoville clay member (Pottsville series) is on an average about 30 feet below Sharon or No. 1 coal, and about 28 feet below Quakertown or No. 2 coal. Widely distributed but lacks continuity developed in localized basins or depressions flanked by uplands composed of strata of Mississippian age.

First described at Sciotoville, Scioto County.

**Scituate Granite Gneiss**

Mississippian(?) or older: Rhode Island.

A. W. Quinn, 1951, Bedrock geology of the North Scituate quadrangle, Rhode Island: U.S. Geol. Survey Geol. Quad. Map [GQ–13]. Light-gray, gray, or pink medium- to coarse-grained granite gneiss. Almost massive in places. Formerly included in Sterling granite gneiss. Intrusive into Blackstone series; intruded by Esmond granite.

G. M. Richmond, 1951, *in* G. M. Richmond and W. B. Allen, Rhode Island Port and Indus. Devel. Comm. Geol. Bull. 4, p. 14. Thickness of one mass in Georgiaville quadrangle is 2,000 to 4,000 feet. Cuts Woonasquatucket formation.

G. E. Moore, Jr., 1958, U.S. Geol. Survey Geol. Quad. Map GQ–105. Described in Hope Valley quadrangle. Younger than Blackstone series; grades into Hope Valley alaskite gneiss (new); cut by dike of Ten Rod granite gneiss (new). Devonian(?) or older.

U.S. Geological Survey currently designates the age of the Scituate Granite Gneiss as Mississippian(?) or older on the basis of a study now in progress.

Named for extensive exposures in Scituate Township, Providence County. Good exposures at east wall of spillway at west abutment of the Kent Dam of the Scituate Reservoir and in small quarry one-half mile west of Snake Den.

Scossa Slates[1]

Jurassic: Northwestern Nevada.

Original reference: J. C. Jones, A. M. Smith, C. Stoddard, 1931, Nevada Univ. Bull., v. 25, no. 4, p. 6, 7, 8.

Scossa district, Pershing County.

Scotia Bluffs Sandstone (in Wildcat Group)

Pliocene, upper: Northwestern California.

B. A. Ogle, 1953, California Div. Mines Bull. 164, p. 13 (fig. 3), 33–55, 111–113, pls. 1, 2. Massive fine-grained sandstone with mudstone members in lower part. Thickness 1,000 to 2,000 feet. Underlies Carlotta formation (new), contact gradational; overlies Rio Dell formation (new). In Wildcat Ridge section, upper part of Carlotta formation is not exposed, and lower part is noticeably more sandy than lower Carlotta in Eel River area. Term Ferndale (MacGinitie, 1943) has been used for the sandstone and conglomerate in section along Wildcat Ridge. The two are mappable units, and name Scotia Bluffs sandstone is proposed for the lithologic unit immediately overlying the Rio Dell formation and underlying Carlotta formation.

Type section: Along Scotia Bluffs on east side of Eel River.

**Scotland Schist**[1]

Scotland schist phase (of Hebron Gneiss)

Pre-Pennsylvanian: Eastern Connecticut.

Original reference: H. E. Gregory, 1906, Connecticut Geol. Nat. History Survey Bull. 6, p. 114, 132, 141, map.

W. G. Foye, 1949, Connecticut Geol. Nat. History Survey Bull. 74, p. 76, 77, pl. 1. Abandoned in favor of Brimfield schist; two units are identical.

John Rodgers and others, Preliminary geological map of Connecticut (1:253,440): Connecticut Geol. Nat. History Survey. Rank reduced to a phase. Occurs in the southern and east-central parts of the Hebron outcrop area. Pre-Triassic.

Crops out in town of Scotland, Windham County.

Scott 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. 821–827, 845, geol. sections. Defined as 44 feet of light- to medium-gray coarse-grained coquinal calcarenite in medium to thick beds, commonly cross laminated,, overlying Head member (new) at Scott Point, Isle La Motte; underlies Wait member (new). Base exposed in cove south of Scott Point is calcarenitic quartz conglomerate, succeeded in lower 24 feet by strongly cross-laminated quartz-sandy calcarenite; upper 6 feet has pinkish cystid fragments and small biostromal swellings, more or less dolomitized and with bryozoans; in contact with Wait member in cove north of point. Thins eastward to 32 feet on Wait Bay; on Wool Point 17 feet; near Chazy, N.Y., minimal thicknesses are 76 and 58 feet and beds are partly dolomitized; thickens from 6 feet on South Hero to about 40 feet on southern Valcour Island where it is poorly defined . Presumably overlapped southward.

Type locality: Scott Point. Isle La Motte, Vt.

**Scott Shale**

Scott Shale (in Pottsville Group)[1]

Middle Pennsylvanian: Eastern Tennessee.

Original reference: A. Keith, 1896, U.S. Geol. Survey Geol. Atlas, Folio 33.

H. R. Wanless, 1946, Geol. Soc. America Mem. 13, p. 89–93, 150. Scott formation (of shale) occurs between Anderson sandstone above and Jellico formation (called Wartburg by Keith) below.

C. W. Wilson, Jr. J. W. Jewell, and E. T. Luther, 1956, Pennsylvanian geology of the Cumberland Plateau: Tennessee Div. Geology [Folio], pl. 1.

As a result of recent fieldwork, names Briceville, Jellico, Scott, and Anderson formations are discontinued and a complete new classification presented.

Named for occurrence in Scott County.

**Scott Canyon Formation**

Lower or Middle Cambrian(?): North-central Nevada.

R. J. Roberts, 1951, Geology of the Antler Peak quadrangle, Nevada: U.S. Geol. Survey Geol. Quad. Map [GQ–10]. Chert, argillite, slate, limestone, and intercalated greenstone (altered andesitic lava) predominate. Chert is dark, thin bedded, and lenticular with argillite partings. Thickness estimated to be more than 2,000 feet and may exceed 5,000 feet. Mississippian(?).

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]. Type locality designated.

R. J. Roberts and others, 1958, Am. Assoc. Petroleum Geologists Bull., v. 42, no. 12, p. 2829–2830. Exposed in Antler Peak quadrangle. Consists of about 5,000 feet of dark thin-bedded chert, shale, and greenstone with a little limestone and quartzite. Overthrust by Harmony formation. Relations to younger formation, such as Valmy, not known.

Type locality: Scott Canyon, a tributary of Galena Canyon, southeast flank of Antler Peak. Well exposed in Galena, Little Cottonwood, and Scott Canyons in southeastern part of Antler Peak quadrangle.

†Scotts Bluff Formation[1]

Miocene: Southwestern Nebraska.

Original reference: H. Engelmann, 1876, Eng. Dept. U.S. Army, J. H. Simpson's Expl. of Great Basin of Terr. of Utah, p. 247, 282–284.

On North Fork of Platte River.

Scotts Creek Flint[1]

Mississippian: Eastern Ohio.

Original reference: E. Orton, 1880, Review of stratigraphy of Ohio, p. 22.

Occurs on all tributaries of Scott's Creek.

Scottville cyclothem (in McLeansboro Group)

Pennsylvanian: Southwestern Illinois.

J. R. Ball, 1952, Illinois Geol. Survey Bull. 77, p. 21, 31–32. Proposed for the cyclothem which includes the Scottville limestone and is well exposed in vicinity of Scottville. At type outcrop, includes basal sandstone and shale, underclay, coal, fossiliferous shale, and Scottville limestone. In sequence occurs above Gimlet cyclothem and below Trivoli cyclothem.

Type outcrop near west limits of Scottville, Macoupin County.

Scottville Limestone Member (of Modesto Formation)

Scottville Limestone (in McLeansboro Group)

Pennsylvanian: Southern Illinois.

J. N. Payne, 1943, Illinois Geol. Survey Circ. 88, p. 4, pls. 1, 2, 3. Gray to dark gray, fossiliferous, fine grained, massive. Lies below Carlinville limestone; separated from underlying Piasa limestone by Scottville coal.

J. R. Ball, 1952, Illinois Geol. Survey Bull. 77, p. 32. Thickness 1 to 6½ feet; average about 2½ feet. Included in Scottville cyclothem (new).

H. R. Wanless and Raymond Siever, 1956, Illinois Geol. Survey Circ. 217, p. 11, pl. 1. In McLeansboro group. Type locality stated.

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 37, 49 (table 1), 69, 70, pl. 1. Rank reduced to member status in Modesto formation (new). Name Rock Branch coal member is applied to coal formerly included in Scottville so that latter name may be restricted to the limestone. Name Athensville coal member is introduced for coal formerly called Upper Scottville. Occurs below Trivoli sandstone member and above Athensville coal member (new). Thickness 6½ feet. Presentation of new rock-stratigraphic classification of Pennsylvanian strata in Illinois.

Type locality: W½SW¼ sec. 16, T. 12 N., R. 9 W., Macoupin County. Well exposed along Apple Creek and its tributaries in southern Morgan and northwestern Macoupin Counties in vicinity of village of Scottville.

**Scotty Wash Quartzite**[1]

Upper Mississippian: Eastern Nevada.

Original reference: L. G. Westgate and A. Knopf, 1932, U.S. Geol. Survey Prof. Paper 171, p. 7, 21, map.

W. H. Easton and others, 1953, Am. Assoc. Petroleum Geologists Bull., v. 37, no. 1, p. 147 (fig. 2). On correlation chart of recommended revision of stratigraphic units of Great Basin, Scotty Wash quartzite is replaced by Diamond Peak formation in Pioche district.

Walter Sadlick, 1960, Intermountain Assoc. Petroleum Geologists Guidebook 11th Ann. Field Conf., p. 81–90. Discussion of aspects of Chainman stratigraphy. Chainman is recognized as a valid stratigraphic unit. Diamond Peak and Scotty Wash are not recognized as distinct units but are referred to as facies within the Chainman.

Named for Scotty Wash which passes through formation east of Silverhorn, Pioche district.

Scrag Granite[1] (in New Hampshire Magma Series)

Upper Devonian or Carboniferous: Northwestern 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. 510, pls. 1, 12. In New Hampshire magma series. Cuts Bethlehem gneiss. Magma series is younger than Lower Devonian, either late Devonian or late Carboniferous.

Named for occurrence on Scrag Hill, Franconia quadrangle.

Scranton Sandstone (in Pottsville Formation)[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 other places around Scranton, Lackawanna County.

**Scranton Shale** (in Wabaunsee Group)

Scranton Shale (in Shawnee Group)[1]

Scranton Shale Member (of Shawnee Group)[1]

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

Original references: Erasmus Haworth and John Bennett, 1908, Kansas Acad. Sci. Trans., v. 21, pt. 1, p. 82; 1908, Kansas Univ. Geol. Survey, v. 9, p. 57–160.

R. C. Moore, 1936, Kansas Geol. Survey Bull. 22, p. 49 (fig. 11), 211–214. Term Scranton discarded. Named subdivision treated as formations in Wabaunsee group.

R. C. Moore and M. R. Mudge, 1956, Am. Assoc. Petroleum Geologists Bull., v. 40, no. 9, p. 2274 (fig. 1), 2277. Scranton shale reintroduced as a formation with same stratigraphic span assigned originally to it by Haworth and Bennett. Consists predominantly of shale but contains some thin limestones and shaly sandstones. Comprises upper half of Sac-Fox subgroup of Wabaunsee group; includes strata between Bern limestone (new) above and Howard limestone below. Thickness about 125 feet. Includes (ascending) White Cloud shale, Happy Hollow limestone, Cedar Vale shale, Rulo limestone, and Silver Lake shale members. Reference section proposed.

Reference section: Exposures along an eastward-flowing stream extending through middle part of sec. 34, T. 12 S., R. 15 E., Shawnee County, Kans.

Scrubgrass cyclothem

Pennsylvanian (Allegheny Series): Southeastern Ohio.

N. K. Flint, 1951, Ohio Geol. Survey, 4th ser., Bull. 48, p. 44–46, table 1, geol. map. Includes (ascending) Scrubgrass sandstone, 9 feet; Scrubgrass coal; Vanport flint or chert, 1 foot; and Ferriferous ironstone. Occurs below Lower Kittanning cyclothem and above Clarion cyclothem. In area of this report, 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. 49 (table 7), 59–60. Cyclothem includes (ascending) Scrubgrass shale and (or) sandstone, Scrubgrass underclay and coal, Vanport flint, limestone or shale members. Occurs above Clarion cyclothem and below Lawrence cyclothem. In this report, Allegheny series is described on a cyclothemic basis; 13 cyclothems are named. [For complete sequence see Brookville cyclothem.]

Type area for Scrubgrass coal is along Scrubgrass Creek in Venango County, Pa.

Scrubgrass Fire Clay (in Allegheny Formation)[1]

Scrubgrass underclay member

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

Original reference: J. P. Lesley, 1879, Pennsylvania 2d Geol. Survey Rept. $Q_2$.

M. T. Sturgeon and others, 1958, Ohio Geol. Survey Bull. 57, p. 59. Scrubgrass underclay is member of Scrubgrass cyclothem, although it is not present in area of this report [Athens County].

Named for association with Scrubgrass coal, type locality of which is along Scrubgrass Creek in Venango County, Pa.

Scrubgrass shale and (or) sandstone member

Pennsylvanian: Eastern Ohio.

M. T. Sturgeon and others, 1958, Ohio Geol. Survey Bull. 57, p. 59. Member of Scrubgrass cyclothem in report on Athens County. Average thickness about 10 feet.

**Seabee Formation** (in Colville Group)

Seabee Member (of Schrader Bluff Formation)

Upper Cretaceous: Northern Alaska (subsurface and surface).

George Gryc, W. W. Patton, Jr., and T. G. Payne, 1951, Washington Acad. Sci. Jour., v. 41, no. 5, p. 166, figs. 2, 3. Formation, of which Seabee is lowest member, consists largely of marine sandstone to south and shale to north, with bentonite and tuff increasing upward through the formation. Top part of member marked by distinctive 150-foot unit of fossiliferous paper shale, which is low-grade oil shale. Thickness at type locality 450 feet. Overlies Niakogon tongue (new) of Chandler formation (new) in outcrop area; overlies Topagoruk member (new) of Umiat formation (new) to the north; underlies Tuluga member (new) of Schrader Bluff formation (new) and Tuluvak tongue (new) of Prince Creek formation (new).

C. L. Whittington *in* George Gryc and others, 1956, Am. Assoc. Petroleum Geologists Bull., v. 40, no. 2, p. 246–248, figs. 2, 4, 5. Redefined as formation to include all dominantly marine rocks of Colville group below Tuluvak tongue of Prince Creek formation. Includes, in many areas, strata previously assigned to lower part of Tuluga member of Schrader Bluff formation as well as strata assigned to Seabee member. Thickness in vicinity of Umiat about 1,500 feet. Unconformably overlies Ninuluk formation at Umiat, and in other areas generally overlies that formation or Niakogon tongue of Chandler formation. South of Umiat area, upper part of formation contains lithologically and faunally distinct unit, the Ayiyak member, but at Umiat and farther north this unit not certainly identified. Ayiyak formerly included in Tuluga member of Schrader Bluff formation. New type locality designated for formation. Although parts of formation are exposed at localities in vicinity of Umiat, only complete section in Umiat area is in Umiat test well No. 11.

Type locality of member: Along Seabee Creek, a tributary of Colville River, for which named. Also well exposed along Maybe Creek, a tributary of Ikpikpuk River.

Type locality of formation: In Umiat test well No. 11, 2½ miles west-northwest of Umiat Mountain, between 545 and 2,040 feet. Named from area of fair to poor exposures in vicinity of Seabee Creek 6½–8½ miles west of Umiat Mountain.

Seahorne cyclothem (in Spoon Formation)

Seahorne cyclothem[1] (in Tradewater Group)

Pennsylvanian: Western and southwestern Illinois.

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

H. R. Wanless, 1957, Illinois Geol. Survey Bull. 82, p. 50 (fig. 22), 76–79, 200. Includes Seahorne limestone and Seahorne sandstone. Thickness 3 to 12 feet. Underlies Wiley cyclothem; overlies DeLong cyclothem. Derivation of name and type locality given.

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 53 (table 2), pl. 1. In Spoon formation (new). Above Delong cyclothem and below Wiley cyclothem. Presentation of new rock-stratigraphic classification of Pennsylvanian strata in Illinois; cyclical classification is independent of rock-stratigraphic classification.

Type outcrop: Seahorne Branch, SE¼SE¼ sec. 5, T. 3 N., R. 3 E., Havana quadrangle, Fulton County.

Seahorne Limestone Member (of Spoon Formation)

Seahorne Limestone (in Cherokee Group)

Seahorne Limestone[1] (in Tradewater Group)

Pennsylvanian: Southwestern and western Illinois and eastern Iowa.

Original references: H. R. Wanless, 1931, Geol. Soc. America Bull., v. 42, p. 801–812; 1931, Illinois Geol. Survey Bull. 60, p. 179–193.

R. C. Moore and others, 1944, Geol. Soc. America Bull., v. 55, no. 6, chart 6 (column 31). Correlation chart shows Seahorne limestone in Cherokee group in Iowa.

H. R. Wanless, 1957, Illinois Geol. Survey Bull. 82, p. 50 (fig. 22), 78–79, geol. sections 5–7, 23, 28–32, 34, 36, 37, 39, 40, 42. Grades from scattered limonite-stained nodules in clay about 4 inches thick to a solid ledge more than 6 feet thick. Included in Seahorne cyclothem, Tradewater group.

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 33, 46 (table 1), pl. 1. Rank reduced to member status in Spoon formation (new). In southwestern area, occurs above Vergennes sandstone member and below Davis coal member; western area, occurs above DeLong coal member and below Wiley 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: S½SE¼ sec. 5, T. 3 N., R. 3 E., Fulton County, Ill.

Seahorne Sandstone (in Tradewater Group)

Pennsylvanian: Western and southern Illinois and southern Ohio.

H. R. Wanless, 1957, Illinois Geol. Survey Bull. 82, p. 77, 200. Sandstone in Seahorne cyclothem, Tradewater group. Thickness 6 inches to 6 feet. Where sandstone is more than 3 feet thick, it generally consists of two units separated by about 1 foot of light-gray sandy shale; this threefold division is found at numerous localities in western Illinois.

Type locality not stated; sandstone crops out at type outcrop of Seahorne cyclothem which is on Seahorne Branch, S½SE¼ sec. 5, T. 3 N., R. 3 E., Havana quadrangle, Fulton County, Ill. Sandstone recognized at many places in western Illinois and southern Ohio.

†Sea Island Sands[1] or loams[1]

Pleistocene: Southern South Carolina.

Original references: E. Sloan, 1905, South Carolina Geol. Survey geognostic map of South Carolina, advance copies; 1907, Summary of mineral resources of South Carolina, p. 2 (table); 1908, South Carolina Geol. Survey, ser. 4, Bull. 2, p. 485.

Named for development on islands off coast of Charleston and Beaufort Counties.

Seaman Ranch Shale (in Brad Group)

Seaman Ranch Shale Member (of Brad Formation)[1]

Pennsylvanian (Canyon Series): North-central Texas.

Original references: F. B. Plummer and R. C. Moore, 1922, Jour. Geology, v. 30, p. 24, 31; 1922, Texas Univ. Bull. 2132, p. 111.

M. G. Cheney, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 1, p. 66 (fig. 1), 88. Shown on chart as formation in Brad group. Brad is here raised to group status.

Named for Seaman Ranch in west part of Palo Pinto County, where it is typically exposed along Caddo Creek.

Searsville Formation

Eocene: 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. Consists of interbedded sandstones, mudstones, and shales. Ratio of sandstone to mudstone is about 4:3. Sandstones are generally feldspathic, thick bedded to massive, and medium to coarse grained with kaolin matrix. Argillaceous rocks are commonly yellowish-buff massive mudstone, but some grade to grayish and brownish fissile shales. Thickness of interlayers of sand and argillaceous rocks varies from several tens of feet to less than 1 foot. Underlies Miocene Los Trancos formation (new), angular discordance; overlapped by Santa Clara formation and Recent alluvium. Name credited to R. G. Thomas (unpub. map).

Type locality and derivation of name not given. Area described is in Santa Clara and San Mateo Counties. Board on Geographic Names states that Searsville was once a town, now abandoned and flooded by Searsville Lake about 3½ miles southwest of Stanford University campus.

Seattle Formation[1]

Oligocene, upper: Northwestern Washington.

Original reference: R. Arnold and H. Hannibal, 1913, Am. Phil. Soc. Proc., v. 52, p. 579, 582, 604.

C. E. Weaver, 1937, Washington [State] Univ. Pubs. in Geology, v. 4, p. 104, 117–118. Upper Oligocene. Suggests name is no longer useful as strata included in the Seattle as originally defined had previously been included in the Lincoln and Blakeley formations.

Probably named for occurrences in vicinity of Seattle.

Seawall Metafelsite

Age not stated: Southeastern Maine.

G. H. Chadwick, 1944, New York Acad. Sci. Trans., ser. 2, v. 6, no. 6, p. 176. Described as pink "sugar granite." Along margins grades into Cranberry Island volcanic facies.

Occurs in central part of southwest lobe of Mount Desert Island, Hancock County.

†Sebastian Stage[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 Sebastian County, Ark.

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**Seboomook Formation**

Seboomook Slate[1]

Lower Devonian: West-central Maine, and Quebec, Canada.

Original reference: E. H. Perkins, 1925, Am. Jour. Sci., 5th ser., v. 10, p. 374–375.

R. A. Marleau, 1958, Quebec Dept. Mines, Geol. Survey Br., Prelim. Rept. 362, p. 2 (table), 3–4. Formation geographically extended into East Megantic area, Quebec, where it occurs as a northeasterly trending band, consists chiefly of slates with minor metasandstones. Stratigraphically equivalent to Compton formation. Underlies Frontenac formation.

A. J. Boucot, Charles Harper, and Keith Rhea, 1959, Maine Geol. Survey Spec. Geol. Studies Ser. 1, p. 6, 7–9, map. In Beck Pond area, formation consists of main body of gray slate, Bear Pond limestone member (new), and a granite talus member. Top of unit eroded; thickness not measured. Nonconformable on granitic basement complex of pre-Silurian age; locally, unconformably overlies Beck Pond limestone (new). Basal part of formation is of New Scotland (low Lower Devonian), but middle and upper parts to southeast of Beck Pond area are Oriskany (high Lower Devonian).

Best exposure at Seboomook Dam on West Branch of Penobscot River in extreme eastern part of Somerset County, Maine.

Sebree Sandstone Member (of Carbondale Formation)[1]

Pennsylvanian: Western Kentucky.

Original reference: L. C. Glenn, 1912, Kentucky Geol. Survey Rept. Prog. 1910 and 1911, p. 27.

H. R. Wanless, 1939, Geol. Soc. America Spec. Paper 17, p. 101. Cliff-forming sandstone. Basal member of Carbondale formation, between No. 8a above and Dekoven coals.

Named for development between Sebree and Steamport Ferry, Webster County.

Sebrina Complex

Triassic(?): Eastern California.

G. A. Schroter, 1938, Eng. Mining Jour., v. 139, no. 4, p. 43–44. Intercalated arkosic sandstones, fine sandy shales, and thin-bedded dolomitic limestones metamorphosed into quartzites, schists, gneisses, and hornfels. Thickness 50 to 1,500 feet. Includes Sanford quartzite (new).

Occurs on east flank of Sierra Nevada Mountains, southwest of Bishop, Inyo County.

Seco Formation[1]

Eocene: Central Texas.

Original reference: R. A. Liddle, 1921, Texas Univ. Bull. 1860, p. 85, map, columnar sections.

Exposed in Seco Creek, 3 miles south of west of Yancey, Medina County.

Second Mountain Member (of Pocono Formation)

Lower Mississippian: Central Pennsylvania.

Bradford Willard and A. B. Cleaves, 1938, Pennsylvania Geol. Survey, ser. 4, Bull. G–8, p. 18. Name proposed for massive gray sandstone and pebble beds composing lowest member of formation. Conformably underlies Peters Mountain member (new) ; overlies Catskill red beds. Lithologically similar to Cove Mountain member (new) at top of Pocono, but lacks coal beds of that member. Has been referred to as "Berea" but there seems little ground for correlation with Berea of northwestern Pennsylvania.

Named for excellent exposure at Second Mountain on the railroad north of Heckton, Dauphin County.

Second Value Formation (in Montoya Group)

Second Value Member (of Montoya Dolomite)

Upper Ordovician: Southwestern New Mexico.

L. P. Entwistle, 1944, New Mexico Bur. Mines Mineral Resources Bull. 19, p. 17, 18. Member consists of deep-purplish-gray sandy dolomite. Sand grains grouped in wormlike aggregates. In a few places, sand is thinly bedded and crossbedded, and red or black chert fragments are visible. Locally lenticular. Maximum thickness at type locality 90 feet. Underlies Par Value member (new) ; overlies El Paso dolomite.

R. H. Flower, 1958, Roswell Geol. Soc. Guidebook 11th Field Conf., p. 70, 72. Formation comprises the Cable Canyon and the Upham members.

Type locality: On Second Value claim, Boston Hill mining district, Grant County.

†Secretan series[1]

Middle Cambrian: Nevada.

Original references: C. R. Keyes, 1923, Pan-Am. Geologist, v. 40, p. 53; 1924, Pan-Am. Geologist, v. 41, p. 78.

**Secret Canyon Shale**[1]

Middle 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., Geology and Mining Ser., no. 31, p. 23–25, 30, fig. 3. Overlies Geddes limestone (new) ; underlies Hamburg dolomite. Thickness 1,035 feet.

T. B. Nolan, C. W. Merriam, and J. S. Williams, 1956, U.S. Geol. Survey Prof. Paper 276, p. 12–16. Subdivided to include Clarks Spring member in upper part. Overlies Geddes limestone; underlies Hamburg dolomite.

F. L. Humphrey, 1960, Nevada Bur. Mines Bull. 57, p. 9–14. Described in White Pine district where it comprises four lithologic members, the lower two of which correspond generally to section at Eureka. Thickness at least 1,500 feet, possibly 2,500. Overlies Geddes limestone(?) ; disconformably underlies Dunderberg shale; Hamburg dolomite, normally present between the Secret Canyon and Dunderberg, missing in this area. Middle Cambrian. [Editor's note on p. 114 includes the following statements: Re-examination of Humphrey's collections from the "Secret Canyon" and re-collection of trilobites from top of member 2 in 1949, show that all known trilobites of "Secret Canyon" in Hamilton district are Upper Cambrian forms. Earlier identifications of *Elrathis*, *Kochaspis*, and *Glyphasis* by Lochman are in error. Trilobites from top of member 2 and also in some of Humphrey's collections represent species of *Aphelaspis* and *Olenaspella*. Member 2 is lithically like the Swarbrick Limestone at Tybo, Nev., and have an *Aphelaspis* in their upper beds. Revision of age of "Secret Canyon" removes need for an unconformity between it and the Dunderberg. As far as can be determined, Cambrian section on west face of Mount Hamilton is without significant stratigraphic breaks.]

Named for exposures in Secret Canyon, Eureka district.

**Sedalia Limestone**

Sedalia Formation (in Chouteau Group)

Sedalia Limestone (in Easley Group)

Sedalia Limestone (in Osage Group)[1]

Lower Mississippian: Central, southwestern, and northeastern Missouri and western Illinois.

Original reference: R. C. Moore, 1928, Missouri Bur. Geology and Mines, v. 21, 2d ser., p. 61, 78, 84, 86, 90, 91, 144, 146, 149–154, 166, 254.

J. M. Weller and others, 1948, Geol. Soc. America Bull., v. 59, no. 2, p. 100, 150–155, chart 5. In standard Mississippian section, Sedalia limestone is included in Easley group (new) of Kinderhookian series; overlies Chouteau limestone; underlies Gilmore City limestone.

C. P. Kaiser, 1950, Am. Assoc. Petroleum Geologists Bull., v. 34, no. 11, p. 2143–2154. In much of the area of this report [southwestern Missouri], Sedalia dolomite lies conformably on Chouteau limestone. Where Chouteau is absent, the Sedalia rests either on Sylamore sandstone or on rocks of Ordovocian age. In southern area, upper noncherty zone of Sedalia conformably overlaps Northview formation. Unconformably overlain by Osagian rocks, ranging in age from St. Joe to Burlington. Thickness 0 to 70 feet; gradual thickening from east to west. Kinderhookian.

T. B. Beveridge and E. L. Clark, 1952, Missouri Geol. Survey and Water Resources Rept. Inv. 13, p. 71, 72 (fig. 1), 74. [Reprinted from Kansas Geol. Soc. Guidebook 16th Regional Field Conf.] Chouteau redefined as group to comprise (ascending) Compton, Sedalia, and Northview formations. Kinderhookian. Note on Moore's type section.

Charles Collinson and D. H. Swann, 1958, Geol. Soc. America Guidebook St. Louis Mtg., p. 24 (fig. 3), 46 (fig. 8), 49, 50 (fig. 9), 51. Described in western Illinois where it is light-buff massive calcareous dolomite or dolomitic limestone. Maximum thickness 20 feet. Conodont faunas show Illinois Sedalia to be Valmeyer in age and type Sedalia to be Kinderhook. On basis of stratigraphic position and lithologically, the Illinois Sedalia correlates with basal Osage Pierson formation of Missouri. Overlies Chouteau formation; underlies Fern Glen formation.

Type section: At M. K. and T. Sweeney quarry in SW¼SW¼SE¼ sec. 4, T. 46 N., R. 19 W., Cooper County. Named for exposures in vicinity of Sedalia, Pettis County, Mo.

Sedley Formation

Pleistocene: Eastern Virginia.

W. E. Moore, 1956, Virginia Acad. Sci., Geology Sec., Field Trip Guidebook, no pagination. Consists of sands, silts, and clays. Younger than Miocene Yorktown but older than either Sunderland or Wicomico terraces. Underlies Kilby formation (new). New formation names are necessary because names Sunderland formation and Wicomico formation are meaningless. Both of these terraces are underlain by the same formation, not two formations as was previously believed. 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.

**Sedwick Limestone Member** (of Moran Formation)[1]

Sedwick Formation (in Moran Group)

Permian (Wolfcamp): Central and central northern Texas.

Original reference: F. B. Plummer and R. C. Moore, 1922, Jour. Geology, v. 30, p. 40.

M. G. Cheney, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 1, p. 66 (fig. 1). Rank raised to formation in Moran group.

R. C. Moore, 1949, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 80, sheet 2. Described in Colorado River valley as succession of dense hard brown-weathering limestone beds, each 1 to 2 feet thick, separated by brownish clay shale, 3 to 10 feet thick; persistent thin dark chert containing gastropods at top of member. About 25 feet thick. Overlies Santa Anna shale member; underlies Santa Anna Branch shale member of Putnam formation.

P. T. Stafford, 1960, U.S. Geol. Survey Bull. 1081–G, p. 270–271. Geographically extended into Brazos River valley where it is 40 to 55 feet thick and consists principally of alternating thin limestone and thick shale beds. South of Clear Fork of Brazos River, basal limestone grades laterally into calcareous sandstone in part of Shackelford County. Uppermost member of Moran formation, three underlying members of formation not differentiated in area. Underlies Santa Anna Branch shale member of Putnam formation.

Named for outcrops west of Sedwick, Shackelford County.

Seeber Flats 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 as much as 60 feet; average 25. Underlies a shale interval 40 to 120 feet thick which in turn underlies the Stockstill sandstone (new); overlies a shale interval 40 to 120 feet thick at base of group.

Named from exposures in the Briceville-Norman School section, Lake City quadrangle, Anderson County. At an elevation of 1,670 feet, a side road leads southward to Seeber Flats, formed on this sandstone.

Seekonk Beds[1]

Pennsylvanian: Southeastern Massachusetts and eastern Rhode Island.

Original reference: J. B. Woodworth, 1899, U.S. Geol. Survey Mon. 33, p. 134, 173–176.

Named for occurrence in Seekonk Township, Bristol County, Mass.

Seekonk Conglomerate[1]

Pennsylvanian: Southeastern Massachusetts and eastern Rhode Island.

Original reference: J. B. Woodworth, 1899, U.S. Geol. Survey Mon. 33, p. 134, 174, 176.

Named for occurrence in Seekonk, Bristol County, Mass.

Seekonk Sandstone[1]

Pennsylvanian: Southeastern Massachusetts.

Original reference: J. B. Woodworth, 1899, U.S. Geol. Survey Mon. 33, p. 134.

**Seeley Slate**[1]

Precambrian (middle? Huronian): Southern Wisconsin.

Original reference: S. Weidman, 1904, Wisconsin Geol. Nat. History Survey Bull. 13, p. 46.

Named for occurrences near Seeley Creek, Sauk County.

Seeleyville Coal Member (of Spoon Formation)

Pennsylvanian: Western Indiana and eastern 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). Only named member of formation in area. Has been referred to as Coal III in Indiana. Presentation of new rock-stratigraphic classification of Pennsylvanian strata in Illinois.

Type locality: Mines in vicinity of Seeleyville, Ind., T. 12 N., Rs. 7 and 8 W., Vigo County, Ind.

**Sego Sandstone** (in Mesaverde Group)

Sego Sandstone Member (of Price River Formation)[1]

Upper Cretaceous: Central eastern Utah and central western Colorado.

Original references: C. E. Erdmann, 1934, U.S. Geol. Survey Bull. 851, p. 23, 35–36, 38–40, pl. 6; D. J. Fisher, 1936, U.S. Geol. Survey Bull. 852.

C. E. Erdmann, 1934, U.S. Geol. Survey Bull. 851, p. 23 (table), 32, 34–40. Lowest mappable division of Mesaverde group in Colorado is Sego sandstone, this name having been applied to these beds in Utah by Fisher (in preparation), who treats them as a member of Price River formation. Coal-bearing rocks and associated strata above the Sego sandstone are herein named Mount Garfield formation. Boundary between Mancos shale and overlying Sego sandstone marks transition from marine shale to deposits of littoral zone. The sandstone in part rests conformably on the shale and in part intertongues with it. At type locality, the Sego consists of single unit of sandstone, but in Book Cliffs of Colorado it is split by Anchor Mine tongue of Mancos shale.

J. D. Fisher, 1936, U.S. Geol. Survey Bull. 852, p. 9 (table), 14, 15–16. Price River formation thickens eastward and beyond Price River is divisible into four members (ascending): Castlegate sandstone, Sego sandstone, Neslen coal-bearing member, and Farrer non-coal-bearing member. In area of this report [Book Cliffs, Utah], Castlegate and Sego sandstones are separated by Buck tongue of Mancos shale. Thickness 140 to 210 feet.

R. G. Young, 1955, Geol. Soc. America Bull., v. 66, no. 2, p. 188, 189–190, figs. 2, 3, pl. 3. Neslen facies of Price River formation includes (ascending) Castlegate, Sego, Corcoran (new), Cozzette (new) and Cameo (new) members. Term Sego member is used to replace name Sego sandstone member as applied by Fisher (1936) to a series of interbedded sandstone and shales at town of Sego. It includes rocks formerly called Sego sandstone as well as the overlying and closely related coal-bearing rocks. Base is drawn at gradational contact of lowermost littoral marine sandstone tongue with underlying marine shale. Upper boundary placed at slight disconformity between the coal-bearing rocks and overlying marine shale tongue beneath Corcoran member. Average thickness 200 feet. Littoral-marine part consists of several thin sandstone tongues; the first appears near Woodside, Utah. Three are more persistent than the rest and can be traced eastward into Colorado. In most localities, each main sandstone tongue is overlain by fresh- or brackish-water deposits of sandstone, sandy shale, or shale. Thin westward-pointing tongues of Mancos grade upward into overlying littoral-marine sandstone tongue and rest disconformably on the brackish- or fresh-water deposits. Littoral-marine sandstones vary from massive-bedded medium-grained buff sandstones to thin-bedded fine-grained silty gray sandstones with shale partings; maximum thickness of sandstones about 50 feet. Above upper sandstone tongue are 60 feet of coal-bearing rocks which include the main coal bed (Anchor coal) of the Sego member. Montana age.

J. D. Fisher, C. E. Erdmann, and J. B. Reeside, Jr., 1960, U.S. Geol. Survey Prof. Paper 332, p. 10–11, 13, 15–16, pls. 5b, 6b, 10–12. Rank raised to formation in Mesaverde group. In eastern Book Cliffs (western Colorado), the Sego is basal unit of Mesaverde and contains Anchor Mine tongue of Mancos shale; underlies Mount Garfield formation. In central Book Cliffs (Utah, east of Green River), the Sego underlies Neslen formation.

Named for settlement of Sego in T. 20 S., R. 20 E., Utah. In Book Cliffs.

Seguin Formation (in Wilcox Group)[1]

Eocene, lower (Midway-Wilcox): Eastern Texas.

F. B. Plummer, 1933, Texas Univ. Bull. 3232, p. 530, 558, 574, 634. Proposed for all marine strata between the compact silty clays of Midway group and base of nonmarine Rockdale formation of Wilcox group. In most places, base is marked by contact of thinly laminated carbonaceous and fossiliferous sands with silty clays; top is limited by a thin concretionary layer made up largely of shells of *Ostrea multilira* Conrad. Consists of about 50 percent fine sand, 30 percent silt, 19 percent clay, and 1 percent carbonaceous matter. Thickness throughout central Texas 50 to 75 feet; Rio Grande Valley probably 190 feet; in wells south of outcrop 100 to 160 feet. Comprises two members: Caldwell Knob oyster bed above and Solomon Creek clays and sands. Conformably overlies Kerens member of Wills Point formation in northeastern Texas; disconformable on middle Wills Point in south-central Texas; disconformable on Kincaid in southwestern Texas.

M. W. Beckman and F. E. Turner, 1943, Am. Assoc. Petroleum Geologists Bull., v. 27, no. 5, p. 608–621. As originally defined, straddles Midway-Wilcox boundary. Solomon Creek clays and Caldwell Knob sands are redefined so that base of Wilcox is placed at a disconformity marking top of Solomon Creek and base of Caldwell Knob clays. where it is possible to recognize these divisions as redefined, Solomon Creek member should be regarded as member of Wills Point formation and Caldwell Knob as basal member of Rockdale formation. Where these divisions cannot be differentiated, it may be necessary to continue use of Seguin formation, recognizing that it contains the break between the Midway and Wilcox.

Type locality: Along banks of Moss Branch 10 miles northwest of Bastrop, in northwestern part of Bastrop County.

Seigas Conglomerate or Sandstone

Upper Silurian: Northern Maine, and New Brunswick, Canada.

O. O. Nylander, 1940, Geological formations of the St. John River valley, northern Maine and New Brunswick: Caribou, Maine, p. 7–8. Limestone conglomerate made up of rounded blue limestone slabs and small boulders in a sand matrix; in center of outcrop is a coarse sandstone, about 3½ feet thick, made up of quartz pebbles.

Named for exposures 2.3 miles east of St. Ann's Church and 1½ miles west of Seigas River, northern Maine.

Seignelay glaciation

Seignelay till[1]

Pleistocene (pre-Nebraskan): Illinois and Iowa.

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.

Seine Series[1]

Precambrian: Ontario, Canada, and northern Minnesota.

Original reference: A. C. Lawson, 1912, Canada Geol. Survey Mem. 28, p. 10.

F. F. Grout and others, 1951, Geol. Soc. America Bull., v. 62, no. 9, p. 1031. Sediments of Seine series are equivalent to Knife Lake group; latter name has priority.

Selah Formation

Selah Tuff Member (of Ellensburg Formation)

Miocene and Pliocene: South-central Washington.

J. H. Mackin, 1947, (abs.) Northwest Sci., v. 21, no. 1, p. 33. Defined as tuff member of Ellensburg formation. Contains distinctive beds of pummicite and quartzitic gravel. Overlies Yakima basalt; underlies Wenas basalt member of Ellensburg.

W. N. Laval, 1956, Dissert, Abs., v. 16, no. 5, p. 945. Rank raised to formation. Consists essentially of fluviatile and aeolian clastics of volcanic origin. Miocene-Pliocene formations are (ascending) Yakima basalt, Selah, Wenas basalt, and Ellensburg. This sequence comprises a part of two mutually interfingered lithosomes—one of sedimentary rocks and other of flood lavas.

Type locality: South flank of Selah Ridge, Yakima-Ellensburg area.

Selah Butte Flow

Miocene and Pliocene: South-central Washington.

A. C. Waters, 1955, Geol. Soc. America Bull., v. 66, no. 6, p. 673, pl. 1. Wenas basalt between Selah Butte and Selah Springs is surmounted by several small buttes eroded from overlying Ellensburg formation. Four of these buttes are capped by remnants of a basalt flow. This flow, here called Selah Butte flow, is basalt tongue in Ellensburg about 150 feet above top of Wenas basalt. Flow could not have extended far to south or west because Ellensburg sequence is well exposed on either side of Yakima Ridge and in lower Wenas Creek, but Selah Butte flow is missing at these localities. Stratigraphically below Elephant Mountain flow (new). Map bracket shows Ellensburg and associated basalt flows as Miocene and Pliocene. Text states that much or all of Ellensburg and its associated intercalated basalt flows is regarded as Pliocene.

Caps four small buttes between Selah Butte and Selah Springs, Yakima East quadrangle.

**Selatna Glaciation**

Pleistocene: Central-southern Alaska.

A. T. Fernald, 1953, *in* T. L. Péwé and others, U.S. Geol. Survey Circ. 289, p. 6, 13 (table 1); A. T. Fernald. 1960, U.S. Geol. Survey Bull. 1071–G, p. 222–225, 232–233. Two major glaciations of western part of Alaska Range recognized in upper Kuskokwim region. The older Selatna preceded the Farewell glaciation (new). Represented along West Fork of Kuskokwim River by high lateral moraines within mountainous area and by broad end moraine on piedmont; along Middle Fork by irregularly shaped, tundra-covered area of greatly subdued morainal topography on the piedmont, 10 to 12 miles north of range; along South Fork by scattered remnants of a lone arcuate moraine which extends to maximum distance of 25 miles from range.

Named from a tributary of Selatna River which originates in the end moraine. In upper Kuskokwim region.

Selby Member (of Rockland Formation)

Middle Ordovician: Southern Ontario, Canada, and northern New York.

G. M. Kay, 1937, Geol. Soc. America Bull., 48, no. 2, p. 252–255, pl. 2. Name proposed for lower member of formation. Includes limestone characterized by *Doleroides ottawanus* Wilson succeeding Black River group. In type section where only upper 4 feet is exposed, unit consists of dark-gray to black medium- to fine-textured petroliferous limestone in thin buff-weathering beds with a jointed splintery fracture. In northwestern New York and Ontario, lithology is variable but similar to that at type locality. Represented by rather heavy-bedded black chert-bearing limestone southeastward. Maximum thickness about 15 feet. Underlies Napanee member (new); overlies Chaumont formation of Black River group. In exposure showing contact of Selby or Watertown limestone, east of Dexter, Jefferson County, N.Y., Black River and Trenton beds are separated by undulating bedding plane. In earlier description of this section (Kay, 1931, Jour. Geology, v. 39, no. 4), the thin metabentonite that is 3 feet from base of Selby was mistakenly believed to separate Leray and Watertown members of Chaumont formation and to be same as persistent clay at that horizon in Glenburnie shale of Ontario. Type Hounsfield metabentonite is of Selby (lower Rockland) age. At Dexter section, the Selby is about 8 feet thick. Probable Selby exposures in Herkimer County, N.Y., previously called Black River. Trenton group. Mohawkian series.

Named for exposure 1 mile north of Napanee Station along Selby Creek in Lot 22, Conc. III, Richmond Township, Lennox and Addington County, Ontario.

Selden Basalt Tongue

Tertiary: Southwestern New Mexico.

F. E. Kottlowski, 1953, New Mexico Geol. Soc. Guidebook 4th Field Conf., p. 32 (map), 33, 146. Olivine basalt, interbedded with basal beds of the Santa Fe group.

Near south end of Selden Canyon, Rio Grande Valley.

Seligman limestone (in Tusayan series)[1]

Permian: Northwestern Arizona.

Original reference: C. R. Keyes, 1922, Pan-Am. Geologist, v. 38, no. 3, p. 251, 338.

Charles Keyes, 1936, Pan-Am. Geologist, v. 66, no. 3, p. 215 (table). Underlies Yampai shales; overlies Pierce shales. In Tusayan series (new) of Carbonic age.

Exposed best perhaps in Aubrey Cliffs near Seligman. In Grand Canyon region.

†Selinsgrove (upper) Limestone[1]

Middle Devonian: Central Pennsylvania.

Original reference: I. C. White, 1883, Pennsylvania 2d Geol. Survey Rept. $G_7$, p. 78–81.

Occurs below Selinsgrove, Snyder County.

Selinsgrove Limestone (in Onondaga Group)

†Selinsgrove (lower) Limestone[1]

Middle Devonian: Central Pennsylvania.

Original reference: I. C. White, 1883, Pennsylvania 2d Geol. Survey Rept. $G_7$, p. 78–81.

Bradford Willard, 1939, Pennsylvania Geol. Survey, 4th ser., Bull. G–19, p. 144, 146–149. White applied Selinsgrove to five members of Middle Devonian. Here proposed to drop name for all but his "Selinsgrove lower limestone" with adjective lower now omitted. Thickness varies—65 feet at Selinsgrove Junction (probably maximum); 7 feet in Lebanon County; 20 feet in Carbon County; farther east, appears to merge with Buttermilk Falls limestone. Overlies Needmore shale (new) with contact gradational; underlies Marcellus black shales. Needmore shale was Selinsgrove shale of White (1883).

P. H. Price and E. T. Heck, 1939, West Virginia Geol. Survey [Rept.] Greenbrier County, p. 313. Lower Selinsgrove (Onondaga) limestone and Lower Selinsgrove shale of White are represented in Greenbrier County but limestone merges into typical Marcellus shale and cannot always be recognized.

G. A. Cooper and others, 1942, Geol. Soc. America Bull., 53, no. 12, pt. 1, chart 4. Age shown on correlation chart as Lower or Middle Devonian.

Named from exposures near Selinsgrove Junction on east bank of Susquehanna, below Sunbury, Northumberland County.

†Selinsgrove (lower) Sandstone[1]

Middle Devonian: Central Pennsylvania.

Original reference: I. C. White, 1883, Pennsylvania 2d Geol. Survey Rept. $G_3$, p. 78–81.

Occurs below Selinsgrove, Snyder County.

†Selinsgrove (upper) Sandstone[1]

Middle Devonian: Central Pennsylvania.

Original reference: I. C. White, 1883, Pennsylvania 2d Geol. Survey Rept. $G_7$, p. 78–81.

Well exposed in railroad cuts just opposite town of Selinsgrove, Snyder County and 1 mile below Selinsgrove Junction, Northumberland County.

†Selinsgrove Shale[1]

Lower Devonian: Central Pennsylvania.

Original reference: I. C. White, 1883, Pennsylvania 2d Geol. Survey Rept. $G_7$, p. 78–81. 363.

Bradford Willard, 1939, Pennsylvania Geol. Survey, 4th ser., Bull. G–19, p. 144. Unit termed Needmore shale.

Exposed about one-fourth mile below Selinsgrove Junction, Northumberland County.

Sellers Limestone Member (of Caseyville Formation)

Sellers Limestone (in Caseyville Group)

Pennsylvanian: Southeastern Illinois.

H. R. Wanless, 1939, Geol. Soc. America Spec. Paper 17, p. 36, 101. Ferruginous dense fossiliferous limestone about 2 feet thick. Between Battery Rock coal above and Lick Creek sandstone.

H. R. Wanless and Raymond Siever, 1956, Illinois Geol. Survey Inf. Circ. 217, p. 9, pl. 1. Correlated chart shows Sellers limestone in Caseyville group below Battery Rock coal and above Battery Rock sandstone. Included in Battery Rock cyclothem. Gives type locality.

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 29, 44 (table 1), pl. 1. Rank reduced to member status in Caseyville formation (redefined). Occurs above Battery Rock sandstone member and below Gentry coal 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. 21, T. 11 S., R. 10 E., near Sellers Landing, Hardin County.

**Sellersburg Limestone**[1]

Middle Devonian: Southern Indiana and north-central Kentucky.

Original reference: E. M. Kindle, 1899, Bulls. Am. Paleontology, v. 3, no. 12, p. 8, 20, 110.

G. G. Sutton and A. H. Sutton, 1937, Jour. Geology, v. 45, no. 3, p. 326, 328. Subdivided to include Speeds limestone member (new) which underlies Silver Creek limestone member.

Guy Campbell, 1942, Geol. Soc. America Bull., v. 53, no. 7, p. 1066–1067. Close relationship of the Silver Creek and Beechwood [herein given formational rank] implied by their treatment as members of the Sellersburg does not exist. Their fossils represent separate time division in standard Hamilton scale and Beechwood species are distinct from those of all other Indiana Hamilton formations. Swanville formation (new) was deposited after the Silver Creek, and the Beechwood is separated from the Silver Creek and apparently from the Swanville by an erosional disconformity. Terms Sellersburg and Sellersburg beds, as they have been used practically, are each equivalent to term Hamilton group (as used in this report) which includes all formations between the Jeffersonville and New Albany. To include the Speeds, Deputy (new), and Swanville in Sellersburg would indicate a relationship of all the formations that is contradicted by the different faunal associations and by the affinities of these faunal associations to those in other areas.

J. B. Patton and T. A. Dawson *in* H. H. Murray, 1955, Indiana Geol. Survey Field Conf. Guidebook 8, p. 41, 42, pl. 1. Term North Vernon limestone includes entire Hamilton sequence. Sellersburg in its original sense was nearly in synonymy with North Vernon, although its author failed to account for lowest rocks of Hamilton age. Sellersburg, as defined by Kindle (1899) and modified by later workers, is present in Clark County and southern Scott County—that is, throughout the area where Hamilton rocks are readily divisible into Beechwood, Silver Creek, and Speed lithologies; it is not applicable in Bartholomew and Jennings Counties or in most of Jefferson County where Hamilton rocks are not readily divisible on lithologic criteria, and a name other than Sellersburg is useful when reference is made to undifferentiated Hamilton limestones of this area. Name North Vernon as set forth by Borden (1876) is meaningful when applied to the relatively homogeneous Hamilton limestone of Bartholemew, Jennings, and Jefferson Counties. If only one name is to be retained, it should be North Vernon on grounds of priority and inclusiveness. At present, Indiana Geological Survey uses both terms North Vernon and Sellersburg as formation names that include all of the limestones of Hamilton age of southeastern Indiana outcrop. Term Beechwood is used for member at top of Hamilton sequence; names Silver Creek and Speed are applied to lithofacies of the Hamilton rocks; these lithofacies may be used as members in southern part of outcrop belt; Deputy and Swanville "formations" might better be called "zones" or "faunal facies" of the Sellersburg (North Vernon) limestone.

Named for Sellersburg, Clark County, Ind.

†Selma division (of Selma Chalk)[1]

Upper Cretaceous: Alabama.

Original reference: E. A. Smith, 1903, 58th Cong., 1st sess., S. Ex. Doc. 19, p. 12–20, map.

Exposed in bluffs along Alabama River from Kings Landing to Selma and beyond. Named for exposures at Selma, Dallas County.

**Selma Group**

Selma Chalk[1]

Upper Cretaceous: Alabama, Mississippi, and Tennessee.

Original reference: E. A. Smith, L. C. Johnson, and D. W. Langdon, 1894, Alabama Geol. Survey Rept. Geol. Coastal Plain of Alabama, p. 15, 22, 27, 255, 276–286.

L. W. Stephenson and W. H. Monroe, 1938, Am. Assoc. Petroleum Geologists Bull., v. 22, no. 12, p. 1639–1657. Chalk overlies Eutaw formation unconformably. Consists of nearly 900 feet of chalk in west-central Alabama, but is broken by minor unconformity or diastem about 300 feet above its base, a few feet above a thin but persistent zone of hard pure limestone layers interbedded with chalk, the Arcola limestone member (new). Northwestward into Mississippi, lower third of Selma passes by merging and intertonguing into Coffee sand; upper third merges into Ripley formation; middle third continues into Tennessee as an impure chalk unit. In eastern part of Alabama, the part of chalk below Arcola limestone member merges by intertonguing into Blufftown formation, middle part merges into and intertongues with Cusseta sand, and upper part merges into Ripley formation. Selma and Ripley are separated from overlying Prairie Bluff chalk by important unconformity.

W. S. Cole, 1938, Florida Geol. Survey Bull. 16, p. 25–26. Referred to as formation in report on stratigraphy and micropaleontology of the two deep wells in Florida.

W. H. Monroe, 1941, Alabama Geol. Survey Bull. 48, p. 48–72. Selma chalk divided into three distinct lithologic members: unnamed lower member that includes typical chalky marl exposed at Selma, Arcola limestone member, and upper member of purer chalk designated Demopolis member. Chalky sand that underlies Prairie Bluff chalk in Sumter County and that merges eastward into Ripley formation has been called part of Selma chalk. In this report, it is treated as chalky facies of Ripley formation, restricting name Selma to purer underlying chalk; thus, Selma is restricted to marl and chalk that intervene between Eutaw formation below and Ripley formation above.

W. E. Belt and others, 1945, Geologic map of Mississippi (1:500,000): Mississippi Geol. Survey. Rank raised to group. Includes Mooreville chalk, Coffee sand, Demopolis chalk, Ripley formation, Prairie Bluff chalk, and Owl Creek formation.

H. L. Reade, Jr., and J. C. Scott, [1958] Profile showing geology along U.S. Highway 331, Montgomery County, Alabama (1:16,000): Alabama Geol. Survey. Map legend shows that Selma group includes (ascending) Eutaw formation, Mooreville chalk, Demopolis chalk, Ripley formation, Prairie Bluff chalk, and Providence sand.

Named for Selma, Dallas County, Ala.

**Seminoe Formation**[1]

Precambrian: Southern Wyoming.

Original reference: T. S. Lovering, 1930, U.S. Geol. Survey Bull. 811–D, p. 221–222.

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.

A typical section is on east bank of Deweese Creek, one-fourth mile south of Pyler's Ranch in SW¼ sec. 19, T. 26 N., R. 85 W., South Park, Carbon County.

**Seminole Formation** (in Skiatook Group)

Seminole Conglomerate[1]

Pennsylvanian (Missouri Series): Northeastern, central, and central southern Oklahoma.

Original reference: J. A. Taff, 1901, U.S. Geol. Survey Geol. Atlas, Folio 74.

R. C. Moore and others, 1937, Kansas Geol. Soc. 11th Ann. Field Conf. Guide Book, p. 40 (table). Included in Skiatook group.

M. C. Oakes, 1940, Oklahoma Geol. Survey Bull. 62, p. 23–26. Use of name Seminole formation extended into northeast Oklahoma and applied to shale and sandstone unit lying above unconformity at base of Missouri subseries and below base of Checkerboard limestone. North of Talala, uppermost Des Moines bed is Lenapah limestone; in vicinity of Oologah, it is Nowata shale; and near Tulsa, it is the Memorial shale. Type locality stated.

E. R. Ries, 1954, Oklahoma Geol. Survey Bull. 71, p. 47–52. In type area, lies above Holdenville formation and below Francis formation. Morgan (1924, Oklahoma Geol. Survey Bull. 2) found that in Pontotoc County the Seminole is overlapped by the Ada formation which normally occurs about 800 feet higher in the section. In Okfuskee and Tulsa Counties and northward, the Seminole lies above the Holdenville and below the Checkerboard.

W. F. Tanner, 1956, Oklahoma Geol. Survey Bull. 74, p. 54–62. Further described in Seminole County.

Type locality: Southeast part of Seminole Nation, now Seminole County (probably T. 6 N., Rs. 7 and 8 E.).

†Seneca Chert (in Boone Limestone?)[1]

Mississippian: Southwestern Missouri.

Original reference: W. P. Jenney, 1894, Am. Inst. Mining Engrs. Trans., v. 22, p. 178.

At Seneca, Newton County.

Seneca 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 purposes 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.

Forms south rim of Seneca Creek valley, eastern Union County.

Seneca Group

Senecan Group[1]

Senecan Series

Senecan Stage

Upper Devonian: North America.

Original reference: J. M. Clarke and C. Schuchert, 1899, Science, new ser., v. 10, p. 874–878.

G. A. Cooper and others, 1942, Geol. Soc. America Bull., v. 53, no. 12, pt. 1, chart 4. As shown on correlation chart, Devonian comprises (ascending) Ulsterian, Erian, Senecan, Chautauquan, and Bradfordian (in part) series. Senecan comprises Finger Lakes stage (new) below and Chemung stage. Upper Devonian.

I. H. Tesmer, 1954, Dissert, Abs., v. 14, no. 12, p. 2317. In study of Cherry Creek quadrangle, New York, Chautauquan series is reduced to Chautauqua group and incorporated in upper part of Senecan series.

I. H. Tesmer, 1955, New York State Mus. Sci. Service Circ. 42, p. 8. Seneca group, Chautauquan series, comprises (ascending) Genesee, Naples, and Chemung formations. Occurs below Arkwright group and above Hamilton group of Erian series.

Charles Schuchert (1910, Geol. Soc. America Bull., v. 20, p. 514) used term Senecan Series for interval between Erian Series (below) and Chautauquan Series above.

Named for exposures in Seneca County and along shores of Seneca Lake.

**Seneca Member** (of Onondaga Limestone)

Seneca Limestone[1]

Middle Devonian: New York.

Original reference: L. Vanuxem, 1939, New York Geol. Survey 3d Rept., p. 275–278.

G. A. Cooper and others, 1942, Geol. Soc. America Bull., v. 53, no. 12, pt. 1, p. 1774–1775, chart 4. In central New York, a third division of the Onondaga, the Seneca limestone, is a dark shaly rock underlying the Marcellus and containing an abundance of *Chonetes lineatus*, *Dalmanites selenurus*, and large coiled cephalopods. Name Seneca has fallen into disuse, but, because interval it defines is a well-marked unit, it is here revived. Onesquethaw stage (new). Lower or Middle Devonian.

W. A. Oliver, Jr., 1954, Geol. Soc. America Bull., v. 65, no. 7, p. 629–635, 637–641. Uppermost member of Onondaga in central and western New York. Underlies Moorehouse member (new). Base of member is defined by "Tioga bentonite," a prominent marker bed and an important paleontologic break. Seneca passes to east into Union Springs black shale of overlying Marcellus formation. Thickness near Union Springs (Auburn quadrangle) about 25 feet. Cooper and others (1942) included much more in "Seneca" than did early workers who defined it.

W. A. Oliver, Jr., 1960, U.S. Geol. Survey Prof. Paper 400–B, p. 173–174. Middle Devonian.

Named for occurrence in Seneca County.

Seneca Quartz Porphyry[1]

Precambrian (pre-Huronian?): Central southern Wisconsin.

Original reference: R. D. Irving, 1877, Geology Wisconsin, v. 2, p. 520.

Occurs in sec. 2, T. 17, R. 11 E., Green Lake County.

**Senora Formation**[1] (in Cabaniss Group)

Pennsylvanian (Des Moines Series): Eastern Oklahoma.

Original reference: J. A. Taff, 1901, U.S. Geol. Survey Geol. Atlas, Folio 74.

M. C. Oakes, 1953, Am. Assoc. Petroleum Geologists Bull., v. 37, no. 6, p. 1525. Included in Cabaniss group (new).

E. R. Ries, 1954, Oklahoma Geol. Survey Bull. 71, p. 26. In northeastern Oklahoma includes (ascending) Tiawah, Chelsea, Verdigris, and Breezy Hill members. Conformably overlies Stuart shale and underlies Calvin sandstone.

Named for old post village of Senora, which was located in southern part of Okmulgee County.

†Senorito Sandstone Lentil (in Chinle? Formation)[1]

Upper Triassic: Central northern New Mexico.

Original reference: B. C. Renick, 1931, U.S. Geol. Survey Water-Supply Paper 620.

Well exposed in Senorito Canyon, western Sandoval County.

Sensori Agglomerate and Limestone[1]

*See* Sinosri Formation, correct spelling.

Sentinel Dolomite[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, 372, 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 the Panamint metamorphic complex to Lower Paleozoic. Sentinel dolomite, Radcliff formation, and Redlands dolomitic limestone are correlated with Noonday dolomite here assigned to Precambrian as defined in this report.

Occurs on Sentinel Peak, southern part of Panamint Range, Inyo County.

**Sentinel Granodiorite**[1] (in Tuolumne Intrusive Series)

Cretaceous: East-central California.

Original reference: F. C. Calkins, 1930, U.S. Geol. Survey Prof. Paper 160, p. 125, 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 88.4 millions of years. Younger than El Capitan granite and older than Half Dome quartz monzonite.

Named for fact it composes Sentinel Rock, Yosemite National Park.

**Sentinel Butte Member** (of Fort Union Formation)

Sentinel Butte Member (of Tongue River Formation)

Sentinel Butte Shale Member (of Fort Union? Formation)[1]

Paleocene: Southwestern North Dakota and northeastern Montana.

Original reference: A. G. Leonard, 1908, North Dakota Geol. Survey 5th Bienn. Rept.

W. E. Benson and W. M. Laird, 1947, (abs.) Geol. Soc. America Bull., v. 58, no. 12, pt. 2, p. 1167. Golden Valley formation (new) overlies Sentinel Butte shale member of Fort Union formation now considered to be of Paleocene age.

R. W. Brown, 1948, Am. Assoc. Petroleum Geologists Bull., v. 32, no. 7, p. 1265–1274. New stratigraphic and paleontologic evidence indicates that Sentinel Butte shale, lately considered by some geologists to be of Wasatch (Eocene) age, is, as originally described and assigned, a dark sequence of strata in upper part of Fort Union formation (Paleocene). Correlations discussed.

E. P. Beroni and H. L. Bauer, Jr., 1952, U.S. Atomic Energy Comm. TEI Rept. 124, p. 6, 14–16. In Golden Valley County, N. Dak., shale member contains a 15-foot uraniferous lignite bed herein referred to as Bullion Butte bed. In southwestern North Dakota, member is 300 to 500 feet thick and is conformable with both underlying Tongue River member and overlying rocks tentatively identified as Golden Valley(?) formation.

S. P. Fisher, 1953, North Dakota Geol. Survey Rept. Inv. 11. Referred to as Sentinel Butte facies of Tongue River formation in area of this report [central McKenzie County].

P. R. May, 1954, U.S. Geol. Survey Bull. 995–G, p. 267, 268. About 200 feet of Sentinel Butte shale, uppermost member of Fort Union, is exposed at top of Blue Mountain in northern Wibaux area, Montana and North Dakota. Composed of gray and brown sandstone and shale and contains thin lignite beds. Overlies Tongue River member. Paleocene.

B. M. Hanson, 1955, North Dakota Geol. Survey Rept. Inv. 18. Reallocated to member status in Tongue River formation. Only lower 250 feet present in area [Elkhorn Ranch area, Billings and Golden Valley Counties]. Contact of Sentinel Butte member and underlying part of Tongue River formation is locally picked at base of most persistent and prominent clinker bed or on basis of characteristic lithologies—Tongue River light-tan to gray sand and clay and Sentinel Butte brown sands and clays. Paleocene.

Typically developed at Sentinel Butte, Billings County, N. Dak.

**Sentinel Hill Member** (of Schrader Bluff Formation)

Upper Cretaceous: Northern Alaska (subsurface and surface)

George Gryc, W. W. Patton, Jr., and T. G. Payne, 1941, Washington Acad. Sci. Jour., v. 41, no. 5, p. 166, figs. 2, 3. Marine unit characterized by volcanic glass shards, abundant bentonite, and tuff. In outcrop beds are less consolidated than the underlying members. A little over 1,100 feet of marine beds of this member and nonmarine beds of Kogosukruk member [tongue] penetrated in Sentinel Hill core test well No. 1. In outcrop belt along Colville River, equivalent intertonguing marine and nonmarine beds total 2,340 feet. Overlies Tuluga member (new); underlies Sagavanirktok formation (new). Intertongues with Kogosukruk tongue (new) of nonmarine Prince Creek formation (new).

C. L. Whittington *in* George Gryc and others, 1956, Am. Assoc. Petroleum Geologists Bull., v. 40, no. 2, p. 251–252, figs. 3, 4, 5. Surface type locality designated. Type section includes 1,040 feet of strata, of which 335 feet near middle of section are nonmarine beds assigned to Kogosukruk tongue.

Type locality: Bluffs along northwest side of Colville River from 5 to 15 miles northeast of Umiat Mountain. Named from section in Sentinel Hill core test well No. 1.

Sentinell Limestone

Cambrian(?): Northwestern Utah.

V. E. Peterson, 1942, Econ. Geology, v. 37, no. 6, p. 471 (table 1). Described as light-gray medium-grained crystalline thin-bedded limestone, usually broken and containing numerous calcite stringers. Thickness 50 to 100 feet. Underlies newly named Vipont limestone; overlies newly named Sentinell quartzite.

In Ashbrook mining district on west side of Goose Creek Range.

Sentinell Quartzite

Cambrian(?): Northwestern Utah.

V. E. Peterson, 1942, Econ. Geology, v. 37, no. 6, p. 471 (table 1). Described as white to tan sucrose quartzite. Thickness 100 feet or more. Underlies newly named Sentinell limestone; overlies Harrison series.

In Ashbrook mining district on west side of Goose Creek Range.

**Sentinel Mountain Dolomite Member** (of Nevada Formation)

Middle Devonian: Central Nevada.

T. B. Nolan, C. W. Merriam, and J. S. Williams, 1956, U.S. Geol. Survey Prof. Paper 276, p. 41, 43–44, pl. 2. Entirely composed of dolomite and typically exhibits an alternation of light- and dark-colored beds. The light-gray beds are thick bedded and are commonly coarse grained and more saccharoidal in texture than the darker dolomites interbedded with them. Mottling and a faint lamination are characteristic of the darker dolomites. Thicknesses assigned to the member are rather variable, ranging from 410 to 590 feet. The contacts between the Sentinel Mountain member and the underlying Oxyoke Canyon sandstone member (new) and the overlying Woodpecker limestone member (new) are gradational ones.

The member takes its name from Sentinel Mountain at the head of Oxyoke Canyon in the vicinity of Eureka, on the lower southeast slope of which it is well exposed.

Sentinel Rock Flow, Lava

Pleistocene to Recent: Southwestern Oregon.

Howel Williams, 1942, Carnegie Inst. Washington Pub. 540, p. 47. Andesite flow from vent on Sentinel Rock. Thickness 300 to 400 feet in central part. Probably coeval with Watchman flow (andesite). [Diller and Patton, 1902, U.S. Geol. Survey Prof. Paper 3, described a Sentinel Rock andesite area].

Sentinel Rock is on southeastern rim of Crater Lake.

**Sequatchie Formation**[1]

Upper Ordovician: Eastern Tennessee, northeastern Alabama, northwestern Georgia, and southwestern Virginia.

Original reference: E. O. Ulrich, 1912, 12th Internat. Geol. Cong., Canada, p. 614, 646, 647, 648, 649, 651, 665, pl.

R. L. Bates, 1939, Virginia Geol. Survey Bull. 51–B, p. 42 (table 1), 55–56, pl. 6. Formation, in Powell Valley, Lee County, is top of Ordovician section. Unconformably overlies Reedsville formation; underlies Clinch formation. Thickness 135 feet along State Highway 64, south of Lee-Wise County line. Richmond age.

R. L. Miller and J. O. Fuller, 1947, U.S. Geol. Survey Prelim. Map 76, 2 sheets. Formation, in Rose Hill oil field, Lee County, Va., underlies Hagan member (new) of Clinch formation. Overlies Reedsville shale. Thickness 274 feet. Upper Ordovician.

Charles Butts and Benjamin Gildersleeve, 1948, Georgia Geol. Survey Bull. 54, p. 33–35, geol. map. Formation known to be present wherever its horizon crops out as far east as northwest slope of White Oak Mountain and its southward continuation, Taylor Ridge. Not observed in ridges carrying Red Mountain formation east and south of Tunnel Hill to and including Lavender Mountain. Thickness about 250 feet. Map legend shows Sequatchie above the Maysville and below the Red Mountain. Silurian or Ordovician.

C. W. Wilson, Jr., 1949, Tennessee Div. Geology Bull. 56, p. 209, 211, 219–229. Term Sequatchie used for the calcareous shale, mudstone, argillaceous limestone in Sumner, Macon, Trousdale, Clay, and Pickett Counties and in Sequatchie Valley that occur between Leipers formation and Brassfield limestone, or Chattanooga shale where Brassfield is absent. Fernvale limestone can be recognized in parts of Sumner and Marion Counties, and the underlying argillaceous beds are referred to Sequatchie formation. Thickness as much as 160 feet. Believed to contain beds equivalent to Mannie shale and Fernvale limestone. Western tongue of Sequatchie underlies Fernvale limestone and overlies the Arnheim or Leipers formation. Richmond group.

L. D. Harris and R. L. Miller, 1958, U. S. Geol. Survey Geol. Quad. Map GQ–111. Name Sequatchie has been applied to sequence of marine rocks between top of Reedsville shale and base of Clinch sandstone on Powell Mountain (Butts, 1940, Virginia Geol. Survey Bull. 52, pt. 1). Purported nonmarine equivalent of the Sequatchie at Clinch Mountain in Duffield quadrangle has been called Juniata formation by Butts (1940). This sequence of rocks on Clinch Mountain is calcareous throughout, and marine fossils have been collected from lower part of formation. Proposed herein to abandon name Juniata in Clinch Mountain area of Duffield quadrangle and to extend use of term Sequatchie for these rocks. Thickness 260 feet at Powell Mountain; about 325 feet at Clinch Mountain.

Named for exposures in Sequatchie Valley, Tenn.

**Sequoyah Formation** (in Pottsville Group)[1]

Lower Pennsylvanian: Southwestern Virginia and southern West Virginia.

Original reference: M. R. Campbell, 1897, U.S. Geol. Survey Geol. Atlas, Folio 44.

Type locality not stated.

Serbin Sand Lentil (in Mount Tabor Member of Yegua Formation)

Eocene (Claiborne): Eastern Texas.

H. B. Stenzel, 1939, Texas Univ. Bur. Econ. Geology Pub. 3945, pt. 2, p. 859 [1940]. Name applied to hard glauconitic sand lentil at top of Mount Tabor member of Yegua.

Type locality: About 1¾ miles northwest of Serbin, Lee County. Forms prominent cuesta.

Sergeant shale[1]

Upper Cretaceous: Northwestern Iowa.

Original reference: C. R. Keyes, 1912, Iowa Acad. Sci. Proc., v. 19, p. 148, 150.

Named for Sergeant Bluff, Woodbury County.

Serna 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, 11.

In section near Picuris, north of Santa Fe, on west flank of Rocky Mountains, in Santa Fe region.

Serpiente Sandstone

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), 20–24, pls. 1, 2. Consists of about 85 percent arkosic sandstone and 15 percent shale. Divided into three members: Huevo—massive conglomeratic, concretionary sandstone with *Glycimcris veatchi* bed—occurs locally at top of formation; Torcido—light-brown finely laminated, fine-grained arkose with hassock structures; conglomerate at top contains *Baculites chicoensis*, *Submortoniceras chicoensis*, *Trigonia* sp.; Avila member (new). Thickness 4,160 feet at type locality. Conformably overlies Aguila sandstone (new) northeast of Johnson Peak and for distance of 2.3 miles northeast of Avila Canyon; at all other places in area an undetermined thickness of basal part of formation is missing where it has been thrust upon other units. In Sawtooth Ridge and Devil's Den synclines, is overlain conformably by Moonlight formation; elsewhere upper contact is fault separating it from Red Man sandstone (new). Huevo is Spanish word for egg and refers to rounded concretions in the unit; Torcido is Spanish word for contorted and refers to contorted bed in the unit. [Hence, Huevo and Torcido are descriptive terms, not formal names.]

Type locality: Serpiente Ridge and vicinity, Pyramid Hills quadrangle, Orchard Peak area which lies principally in northwestern Kern County.

**Serrano Clay Bed** (in Silverado Formation)

Paleocene: Southern California.

W. P. Woodring and W. P. Popenoe, 1945, U.S. Geol. Survey Oil and Gas Inv. Prelim. Chart 12. Name applied to a white clay that lies 275 feet above the Claymont clay bed (new). It is generally a quartzose sandstone with a light-gray clay matrix. Thickness variable, not more than 1⅓ feet.

Type locality: Serrano clay pits about half a mile southeast of divide between Santiago Creek and Aliso Creek, northeastern Santa Ana Mountains, Orange County.

Servilleta Formation

Pliocene, upper, or Pleistocene, lower: Central northern New Mexico.

Arthur Montgomery, 1953, New Mexico Bur. Mines Mineral Resources Bull. 30, p. 53, 83, pl. 1. Consists of alluvial beds with prominent interlayered basalt flows. Alluvial beds composed of gravel, sand, and clay. Gravels distinguished by abundant layers of micaceous sand and much limonite. Flows of basalt are typically about 50 feet thick. Thickness at least 1,500 feet in area north of Picuris Range along the Rio Grande and near Embudo. Unconformably overlies both Picuris and Santa Fe beds along northeasterly and north-central borders of Picuris Range. Name credited to Butler (unpub. thesis).

Exposed along northeasterly and north-central borders of Picuris Range, Taos County.

**Sespe Formation**

Eocene, upper, and Oligocene: Southern California.

Original reference: W. L. Watts, 1897, California State Mining Bur. Bull. 11, p. 22–38.

W. C. Putnam, 1942, Geol. Soc. America Bull., v. 53, no. 5, p. 697 (fig. 3). Shown on generalized columnar section of Ventura region as overlying Coldwater sandstone member of Tejon formation and underlying Vaqueros formation. Thickness about 4,000 feet. Oligocene; lower part Eocene.

T. L. Bailey, 1947, Am. Assoc. Petroleum Geologists Bull., v. 31, no. 11, p. 1913–1935. Name applied to nonmarine red-bed facies of group of sedimentary rocks up to 7,500 feet thick that range in age from upper Eocene to lower Miocene in southern and eastern parts of Ventura basin but that are probably restricted to the Oligocene in most of northern and western part of basin. Variation in age of Sespe is from east to west. North of Santa Clara River, between Fillmore and Point Conception, overlies Coldwater sandstone.

T. W. Dibblee, Jr., 1950, California Div. Mines Bull. 150, p. 31, 38 (fig. 2), pls. 1, 2. Formation, in western Santa Ynez Mountains, is series of continental sandstones, clays, and conglomerate lying above the Gaviota or older formations and below Vaqueros sandstone. Thickness 2,200 feet. Between Refugio and Gaviota Canyons progressively lower beds of formation grade laterally westward into marine Alegria formation (new). Oligocene.

Type locality: On Sespe Creek about 6 miles north of Fillmore, in northwestern part of Camulos quadrangle.

Seth Limestone (in Kanawha Formation[1] or Group)

Pennsylvanian: Southwestern West Virginia.

Original reference: R. V. Hennen and D. B. Reger, 1914, West Virginia Geol. Survey Rept. Logan and Mingo Counties, p. 168.

H. R. Wanless, 1939, Geol. Soc. America Special Paper 17, p. 60, 101, pl. 9. Blue-gray fossiliferous limestone that occurs a few feet above the Cedar Grove coal. Kanawha group.

Type locality: Near Seth, Sherman district, Boone County.

**Setters Formation[1]**

Setters Quartzite

Lower Paleozoic(?) (Glenarm Series): Maryland, Pennsylvania, and Virgina.

Original reference: J. P. Lesley, 1892, Pennsylvania 2d Geol. Survey Summ. Rept., v. 1, p. 130–132.

E. B. Bailey and J. H. Mackin, 1937, Am. Jour. Sci., v. 33, no. 195, p. 187. Baltimore gneiss, which forms basement complex, is Precambrian; the succeeding Setters quartzite, Cockeysville marble, and Wissahickon schist are Lower Paleozoic.

A. J. Stose and G. W. Stose, 1946, Maryland Dept. Geology, Mines and Water Resources [Rept. 12], Carroll and Frederick Counties, p. 53–55, 81. Formation directly overlies Baltimore gneiss; structural discordance is observable in many places, but in many places the contact is obscured. Comprises three lithologic types: mica schist, vitreous quartzite, and mica gneiss; base of formation in Maryland is a feldspathic mica schist. Underlies Cockeysville marble. Maximum thickness, measured on north side of Glenarm-Towson anticline in Baltimore County, 1,100 feet; estimated thickness on borders of Woodstock anticline, 250 feet. May be Lower Cambrian.

P. W. Choquette, 1960, Geol. Soc. America Bull., v. 71, no. 7, p. 1029 (table 1). At base of Glenarm series. Underlies Cockeysville formation; overlies Basement complex. Pre-Silurian.

Carlyle Gray and others, 1960, Geologic map of Pennsylvania (1:250,000): Pennsylvania Geol. Survey, 4th ser. Probably Lower Paleozoic.

Most characteristic occurrence is in Setters Ridge, which forms the north front of the Chattolanee anticline, Baltimore County, Md.

Setters Ridge Quartzite[1].

Precambrian (Glenarm Series): Maryland, southeastern Pennsylvania, and Virginia.

Original reference: J. P. Lesley, 1892, Pennsylvania 2d Geol. Survey Summ. Rept., v. 1, p. 130–132.

**Seven Devils Volcanics**[1]

Permian and Upper Triassic: Central Idaho.

Original reference: Waldemar Lindgren, 1900, U.S. Geol. Survey 20th Ann. Rept., pt. 3, p. 193–198, pl. 8.

E. F. Cook, 1954, Idaho Bur. Mines and Geology Pamph. 97, p. 3. Age changed to Permian and Upper Triassic. Described as thick series of clastic and volcanic rocks, including andesitic flows and tuffs metamorphosed to greenstones, rhyolitic flows, waterlaid volcanic grits and conglomerates, quartzites, lenses of impure limestone, and small intrusive bodies. Because metamorphosed andesitic rocks predominate, the most common rock colors are dark green to black; some tuffs are reddish purple, quartzitic rocks are pale green or gray, and rhyolites are gray to almost white. Thickness probably exceeds 10,000 feet in Seven Devils region.

Mapped over large area at and around Seven Devils Mountains.

Seven-Mile Tuff and Sand 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 is subdivided into five members. Seven-Mile tuff and sand is third in sequence (ascending). Underlies Iron Canyon agglomerate member; overlies Bald Hill agglomerate member.

Occurs at Iron Canyon dam site near Red Bluff, Tehama County.

**Seven Rivers Formation** (in Artesia Group or Whitehorse Group)

Seven Rivers Formation (in Carlsbad Group)

Seven Rivers Gypsiferous Member (of Chalk Bluff Formation)[1]

Permian (Guadalupe Series): Southeastern New Mexico and western Texas.

Original reference: O. E. Meinzer, B. C. Renick, and Kirk Bryan, 1926, U.S. Geol. Survey Water-Supply Paper 580–A, p. 6–7, 13–15, map.

R. K. DeFord and E. R. Lloyd, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 1, p. 9. Whitehorse group of West Texas and New Mexico is divided into (ascending) Grayburg, Queen, Seven Rivers, Yates, and Tansill formations.

P. B. King, 1948, U.S. Geol. Survey Prof. Paper 215, p. 67–68, 101 (fig. 12). Term Seven Rivers gypsiferous member of Chalk Bluff used for outcrop area of this report [southern Guadalupe Mountains]; correlation chart shows Seven Rivers formation in Whitehorse group in subsurface in Midland Basin.

N. D. Newell, 1953, The Permian reef complex of the Guadalupe Mountains region, Texas and New Mexico: San Francisco, W. H. Freeman and Co., p. 46. Carlsbad group comprises (ascending) Seven Rivers, Yates, and Tansill formations; in each of these are several laterally equivalent interfingering lithologic facies arranged in belts parallel to Capitan reef. Within a few miles of equivalent part of reef, the Seven Rivers consists of thin-bedded fine-grained white dolomite about 500 feet thick. In some areas, thin sandstones, which wedge out toward reef, are interbedded with the dolomites. Entire formation passes shelfward from dolomite to gypsum within a few miles. Tongue of fine-grained thin-bedded dolomite (Azotea) in upper part of formation extends several miles shelfward into red facies.

Hugh Hay-Roe, 1957, Texas Univ. Bur. Econ. Geology Geol. Quad. Map 21. Seven Rivers limestone described in Wylie Mountains region, Texas, where it is youngest Paleozoic formation. Maximum thickness 160 feet. Overlies Victorio Peak formation; unconformable below Cretaceous Cox sandstone.

P. T. Hayes, 1957, U.S. Geol. Survey Geol. Quad. Map GQ–98. Formation described in Carlsbad Cavern East quadrangle, New Mexico, where it is lowermost formation in Carlsbad group. Underlies Yates formation; grades laterally into Capitan limestone.

P. T. Hayes and R. L. Koogle, 1958, U.S. Geol. Survey Geol. Quad. Map GQ–112. Described in Carlsbad West quadrangle, New Mexico-Texas. Basal formation of Carlsbad group. Formation present at surface in broad outcrop band, in numerous nearby outliers, and in one inlier in northwest part of quadrangle. Conformably overlain by Yates formation. Seven Rivers grades laterally into lower part of Capitan limestone of Delaware Basin margin area. In stratigraphically higher beds this facies change takes place progressively to southeast. Individual beds thicken considerably and change from dolomite to limestone within horizontal distance of several hundred feet. A little northwest of gradation between Capitan and Seven Rivers, another lateral gradation from predominant dolomite to predominant gypsum occurs within Seven Rivers. This takes place in and near Johnson Canyon. Within limits of this report gypsiferous facies contains high percentage of dolomite, but percentage of dolomite decreases in northwesterly direction. Thickness 460 feet in Bear Canyon.

Terms Carlsbad Group and Chalk Bluff Formation abandoned; replaced by Artesia Group (D. B. Tait and others, 1962, Am. Assoc. Petroleum Geologists Bull., v. 46, no. 4).

Named from exposures in bluffs south of Seven Rivers, notably bluff that lies in secs. 17 and 18, T. 20 S., R. 26 E., Eddy County, N. Mex.

†Seven Sisters Sandstone[1]

Pennsylvanian: Eastern Kentucky.

Original reference: G. H. Ashley and L. C. Glenn, 1906, U.S. Geol. Survey Prof. Paper 49, p. 119.

Exposed at Seven Sisters on Cumberland River.

Seven Springs Formation (in McCutcheon Volcanic Series)

Tertiary: Southwestern Texas.

G. K. Eifler, Jr., 1951, Geol. Soc. America Bull., v. 62, no. 4, p. 345–346, pl. 1. Name applied to the lavas, tuffs, and interbedded sediments between Star Mountain rhyolite (new) and top of McCutcheon volcanic series. Formation is divided into four lava members and four tuff members that alternate with one another. Composite section near type locality is 682 feet thick.

Named for Seven Springs near Willis McCutcheon ranchhouse 7 miles south of Toyahvale, Reeves County. Exposed in syncline north of Star Mountain.

†Severn Formation[1]

Upper Cretaceous and Eocene: Eastern Maryland.

Original reference: N. H. Darton, 1891, Geol. Soc. America Bull., v. 2, p. 431, 438.

N. D. Darton, 1951, Geol. Soc. America Bull., v. 62, no. 7, p. 748. Incidental mention in discussion of Magothy formation. Overlies Magothy.

Named for exposures in cliffs at Round Bay, Severn River.

**Severy Shale** (in Wabaunsee Group)

Severy Shale (in Shawnee Group)[1]

Severy Shale Member (of Shawnee Formation)[1]

Pennsylvanian (Virgil Series): Eastern Kansas, southwestern Iowa, northeastern Missouri, southeastern Nebraska, and northern Oklahoma.

Original reference: E. Haworth, 1908, Kansas Univ. Geol. Survey, v. 3, p. 66.

G. E. Condra, 1949, Nebraska Geol. Survey Bull. 16, p. 20. Thickness in Iowa and southeastern Nebraska 9 to 20 feet.

R. C. Moore and others, 1951, Kansas Geol. Survey Bull. 89, p. 63. Underlies Bachelor Creek limestone member of Howard limestone; overlies Coal Creek limestone member of Topeka limestone. Thickness commonly 70 to 80 feet.

P. B. Greig, 1959, Oklahoma Geol. Survey Bull. 83, p. 45 (fig. 18), 47–48. Moore (1936, Kansas Geol. Survey Bull. 22) redefined Severy as basal formation of Wabaunsee group, including section between top limestone of Topeka formation and bottom limestone of Howard formation. Moore (1932) introduced name Aarde for shale section between lower and middle limestone members (Bachelor Creek and Church limestones, respectively) of Howard formation and suggested (1936) that where basal limestone is missing, the resulting shale section should be called Severy-Aarde shale. Lowest stratigraphic unit of Wabaunsee group in Pawnee County is shale-sandstone section between Turkey Run and Bird Creek limestones. Branson (1956, Oklahoma Geology Notes, v. 16, no. 11) applied name Severy shale to this unit in north-central Oklahoma. Inasmuch as Bird Creek is equivalent to Church limestone member of Howard, it is evident that Severy shale of Pawnee County is equivalent to Severy-Aarde shale of Kansas. Severy can be traced southward from Kansas into Creek and Lincoln Counties, Okla., where one or both of the limiting limestones pinch out. Thickness 27 to 40 feet in Pawnee County. Overlies Turkey Run limestone member of Pawhuska; underlies Bird Creek limestone.

H. G. Hershey and others, 1960, Iowa Highway Research Board Bull. 15, p. 14, fig. 5. Forms base of Wabaunsee group. In places, underclay is present beneath Nodaway coal. Black slaty shale or gray fossiliferous shale overlies coal, and gray shale with some limestone nodules forms base of formation. Average thickness about 7 feet. Underlies Howard limestone; overlies Topeka limestone.

Named for Severy, Greenwood County, Kans.

**Sevier Shale or Formation**

Sevier Shale (in Blount Group)[1]

Middle Ordovician: Eastern Tennessee, northern Georgia, western North Carolina, and southwestern Virginia.

Original reference: A. Keith, 1895, U.S. Geol. Survey Geol. Atlas, Folio 16, p. 4.

C. H. Gordon, 1924, Tennessee Dept. Ed. Div. Geol. Bull. 28, p. 39–40, 63–65, map. Near Friendsville, Tenn. includes Meadow marble member (new).

C. E. Prouty, 1946, Am. Assoc. Petroleum Geologists Bull., v. 30, no. 7, p. 1182–1183. Discussion of lower Middle Ordovician of southwestern Virginia and northeastern Tennessee and suggests recommendations for revision of nomenclature. The Sevier and "Ottosee" are essentially equivalent formations, the latter being named by Ulrich to obviate use of term Sevier, which had been erroneously applied to the younger Martinsburg formation in much of earlier mapping in Virginia and Tennessee. In this respect, Ottosee formation offers no improvement over Sevier since it too has been applied erroneously in northeast Tennessee and southwest Virginia. Gratton limestone is absent in Knoxville region. Benbolt and Wardell equivalents are not readily differentiated lithologically. Therefore, terms Benbolt and Wardell are not applicable in that area; either Sevier should be redefined or a new formational name applied to these beds. According to type description, the Sevier occurs between Tellico and "Bays" sandstones. The type Bays is same as the Moccasin. The latter is in better usage in Tennessee and Virginia and should have precedence over "Bays." Base of Moccasin as generally mapped was not included in type Moccasin by Campbell and was assigned name Bowen (Cooper and Prouty, 1943). The Bowen forms base of the "Bays" and would therefore mark top of Sevier formation. The Sevier might be redefined as bluish-gray buffish-weathering shaly limestone occurring between the Tellico sandstone and Bowen formation. In absence of the latter, the Sevier would underlie Witten limestone and, in absence of this, would underlie Moccasin proper. Section southeast of Lenoir City, Tenn., may serve as a standard for the Sevier. Inasmuch as the Sevier contains equivalents of the Benbolt, Gratton(?), and Wardell, it might be considered a group. However, it is useful as a mapping unit in Tennessee and is herein maintained under formational status.

Charles Butts and Benjamin Gildersleeve, 1948, Georgia Geol. Survey Bull. 54, p. 29. In belt north of Dalton, Holston marble is overlain by yellowish fossiliferous shale about 100 feet thick. This answers character of much of Sevier or Ottosee shale in Tennessee and is tentatively referred to Ottosee. If it is Sevier, Athens shale and Tellico sandstone which normally intervene between the Holston and Sevier are absent from section in this narrow belt. No Ottosee or Sevier was recognized elsewhere in Georgia.

John Rodgers, 1953, Tennessee Div. Geology Bull. 58, pt. 2, p. 76–81, pls. Keith (1895) named Sevier shale for the wide belt of shale in Sevier

County immediately northwest of Chilhowee Mountain. First published maps on which formation is shown are plate 57 in 13th Annual Report of the U.S. Geological Survey in 1893 and Estillville folio (Campbell, 1894); on these maps, name Sevier was applied to whole mass of shale between the thin limestone below (called Chickamauga by Campbell and Keith) and Bays formation above (Campbell also applied it to the younger Martinsburg shale north of Clinch Mountain, but this erroneous usage may be ignored). Later Keith attempted to subdivide the shale in Bays Mountain area into Athens shale below and Sevier shale above and that in Sevier County area into three units—Athens shale, Tellico sandstone, and Sevier shale, but as result he actually mapped very little of type belt as Sevier. Except southwest of Sevier County, Keith's subdivisions have not proved usable, partly because of complex structure; the mass of shale forms a single mappable unit, though locally it may be possible to map members in it. It is proposed here to return to original meaning of term Sevier and apply it to whole mass of shale where undivided. As thus defined, includes equivalents of typical Athens and Ottosee shale and also of typical Lenoir and Holston formations.

R. B. Neuman, 1955, U.S. Geol. Survey Prof. Paper 274–F, p. 145 (table), 160–164, pl. 28. Discussion of Middle Ordovician rocks of Tellico-Sevier belt, eastern Tennessee; it includes type area of Sevier shale of Keith. Term Sevier formation is applied to sequence of calcareous shale, calcareous sandstone, and calcarenite about 1,800 feet thick. At top is distinctive unit, 40 to 165 feet thick, characterized by slump-bedding structures, here named Bacon Bend member. Main body of Sevier is similar to Tellico formation, having beds and lenses of sandstone and calcarenite interbedded with shale. Keith (1895) applied term Sevier to interbedded sandstone, shaly limestone, and shale northwest of Chilhowee Mountain. He divided formation into three parts: two shale divisions separated by sandstone lentil. In present report, the shale division below the lentil is assigned to Tellico formation, the sandstone lentil is termed Chota formation, and the Sevier is restricted to shales and sandstones that lie between the Chota and Bays formations.

J. M. Cattermole, 1955, U.S. Geol. Survey Geol. Quad. Map GQ–76. Keith (1895) mapped as Sevier shale the rocks in Shooks quadrangle herein called Ottosee.

G. A. Cooper, 1956, Smithsonian Misc. Colln., v. 127, pt. 1, p. 90. Name is applied to thick series of sandy shales and fine-grained sandstones with intercalated beds of calcarenite, bryozoan "reefs" and thin lenses of sandy limestone. Best developed in belts south of Knoxville and along Great Smoky Mountain front into northern Georgia. In vicinity of Friendsville, overlies Red Knobs formation (new) and contains fossils that suggest a Benbolt age. In belt along Great Smoky Mountain Front, the Sevier is very extensive. In northern Georgia, near village of Cisco, Sevier-type lithology succeeds Tellico sandstone and extends to base of Bays red beds. The Sevier appears to be a facies rather than a definite formation.

Josiah Bridge, 1956, U.S. Geol. Survey Prof. Paper 277, p. 57. Term Blount group discarded.

Named for exposures in Sevier County, Tenn.

**Sevier River Formation**

Pliocene, upper, or Pleistocene, lower: Central Utah.

Eugene Callaghan, 1937, (abs.) Washington Acad. Sci. Jour., v. 27, p. 359; 1938, U.S. Geol. Survey Bull. 886–D, p. 100–101. Series of partly consolidated sediments of fanglomerate, conglomerate sand, and silt; fanglomerate and conglomerate grade eastward into pinkish sand and silt, which in turn grade into white diatomite beds. Overlies Tertiary volcanic rocks; underlies Quaternary alluvium.

P. E. Dennis, G. B. Maxey, and H. E. Thomas, 1946, Utah State Engineer Tech. Pub. 3, p. 28 (table). Shown on table of rocks exposed in vicinity of Pavant Valley. Thickness about 800 feet. Occurs below Pavant flow.

P. F. Kerr and others, 1957, Geol. Soc. America Spec. Paper 64, p. 36–37. Only widespread younger sedimentary unit in Marysvale region. Importance of this sediment is its indirect structural implication. Believed to represent accumulation from torrential runoff. It is plastered on steep walls of Mount Belknap rhyolite along Beaver Creek Canyon. Probably deposited after, partly as a result of, main period of Pleistocene graben faulting. Thickness commonly less than a few hundred feet and related to underlying topography.

R. R. Kennedy, 1960, Brigham Young Univ. Research Studies, Geology Ser., v. 7, no. 4, p. 26, 28, 29, geol. map. Thickness in Tushar Range 300 feet. Unconformable above Tushar conglomerate (new).

Well exposed north of Junction of Clear Creek and Sevier River, Sevier County.

Seville cyclothem (in Abbott-Spoon Formation)

Seville cyclothem[1] (in Tradewater Group)

Pennsylvanian: Western and central Illinois.

Original reference: H. R. Wanless, 1931, Illinois Geol. Survey Bull. 60, p. 189, 192.

H. R. Wanless, 1957, Illinois Geol. Survey Bull. 82, p. 50 (fig. 22), 63, 70–73. Thickness in outcrop 3 to 26 feet. Includes (ascending) Bernadotte sandstone, Rock Island (No. 1) coal, and Seville limestone. Underlies DeLong cyclothem; commonly rests unconformably on Pope Creek shale or coal. Type locality and derivation of name given.

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 53 (table 2), pl. 1. In Abbott-Spoon formations (both new). Above Pope Creek cyclothem and below Hermon cyclothem (new). Presentation of new rock-stratigraphic classification of Pennsylvanian strata in Illinois; cyclical classification is independent of rock-stratigraphic classification.

Type locality: In bluff of Spoon River, in SW¼SW¼ sec. 23, T. 6 N., R. 1 E., about 1 mile southwest of Seville, Vermont quadrangle, Fulton County.

Seville Limestone Member (of Spoon Formation)

Seville Formation (in Cherokee Group or Krebs Group)

Seville Limestone (in Pottsville Formation)[1]

Seville Limestone (in Tradewater Group)

Pennsylvanian: Central Illinois, Iowa, southeastern Kansas, and western Missouri.

Original reference: H. R. Wanless, 1931, Geol. Soc. America Bull., v. 42, no. 3, p. 805.

W. V. Searight and others, 1953, Am. Assoc. Petroleum Geologists Bull., v. 37, no. 12, p. 2748, (fig. 1). Shown on composite stratigraphic column of Desmoinesian rocks in northern midcontinent as Seville formation in Krebs group. Underlies Weir formation; overlies Bluejacket formation.

W. B. Howe, 1956, Kansas Geol. Survey Bull. 123, p. 22 (fig. 4), 41. Seville formation, as defined in southeastern Kansas and southwestern Missouri, includes only Seville limestone (Wanless, 1931). Present in Barton and Vernon Counties, Mo., and in southeastern Kansas near Pittsburg, Crawford County. At this place, identification is tentative being based mainly on stratigraphic position because limestone is very impure, has little resemblance to Seville of western Missouri, and, although fossiliferous, does not contain fauna characteristic of Seville. In Kansas, bed tentatively identified as Seville is argillaceous and weathers to thin, irregular slabs; thickness about 6 inches. Seville lies above Bluejacket coal and below underclay of Weir-Pittsburg coal bed where complete succession is present. Forms uppermost unit of Krebs subgroup of Cherokee group. Also present in Iowa.

H. R. Wanless, 1957, Illinois Geol. Survey Bull. 82, p. 50 (fig. 22), 72–73, 201 (geol. section 33). Seville limestone included in Seville cyclothem, Tradewater group. At type exposure of cyclothem, the limestone is about 4 feet thick and is argillaceous, blue gray, unevenly bedded, fossiliferous (brachiopods, bryozoa, crinoid stems). Was designated Parks Creek sandstone by Savage (1927)—apparently a typographical error for Barker Creek near Seville.

R. M. Kosanke and others, 1961, Illinois Geol. Survey Rept. Inv. 214, p. 33, 45 (table 1), 63, pl. 1. Assigned to member status in Spoon Formation (new). Occurs above Rock Island (No. 1) coal member and below Hermon coal member (new). Thickness 3¼ feet at type section of Spoon formation. 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: Southwest bank of Spoon River, SW¼SW¼ sec. 23, T. 6 N., R. 1 E., Vermont quadrangle, Fulton County, Ill.

Sevilleta Metarhyolite

Sevilleta Rhyolite or Formation

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. Rhyolite younger than White Ridge quartzite (new); intruded by Los Pinos granite (new).

J. T. Stark and E. C. Dapples, 1946, Geol. Soc. America Bull., v. 57, no. 12, pt. 1, p. 1134–1135, pl. 1. Two distinct facies of rhyolite recognized—light-buff to reddish-brown sericitic schistose rock at base and upper flows of dense dark-red to black less metamorphosed rhyolite. Base of formation contains about 500 feet of sericitic rhyolite which grades downward into White Ridge quartzite; its groundmass extremely fine grained and compact and exhibits silky luster due to abundance of sericite. Thickness measured north of Los Pinos Arroyo 4,500 feet but undoubtedly greater than exposed in this section. Derivation of name given.

J. T. Stark, 1956, New Mexico Bur. Mines Mineral Resources Bull. 34, p. 11–13, pl. 1. Mapped and described as metarhyolite in South Manzano Mountains. Easily recognized rock types are banded rhyolite, sericite schist, garnet schist, chloritoid schist, and hornblende-rich rhyolite. Name spelled Sevillita in text.

Named after old Sevilleta Grant within the bounds of which the rhyolites occur; Los Pinos Mountains.

Sevillita Metarhyolite

*See* Sevilleta Metarhyolite.

**Sevy Dolomite**[1]

Lower(?) and Middle Devonian: Western Utah and east-central Nevada.

Original reference: T. B. Nolan, 1930, Washington Acad. Sci. Jour., v. 20, no. 17, p. 421–432.

J. C. Osmond, 1954, Am. Assoc. Petroleum Geologists Bull., v. 38, no. 9, p. 1911–1931. Geographically extended into east-central Nevada. Overlies Laketown dolomite; underlies Simonson dolomite. Lower part probably late Silurian. Tentatively correlated with Lone Mountain formation. Detailed discussion of unit.

J. K. Rigby, 1958, Utah, Geol. Soc. Guidebook 13, p. 34–35. Described in Stansbury Mountains where it is as much as 80 feet thick; gradationally overlies Laketown and underlies Simonson(?) dolomite.

M. H. Staatz and F. W. Osterwald, 1959, U.S. Geol. Survey Bull. 1069, p. 8, 29–31, pl. 1. Described in Juab County, Utah, where it is 1,122 feet thick; overlies Thursday dolomite (new) and underlies Simonson dolomite and Guilmette formations undifferentiated.

H. J. Bissell, 1959, Utah Geol. Soc. Guidebook 14, p. 143–145. Described in Fivemile Pass-North Boulter Mountain area where it is 128 feet thick; disconformably overlies Laketown dolomite and underlies Simonson dolomite. Dora dolomite (in part at least) should be termed Sevy.

U.S. Geological Survey currently designates the age of the Sevy Dolomite as Lower(?) and Middle Devonian on the basis of a study now in progress.

Named for exposures in Sevy Canyon, on western side of Deep Creek Range, Gold Hill region, Utah.

**Sewanee Conglomerate** (in Lee Group)[1]

**Sewanee Conglomerate Member** (of Lookout Sandstone)

**Sewanee Member** (of Crab Orchard Mountains Formation)

Sewanee Conglomerate (in Crab Orchard Mountains Group)

Sewanee Conglomerate Member (of Lee Formation)

Lower Pennsylvanian: Eastern Tennessee and northern Georgia.

Original reference: J. M. Safford, 1893, Tennessee State Bd. of Health Bull., v. 8, no. 6, p. 89–98.

H. R. Wanless, 1939, (abs.) Geol. Soc. America Bull., v. 50, no. 12, pt. 2, p. 1941. Listed as member of Lee formation.

V. H. Johnson, 1946, Coal deposits of 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. Overlies Gizzard member; underlies Whitwell shale.

C. W. Wilson, Jr., J. W. Jewell, and E. T. Luther, 1956, Pennsylvanian geology of the Cumberland Plateau: Tennessee Div. Geology [folio],

p. 4, 19, pls. 2, 3, 4, 12–C. Basal unit of Crab Orchard Mountains group (new). Medium- to coarse-grained crossbedded massive extremely conglomeratic sandstone in most areas. Thickness as much as 160 feet; average about 80 feet. In northwestern part of the plateau, merges into Fentress formation. The sandstone that has been called "Bon Air" at Bon Air, White County, is equivalent to the Sewanee conglomerate; Sewanee has priority, and name Bon Air is discontinued. Pottsville series. Type locality stated.

Type locality: In area around town of Sewanee, Franklin County, Tenn.

Seward Formation

Pliocene: Southeastern Nebraska.

G. E. Condra and E. C. Reed, 1947, Nebraska Geol. Survey Bull. 15, p. 15–16, fig. 8. Consists principally of medium- to light-gray, in part brownish-gray, very calcareous silts and siltstones with some interbeded marly zones; locally includes basal gravel member composed principally of pebbles of reworked Cretaceous bedrock. Thickness varies from knife edge to about 200 feet. Unconformably overlies Cretaceous or older bedrock; unconformably underlies Holdrege sands and gravels or younger Pleistocene formations. Can be traced westward through late Tertiary channels into typical Ogallala sediments.

Profile section shows Seward present from Lancaster County westward into Buffalo County.

†Sewell Formation (in Rancocas Group)[1]

Eocene: New Jersey.

Original reference: W. B. Clark, R. M. Bagg, and G. B. Shattuck, 1897, Geol. Soc. America Bull., v. 8, p. 316–338.

Named for Sewell, Gloucester County.

**Sewell Member** (of New River Formation)

Sewell Formation (in Pottsville Group)[1]

Lower Pennsylvanian; Southern West Virginia and southwestern Virginia.

Original reference: M. R. Campbell and W. C. Mendenhall, 1896, U.S. Geol. Survey 17th Ann. Rept., pt. 2, p. 487, 494.

U.S. Geological Survey currently classifies the Sewell as a member of the New River Formation on the basis of a study now in progress.

Occurs along New and Kanawha Rivers, W. Va. Named for Sewell, Fayette County.

**Sewemup Member** (of Moenkopi Formation)

Lower and Middle(?) Triassic: Southwestern Colorado and southeastern Utah.

E. M. Shoemaker and W. L. Newman, 1959, Am. Assoc. Petroleum Geologists Bull., v. 43, no. 8, p. 1839–1840, 1842, 1846–1847. Chiefly chocolate-brown fissile siltstone or shale with subordinate interbedded light-brown fine-grained sandstone; gypsum present throughout member, mainly as interstitial cement or crosscutting veinlets near base and in discrete thin nodular beds near top; some beds of light maroon coarse-grained sandstone; locally sandstone is conglomeratic. Thickness 0 to about 450 feet. Cut out toward Uncompahgre Plateau, and locally over salt anticlines and small folds peripheral to Fisher Valley by angular unconformity at base of overlying Chinle formation; in Sinbad Valley, overlapped by Pariott member (new) toward axis of anticline. Conformably overlies and intertongues with Ali Baba member (new). Underlies Pariott member (new).

Type section: East side Sinbad Valley, sec. 15, T. 49 N., R. 19 W., Mesa County, Colo. Named for Sewemup Mesa which forms east wall of Sinbad Valley.

Sewickley cyclothem

Pennsylvanian (Monongahela Series): Southeastern Ohio.

M. T. Sturgeon and others, 1958, Ohio Geol. Survey Bull. 57, p. 158 (table 13), 173–176. Embraces interval between Lower Sewickley cyclothem (new) below and Benwood cyclothem (new) above. Normal sequence includes six members (ascending): unnamed shale and sandstone, Sewickley redbed, Sewickley limestone, Sewickley underclay, Sewickley (Meigs Creek) (No. 9) coal, and Sewickley roof shale. Thickness ranges from 11 to 64 feet and averages 33. This variation is accounted for in part by where basal boundary is drawn. Usually base of cyclothem is placed at top of Fishpot coal bed and roof shale; however, if Lower Sewickley cyclothem is present, base is drawn at top of Lower Sewickley coal bed, which results in average thickness of 17 feet for Sewickley cyclothem. Wherever Lower Sewickley cyclothem is present, base of Sewickley cyclothem is placed at top of Lower Sewickley coal zone, and an unnamed shale and sandstone of local occurrence becomes basal member of Sewickley cyclothem. Laterally, this sandstone grades into redbed or is lost in a thick deposit of Lower Sewickley sandstone and cannot be identified. Wherever this unnamed sandstone and underlying Lower Sewickley coal zone cannot be carried laterally Lower Swickley cyclothem is lost and base of Sewickley cyclothem is then drawn at top of Fishpot coal bed and roof shale. Name Lower Sewickley shale and sandstone is used for lowest unit of Sewickley cyclothem 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. Also, Lower Sewickley redbed member may be represented laterally as either a redbed or sandstone facies of Sewickley cyclothem when base of that cyclothem is considered to be a top of Fishpot coal and roof shale. Under this condition, name Sewickley redbed is more appropriate than Lower Sewickley redbed and is adopted for this facies where Lower Sewickley cyclothem is absent. In area of this report Monongahela series is discussed on a cyclothemic basis; 12 cyclothems are named. [For sequence see Pittsburgh cyclothem.]

Present in Athens County.

†Sewickley Limestone (in Monongahela Formation)[1]

Sewickley limestone member

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

Original reference: F. Platt and G. W. Platt, 1877, Pennsylvania 2d Geol. Survey Rept. $H_3$, p. 55–104, 286.

M. T. Sturgeon and others, 1958, Ohio Geol. Survey Bull. 57, p. 175. Name Sewickley limestone was first used by Platt and Platt (1877) to designate the fresh-water limestone underlying Sewickley coal bed in Somerset County, Pa. White (1891, U.S. Geol. Survey Bull. 65) continued to use this term but applied it to all limestone strata between the Redstone and Sewickley coal beds, and it was not until after Clark and Martin (1905, Maryland Geol. Survey, v. 5) named and described Fishpot coal bed that name Sewickley limestone was restricted to interval between Fishpot and Sewickley coal beds. In present report [Athens County], Sewickley limestone is referred to as a member of Sewickley cyclothem. Occurs between Sewickley redbed member and Sewickley underclay member. Limestone member is thin or wanting in Athens County but prominent in parts of West Virginia and Pennsylvania.

Named for association with Sewickley coal in Somerset County, Pa.

Sewickley Member (of Monongahela Formation)[1]

Pennsylvanian: Western Pennsylvania.

Original reference: M. E. Johnson, 1929, Pennsylvania Geol. Survey Topog. and Geol. Atlas 27, p. 31.

Pittsburgh quadrangle.

Sewickley redbed member

Pennsylvanian (Monongahela Series): Eastern Ohio.

M. T. Sturgeon and others, 1958, Ohio Geol. Survey Bull. 57, p. 175. Member of Sewickley cyclothem in Athens County. Present above an unnamed shale and sandstone member and below Sewickley limestone member. Thickness 2 to 26 feet.

Sewickley roof shale member

Pennsylvanian (Monongahela Series): Eastern Ohio.

M. T. Sturgeon, 1958, Ohio Geol. Survey Bull. 57, p. 176. Member of Sewickley cyclothem in Athens County. Persistent clay shale 3 or 4 inches to 5½ feet thick. Overlies Sewickley coal bed.

**Sewickley Sandstone Member** (of Monogahela Formation)[1]

Sewickley Sandstone (in Monongahela Group)

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

Original reference: I. C. White, 1891, U.S. Geol. Survey Bull. 65, p. 60.

R. V. Hennen, 1912, West Virginia Geol. Survey [Rept.] Doddridge and Harrison Counties, p. 199–200. Sewickley sandstone (White, 1891) is herein renamed Upper Sewickley sandstone in contradistinction to Lower Sewickley ledge belonging immediately under Sewickley coal. Thickness 40 to 60 feet.

W. O. Hickok 4th and F. T. Moyer, 1940, Pennsylvania Geol. Survey, 4th ser., Bull. C–26, p. 100, 121, 124 (fig. 29). In Fayette County, Sewickley sandstone lies 120 to 150 feet above Pittsburgh coal which is base of Monongahela group. Thickness as much as 35 feet; average 20 feet. Separated from underlying Fishpot limestone by lower Sewickley coal and from overlying Benwood limestone by upper Sewickley coal.

R. L. Nace and P. P. Bieber, 1958, West Virginia Geol. Survey Bull. 14, p. 19 (table 3). Shown on summary of stratigraphic sections of Monongahela formation in Harrison County as Lower and Upper Sewickley sandstone. Units are separated by (ascending) unnamed sandy shale, Sewickley coal and (or) slate, and unnamed brown shale. Underlies unnamed shale below Benwood limestone; overlies Sewickley limestone and (or) shale.

*See* Lower Sewickley Sandstone and Upper Sewickley Sandstone.

Probably named for its association with Sewickley coal which was named for exposures along Sewickley Creek, Westmoreland County, Pa.

Sewickley shale and sandstone member

Pennsylvanian (Monongahela Series): Eastern Ohio.

M. T. Sturgeon and others, 1958 Ohio Geol. Survey Bull. 57, p. 177. Shale and sandstone member of Benwood cyclothem in Athens County. Sewickley sandstone was named by White (1891, U.S. Geol. Survey Bull. 65) in his study of Pennsylvanian coal fields of Ohio, West Virginia, and Pennsylvania. In much of its area of occurrence, this member varies radically from thin flaggy sandstone to a massive one from 20 to 60 feet thick or gives way entirely to limestone or redbeds. In Athens County, member is represented by all gradations of sandy shale to massive sandstone. Average thickness 27 feet. Locally member gives way laterally almost in its entirety to redbed facies; more commonly, it is upper part of the member that grades laterally into redbeds and is interbedded with them. Below Tyler redbed member.

Sewickley underclay member

Pennsylvanian (Monongahela Series): Eastern Ohio.

M. T. Sturgeon and others, 1958, Ohio Geol. Survey Bull. 57, p. 175. Referred to as member of Sewickley cyclothem in Athens County. Usually occurs in association with Sewickley coal bed. Discontinuous in its lateral extent.

Sexton Creek Limestone[1]

Lower Silurian (Alexandrian Series): Southwestern Illinois and eastern Missouri.

Original reference: T. E. Savage, 1909, Am. Jour. Sci., 4th v. 28, p. 518.

J. M. Weller *in* J. M. Weller and G. E. Ekblaw, 1940, Illinois Geol. Survey Rept. Inv. 70, p. 10; J. M. Weller. 1940, Illinois Geol. Survey Rept. Inv. 71. p. 20. In southern Illinois, overlies both Edgewood and Girardeau limestones and may overlap locally on Orchard Creek shale; in Missouri, overlaps upon strata as old as Kimmswick. Underlies Bainbridge limestone. Consists principally of more or less cherty limestone; lower part of formation is gray, more or less crystalline limestone with thin tabular masses or continuous beds of chert; higher strata are more massive, crystalline, generally darker colored, slightly glauconitic, and less cherty. Locally as much as 40 feet thick.

Named for exposures on Sexton Creek, Alexander County, Ill .

**Seymour Formation[1]**

Pleistocene: Central northern Texas.

Original reference: W. F. Cummins, 1893, Texas Geol. Survey, 4th Ann. Rept., pt. 1, p. 181–190.

G. W. Willis and D. B. Knowles. 1953. Texas Board Water Engineers Bull. 5301, p. 9. In Odell Sand Hills, Wilbarger County, composed of discontinuous layers of sandy clay, sandy caliche, medium- to very coarse-grained sand, and pebbles that range in diameter from about an eighth of an inch to slightly more than an inch; the beds of pebbles and coarse-grained sand range in thickness from about 1 foot to 85 feet and are, in general, near base of formation. Unconformably overlies Permian rocks. Type locality stated.

Type locality: Between Brazos and Wichita Rivers in Baylor and Knox Counties. Named for town of Seymour, Baylor County.

Shadehill facies

*See* **Ludlow Member** (of Fort Union Formation)

**Shades Sandstone Member** (of Pottsville Formation)[1]

Lower Pennsylvanian: Central Alabama.

Original reference: Charles Butts, 1910, U.S. Geol. Survey Geol. Atlas, Folio 175, p. 10, 11.

T. N. McVay and L. D. Toulmin, 1945, Alabama Geol. Survey Bull. 55, p. 27. Mentioned in report on Alabama shales and fire clays. Base of Pottsville is placed at base of Brock coal seam which underlies Shades sandstone in Cahaba coal field.

Named for occurrence on Shades Mountain, Jefferson County.

Shadow Mountain Basalt Flow

Quaternary: Northwestern Arizona.

D. N. Hinckley, 1955, U.S. Atomic Energy Comm. [Pub.] RME-81 (rev.), p. 8. The Quaternary period was marked by igneous activity in the region. The Tappan lava flow and the Shadow Mountain cinder cone and basalt flow are the nearest volcanics.

In Cameron region, Coconino County.

Shadrick Mill Sandstone (in Strawn Formation)[1]

Pennsylvanian: Central Texas.

Original reference: N. F. Drake, 1893, Texas Geol. Survey 4th Ann. Rept. pt. 1, p. 374, 376.

D. A. Zimmerman and G. D. Glover, 1956, Soc. Econ. Paleontologists and Mineralogists Permian Basin Sec. [Guidebook] Spring Mtg., p. 76. Sandstone, commonly massive but with some flaggy beds and thin conglomerate. Thickness 150 feet. Overlies Elliott Creek bed; underlies bed no. 8. 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.

Named for Shadrick Mill, Lampasas County.

**Shady Dolomite**[1] or **Formation**

Lower Cambrian: Eastern Tennessee, northern Alabama, northwestern Georgia, western North Carolina, and southwestern Virginia.

Original reference: A. Keith, 1903, U.S. Geol. Survey Geol. Atlas, Folio 90.

G. W. Stose and A. I. Jonas, 1938, Virginia Geol. Survey Bull. 51-A, p. 1-30. Shady dolomite of Great Valley of Virginia is Lower Cambrian and rests on Erwin quartzite and is overlain by Rome formation. Shady dolomite is equivalent to Tomstown dolomite. On lithologic grounds, they may be divided in most places into a lower blue argillaceous banded dolomite and an upper gray to white purer granular dolomite. In southwestern Virginia, Butts (1933) divided Shady into a lower ribboned limestone member (Patterson) and an upper saccharoidal dolomite member. Currier (1935, Virginia Geol. Survey Bull. 43) locally included at top of saccharoidal dolomite member a pure limestone which he named Ivanhoe member. In present report, the Ivanhoe is included in base of Rome formation. Partial section of typical Shady south of Fosters Falls Mountain is about 620 feet thick. The equivalent of the Lower Cambrian dolomite in small area on southeastern edge of Great Valley, southeast of Austinville contains group of fossiliferous beds whose fauna, lithology, and stratigraphic position are comparable with Kinzers formation of the York and Lancaster valleys of Pennsylvania. This fossil-bearing series of beds, although equivalent to Shady dolomite of Great Valley, is different sedimentary facies deposited to southeast of main Applachian geosyncline and has been carried northwestward by thrust faulting to rest on typical Shady dolomite. Proposed to extend Pennsylvania names Vintage dolomite, Kinzers formation, and Ledger dolomite to the lower dolomite, middle fossil-bearing beds, and upper dolomite, respectively, of the Shady equivalents of this area.

Charles Butts, 1940, Virginia Geol. Survey Bull. 52, pt. 1, p. 40-56. Name Shady has been used south of Roanoke and name Tomstown north of Roanoke. Term Shady has priority and is used throughout this report. Predominantly dolomite, but in some areas includes limestone in both upper and lower parts. In New River district, three members recognized: Patterson limestone in lower part; saccharoidal dolomite in middle herein named Austinville; and Ivanhoe limestone at top. Thickness 1,400 feet at Jackson Ferry; 5,040 feet near Austinville. Overlies Erwin quartzite-Antietam sandstone; underlies Rome formation.

T. L. Kesler, 1950, U.S. Geol. Survey Prof. Paper 224, p. 10–12, pl. 1. In Cartersville district, Georgia, the Shady dolomite consists of variably siliceous specular hematite interbeded with dolomite. Age of rocks is established by fossils, which occur in great numbers in some parts of hematite beds and in residual silicified parts of the dolomite. Thickness about 30 feet. Conformably overlies Weisner formation but is lenticular and not everywhere present. Overlain in most places by dolomite, which has been regarded previously as Shady dolomite. However, name Shady should be restricted to stratigraphic zone containing interbedded hematite and dolomite. The dolomite beds are here included in the carbonate rocks of Rome formation.

S. S. Oriel, 1950, North Carolina Div. Mineral Resources Bull. 60, p. 9–12, pl. 1. Shady dolomite, within Hot Springs window, exhibits the several distinct rock types noted in Shady in Tennessee—basal ribboned member, lower blue member, ribboned member, middle blue member, upper white member, and upper blue member. Thickness about 1,975 feet. Overlies Helenmode member of Erwin formation; underlies maroon shales of Rome formation.

J. M. Cattermole, 1955, U.S. Geol. Survey Geol. Quad. Map GQ–76. Shady dolomite, oldest exposed unit in Shooks Gap quadrangle, Tennessee, is at base of overriding block of Dumplin Valley fault southwestward from Bean Ridge. Keith (1895, U.S. Geol. Survey Geol. Atlas, Folio 16) mapped these beds with considerable thickness of overlying beds as Apison shale. Underlies Rome formation; faulted against Knox dolomite.

P. B. King and H. W. Ferguson, 1960, U.S. Geol. Survey Prof. Paper 311, p. 45–52, pl. 1. Shady dolomite is lowest carbonate unit of Paleozoic section of Appalachians. The Shady is widely distributed and underlies wide areas of lowlands of Shady Valley, Stony Creek valley, Johnson

County cove, and Doe River cove; north of area of this report, north of Damascus, Va., it crops out in Appalachian Valley. Few outcrops occur at type locality. Much better section is exposed in Stony Creek valley but whole sequence not exposed at single locality. Here Shady is 1,150 feet thick and consists of six members: lower white member (dolomite), about 35 feet; lower blue member (dolomite), 90 feet; ribboned member (dolomite and limestone), 250 feet; middle blue member (dolomite), 250 feet; upper white member (dolomite), 125 feet; and upper blue member (dolomite), 400 feet. Regionally the members probably form interfingering wedges because same members cannot recognized everywhere. In Shady Valley, type locality, the dolomite underlies upper basin and basin below Crandull, the two areas being separated by Helenmode member of Erwin formation of Chilhowee group. Here whole formation is probably present because red shale of Rome formation is exposed along U.S. Highway 421. Inferred that same members are present as in Stony Creek valley and that thickness is about the same.

Typically exposed in Stony Creek valley, Carter County, Tenn. Named for Shady, Johnson County, Tenn.

Shaffer Shale[1]

Middle Devonian: West-central New York.

Original reference: J. M. Clarke, 1903, New York State Mus. Handb. 19, p. 22, table.

Ontario County.

**Shafter Limestone** (in Trinity Group)[1]

Lower Cretaceous (Comanche Series): Western Texas.

Original reference: J. A. Udden, 1904, Texas Univ. Min. Survey Bull. 8, p. 10, 11, 25, 30–39.

C. P. Ross, 1943, U.S. Geol. Survey Bull. 928–B, p. 78–83, pl. 7. Rocks herein designated Shafter limestone are exposed in and around town of Shafter and on banks of Cibolo Creek south of Shafter and form part of prominent range of hills about 3.2 miles southeast of Shafter and the valley north of the range. They appear to rest unconformably on Presidio formation. Shafter is defined by Udden contains rocks of both Trinity and Fredericksburg age. Because the Walnut(?) and other younger rocks are susceptible of being mapped separately and are not present close to Shafter, it is here proposed to restrict name Shafter to beds of upper Trinity. Thickness as restricted 1,085 feet. Shafter (restricted) is lithologically similar to Glen Rose limestone and contains similar faunal assemblage.

Exposed in and around town of Shafter, Presidio County.

**Shaggy Peak Rhyolite**[1]

Eocene(?): Central northern Utah.

Original reference: J. Gilluly, 1932, U.S. Geol. Survey Prof. Paper 173, p. 59–60.

In Shaggy Peak, Fairfield quadrangle.

**Shakopee Dolomite** (in Prairie du Chien Group)[1]

Shakopee Dolomite Member (of Prairie du Chien Formation)

Lower Ordovician: Southern Minnesota, northern Illinois, Iowa, and southern Wisconsin.

Original reference: N. H. Winchell, 1874, Minnesota Geol. Nat. History Survey 2d Ann. Rept., p. 138–147.

C. R. Stauffer and G. A. Thiel, 1941, Minnesota Geol. Survey Bull. 29, p. 62, 63–66. Overlies and interbedded with Root Valley sandstone (new). Underlies St. Peter sandstone. Thickness 35 feet in Winona County.

R. L. Heller, 1956, Geol. Soc. America Guidebook Minneapolis Mtg. Field Trip 2, p. 38–39. Prairie du Chien group reduced to formation and Oneota dolomite, New Richmond sandstone, and Shakopee dolomite reduced to member status. Name Root Valley shale suppressed. Typical Shakopee is fine- to medium-grained light-brownish-gray to buff thin- to thick-bedded dolomite. Chert not common but where present can be of use in differentiating upper and lower dolomites of the Prairie du Chien. Thickness 37 to 56 feet.

Named for outcrops at Shakopee, Scott County, Minn.

†Shakopee Group[1]

Ordovician: Minnesota.

Original reference: F. W. Sardeson, 1924, Pan-Am. Geologist, v. 41, p. 107–122.

**Shaktolik Group[1]**

Lower Cretaceous: Central western and central Alaska.

Original reference: P. S. Smith and H. M. Eakin, 1911, U.S. Geol. Survey Bull. 449, p. 57.

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. Mostly marine. Group divided into (descending) Kaltag formation (nonmarine), Nulato, and Melozi formations (marine) in Koyukuk geosyncline and Hogatza uplift areas.

J. M. Hoare and W. L. Coonrad, 1959, U.S. Geol. Survey Misc. Geol. Inv. Map I–292. Group, in Russian Mission quadrangle, comprises part of rocks mapped and described by Harrington (1918, U.S. Geol. Survey Bull. 683) north of the Yukon as Upper Cretaceous. Rocks described by Harrington that are included in group are interbedded sandstone, shale, "argillite," grit, and conglomerate. They are mapped on basis of Harrington's field notes and on basis of photogeologic interpretation. Tuffaceous, "argillaceous," and siliceous rocks as well as "associated grit and conglomerate" mapped by Harrington as Upper Cretaceous are probably of Early Cretaceous (Neocomian) age or older and do not belong to Shaktolik group. Fossils indicate Shaktolik is late Early Cretaceous (Albian) age. Not subdivided in this area. Correlative with lower part of Kuskokwim group.

Named after Shaktolik River which affords good section of the beds. In Lower Yukon River, Norton Bay-Nulato, and Koyukuk River regions.

Shamokin Black Shale Member[1] (of Marcellus Formation)

Middle Devonian: Central Pennsylvania.

Original reference: Bradford Willard, 1935, Geol. Soc. America Bull., v. 46, Proc. Paleont. 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. Includes a dark coquinite. Usually lithologically indistinguishable from Mahanoy black shale member above unless intervening sandy members are present.

H. H. Arndt and others, 1959, Geol. Soc. America Guidebook 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 members. Thickness 82 feet at East Waterford section.

Named for Shamokin Creek in western part of Northumberland County.

Shandon Formation

†Shandon Quartzite[1]

Upper Cambrian: Southwestern New Mexico.

Original reference: C. H. Gordon, 1907, Jour. Geology, v. 15, p. 91–92.

R. H. Flower, 1958, Roswell Geol. Soc. Guidebook 11th Field Conf., p. 65–66. Discussion of Cambrian-Mississippian beds of southern New Mexico. Here are included basal sandy beds of the Paleozoic which lies between the Precambrian and the El Paso. They are conspicuous dark-weathering beds, appearing black between the tan El Paso and the Precambrian which is pink and granitic. These beds were formerly known as Shandon quartzite in New Mexico, but this name was suppressed in favor of older name Bliss sandstone because they were believed to be identical. Bliss has long been considered Cambrian. Discovery of Canadian fossils in the Bliss in Van Horn region has raised question as to whether whole of formation might be Ordovician. In Caballo Mountains, Mud Springs Mountain, and Tonuco Mountain, the so-called Bliss consists of two parts. Lower unit is of very late Franconian age. Above is 70 feet of dominantly very thin bedded sands and glauconites, somewhat calcereous, and with a narrow but thin conspicuous zone of green silt near top which yields *Dictyoncma flabelliforme* var. angelicum. Term Shandon formation is applied to this unit. The Shandon here contains a hiatus, embracing Trempealeauan time, upper Upper Cambrian and Canadian deposition begins with a conspicuous coarse crossbedded sandstone.

Named for Shandon, eastern part of Sierra County.

**Shannon Sandstone Member** (of Cody Shale)

Shannon Member (of Eagle Formation)

Shannon Sandstone Member (of Steele Shale)[1]

Upper Cretaceous: Central Wyoming.

Original reference: C. H. Wegemann, 1911, U.S. Geol. Survey Bull. 452, p. 43, 47.

C. J. Hares and others, 1946, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 51. Stratigraphic section [southeastern part of Wind River Basin and adjacent areas in central Wyoming] shows Shannon sandstone member of Cody shale. Occurs in upper part of formation. Term Cody shale replaces terms Carlile shale, Niobrara shale, and Steele shale as used in this area by Hares (1916, U.S. Geol. Survey Bull. 641–I).

J. M. Parker, 1958, Wyoming Geol. Assoc. Guidebook 13th Ann. Field Conf., p. 90–102. Reallocated to member status in Eagle formation in Powder River Basin. Subsurface cross section shows that the Shannon extends into Montana. Stratigraphic unit terms Lewis, Mesaverde, Steele, Cody, Ferguson, and Ash Creek should not be used in Powder River Basin.

W. J. Mapel, 1959, U.S. Geol. Survey Bull. 1078, p. 49, pls. Described in Buffalo-Lake De Smet area, Johnson and Sheridan Counties, Wyo., where it is member of Cody shale. Consists mainly of nonresistant fine-grained light-gray sandstone with thin partings of dark-gray shale. Thickness 215 feet near Elgin Creek. Separated from underlying Niobrara shale member by unnamed shale and sandstone member; underlies unnamed upper shale member.

Shannondale Limestone Member (of Benbolt Formation)

Middle Ordovician: Southwestern Virginia.

B. N. Cooper and C. E. Prouty, 1943, Geol. Soc. America Bull., v. 54, no. 6, p. 833, 834–835, 868–869, 870, 871, 884 (fig. 3). 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 Shannondale limestone member is applied to zones 11 and 12. These comprise the second coarse-grained limestone below and the *Opikina* beds, which in type locality are 19 and 60 feet thick respectively. Maximum thickness 125 feet. Underlies Burkes Garden member (new); overlies Peery limestone member (new).

Type section: About three-fourths mile south of Shannondale, Tazewell County.

Shannon Run Limestone (in Washington Formation)[1]

Permian: Northern West Virginia.

Original reference: E. L. Core, 1929, West Virginia Acad. Sci. Proc., v. 3, p. 205.

Named from its exposure on Shannon Run, 2 miles west of Mount Morris, Monongalia County.

**Shark River Marl**[1]

Eocene, middle: Northeastern New Jersey.

Original reference: T. A. Conrad, 1865, Acad. Nat. Sci. Philadelphia Proc., v. 17, p. 70–73.

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 the 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. 8 (fig. 4), 59–61. Originally described as separate formations, Manasquan and Shark River marls are 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 the formation occurs in which both upper and lower limits are exposed; hence, thickness is not known but is probably 25 to 30 feet. Chart shows Shark River-Manasquan stratigraphically below Kirkwood formation.

Typically developed in valley of Shark River, Monmouth County.

Sharon Clay[1]

*See* Sharon cyclothem.

**Sharon Conglomerate Member** (of Pottsville Formation)[1]

Sharon Conglomerate (in Pottsville Group)

Pennsylvanian: Western Pennsylvania, Maryland, eastern Ohio, and northern West Virginia.

Original reference: J. P. Lesley, 1879, Pennsylvania 2d Geol. Survey Rept. $Q_2$, p. 319–333.

Wilber Stout, Karl Ver Steeg, and G. F. Lamb, 1943, Ohio Geol. Survey, 4th ser., Bull. 44, p. 141. Conglomerate is at base of Pottsville formation in Ohio. Varies from medium-grained sandstone to coarse pebbly conglomerate, very loosely cemented. Deposits occupy broad, deep depressions, resembling erosion valleys, cut in Mississippian floor; erratic in distribution; vary from 10 to 250 feet in thickness.

J. O. Fuller, 1955, Geol. Soc. America Bull., v. 66, no. 2, p. 159–176. Basal Pennsylvanian Sharon conglomerate of Ohio lies disconformably on even-bedded marine Mississippian shale and sandstone, in relationship similar to its correlatives, the Olean of New York and the Mansfield of Indiana. Crops out in three separate areas: A, B, and C. A covers about 150 square miles in Ohio and is continuation from type area in Mercer County, Pa.; B covers about 2,400 square miles and is separated from area A by the 12-mile-broad Grand River valley; C. covers about 450 square miles in south-central Ohio and is separated from areas A and B by an area about 100 miles along the strike in which the Sharon is lacking and basal Pennsylvanian is a younger formation than the Sharon. This paper deals chiefly with area B in which mapping has been most detailed. In this area, the Sharon is dominantly an orthoquartzite; long narrow belts of conglomerate with a southerly trend lie in the orthoquartzite. It is difficult to separate Sharon orthoquartzite phase from Massillon sandstone (orthoquartzite) when Sharon shale is absent; hence, many sections of sandstone have been classed as Sharon when actually both Sharon and Massillon are present; also lack of recognition that Sharon is dominantly orthoquartzite instead of conglomerate has caused much of orthoquartzite away from conglomerate belts to be classed as Massillon rather than Sharon. This latter fact supported idea of a formation confined to long narrow depressions. Detailed mapping has established the Sharon as a sheetlike deposit with fairly flat top and an irregular base, caused by filling of irregular topography of Mississippian surface. Thickness of sheet of orthoquartzite in area B, 0 to 170 feet. Source of conglomerate and environment of deposition discussed.

R. R. Dutcher and others, 1959, Geol. Soc. America Guidebook Pittsburgh Mtg., p. 68. In extreme western and northwestern Pennsylvania, and also in southwestern Pennsylvania, the Sharon conglomerate [conglomerate sandstone] forms basal Pottsville but is thought to be absent in other areas.

Type area: Sharon, Mercer County, Pa.

Sharon cyclothem

Pennsylvanian (Pottsville Series): Eastern Ohio.

N. K. Flint, 1951, Ohio Geol. Survey Bull. 48, p. 21. Consists of (ascending) Sharon sandstone, shale, and conglomerate, Sharon clay, Sharon (No. 1) coal, unnamed shale, Sharon ironstone, marine. None of named units definitely identified in Perry County [this report].

Name derived from Sharon, Mercer County, Pa.

Sharon Group[1] or Series[1]

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

Original reference: H. D. Rogers, 1858, Geology Pennsylvania, v. 2, pt. 1, p. 474–477, 489.

Named for Sharon, Mercer County, Pa.

Sharon Sandstone[1]

*See* **Sharon Conglomerate Member** (of Pottsville Formation).

†Sharon Shale Member (of Pottsville Formation)[1]

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

Original reference: H. D. Rogers, 1858, Geology of Pennsylvania, v. 2, pt. 1, p. 474–477, 489.

R. E. Lamborn, C. R. Austin, and Downs Schaaf, 1938, Ohio Geol. Survey, 4th ser., Bull. 39, p. 67–70. In this report, term Sharon (Pottsville series) is used to include the rock strata in interval between top of Sharon No. 1 coal and base of Sciotoville clay. Thickness about 25 feet.

Named for Sharon, Mercer County, Pa.

**Sharon Syenite**[1]

Devonian(?): Southeastern Massachusetts.

Original reference: B. K. Emerson, 1917, U.S. Geol. Survey Bull. 597, p. 182–184, map.

Well developed in town of Sharon, Norfolk County.

Sharon Mountain Quartz Diorite[1]

Precambrian(?): Northwestern Connecticut.

Original reference: W. M. Agar, 1929, Am. Jour. Sci., 5th, v. 17, p. 202–238.

Occurs only in range of hills between Sharon, Litchfield County, and Housatonic River.

†Sharon Springs Formation

Middle Devonian: East-central New York.

Winifred Goldring and R. H. Flower, 1942, Am. Jour. Sci., v. 240, no. 10, p. 677–678, 679, 689–690, 694. Name applied to 20 feet of siliceous shale in vicinity of Sharon Springs, set off from Esopus below and Schoharie above by comparatively thick beds of glauconite. Beds were formerly included in Esopus shale. Both at top and base, contact may be gradational, and exact position of its boundaries is a matter of opinion for many sections in the Helderbergs and in Hudson Valley. In Port Jervis region, has estimated thickness of 200 to 225 feet.

Winifred Goldring and R. H. Flower, 1944, Am. Jour. Sci., v. 242, no. 6, p. 340. Preoccupied name Sharon Springs replaced by term Carlisle Center.

Named for exposures near Sharon Springs, Schoharie County.

**Sharon Springs Member** (of Pierre Shale)[1]

Upper Cretaceous: Northwestern Kansas, eastern Colorado, western and northwestern Nebraska, and southeastern South Dakota.

Original reference: M. K. Elias, 1931, Kansas Univ. Bull., v. 32, no. 7.

W. V. Searight, 1938, Iowa Acad. Sci. Proc., v. 45, p. 137. Geographically extended into South Dakota where it underlies Gregory zone [marl] of Sully formation. Overlies Niobrara. Considered contemporaneous with beds described by Searight (1937) as lower Gregory.

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. In South Dakota, all beds above the Niobrara and below Gregory marl are included in Sharon Springs. Member as here identified consists of beds of dark bituminous shale in lower part, and dark-rusty-weathering beds above. Thicknesses: 7 feet at Yankton; 155 feet at mouth of White River and eastward; possibly 200 to 250 feet north of Belle Fourche.

J. P. Gries and E. P. Rothrock, 1941, South Dakota Geol. Survey Rept. Inv. 38, p. 8 (fig. 2), 9–11, 31–32; J. P. Gries, 1942, South Dakota Geol. Survey Rept. Inv. 42, p. 6 (fig. 2), 7–9. Beds comprising "upper" member (Moxon and others, 1939) actually lie above Gregory marl and are characterized by absence of fish remains. The Sharon Springs of Moxon and others and the "upper beds" are included in redefined Gregory member. Sharon Springs of this report underlies Gregory member (redefined) and overlies Niobrara formation. Divisible into a lower zone, characterized by fish remains and an upper zone in which fish remains are absent. Thickness 35 feet at Rosebud Bridge, Gregory County.

D. R. Crandell, 1950, Am. Assoc. Petroleum Geologists Bull., v. 34, no. 12, p. 2346. Restricted to the fish-bearing bituminous shale that underlies Gregory member and overlies Niobrara formation.

J. M. Jewett, 1959, Graphic column and classification of rocks in Kansas: Kansas Geol. Survey. Columnar section shows Sharon Springs shale member underlying Weskan member and overlying Smoky Hill chalk.

H. E. Simpson, 1960, U.S. Geol. Survey Prof. Paper 328, p. 31–34. Described in Yankton area, South Dakota and Nebraska, where it is 5½ to 11 feet thick and consists of a lower bituminous unit and an upper nonbituminous unit. Underlies Gregory member; overlies Smoky Hill chalk member of Niobrara formation.

First described and mapped at and around Sharon Springs, Wallace County, Kans.

**Sharp Mountain Member** (of Pottsville Formation)

Sharp Mountain Formation (in Pottsville Group)

Lower and Middle Pennsylvanian: Eastern Pennsylvania.

G. H. Wood, Jr., and others, 1956, Am. Assoc. Petroleum Geologists Bull., v. 40, no. 11, p. 2674 (fig. 3), 2676–2678, 2679; 1957, U.S. Geol. Survey Coal Inv. Map C–43, sheet 1. Consists chiefly of cobble and coarse pebble conglomerate and fine to coarse sandstone and siltstone, shale, and coal; basal conglomerate beds are coarser and topographically more conspicuous than the other beds in member and are followed by several sequences of conglomeratic sandstone, sandstone, siltstone, shale, and coal intercalated with sequence of finer pebble conglomerate. Comprises upper 280 feet of formation at type section. Conformably overlies Schuylkill member (new). In many localities in the southern anthracite field, basal beds are 30 feet more or less above the Lykens Valley No. 1 coal bed; at type section, they are 40 to 70 feet above the Lykens Valley No. 1 coal; such variations in stratigraphic interval may be due either to local intertonguing of the fine conglomerate and sandstone and shale facies of the Schuylkill member with coarser conglomerate and sandstone facies of the Sharp Mountain. Upper contact of Sharp Mountain with post-Pottsville rocks is at base of carbonaceous shale beneath the Buck Mountain coal bed which rests conformably on the conglomerate; contact is sharp and even.

Carlyle Gray, 1960, Geologic map of Pennsylvania (1:250,000): Pennsylvania Geol. Survey, 4th ser. Mapped as formation in Pottsville group in anthracite region.

Type section: Included in Pottsville reference section which is in roadcut on east side of U.S. Highway 122, about 150 feet farther east than original type section of Pottsville which is on eastern side of Pennsylvania Railroad cut through water gap south of Pottsville, Schuylkill County.

Sharps Formation (in White River Group or Arikaree Group)

Miocene: Southwestern South Dakota.

J. C. Harksen, 1960, Geology of the Sharps Corner quadrangle, South Dakota (1:62,500): South Dakota Geol. Survey. Composed of massive poorly consolidated compact pinkish-tan silt with gray calcareous potato-ball concretions; some lenses of impure limestone; clastic and chalcedonic dikes present throughout formation but not as common as in underlying Brule; channel sands and gravels present at several levels. Thickness approximately 340 feet. Includes Rockyford ash member (new) at base. Underlies Monroe Creek formation of Arikaree group. White River group.

S. G. Collins, 1960, Geology of the Patricia quadrangle, South Dakota (1:62,500): South Dakota Geol. Survey. Lowermost formation in Arikaree group. Thickness at least 153 feet. Underlies Monroe Creek formation. Contact with Monroe Creek only approximately located; practicality of separating the two units in future mapping farther east questionable.

Named for exposures 8 miles north and 5 miles west of Sharps corner.

Sharpsdale Formation

Pennsylvanian: Southwestern Colorado.

D. R. Williamson and Lorraine Burgin, 1950, Colorado School Mines Mineral Industries Bull., v. 3, no. 1, p. 11 (chart), 12. About 400 feet of red-gray siltstone, sandstone, and conglomerate that contains several fossiliferous marine limestones. Transitional into overlying Madera formation; overlies Kerber formation.

May extend as far north as Hayden Pass and as far south as New Mexico border. Type locality and derivation of name not stated.

Sharpsville formational suite[1]

Mississippian: Northwestern Pennsylvania.

Original reference: K. E. Caster, 1934, Bulls. Am. Paleontology, v. 21, no. 71, p. 131, table facing p. 131.

**Sharpsville Sandstone** (in Cuyahoga Group)

Sharpsville Sandstone Member (of Cuyahoga Formation)[1]

Mississippian: Northwestern Pennsylvania and northeastern Ohio.

Original reference: I. C. White, 1880, Pennsylvania 2d Geol. Survey Rept. $Q_3$, p. 61–62.

H. P. Cushing, Frank Leverett, and F. R. Van Horn, 1951, U.S. Geol. Survey Bull. 818, p. 50–52. Cuyahoga, in its typical area, is elevated to group rank and its subdivisions (ascending) Orangeville shale, Sharpsville sandstone, and Meadville shale are treated as formations. Thickness 25 to 50 feet in Cleveland, Ohio, district. Contacts with Orangeville and Meadville transitional.

F. T. Holden, 1941, Illinois Acad. Sci. Trans., v. 34, no. 2, p. 172; 1942, Jour. Geology, v. 50, no. 1, p. 41. 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. Sharpsville is composed of varying amounts of flaggy sandstone and interbedded sandy shales. Base is drawn at first massive sandstone in shale section above Berea sandstone or Corry sandstone. Locally, near Warren, Ohio, and Meadville, Pa., lower part of Sharpsville is composed almost completely of massive sandstone and can be used for local correlation. Elsewhere the Sharpsville is composed of thin flaggy sandstones, and boundaries can not be drawn definitely. Base of Sharpsville is irregular. In some areas, flags of the Sharpsville are almost in contact with the Berea, but in some areas a thick shale separates the two units. In vicinity of Titusville, Pa., the Sharpsville merges with underlying Orangeville shale.

J. F. Pepper, Wallace de Witt, Jr., and D. F. Demarest, 1954, U.S. Geol. Survey Prof. Paper 259, p. 45. In Ohio, base of Sharpsville is generally placed at base of first massive bed of siltstone in shale sequence above the Berea except in those areas where the Aurora or Chardon member is present near base of Orangeville shale. In northwestern Pennsylvania, the Sharpsville is first massive siltstone above Bartholomew siltstone member of Orangeville shale, except in local area in Crawford County where the Bartholomew is absent and its place is occupied by Hungry Run sandstone member.

E. J. Szmuc, 1958, Dissert. Abs., v. 18, no. 6, p. 2109. In northern Ohio, eight members recognized in Cuyahoga formation. They are (ascending) Orangeville, Sharpsville, Strongville (new), Meadville, Rittman, Armstrong, Wooster (new), and Black Hand.

Named from village of Sharpsville on Shenango River, in Mercer County, Pa.

Shasta Lavas

Pliocene: California.

O. P. Jenkins, 1938, Geologic map of California (1:500,000): California Div. Mines, sheet 4. Shown on map legend.

**Shasta Series**[1]

Shasta Group

Lower Cretaceous: California and Oregon.

Original reference: W. M. Gabb, 1869, California Geol. Survey Pal., v. 2, p. vii, xvi, 129, 133.

F. M. Anderson, 1938, Geol. Soc. America Spec. Paper 16, p. 37–86, pl. 84. Series in Great Valley sections in California has been divided into two major groups, primarily upon paleontological grounds, but division is supported by other important criteria, found in their distribution and lack of coincidence, and in the thick beds of conglomerate usually lying between them, and in some places by direct evidence of disconformity and transgression. Later, and somewhat thicker, part of series constitutes Horsetown group and lower part is Paskenta group. In its more complete sections, Shasta series is set off from underlying Knoxville and overlying Chico series by well-marked unconformities.

N. L. Taliaferro, 1943, California Div. Mines Bull. 118, pt. 2, p. 129, 130 [preprint 1941]. Referred to as Shasta group. The divisions of Shasta, the Paskenta and Horsetown, classed as groups by some authors, are here considered to be stages. Mid-Cretaceous disturbance separates Shasta group from Upper Cretaceous Pacheco group (new). Group in northern Coast Ranges has maximum thickness of over 20,000 feet; maximum thickness in central Coast Ranges not known, but in some localities group is more than 5,000 feet thick.

F. M. Anderson, 1943, California Div. Mines Bull. 118, pt. 2, p. 183, 184 (fig. 68) [preprint 1941]; 1945, Geol. Soc. America Bull., v. 56, no. 10, p. 914–937. Paskenta group of Shasta series overlies Newville group (new) of Knoxville series. Where Shasta is in contact with Knoxville, it is generally unconformable, but in places it overlaps the Knoxville and rests directly upon pre-Knoxville. Lower Cretaceous.

J. M. Kirby, 1943, Am. Assoc. Petroleum Geologists Bull., v. 27, no. 3, p. 287–2891. Shasta series, in Sacramento Valley south of Willows, Glenn County, underlies Venado formation (new) of Chico series. Evidence of mid-Cretaceous disturbance of Santa Lucian orogeny, postulated by Taliaferro as separating Chico and Shasta series and as basis for his Pacheco and Asuncion groups respectively, is meager in this area.

C. E. Weaver, 1949, Geol. Soc. America Mem. 35, p. 31–39, pls. 6, 7, 11, 12. Shasta series as used in this report [Coast Ranges immediately north of San Francisco Bay region] includes Knoxville and Horsetown(?) formations. Rocks of series are mainly thinly laminated siltstones with interbedded medium-grained brownish-gray sandstones, lenses of conglomerates, and occasional thin layers of limestone. These are entirely marine and nearly 19,000 feet thick. No definite depositional base of Knoxville observed in area, but formation is in contact with Franciscan group at many places such as south of St. John Mountain, west of Oakville, and in area west and north of Capell Valley. The contacts are along thrust or normal faults, Underlies Chico formation, erosional unconformity. Jurassic and Lower Cretaceous.

W. P. Irwin, 1957, Am. Assoc. Petroleum Geologists Bull., v. 41, no. 10, p. 2284–2297. Discussion of Franciscan group in Coast Ranges and its equivalents in Sacramento Valley. Shasta series has been divided into a lower and upper part, Paskenta and Horsetown formations, respectively. Contact between Shasta and Knoxville is marked by a fairly abrupt and complete change in fauna, and at many places by beds of conglomerate. The concept of a "basal conglomerate" has much influenced the subdivision of the Sacramento Valley section. However, along much of Sacramento Valley, the transition from one unit to the other is one of nearly continuous deposition and, judged from broad structural conformity, was accomplished with little disturbance. Strata referred to Shasta series have higher ratio of sandstone to shale than has Knoxville formation. Average total thickness of the Shasta is about 10,000 feet, and is divided about equally between lower and upper faunal divisions, the Paskenta and Horsetown. Term Shasta series has generally been considered as including only Lower Cretaceous strata, but along much of west side of Sacramento Valley there has been little agreement as to contact between Shasta series and Upper Cretaceous strata. This lack of agreement casts doubt as to validity of a hiatus many earlier workers have postulated between the Lower and Upper Cretaceous. Some geologists have placed contacts at base of Venado sandstone (Kirby, 1943). Others have placed it lower in the section, at base of a conglomerate. The conglomerate and Venado are separated by thickness of several thousand feet of shale referred to by Kupper (1956) as Antelope shale of Taliaferro. If Shasta series is to be restricted to Early Cretaceous, the base of the conglomerate below the so-called Antelope shale fo Taliaferro appears to be a better choice for its upper limit, and is so considered in this paper. Evidence indicates that Franciscan group has been deposited contemporaneously with the Knoxville, Paskenta, Horsetown, and lower Upper Cretaceous strata.

Named for development of the rocks in Shasta County, Calif.

Shasta Bally Quartz Diorite

[Jurassic]: Northern California.

G. H. Curtis, J. F. Evernden, and J. Lipson, 1958, California Div. Mines Spec. Rept. 54, p. 5–6. Name applied to quartz diorite in Shasta Bally pluton. Potassium-argon dating gives age of 134 million years.

Batholith is southernmost of granitic masses exposed in Klamath Mountains, northern California. Specimens collected 1 mile north of Ono, Shasta County.

†Shastan System[1]

†Shastian System[1]

Lower Cretaceous: Western North America.

Original reference: T. C. Chamberlin and R. D. Salisbury, 1906, Geology, v. 3, p. 107–137.

Shattuck Member (of Queen Formation)

Permian (Guadalupian): New Mexico and Texas.

N. D. Newell and others, 1953, Permian reef complex of the Guadalupe Mountains region, Texas and New Mexico: San Francisco, W. H. Freeman and Co., p. 15 (fig. 6), 43 (fig. 26), 44 (fig. 27), 45–46. Name applied to persistent sandstone in upper part of Queen formation. Thins rapidly from 100 feet at Wind River Gap to a series of small lenses and pockets of sandstone at top of Goat Seep reef, about 1 mile down North McKittrick Canyon. Underlies Seven Rivers formation. Mapped by King (1948, U.S. Geol. Survey Prof. Paper 215) as basal sandstone of Carlsbad group.

Named from outcrops along Shattuck Valley escarpment in vicinity of Devils Den, El Paso quadrangle, New Mexico.

**Shawangunk Conglomerate[1]**

Shawangunk Formation

Silurian: Southeastern New York, northern New Jersey, and Pennsylvania.

Original reference: W. W. Mather, 1840, New York Geol. Survey 4th Rept., p. 246–250.

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

K. L. Glenby, 1942, Geological Review, v. 2, no. 2, p. 11, 12, 13. Conglomerate overlies Ordovician Hudson River shales in Shawangunk Mountains.

Bradford Willard, 1943, Geol. Soc. America Bull., v. 54, no. 8, p. 1089. Shawangunk formation unconformably overlies Martinsburg group in northern New Jersey and at Otisville, N.Y. Contact not exposed at Delaware Water Gap.

P. K. Sims and P. E. Hotz, 1951, U.S. Geol. Survey Bull. 978–D, p. 104–105. Thickness 250 to 300 feet at Shawangunk mine, Sullivan County, N.Y., section does not include approximately 475 feet of lower part of the Shawangunk. Underlies High Falls shale; unconformably overlies Ordovician slates, shales, and sandstone.

Carlyle Gray and others, 1960, Geologic map of Pennsylvania (1:250,000): Pennsylvania Geol. Survey, 4th ser. Formation, as mapped, consists of light-gray to tan thick-bedded impure quartzitic sandstone and conglomerate with thin shale interbed. In eastern Pennsylvania only.

Named for occurrence on Shawangunk Mountain, Ulster County, N.Y.

**Shaw Mountain Formation**

Lower or Middle Silurian: Central Vermont.

L. W. Currier and R. H. Jahns, 1941, Geol. Soc. America Bull., v. 52, no. 9, p. 1492, 1496–1501. Thin group of beds with three lithologic varieties; at base is massively bedded quartz conglomerate which grades upward into papery to platy soda rhyolite tuff; near top is white to slightly bluish crinoidal limestone occurring as thin beds and lenses usually interbedded with the tuff. Thickness difficult to determine, maximum total probably about 900 feet. Underlies Northfield slate unconformably; overlies Cram Hill formation (new) unconformably. Ordovician(?).

Phillip Fowler, 1950, Vermont Geol. Survey Bull. 2, pl. 1. Middle Ordovician.

W. H. Bucher, 1953, Geol. Soc. America Bull., v. 64, no. 3, p. 283. Devonian.

W. M. Cady, 1956, U.S. Geol. Survey Geol. Quad. Map GQ–79. In Montpelier quadrangle, underlies Northfield slate; overlies Moretown formation. Silurian.

W. M. Cady, 1960, Geol. Soc. America Bull., v. 71, no. 5, pl. 3. Lower and Middle Silurian.

Named for good exposure near base of north slope of Shaw Mountain, 2 miles south-southwest of Northfield, Barre quadrangle. Also occurs in Randolph and Montpelier quadrangles, and is traced northward by reconnaissance to Quebec border.

**Shammut 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 Shawmut mine, Houghton County.

**Shawmut Conglomerate**[1]

Precambrian (Keweenawan): Northern Michigan.

Original reference: A. C. Lane, 1911, Michigan Geol. and Biol. Survey Pub. 6, geol. ser. 4, p. 527, 536, 546, 554, pls. 11, 12, fig. 50.

Named for occurrence at Shawmut mine, Houghton County.

**Shawmut Flow**[1]

Precambrian (Keweenawan): Northern Michigan.

Original reference: B. S. Butler and W. S. Burkank, 1929, U.S. Geol. Survey Prof. Paper 144 (chart compiled by M. G. Wilmarth).

Named for occurrence in Shawmut mine, Houghton County.

Shawmut Group[1]

Devonian or Carboniferous: Eastern Massachusetts.

Original reference: W. O. Crosby, 1877, Geol. map of eastern Mass.

Occurs near Boston, on Marblehead Neck and neighboring islands, and in basin of Parker River, Boston Basin region.

**Shawnee Group**[1]

Shawnee Formation[1]

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

Original reference: E. Haworth, 1898, Kansas Univ. Geol. Survey, v. 3, p. 93–94.

R. C. Moore, 1936, Kansas Geol. Survey Bull. 22, p. 48 (fig. 10), 159–199. Redefined group comprises (ascending) Oread limestone, Kanwaka shale, Lecompton limestone, Tecumseh shale, Deer Creek limestone, Calhoun shale, and Topeka limestone. Overlies Douglas group; underlies Wabaunsee group.

H. S. McQueen and F. C. Greene, 1938, Missouri Geol. Survey and Water Resources, 2d ser., v. 25, p. 28–29, pl. 5. Group in Missouri comprises (ascending) Kanwaka shale, Lecompton limestone, Tecumseh shale, Deer Creek limestone, Calhoun shale, Topeka limestone, Severy shale, Howard limestone, White Cloud shale, Happy Hollow limestone, Cedar Vale shale, Rulo limestone, Silver Lake-Auburn shale interval, Reading limestone, Harveyville shale, Elmont ("Emporia") or Preston limestone, and Willard shale. Succession of beds shown on plate 5 from base of Kanwaka to top of Howard limestone is fairly accurate and beds are regular with the limits indicated. Above Howard limestone, outcrops are so restricted and so widely scattered, that some errors may be present. There are no complete exposures of the White Cloud. Between top of White Cloud shale and Reading limestone there is discrepancy in nomenclature, thickness and lithology in section in plate 5 and sections published by Kansas and Nebraska Geological Surveys. Overlies Douglas group; underlies Wabaunsee group.

R. C. Moore, 1948, Am. Assoc. Petroleum Geologists Bull., v. 32, no. 11, p. 2034–2036. Interstate agreement recognized Shawnee group as comprising interval from base of Oread formation to top of Topeka. Agreed that where stratigraphic variation calls for omission or combination of stratigraphic terms, appropriate adjustment of nomenclature is to be employed.

F. C. Greene and W. V. Searight, 1949, Missouri Geol. Survey and Water Resources Rept. Inv. 11, p. vii (fig. 3), 16–18. Shawnee group redefined for Missouri to accord with interstate agreement. Expanded at base to include Oread limestone and restricted above to exclude beds above the Topeka.

H. G. Hershey and others, 1960, Iowa Highway Research Board Bull. 15, p. 15–23, fig. 5. Group in Iowa includes interval from base of Oread limestone to top of Topeka. Formations are persistent although members are not everywhere recognized.

Type locality: Shawnee County, Kans.

†Shawnee Limestone (in Allegheny Formation)[1]

Shawnee limestone member

Pennsylvanian: Southeastern Ohio.

Original reference: E. Orton, 1878, Ohio Geol. Survey, v. 3, p. 888, 895, pls.

M. T. Sturgeon and others, 1958, Ohio Geol. Survey Bull. 57, p. 48 (table 7), 84, 86–87. Member of Bolivar cyclothem in report on Athens County. Proposed that name Shawnee be reinstated to good standing and be used for the fresh-water limestone associated with Bolivar underclay and that name Upper Freeport, as applied to limestone, be restricted to limestone associated closely with Upper Freeport underclay. Shawnee limestone is stratigraphically below Upper Freeport shale and sandstone, and the Upper Freeport limestone is above the same shale and sandstone.

Named for Shawnee, Perry County.

Shawnee Sandstone[1]

Pennsylvanian: Oklahoma.

C. C. Branson, 1957, Oklahoma Geology Notes, v. 17, no. 11, p. 108. Abandoned by Oklahoma Geological Survey. Named by Taff (1899, U.S. Geol. Survey 19th Ann. Rept., pl. 6). A Pennsylvanian limestone in Ohio was given name Shawnee in 1878. Haworth named Shawnee formation in Kansas in 1898 and this unit has since been raised to group status. Shawnee sandstone of Taff was named Thurman sandstone in text of his [Taff's] 1899 report (p. 439).

Shawneetown Coal Member (of Carbondale Formation)

Pennsylvanian: Eastern and southern Illinois (subsurface).

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 35, 47 (table 1), pl. 1. Proposed for coal believed to be lower of two coals formerly called No. 2 A (Harrison, 1951, Illinois Geol. Survey Rept. Inv. 153). Not recognized in outcrops but encountered at depth of 543 feet 10 inches in drill hole. In southern Illinois, stratigraphically above Colchester (No. 2) coal member and below Roodhouse coal member (new). In eastern Illinois, occurs above Colchester (No. 2) coal member and below Summum 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: Union Colliery Co. drill hole 28, sec. 23, T. 9 S., R. 9 E., Gallatin County.

Shaw Point cyclothem

Pennsylvanian: Southwestern Illinois.

C. L. Cooper, 1946, Illinois Geol. Survey Bull. 70, p. 12, 13. In Macoupin County, four cyclothems are recognized of which the Shaw Point is fourth in series (ascending). Occurs above the Macoupin. Name credited to J. R. Ball in manuscript report.

Type locality and derivation of name not given.

Shaws sandstone member[1]

Mississippian: Northwestern Pennsylvania.

Original reference: K. E. Caster, 1934, Bulls. Am. Paleontology, v. 21, no. 71, p. 132, table opposite p. 61.

Well exposed in ravine behind Shaws brick schoolhouse on Meadville-Franklin Highway, Meadville quadrangle.

**Shea Basalt** (in Ash Creek Group)

Shea Diabase

Precambrian (Yavapai Series): Central Arizona.

L. E. Reber, Jr., 1938, Arizona Bur. Mines Bull. 145, Geol. Ser. 12, p. 58, 61, pl. 8. Diabase is a dark moderately fine-grained dioritic rock.

C. A. Anderson and S. C. Creasey, 1958, U.S. Geol. Survey Prof. Paper 308, p. 12–13, pl. 1. Term Shea diabase modified to Shea basalt. Included in Ash Creek group (new). Composed mostly of lava flows and intercalated tuffaceous beds, and in Black Canyon, many coarse fragmental deposits contain vesicular fragments as much as 6 inches in diameter. Basalt is a dark-green to black rock. Flows commonly contain quartz and chlorite amygdules and, in a few places, pillow lavas. Interbedded tuffaceous sedimentary rocks commonly thin, from 2 to 4 feet thick. In northern exposures, tuffaceous rocks range from 20 to 40 feet in thickness. These sedimentary rocks are dark green to greenish gray. Massive lava from thick flows has diabasic texture. Overall thickness on north side of Black Canyon about 2,000 feet. Underlies Deception rhyolite; overlies Buzzard rhyolite (new).

In vicinity of Shea mine, Jerome district, Yavapai County. Crops out southeast and east of Mingus Mountain. Southeastern exposures appear north and south of Black Canyon and in the canyon west of the Verde fault. Eastern exposures form continuous belt northward from Oak Wash to Mescal Gulch.

**Shedhorn Sandstone**

Permian: Southwestern Montana and northwestern Wyoming.

E. R. Cressman and R. W. Swanson *in* V. E. McKelvey and others, 1956, Am. Assoc. Petroleum Geologists Bull., v. 40, no. 12, p. 2852–2854; 1959, U.S. Geol. Survey Prof. Paper 313–A, p. 31–33, pl. 3. Medium- to very fine-grained quartz sandstone that contains small amounts of black chert and phosphate grains and amber to white phosphatic shell and bone fragments; some sandstone slightly glauconitic. At type locality, consists of lower member 17 feet thick and upper member 78 feet thick, separated by tongues of Retort and Tosi members (both new) of Phosphoria formation; at this locality, sandstone is underlain by Quadrant quartzite and overlain by Dinwoody formation. In Madison Range and adjacent areas, Shedhorn is medium to brownish gray in contrast to the light gray of quartz sandstone in underlying Quadrant quartzite.

Type section: In cliffs on north side of Indian Creek in SW¼ sec. 20, T. 8 S., R. 2 E., Madison County, Mont., about one-fourth mile west of mouth of Shedhorn Creek. In Montana, Shedhorn extends east to Yellowstone River, north to Three Forks, northwest to Garrison in Garnet Range, and west to Dalys Spur; thin tongues extend southeast in Wyoming to Wyoming and Salt River Ranges.

**Shedroof Conglomerate**

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), 7–9, pl. 1. Name applied to a coarse poorly sorted gray-brown conglomerate. Thickness 3,000 to 11,000 feet. Unconformably overlies Priest River group(?); underlies and is gradational into Leola volcanics (new).

Named for exposures on Shedroof Mountain, Pend Oreille County, Wash.

**Sheep Bay Granite**[1]

Paleozoic(?): Southeastern Alaska.

Original reference: U.S. Grant and D. F. Higgins, 1910, U.S. Geol. Survey Bull. 443, p. 43, 46.

Occupies northeastern third of point of land separating Port Gravina from Sheep Bay, Prince William Sound region.

Sheep Canyon Basalt (in Buck Hill Volcanic Series)

Sheep Canyon Basalt (in Pruett Formation or Tuff)

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. Lava flows intercalated with Pruett tuff (new) are (ascending) Crossen trachyte, Sheep Canyon basalts, and Potato Hill andesite (all new).

S. S. Goldich and C. L. Seward, 1948, West Texas Geol. Soc. [Guidebook] Fall Field Trip, Oct. 29–31, p. 14 (table 1), 17 (fig. 3), 19–20; 1949, Geol. Soc. America Bull., v. 60, no. 7, p. 1153–1155. In Sheep Canyon (type area), the Sheep Canyon basalt consists of four flows separated by beds of tuff and tuffaceous limestone. Thickness of flows together with intervening tuff and tuffaceous limestone, 234 feet. Flows rest on both Crossen trachyte and on Pruett fresh-water limestone underlying the trachyte. Thick flows assigned to Sheep Canyon basalt occur on Pruett tuff in Elephant Mountain where there are three flows totaling 380 feet. Underlies Potato Hill andesite. Eocene(?).

W. N. McAnulty, 1955, Geol. Soc. America Bull., v. 66, no. 5, p. 536 (table 1), 547–549, pl. 1. Described in Cathedral Mountain quadrangle. Rank raised to formation in Buck Hill volcanic series. Term Pruett restricted to the tuff, sandstone, conglomerate, and limestone below Crossen trachyte which underlies Sheep Canyon basalt. Underlies Potato Hill andesite. Thickness 0 to 454 feet. Oligocene and younger(?).

Named for Sheep Canyon, a reentrant of Calamity Creek valley in Alpine quadrangle, Brewster County.

Sheep Canyon Granite

Precambrian: Southeastern Arizona.

F. F. Sabins, 1957, Geol. Soc. America Bull., v. 68, no. 10, p. 1321–1322, pl. 1. Gneissose granite. Very pale orange on fresh surfaces and weathers light brown. Bounded on the west by a Tertiary stock of quartz monzonite, and on south by Pinal schist. Overlapped by alluvium on the north and east. Oldest of the Precambrian igneous rocks in area.

Crops out over area of about 4 square miles in northwest corner of Cochise Head quadrangle, Cochise County. Exposure cut by steep-sided gorge of Sheep Canyon.

Sheep Creek Conglomerate[1]

Upper Paleozoic or Mesozoic: Northeastern Washington.

Original reference: C. E. Weaver, 1920, Washington Geol. Survey Bull. 20, p. 91, map.

Exposed on east side of Sheep Creek, Stevens County, at international boundary.

**Sheep Creek Formation**

Sheep Creek Beds[1] or Group

Sheep Creek Formation (in Hemingford Group)

Miocene: Western Nebraska and eastern Wyoming.

Original reference: W. D. Matthew and H. J. Cook, 1909, Am. Mus. Nat. History Bull., v. 26, art. 27, p. 362–363.

A. L. Lugn, 1938, Am. Jour. Sci., v. 36, 5th ser., no. 213, p. 226, 227. Upper formation in Hemingford group (new). Thickness 140 feet. Contains *Stipidium* and *Berriochloa* fossil seeds. Unconformable above Marsland formation (new). Underlies Valentine formation of Ogallala group.

A. L. Lugn, 1939, Geol. Soc. America Bull., v. 50, no. 8, p. 1254–1258, 1266 (table 2). Discussion of confusion in use of terms Snake Creek and Sheep Creek formation, both of which were named by Matthew and Cook and both of which have their type localities in south-central Sioux County, Nebr. The Sheep Creek beds were said to lie unconformably on lower Miocene, equivalent to the *Daemonelix* beds of Niobrara valley [Harrison formation]. Matthew and Cook considered the Snake Creek beds to be the remains of a formation which they regarded as an outlier of the Ogallala. The Snake Creek was said to lie on the eroded surface of the Sheep Creek beds. Later, confusion resulted especially because of the "mixed" faunal lists which have resulted from mixed collections from the Sheep Creek-Snake Creek locality. The typical "Snake Creek" formation, or at least the so-called "upper Snake Creek," is correlative with some part of upper Ogallala group. However "Snake Creek" has been incorrectly(?) applied to beds, mainly channel fills, as late as Pleistocene and to other beds as old as Miocene. Much of the Miocene "Snake Creek" or perhaps the so-called "lower Snake Creek" seems to be in part not Snake Creek at all but Sheep Creek channel beds in place and in proper stratigraphic sequence. Also, some of the Miocene and "Sheep Creek" vertebrate fossils collected from "Snake Creek" channel deposits have come from large blocks of Sheep Creek formation, which were broken away from banks of Snake Creek streams. These large blocks have dimensions of 10 to 20 feet or more and were never broken up or distintegrated by Snake Creek rivers. They lie buried in younger silt and sand, the true Snake Creek sediments, which are always channel-fill material. Sheep Creek formation consists of channel gravels and sands; fine silty sands, silt and clay, and harder caliche beds of widely ranging textural characteristics, all of which fill for the most part narrow valleys or ravines to depths ranging from 30 or 40 feet to 140 feet or more. These deposits, many of which are isolated and unconnected, are widespread in northwestern Nebraska. In central part of south half of Sioux County, the Sheep Creek extends continuously as a basin deposit of channel, flood-plain, and slack-water sediments over about 25 square miles. Total thickness of Sheep Creek exposed above unconformable contact on Harrison formation in type locality is more than 200 feet. Overlapping exposures in Dawes County indicate that fundamental formational entity includes about 70 feet of additional beds which are stratigraphically higher than uppermost Sheep Creek exposures in type locality. This does not include a still higher "member" to be described later. It is mainly this upper part of the Sheep Creek that has been called by some workers "lower Snake Creek beds." The distribution of this heretofore unrecognized member of the Sheep Creek seems to have been nearly the same as that of Marsland formation, and at present it overlies and extends beyond limit of most of the Sheep Creek valley fills more or less throughout areal extent of Hemingford group and in some areas rests on Harrison formation. Original definition of Snake Creek and Sheep Creek formations may be essentially valid and it is proposed to continue use of these names to correctly differentiated formations.

R. C. Cady, 1940, Am. Jour. Sci., v. 238, no. 9, p. 663–667. Includes Box Butte member (new) in uppermost part. Formation, exclusive of Box Butte member, fills narrow channels in Marsland formation.

M. K. Elias, 1941, Geol. Soc. America Spec. Paper 41, p. 126–132. As used by Nebraska Geological Survey, the Sheep Creek includes all higher rocks of Hemingford group between Marsland formation below and Ogallala group above. Comprises three members (ascending) Spottedtail (new), Sand Canyon (new), and Box Butte.

H. J. Cook, 1960, Internat. Geol. Cong., 21st, Copenhagen, pt. 12, p. 204. Sheep Creek group, as shown on generalized geologic section in type localities of late Tertiary deposits of northwestern Nebraska and eastern Wyoming, overlies Runningwater formation (new) of "Marsland" group and underlies Snake Creek beds of Ogallala group.

Named for Sheep Creek, Sioux County, Nebr.

Sheepeaters Basalt

Tertiary: Northwestern Wyoming.

R. E. Wilcox, 1944, Geol. Soc. America Bull., v. 55, no. 9, p. 1053–1054, 1059–1060, pls. 1, 2. Younger of two basalt flows not included in Gardiner River rhyolite-basalt complex (new)—that is, younger than Elkhorn basalt (new) and also younger than Cataract basalt (new) of Gardiner River rhyolite-basalt complex. Even-grained texture and columnar structure.

Typically exposed along Sheepeaters Cliffs on north side of Gardiner River, Yellowstone Park. Blankets entire northwest part of mapped area and crops out consistently at elevations near 7,300 feet at top of cliffs; forms walls of "The Amphitheater," an extinct waterfall of glacial tributary of the Gardiner just below Sevenmile Bridge. Outcrop continues along left bank of river almost without interruption to First Cataract where it apparently overlaps part of complex.

Sheep Mountain Quartzite[1] (in Missoula Group)

Precambrian (Belt Series): Western Montana.

Original reference: C. H. Clapp and C. F. Deiss, 1931, Geol. Soc. America Bull., v. 42, p. 683, fig. 2, 3.

D. A. Andrews, G. S. Lambert, and G. W. Stose, 1944, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 25. Missoula group comprises (ascending) Miller Peak, Hellgate, McNamara, and Garnet Range formations, and Sheep Mountain quartzite.

On upper slopes of Sheep Mountain, sec. 24, T. 15 N., R. 18 W., and sec. 30, T. 14 N., R. 17 W. In Missoula to Helena region.

**Sheep Mountain Quartz Latite** (in Potosi Volcanic Group)

Sheep Mountain Andesite (in Potosi Volcanic Series)[1]

Tertiary, middle or upper: Southwestern Colorado.

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

E. S. Larsen, Jr., and Whitman Cross, 1956, U.S. Geol. Survey Prof. Paper 258, p. 13, 93 (table 18), 124–132. Name Sheep Mountain quartz latite is applied to unit of dark quartz latites belonging to Potosi volcanic series and normally lying between Treasure Mountain rhyolite below and Alboroto rhyolite above. Lower contact regular; upper contact irregular. Erupted from at least four centers: San Cristobal quadrangle, Summitville quadrangle, Saguache quadrangle, and Del Norte quadrangle.

U. S. Geological Survey currently designates the age of the Sheep Mountain Quartz Latite as middle or late Tertiary. This designation is made on the basis of an age change of Potosi Volcanic Group.

Named for development under Sheep Mountain, northwestern part of Summitville quadrangle.

**Sheep Pass Formation**

Eocene: East-central Nevada.

W. M. Winfrey, Jr., 1958, Am. Assoc. Petroleum Geologists Rocky Mountain Sec., Geol. Rec., p. 77–82. Divided into six members (ascending): A, conglomerate breccia, 630 feet; B, interbedded fossiliferous limestones, shales and mudstones, 983 feet; C, clastic sequence of sandstones, siltstones, shales, and gritty conglomerates, 642 feet; D, homogeneous interval of white, siliceous, extremely fine-grained siltstones, in part calcareous, 731 feet; E, tan lithographic thickly bedded limestone, 90 feet; and F, siltstone-claystone beds, 147 feet. At type locality unconformably overlies Ely limestone (Pennsylvanian) and Chainman shale (Mississippian); unconformably underlies Oligocene(?) Garrett Ranch volcanic group (new).

Type section: Sheep Pass Canyon, sec. 12, T. 10 N., R. 62 E. and sec. 7, T. 10 N., R. 63 E., White Pine County. Exposed continuously along western flank of Egan Range for distance of 10 miles southwesterly from sec. 21, T. 11 N., R. 63 E.

Sheep Pen Sandstone[1] (in Dockum Group)

Upper Triassic: Northeastern New Mexico.

Original references (Sheep Pen Canyon): B. H. Parker, 1930, Kansas Geol. Soc. [Guidebook] 4th Ann. Field Conf., p. 19; 1933, Jour. Geology, v. 41, no. 1, p. 40–43.

Brewster Baldwin and W. R. Muehlberger, 1959, New Mexico Bur. Mines Mineral Resources Bull. 63, p. 35 (table 2), 40–42. Uppermost formation in Dockum group. Consists of thin-bedded light-brown sandstone. As much as 107 feet thick. Overlies Sloan Canyon formation; underlies Exeter sandstone.

Type locality: E½NW¼ sec. 35, T. 32 N., R. 35 E., Union County. Named for Sheep Pen Canyon, which joins Cimarron Valley about one-half mile northwest of type locality.

Sheep Pen Canyon Formation

*See* Sheep Pen Sandstone (in Dockum Group).

†Sheep Rock Conglomerate[1]

Age(?) : Virginia.

Original reference: J. P. Lesley, 1873, Am. Philos. Soc. Proc., v. 12, p. 492–496.

Forms Sheep Rock between Big Tom's Creek and Little Tom's Creek, east of Gladeville (now called Wise), Wise County.

Sheeprock Group or Series

Precambrian: West-central Utah.

DeVerle Harris, 1958, Bringham Young Univ. Research Studies, Geology Ser., v. 5, no. 1, p. 6–8, pl. 1. Consists of phyllites, phyllitic quartzites, quartzites, graywackes, graywacke conglomerates, graywacke conglomerate semischists, and tillites(?). Includes Auts Canyon formation (new) below and Ekker formation (new) above. Total measured thickness of two formations is 9,718 feet. Base of group marked by plane of Sheeprock thrust in Dutch Peak area. Underlies Quaternary alluvium.

R. E. Cohenour, 1959, Utah Geol. and Mineralog. Survey Bull. 63, p. 17–19, 24, 128–138, pl. 1. Sheeprock series, in Sheeprock Mountains, is a 9,000- to 10,000-foot sequence of metasediments composed of slate, tillite, phyllite, quartzite, and conglomerate. Subdivided into—lower Sheeprock series, Dutch Peak tillite (new), and upper Sheeprock series. Oldest rocks exposed in Sheeprock Mountains; underlies Mutual(?) formation.

In Dutch Peak area, Sheeprock Range, Tooele County.

Sheepskull Gap Tuffs

*See* Keechelus Andesitic Series.

Sheffield Formation[1]

Upper Devonian: Central northern Iowa.

Original reference: C. L. Fenton, 1919, Am. Jour. Sci., 4th, v. 48, p. 355–376.

Walter Youngquist and R. F. Peterson, 1947, Jour. Paleontology, v. 21, no. 3, p. 242–253. Conodont fauna from type area of Sheffield indicates Upper Devonian age. Specimens in this report procured from clay pit of Sheffield Brick and Tile Co., near center sec. 9, T. 93 N., R. 20 W., Franklin County.

M. A. Stainbrook, 1950, Jour. Paleontology, v. 24, no. 3, p. 365–366. Stratigraphically restricted above to exclude a series of dolomitic beds here named Aplington formation.

Named for exposures in vicinity of Sheffield, Franklin County.

Sheffield Shale (in McLeansboro Formation)

Sheffield Shale (in Carbondale Group)

Pennsylvanian: West-central Illinois.

H. R. Wanless, 1939, Geol. Soc. America Spec. Paper 17, p. 102. In McLeansboro formation between Copperas Creek sandstone (above) and Brereton limestone.

H. R. Wanless, 1957, Illinois Geol. Survey Bull. 82, p. 50 (fig. 22), 112–113. Light gray, with brownish, olive, or bluish cast. Maximum thickness 22 feet: average 8 or 10; 4 feet in Beardstown quadrangle; variations in thickness due to trucation by overlying Copperas Creek sandstone. Included in Brereton cyclothem, Carbondale group. Savage [1927] used name Copperas Creek to include Sheffield shale and the overlying sandstone, but name Copperas Creek has been restricted to the sandstone.

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 35. Replaced by Lawson shale member of Carbondale formation (redefined).

Named for exposures near Sheffield, near center sec. 24, T. 16 N., R. 6 E., Bureau County.

**Shelburn Formation**[1]

Upper Pennsylvanian: Southwestern Indiana.

Original reference: E. R. Cumings, 1922, Indiana Dept. Conserv., Pub. 21, pt. 4, p. 408, 525, 529, chart.

C. E. Wier, 1950, U.S. Geol. Survey Coal Inv. Map. C–1. Unconformably overlies Dugger formation (new).

C. E. Wier, 1951, U.S. Geol. Survey Coal Inv. Map C–9. As proposed by Cumings, included rocks in the interval from top of Coal VII to base of Merom sandstone, thus including in upper part beds that had previously been included in West Franklin and Ditney formations. Upper part of Cuming's Shelburn formation has been separated from it by Schrock and Malott (1929) who restored name West Franklin formation to include two limestone members and the shale and coal between them and by Malott (1948) who restored name Ditney for formation overlying West Frankfort and underlying Merom sandstone. Shelburn is here restricted to those rocks above the unconformity that overlies Coal VII or locally cuts out Coal VII and below base of West Franklin formation. Contains 250 feet of sandstone, shale, limestone, and thin lenticular coal beds, of which only basal part, approximately 30 feet, of Busseron sandstone member is exposed in Linton quadrangle.

F. E. Kottlowski, 1954, U.S. Geol. Survey Coal Inv. Map C–11. In Dugger quadrangle, includes (ascending) Busseron sandstone member and Maria Creek limestone member (new).

Courtney Waddell, 1954, U.S. Geol. Survey Coal Inv. Map C–17. In Shelburn quadrangle, formation includes Vigo sandstone member (new).

J. D. McGregor, 1958, Indiana Geol. Survey Bull. 15, p. 46 (table 8). Table shows Shelburn formation, 210 to 300 feet, comprises (ascending) Busseron sandstone, Maria Creek limestone, Vigo limestone, and Murphys Bluff sandstone members.

Named for Shelburn, Sullivan County.

†Shelburne Gneiss[1]

Age(?): Massachusetts.

Original reference: W. O. Crosby, 1876, Rept. on geol. map of Massachusetts, Massachusetts Comm. to Centennial Exposition, Boston, p. 1–42.

At Shelburne Falls.

**Shelburne Marble**[1] or **Formation** (in Stockbridge Group)

Shelburne Formation

Lower Ordovician: West-central Vermont and northwestern Massachusetts.

Original reference: Arthur Keith, 1923, Am. Jour. Sci., 5th ser., v. 5, p. 115.

W. M. Cady, 1945, Geol. Soc. America Bull., v. 56, no. 5, p. 524, 539–541, pl. 10. Shelburne marble mapped in west-central Vermont. Occurs between Clarendon Springs dolomite below and Cutting dolomite (new) above. Lower Ordovician.

Norman Herz, 1958, U.S. Geol. Survey Geol. Quad. Map GQ–108. Shelburne marble included in Stockbridge group in Cheshire quadrangle, Massachusetts. Overlies Clarendon Springs dolomite; underlies Bascom formation. Lower Ordovician.

J. B. Thompson, Jr., 1959, New England Intercollegiate Geol. Conf. Guidebook 51st Ann. Mtg., p. 75. Formation described in Clarendon-Dorset area where it consists of Sutherland Falls marble member, 50 to 100 feet; intermediate dolomite member, 150 to 200 feet; and Columbian marble member, 200 to 250 feet. Underlies Bascom formation; overlies Clarendon Springs formation. Lower Ordovician.

Main belt of outcrop in town of Shelburne, Burlington quadrangle, Vermont.

Shelby cyclothem

Pennsylvanian: South-central Illinois.

C. L. Cooper, 1946, Illinois Geol. Survey Bull. 70, p. 13. Studies by S. E. Ekblaw led to tentative recognition of six cyclothems of which the Shelby is fifth in sequence (ascending). Succeeds Omega cyclothem and is followed by Shumway cyclothem. Subsequent attempts to set up a single standard section based on assumption that Omega and Greenup limestones are equivalent resulted in a series of 13 cyclothems in which the term Shelby was omitted. If the Greenup and Omega are not equivalent, the section includes 14 cyclothems with the Shelby below the Shumway or Newton and above the Omega. If this sequence is correct, or nearly so, it is probably incomplete, and other cyclothems may occur both above and below the Omega. Another difficulty in this arrangement is that the Shelbyville coal, which according to Ekblaw is a part of the Shelby cyclothem, was assigned to the Newton cyclothem by Newton (1941, Illinois Geol. Survey Rept. Inv. 76) who believed that it occurred beneath the Omega in Shelby County.

Type locality and derivation of name not given.

†Shelby Dolomite[1]

Silurian: Western New York.

Original reference: J. M. Clarke and R. Ruedemann, 1903, New York State Mus. Mem. 5, p. 9–13.

B. F. Howell and J. T. Sanford, 1947, Wagner Free Inst. Sci. Bull., v. 22, no. 4, p. 33–34. Preoccupied name Shelby replaced by Oak Orchard Creek member (new) of Lockport formation.

Named for exposures along Oak Orchard Creek, south of village of Shelby, in Shelby, the southwest township of Orleans County.

†Shelby Limestone[1]

Middle Devonian: Central Indiana.

Original reference: A. F. Foerste, 1898, Indiana Dept. Geology and Nat. Resources 22d Ann. Rept., p. 234–235.

Type locality not stated but probably named for Shelby County.

Shelbyville 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 McClearys Bluff coal member and below Trowbridge coal member. Coal named by Broadhead (1875, *in* Geology and Paleontology, v. 4, Illinois Geol. Survey). Presentation of new rock-stratigraphic classification of Pennsylvanian strata in Illinois.

Type locality: Outcrops and mines in vicinity of Shelbyville, T. 11 N., Rs. 3 and 4 E., Shelby County.

Shelbyville Drift or Till

Pleistocene (Wisconsin): Central Illinois.

H. B. Willman and others, 1942, Illinois Geol. Survey Bull. 66, p. 145 (fig. 85), 146 (fig. 86), 155–158. Consists of (1) till, (2) outwash, and (3) laminated clays, silts, and sand deposited in Lake Kickapoo. Maximum thickness at least 40 feet. Overlies Illinoian till and Sangamon interglacial deposits and underlies widespread pink till of Bloomington age; at some places, lake beds are overlain by gravel and sand outwash thought to be of Bloomington age. Six drifts listed in the Tazewell (ascending): Shelbyville, Bloomington, Cropsey, Farm Ridge, Chatsworth, and Marseilles.

Leland Horberg, 1950, Illinois Geol. Survey Bull. 75, pt. 1, p. 29. In Peoria area, Shelbyville drift is listed as older than Leroy drift.

J. C. Frye and H. B. Willman, 1960, Illinois Geol. Survey Circ. 285, p. 8, 11. Shelbyville till, 40 feet thick, occurs above Morton loess (new) and below Richland loess (new). Woodfordian substage.

Named for Shelbyville, Shelby County. Deposits occur principally in preglacial Ticona Valley and crop out at many places along Fox Valley and its tributaries above Dayton, along Illinois Valley east of Marseilles, and a few localities along Vermilion River.

**Sheldon Limestone Member** (of Topeka Limestone)

Sheldon Limestone (in Calhoun Shale)[1]

Pennsylvanian (Virgil Series): Southeastern Nebraska, southwestern Iowa, northeastern Kansas, and northwestern Missouri.

Original reference: G. E. Condra, 1930, Nebraska Geol. Survey Bull. 3, 2d ser., p. 47.

G. E. Condra and E. C. Reed, 1937, Nebraska Geol. Survey Bull. 11, 2d ser., p. 26, 30, 45, 46, 48–49. Reallocated to member status in Topeka limestone. Underlies Turner Creek shale member; overlies Jones Point shale member. Thickness varies from maximum of 3 feet or more in northern outcrops to 2 feet or less in northeastern Kansas and northwestern Missouri. Occurrences in Iowa noted. Derivation of name given.

R. C. Moore, 1948, Am. Assoc. Petroleum Geologists Bull., v. 32, no. 11, p. 2035. Member of Topeka formation. Overlies Jones Point shale member; underlies Turner Creek shale 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-gray fossiliferous generally fine-grained complex of two or three beds depending upon presence of shale separations. Usually at least one of beds is massive unit containing brachiopods and pelecypods. Thickness 3. 2 feet north of Thurman, Fremont County; 2.1 feet west of Macedonia, Pottawattomie County; 5 feet near Howe, Adair County. Underlies Turner Creek shale member; overlies Jones Point shale members.

Named for exposures at Vilas Sheldon quarry, east of Nehawka, Cass County, Nebr.

**Shelikof Formation**[1]

Upper Jurassic: Southwestern Alaska.

Original reference: S. R. Capps, 1923, U.S. Geol. Survey Bull. 739, p. 91, 97, map.

L. B. Kellum, 1945, New York Acad. Sci. Trans., ser. 2, v. 7, no. 8, p. 203 (table 1). Comprises (ascending) interbedded sandy shale and fine- to medium-grained silty sandstone, about 100 feet thick; well-stratified gray shale interbedded with thin lenticular layers of limestone and thin beds of soft gray sandstone, 950 feet; Chinitna shale member, 400 to 1,300 feet; gray sandy shale, 200 to 1,200 feet; massive brown to gray sandstone, 4,000 to 4,700 feet; and massive black shale, 700 to 1,000 feet.

R. W. Imlay, 1953, U.S. Geol. Survey Prof. Paper 249–B, p. 48–49, table 5 facing p. 60. In Wide Bay and Puale Bay areas, consists of three lithologic members. Lower siltstone member, 800 to 1,800 feet thick, mainly of gray siltstone and sandy siltstone which contains many sandy interbeds from few inches to 200 feet thick in Wide Bay area and represented by about 800 feet of brown-weathering siltstone that includes many concretions at Puale Bay; middle sandstone member, 1,000 to 3,500 feet, dominantly of massive gray sandstone with interbeds of siltstone and lenses of conglomerate; and upper siltstone member, 900 to 1,500 feet, mostly of hard dark-gray gray-weathering siltstone. Formation shown on table as lateral correlative of Chinitna formation.

Prevailing rock formation on northwest shore of Shelikof Strait, from Katmai Bay at least as far southwest as Kialagvik Bay and in Wide Bay and Puale Bay (formerly Cold Bay) areas.

†Shell Bluff Marl[1] or Group[1] (in Barnwell Formation)[1]

Eocene, upper: Eastern Georgia and South Carolina.

Original reference: T. A. Conrad, 1866, Am. Jour. Sci., 2d, v. 41, p. 96.

Named for Shell Bluff, on Savannah River in Burke County, Ga.

Shell Creek Shale

Lower Cretaceous: Central northern Wyoming.

R. A. Paull, 1957, Dissert. Abs., v. 17, no. 10, p. 2249. Name proposed for the shale sequence above the Muddy and below the Mowry shale. Formerly included in upper part of Thermopolis shale.

**This may or may not be same unit as Shell Creek Shale of Eicher (1960). In Bighorn Basin.**

Shell Creek Shale

Lower Cretaceous: Central northern Wyoming.

D. L. Eicher, 1960, Yale Univ., Peabody Mus. Nat. History Bull. 16, p. 17–18, 34–36, 39, 52, 80. Proposed for soft black shale sequence that underlies Mowry shale and that was included in the upper part of Thermopolis shale of Lupton. Includes a few ironstone beds and concretions and a few prominent white bentonite beds. Thickness at type locality 252 feet; thins southward and pinches out in southern Wyoming. Overlies Muddy sandstone; contact becomes increasingly gradational southward.

Type section: Measured 6 miles northwest of Greybull in N½ sec. 14, T. 53 N., R. 94 W., Big Horn County. Named for exposures along Shell Creek, which flows within 6 miles of type locality; also mappable to north and northeast of Bighorn Basin.

**Shellhammer Hollow Formation**

Mississippian: Northwestern Pennsylvania.

Wallace de Witt, Jr., 1951, Geol. Soc. America Bull., v. 62, no. 11, p. 1347, 1351, 1362. Name proposed for thin sequence of intercalated siltstones, silty mudstones, and shales. Composed of about equal parts of each rock-type in thickest parts; composed almost completely of shale in thinnest parts. Thickness 4 inches to 5 feet. Underlies Bartholomew siltstone member (new) of Orangeville shale; overlies Cussewago sandstone. Grades laterally into easternmost recognizable Bedford shale and Berea sandstone near Meadville. Grades laterally eastward into Corry sandstone. Lower Mississippian.

J. F. Pepper, Wallace de Witt, Jr., and D. F. Demarest, 1954, U.S. Geol. Survey Prof. Paper 259, p. 18 (fig. 9), 41. Further described. More exact location of type section stated.

Type locality: Two miles north of Meadville, Crawford County, where Meadville-Saegerstown Road on east side of French Creek crosses Shellhammer Hollow. Exposed on road on each side of hollow about 20 feet above stream.

Shell Rock Formation

Shell Rock Limestone[1]

Upper Devonian: Central northern Iowa.

Original reference: A. O. Thomas, 1924, Iowa Geol. Survey, v. 29, p. 411–412.

A. H. McNair, 1942, Jour. Paleontology, v. 16, no. 3, p. 349, 350. Fossil collections made from Mason City dolomite member of Shell Rock (Shellrock) formation.

M. A. Stainbrook, 1945, Am. Jour. Sci., v. 243, no. 2, p. 661. Formation includes (ascending) Mason City, Rock Grove, and Nora members.

Named for development along Shell Rock River between Rockford and Nora Springs and northward, Floyd County.

**Shelter Formation**

Lower Cretaceous(?): Southeastern Alaska.

Fred Barker, 1957, U.S. Geol. Survey Geol. Quad. Map GQ–100. Conglomerate with interlayered pebbly graywacke, graywacke, and greenstone. Conglomerate ranges from rock with 40 percent pebbles (by volume) through pebbly graywacke to graywacke. Massive very fined grained chlorite-albite-epidote greenstone with aggregates of opaque white clay overlies the conglomerate. Parent rocks probably were flows and sills of basalt or andesite. Conglomerate and graywacke about 500 to 1.000 feet thick: overlying greenstone at least several hundred feet thick. Formation may grade by facies change into Symonds formation (new).

Extends the length of Shelter Island, and crops out at north end of Portland Island, Juneau (B–3) quadrangle.

Shelton Granite Gneiss[1]

Precambrian: Northern North Carolina and central southern Virginia.

Original reference: A. I. Jonas, 1928, Virginia Geol. Survey prelim. ed. geol. map of Virginia.

C. B. Brown, 1937, Virginia Geol. Survey Bull, 48, p. 14. Exposed in small area northwest of Tabscott, Goochland County. A mylonitized or crushed facies of Columbia granite.

Quarried near Shelton, Caswell County, N.C.

Shelton Cliff Sandstone[1]

Pennsylvanian: Southwestern Indiana.

Original reference: W. N. Logan, 1924, Indiana Dept. Conserv. Pub. 42, p. 16.

Shely Group

Oligocene(?): Southwestern Texas.

D. L. Amsbury, 1957, Dissert. Abs., v. 17, no. 9, p. 1981. Named in a stratigraphic sequence as younger than Vieja formation and older than Moonstone rhyolite (new).

D. L. Amsbury, 1958, Texas Univ. Bur. Econ. Geology Quad. Map 22. Group consists of trachyte tuff, trachyte, rhyolite and rhyolite ignimbrite, and conglomerate. Near Loma Plata mine, overlies Buckshot ignimbrite; from Loma Plata mine to Pinto Creek, overlies progressively older Comanche strata and along the Shely rim rests on Pinto Canyon formation. Underlies Brite rhyolite.

Type locality: In canyon west of Cleveland triangulation station, Pinto Canyon area, Presidio County. Named for Terry Shely Ranch.

**Shenandoah Limestone**[1]

Shenandoah Group

Lower Cambrian to Middle Ordovician: Eastern West Virginia and western Virginia.

Original reference: H. R. Geiger and A. Keith, 1891, Geol. Soc. America Bull., v. 2, p. 157–163, pl. 4.

C. E. Resser, 1938. Geol. Soc. America Spec. Paper 15, p. 3, 4. Shenandoah limestone listed among abandoned names. It was common practice of earlier workers to group the calcareous strata of Appalachian Valley under one term; thus the Shenandoah limestone was used for the calcareous rocks above the clastics; consequently Shenandoah group of older usage includes all formation from Lower Cambrian Shady or Middle Cambrian Elbrook to Ordovician.

A. A. Pegau, 1958, Virginia Div. Mineral Resources Circ. 7, p. 9. In northern valley of Virginia, Shenandoah group includes Stones River limestone below and Chambersburg limestone. Ordovician. Undifferentiated Shenandoah is classed as Cambro-Ordovician.

Shenandoah River valley, West Virginia, is characterized by this limestone.

Shenandoah Mountain Granite[1]

Precambrian: Southeastern New York.

Original reference: C. E. Gordon, 1911, New York State Mus. Bull. 148, p. 11, 17–18.

Occurs on Shenandoah Mountain, at summit of steep northwest slope, along road from East Hook to Hortontown, Poughkeepsie quadrangle.

Shenandoan Series[1]

Lower Ordovician: Southern Appalachians and Mississippi regions.

Original reference: A. W. Grabau, 1936, Pan-Am. Geologist, v. 66, no. 1, p. 27.

A. W. Grabau, 1937, Paleozoic formations in the light of the pulsation theory, v. 3, Cambrovician pulsation, pt. 2, Appalachian, Palaeocordilleran, Pre-Andean, Himalayan, and Cathaysian geosynclines: Peiping, China, Univ. Press, Natl. Univ. Peking, p. 11–12, 13 (table), 15, 282 (table). Proposed to revive name Shenandoan group or Shenandoan by restricting it to cover the post-Ozarkian part of the Cambrovician as here defined—that is—southern equivalent of the Beekmantown or Canadian. Term is used for Lower Ordovician of southern Appalachians and Mississippian region in place of Beekmantownian or Canadian, but excluding from it the Stonehenge division and its equivalents elsewhere in this southern region.

Shenango Formation (in Pocono Group)

†Shenango Group[1]

Mississippian: Northwestern Pennsylvania and northeastern Ohio.

Original reference: I. C. White, 1881, Pennsylvania 2d Geol. Survey Rept. $Q_4$, p. 66, 77–81.

Carlyle Gray and others, 1960, Geologic map of Pennsylvania (1:250,000): Pennsylvania Geol. Survey, 4th ser. As mapped, Pocono group includes, in Appalachian Plateau, Burgoon, Shenango, Cuyahoga, Cussewago, Corry, and Knapp formations.

Named for exposures on Shenango River, Mercer County, Pa.

Shenango monothem[1]

Mississippian: Northwestern Pennsylvania and northeastern Ohio.

Original reference: K. E. Caster, 1934, Bulls. Am. Paleontology, v. 21, no. 71, p. 138–139.

Shenango Sandstone[1]

Lower Mississippian: Northwestern Pennsylvania and eastern Ohio.

Original reference: J. P. Lesley and I. C. White, 1879, Pennsylvania 2d Geol. Survey geol. map of Mercer County.

E. J. Szmuc, 1958, Dissert. Abs., v. 18, no. 6, p. 2109. Shenango sandstone wedges out a short distance west of Ohio-Pennsylvania State line. Evidence indicates that sandstone and overlying Hempfield shale are stratigraphic equivalents of upper part of Meadville member of Cuyahoga; previous correlations with Logan formation are erroneous.

Exposed along Shenango River, Mercer County, Pa.

†Shenango Series[1]

†Shenango River Series[1]

Mississippian and Pennsylvanian: Western Pennsylvania.

Original reference: F. Platt, 1875, Pennsylvania 2d Geol. Survey Rept. H., p. 1–9.

Named for Shenango River, Mercer County.

Shenango Shale[1]

Mississippian: Northwestern Pennsylvania.

Original reference: I. C. White, 1880, Pennsylvania 2d Geol. Survey Rept. $Q_3$, p. 59–60.

R. M. Leggette, 1936, Pennsylvania Geol. Survey, 4th ser., Bull. W-3, p. 114. Top 75 feet of sandstone and shale of the Pocono group in this area (Crawford County) has been correlated with the Burgoon sandstone and is now called by that name. These beds are the Shenango shale and Shenango sandstone of White. The shale which occurs between the Sharon conglomerate [above] and the sandstone is as much as 60 feet thick.

Named for exposures on Shenango River, Mercer County.

Shenango Stage[1]

Mississippian: Pennsylvania.

Original reference: K. E. Caster, 1934, Bulls. Am. Paleontology, v. 21, no. 71, p. 138–139.

Hugo Greiner, 1957, Yale Univ., Peabody Mus. Nat. History Bull. 11, p. 9 (table). Discussion of evolution and paleoecology of "*Spirifer disjunctus*" in Catskill delta. Stratigraphic chart lists Shenango stage at top of Kinderhookian series. Follows Meadville stage.

Named derived from Shenango River, Mercer County.

**Shepard Formation**[1] (in Missoula Group)

Shepard Dolomite (in Siyeh or Wallace Group)

Shepard Formation (in Piegan Group)

Precambrian (Belt Series): Northwestern Montana, and southern 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. 1899–1900. Shepard formation consists of argillaceous and siliceous dolomites and magnesian limestones in thin strata but thick beds; dark gray, green gray, or brown. Interbeds of greenish-white magnesian quartzites basally. Ripple marks, mud cracks, channel fillings, and edgewise mud breccias characteristic. Represents final stage of Piegan sedimentation. Thickness 585 to 1,500 feet. Younger than Spokane formation, older than Miller Peak formation. Type locality given.

C. P. Ross, 1949, (abs.) Washington Acad. Sci. Jour., v. 39, no. 3, p. 112, 113. Reallocated to Missoula group. This classification follows Clapp and Deiss (1931, Geol. Soc. America Bull., v. 42, chart and p. 691).

S. D. Theodosis, 1955, Billings Geol. Soc. Guidebook 6th Ann. Field Conf., p. 62, chart facing p. 62. Considered to be the upper member of Upper Siyeh limestone and part of Siyeh or Wallace group.

C. P. Ross, 1959, U.S. Geol. Survey Prof. Paper 296, p. 19 (table), 52–53, pls. 1, 2. Shepard [originally spelled Sheppard] formation in Glacier National Park is coextensive with underlying Purcell basalt. Thickness about 400 feet. Missoula group.

Type locality: Cliffs of Lewis Range near Shepard [Sheppard] Glacier, Glacier National Park, Mont. Well exposed on Mount Carthew, Boulder, and Swiftcurrent Peaks, mountains near Logan Pass, and in valley of Middle Fork of Flathead River.

Shepherdstown Gravel[1]

Pliocene(?): Northern West Virginia and southern Pennsylvania.

Original reference: M. R. Campbell, 1933, Geol. Soc. America Bull., v. 44, no. 3, p. 558–573.

Well developed at Shepherdstown, W. Va.

Sheppard Formation

*See* **Shepard Formation.**

**Sheppard Granite**[1]

Tertiary: Southern British Columbia, Canada, and northeastern Washington.

Original reference: R. A. Daly, 1912, Canada Geol. Survey Rept. Mines Mem. 38, p. 354–356, map 8.

Forms small stock at head of Sheppard Creek, British Columbia.

Sherburne Conglomerate[1]

Cambrian or Ordovician: Southern Vermont.

Original reference: C. H. Richardson, 1929, Vermont State Geologist 16th Rept., p. 208–246, table opposite p. 288.

H. E. Hawkes, Jr., 1941, Geol. Soc. America Bull., v. 52, no. 5, p. 654, 655, 657. Included in upper part of Plymouth Union series (new) north of Sherburne.

W. F. Brace, 1953, Vermont Geol. Survey Bull. 6, p. 46–47, pl. 1. Included in Cambro-Ordovician Tyson formation as unnamed coarse conglomerate near base.

Good exposures about 2 miles southeast of North Sherburne, Rutland County, at head of narrow valley leading down to Sherburne.

**Sherburne Flagstone Member** (of Genesee Formation)

Sherburne Flagstone Member (of Portage Formation)[1]

Sherburne Formation

Upper Devonian: Eastern and central New York.

Original reference: L. Vanuxem, 1840, New York Geol. Survey 4th Ann. Rept., p. 381.

W. L. Grossman, 1944, Geol. Soc. America Bull., v. 55, no. 1, p. 45, 47 (fig. 2), 66–70. Name Sherburne includes rocks between top Penn Yan tongue (new) of West River and base of Middlesex remnant. According to original definition (Vanuxem, 1840), the Sherburne at type locality is a sparsely fossiliferous shale and sandstone series overlying Geneseo and terminating at first appearance in abundance of Ithaca fossils. Cooper and Williams (1935) indicate that the Sherburne east of type locality, as indicated by workers after Vanuxem, includes beds as low as the Tully, which in this area is same facies as the Sherburne. Sherburne as used in this report includes 310 feet of interbedded shales and flags (siltstones and very fine sandstones) between Penn Yan tongue (new) of the West River and the attenuated remnant of Middlesex black shale in Cayuga Lake valley. Starkey tongue (new) penetrates westward into West River shale, between Penn Yan tongue and Milo tongue (new) of West River in central New York.

R. G. Sutton, 1959, Am. Assoc. Petroleum Geologists Bull., v. 43, no. 1, p. 231 (table 1), 236 (fig. 4), 237. Discussion of use of flute casts in stratigraphic correlation. West River shale is equivalent to Sherburne sandstone and Ithaca formation.

Wallace de Witt, Jr., and G. W. Colton, 1959, Am. Assoc. Petroleum Geologists Bull., v. 43, no. 12, p. 2814 (fig. 3), 2815, 2821, 2824. Sherburne flagstone member is excluded from Portage formation of Williams (1906, Science, new ser., v. 24: Williams and others, 1909, U.S. Geol. Survey Geol. Atlas, Folio 169) and assigned to Genesee formation. Flagstone member, as here defined, lies above Penn Yan shale member and below Renwick shale member. Name Sherburne was originally applied to a sequence of silty and sandy rocks above a black shale that overlies the Tully limestone in vicinity of Sherburne. Member in vicinity of Cayuga Lake is western part of wedge of sandy rocks that was originally named Sherburne by Vanuxem. At reference section, herein designated, member is 110 feet thick. Member is composed largely of very silty shale, very silty mudrock, and cross-laminated siltstone in beds 1 inch to 3 feet thick. Near Ithaca, the first *Reticularia laevis* zone of Williams and others (1909) is upper 35 feet of the member. Upper boundary of the Sherburne member is at base of lowest bed of brownish black shale of Renwick member. Traced westward from vicinity of Ithaca to exposures near south end of Seneca Lake where it is about 40 feet thick. Grades laterally into gray shale and mudrock in lower part of Penn Yan shale member in area north and west of Fir Tree Point, on west side of Seneca Lake, 6 miles north of Watkins Glen, and is not present in exposures at Keuka Lake.

Reference section: Glenwood Creek, in Cayuga Lake area. Named for occurrence near Sherburne, Chenango County.

†Sherburne Group[1]

Devonian: New York.

Original reference: T. A. Conrad, 1841, New York Geol. Survey 5th Ann. Rept., p. 31.

Occurs near Apulia, Onondaga County.

†Sherburne Shale[1]

Middle Devonian: Central southern New York.

Original reference: W. W. Mather, 1843, Geology New York, v. 1

†Sheridan Beds[1]

Pleistocene: South Dakota to panhandle of Texas.

Original reference: W. B. Scott, 1897, Introduction to geology, p. 532–533.

J. C. Frye and A. B. Leonard, 1952, Kansas Geol. Survey Bull. 99, p. 110. Used by Scott (1897) for beds that are now, at least in part, the Sanborn formation.

Named for exposures in Sheridan County, Nebr.

Sheridan Formation[1]

Middle Ordovician: Northwestern Michigan.

Original reference: R. C. Allen, 1910, Michigan Geol. and Biol. Survey Pub. 3, geol. ser. 2, p. 113.

On Sheridan Hill, Iron River district.

†Sheridan Quartzite[1]

Precambrian: Northwestern Wyoming.

Original reference: W. H. Weed, 1896, U.S. Geol. Survey Geol. Atlas, Folio 30.

J. D. Love and others, 1951, U.S. Geol. Survey Oil and Gas Inv. Chart OC-43. Term abandoned. Lower 40 feet of the "rusty beds" of Morrison(?)—Cloverly sequence is a quartzite that forms cliffs. This is part of quartzite sequence that Weed (1896) named Sheridan quartzite and that he considered to be of Precambrian age. Weed's type area of the Sheridan was restudied; in several places, a normal stratigraphic section is exposed in which the lower quartzite overlies variegated beds of the Cloverly and is overlain by black Thermopolis shale. This shale is, in turn, overlain by an upper quartzite that is in the stratigraphic position of Muddy sandstone member of the Thermopolis. Weed did not explain why he considered the quartzite Precambrian.

Well exposed on slopes of Mount Sheridan, Yellowstone National Park.

Sheridan Sandstone[1]

Silurian: Northeastern Maine.

Original reference: H. S. Williams, 1900, U.S. Geol. Survey Bull. 165, p. 21, 45, 47–49, 51.

W. H. Twenhofel, 1941, Jour. Paleontology, v. 15, no. 2, p. 172–173, 174. Stratigraphic revision. Unit now considered younger than shales and limestones of the Ashland formation.

R. L. Miller, 1947, Maine Geol. Survey Bull. 4, p. 8, 9. Name not used; preoccupied by a Precambrian unit in Yellowstone National Park.

Named for exposures on Sheridan plantation, south of Aroostook River, in Aroostook County.

**Sherman Diorite[1]**

Miocene: Yellowstone National Park, Wyoming.

Original reference: A. Hague and others, 1904, U.S. Geol. Survey Mon. 32, Atlas.

Exposed on Sulphur Creek in vicinity of Hot Springs, Canyon quadrangle. Derivation of name not stated.

**Sherman Granite[1]**

Precambrian: Southeastern Wyoming and northern Colorado.

Original reference: E. Blackwelder, 1908, Science, new ser., v. 27, p. 778–788.

T. S. Lovering and E. N. Goddard, 1950, U.S. Geol. Survey Prof. Paper 223, p. 28. Older than Silver Plume granite and probably correlated with Pikes Peak granite.

Exposed in large batholith extending from northern part of Front Range, Colo., well into Wyoming. Mapped over large area at and around Sherman, Albany County, Wyo.

Sherman Marble[1]

Lower Cambrian(?): Southeastern Vermont.

Original reference: G. D. Hubbard, 1924, Vermont State Geologist 14th Rept., p. 269–276, map.

Well exposed in and named for town of Sherman, on Hoosac Tunnel and Wilmington Railroad, Whitingham Township, Windham County.

Sherman Fall Formation (in Trenton Group)[1]

Middle Ordovician: Northwestern New York, and Ontario, Canada.

Original reference: G. M. Kay, 1929, Jour. Geology, v. 37, no. 7, p. 664–671.

G. M. Kay, 1937, Geol. Soc. America Bull., v. 48, no. 2, p. 263–268, 271. Overlies Hull formation and underlies Cobourg limestone in northwestern New York and Ontario. Type section lacks exposure of about 30 feet of base of formation, but total thickness in vicinity is about 200 feet. Comprises Shoreham and Denmark members (both new). In Oneida County, includes Dolgeville facies. Trenton group.

P. A. Chenoweth, 1952, Geol. Soc. America Bull., v. 63, no. 6, p. 525–535. In this report, Shoreham and Denmark members are raised to formational rank.

Marshall Kay, 1953, New York State Mus. Bull. 347, p. 42. Sherman Fall was originally defined as "the 'Prasopora beds' or 'Trenton (restricted)' of Raymond, Johnston and others." It was originally supposed to include beds now classified as the whole of the Russia and lower half of Rust limestone at Trenton Falls, 105 feet of beds above Sherman Fall; subsequent study shows that the "Prasopora beds" correspond to the Shoreham and Denmark formations of this report [Utica quadrangle].

Named for Sherman Fall, in Trenton Falls Gorge of West Canada Creek, Oneida County, N.Y.

Shermanian (Sherman Fall) Stage

Middle Ordovician (Trentonian): Eastern North America.

G. M. Kay, 1937, Geol. Soc. America Proc. 1936, p. 82. Stage in middle Trenton.

G. M. Kay, 1937, Geol. Soc. America Bull., v. 48, no. 2, p. 263–277, 293, 298. Discussion of stratigraphy of Trenton group and list of formations of Sherman Fall age. Medial Trenton marked a time of distinct alteration of preceding conditions [Rockland and Hull stages]. Maximum of lower Trenton submergence seems to have been reached in earliest part of Sherman Fall stage—the Shoreham. In middle Trenton Sherman Fall stage, the Vermontian disturbance produced a geanticline east of the region that became an important synchronous elevation of Adirondack arch.

Marshall Kay, 1960, Internat. Geol. Cong., 21st, Cophenhagen, pt. 7, p. 30. Suggested that term Shermanian stage be applied to Shorehamian and Denmarkian substages. Shermanian stage follows Nealmontian stage and is followed by Pictonian stage.

Name derived from Sherman Fall, Trenton Falls gorge, New York, for which Sherman Fall limestone was named.

Sherman Ridge Formation (in Hamilton Group)

Upper Devonian: East-central Pennsylvania.

H. H. Arndt and others. 1959, Geol. Soc. America Guidebook Pittsburgh Mtg., p. 3–4. Overlies Montebello formation and consists of Mahantango-type shales. Includes as much as 550 feet of section. Name credited to Miller (unpub. ms.).

Type locality and derivation of name not stated.

**Sherwin Glaciation**

Sherwin glacial stage[1]

Sherwin 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. 1281, 1290. At least four ice advances occurred in Pleistocene: earliest, here named Aeolian Buttes, was followed by Sherwin, Tahoe, and Tioga, previously named by Blackwelder. Constructional forms have been destroyed on the two older tills but preserved on the later ones. Rhyolitic ash and pumice, now Bishop welded tuff, were erupted in interval between Aeolian Buttes and Sherwin glacial stages.

W. C. Putnam, 1960, California Univ. Pubs., Geol. Sci., v. 34, no. 5, p. 233–235, map 1. Sherwin till is pre- rather than post-Bishop tuff. Name Aeolian Buttes considered invalid as representing an earlier Pleistocene. pre-Sherman glacial stage. Sherwin is second in sequence of four major glacial tills on eastern slope of the Sierra Nevada; it was preceded by McGee stage. Part of till rests unconformably on pre-Tertiary crystalline rocks, another part on late Tertiary (?) basalt.

Name amended to glaciation in compliance with 1961 Code of Stratigraphic Nomenclature.

Well developed in area north of Sherwin Hill, northwest of Bishop, in Mount Morrison quadrangle. Putnam states type locality of till at Sherwin Hill in Mount Goddard quadrangle. Greatest expanse of till is in lobe east of Whiskey Canyon; along both sides of Rock Creek gorge, thickness of about 450 feet of glacial detritus is exposed.

†Sherwood Limestone[1]

Lower Cambrian: Central western Virginia.

Original reference: H. D. Campbell, 1905, Am. Jour. Sci., 4th, v. 20, p. 445–447.

Named for exposures in James River at Sherwood, Rockbridge County.

Sherwood 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. 24, figs. 3, 12. Dolomite, argillaceous and very cherty in upper part. Thickness about 10 feet. Shown on columnar section as underlying Wall member (new) and overlying Rivoli member (new).

Occurs in Dixon-Oregon area.

Shetlerville Formation[1]

Shetlerville Member (of Renault Formation)

Mississippian (Chester Series): Southeastern Illinois and northern Kentucky.

Original references: S. Weller, 1920, Jour. Geology, v. 28, no. 4, p. 281–290 and no. 5, p. 395–416; 1920, Illinois Geol. Survey Bull. 41.

Elwood Atherton, 1947, Illinois Acad. Sci. Trans., v. 40, p. 129, 130 (fig. 7), 131 (fig. 8). Frank Tippee (unpub. ms.) correlated upper part of Renault with basal Paint Creek of western Illinois and proposed name Downeys Bluff for this member of the Paint Creek; remainder of the Renault is referred to as the Shetlerville member. Overlies Levias member of Ste. Genevieve.

J. M. Weller and others, 1952, Illinois Geol. Survey Bull. 76. p. 62–63. In fluorspar district, discussed as member of Renault; consists of alternating beds of limestone and shale in about equal proportions. Thickness about 60 feet. Underlies Downeys Bluff member; at most places, separation of the two is difficult, especially where shale is not abundant in the Shetlerville; at Downeys Bluff, contact is unconformable; overlies Levias limestone unconformably, and at some places zone of rounded limestone pebbles marks this boundary.

Named for Shetlerville, Hardin County, Ill. Well exposed just east of Shetlerville between Rich and Melcher Hills.

**Shields 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. Most prominent rocks are sandstone and conglomerate which form units a few feet to more than 1,000 feet thick that project in ledges and ridges; sandstones are coarse grained, feldspathic, and not graded; conglomerates are interbedded with the sandstones as seams, lenses, and thick beds; associated with sandstone and conglomerate is argillaceous shale, which contains thin lenses of gritty sandstone. In type area, shales dominate upper half of formation but intertongue at their base with sandstones and conglomerates of the lower half. Overlies Licklog formation (new); underlies Sandsuck formation.

Named for Shields Mountain, [Sevier County], a high ridge along the northwest edge of the foothills west of the Little River, which is made up of a southeastward-dipping sequence of the formation 2,000 to 2,500 feet thick.

**Shiloh Marl Member** (of Kirkwood Formation)[1]

Miocene, middle: Southern New Jersey.

Original reference: W. H. Dall and G. D. Harris, 1892, U.S. Geol. Survey Bull. 84, p. 40–44.

H. E. Wood 2d and others, 1941, Geol. Soc. America Bull., v. 52, no. 1, p. 31, pl. 1. Probably late Hemingfordian.

D. S. Malkin, 1953, Jour. Paleontology, v. 27, no. 6, p. 763. Incidentally mentioned in discussion of ostracods from middle Miocene formations.

Unit from which samples were taken might be more accurately described as a fine-grained argillaceous fossiliferous sand.

First described at Shiloh, Cumberland County.

**Shimer Gypsum Member** (of Blaine Formation)[1]

Permian: Central southern Kansas and western Oklahoma.

Original reference: F. W. Cragin, 1896, Colorado Coll. Studies, v. 6, p. 27, 28, 31.

G. H. Norton, 1939, Am. Assoc. Petroleum Geologists Bull., v. 23, no. 12, p. 1794, 1797. Overlies Nescatunga gypsum (new). Thickness at type locality 24 feet.

R. C. Moore and others, 1951, Kansas Geol. Survey Bull. 89, p. 39. Underlies Haskew gypsum member; overlies Nescatunga gypsum member. Leonard series.

Type locality: Shimer Township, Comanche County, Kans. Well exposed at confluence of Nescatunga Creek with Salt Fork Creek, where it caps an outlier of the Blaine.

Shinarump Clay[1]

[Upper Triassic]: Southern Utah.

Original reference: A. C. Lawson, 1913, Econ. Geology, v. 8, p. 435.

†Shinarump Group[1]

Triassic: Utah, Arizona, and northwestern New Mexico.

Original reference: J. W. Powell, 1876, Geology of eastern portion of Uinta Mountains, p. 41, 53, 54, 68, 150, 152.

Named for Shinarump Cliffs, south of Vermilion Cliffs, Kane County, southern Utah.

**Shinarump Member** (of Chinle Formation)

Shinarump Conglomerate[1]

Upper Triassic: Southern and northeastern Utah, northern Arizona, southeastern Nevada, and northwestern New Mexico.

Original reference: G. K. Gilbert, 1875, U.S. Geol. and Geog. Survey W. 100th M., v. 3, p. 1–187.

A. A. Baker, 1936, U.S. Geol. Survey Bull. 865, p. 44–47, pl. 1. Shinarump conglomerate, in Monument Valley-Navajo Mountain region, San Juan County, Utah, has maximum thickness of 210 feet. Unconformably overlies Moenkopi formation; underlies Chinle formation.

Parry Reiche, 1937, Am. Jour. Sci., 5th, v. 34, no. 200, p. 130. In Cameron area, Arizona, Shinarump sandstones underlie Tolchaco gravels (new).

H. E. Gregory, 1938, U.S. Geol. Survey Prof. Paper 188, p. 48–49. Shinarump conglomerate, in San Juan country is 0 to 120 feet thick. Unconformably overlies Moenkopi; underlies Chinle.

E. T. McKnight, 1940, U.S. Geol. Survey Bull. 908, p. 63–66, pls. Shinarump conglomerate, in area between Green and Colorado Rivers, Grand and San Juan Counties, Utah, is 0 to 50 feet thick. Unconformably overlies Moenkopi formation; underlies Chinle formation.

K. G. Brill, Jr., 1942, Am. Assoc. Petroleum Geologists Bull., v. 26, no. 8, p. 1392. Shinarump conglomerate in Gore area, Eagle and Summit Counties, Colo., unconformably overlies State Bridge formation.

J. S. Williams, 1945, Am. Jour. Sci., v. 243, no. 9, p. 477–478. Shinarump conglomerate, in eastern Uinta Mountains, underlies Chinle shale and unconformably overlies Red Wash formation (new).

A. A. Baker, 1946, U.S. Geol. Survey Bull. 951, p. 58–60, pls. 1, 3. Shinarump conglomerate, in Green River Desert-Cataract Canyon area, Emery, Wayne, and Garfield Counties, Utah, is 0 to 135 feet thick. Overlies Moenkopi formation; underlies Chinle formation.

C. L. Camp and others, 1947. Plateau, v. 20, no. 1, p. 1, 8 (chart). Shinarump believed to be basal conglomerate of Chinle.

H. J. Bissell, 1952, Am. Assoc. Petroleum Geologists Bull., v. 36, no. 4, p. 594, 595. In Strawberry Valley quadrangle, Utah, disconformably overlies Ankareh shale and underlies Chinle formation. Thickness 35 feet.

E. D. McKee, 1952, New Mexico Geol. Soc. Guidebook 2d Field Conf., p. 87 (fig. 1). In Little Colorado River area overlies Holbrook member of Moenkopi.

D. M. Kinney, 1955, U.S. Geol. Survey Bull. 1007, p. 63–67, pls. 3, 6. Shinarump conglomerate, in Uinta River-Brush Creek area, Duchesne and Uintah Counties, Utah, is 0 to 90 feet thick and consists of light-gray medium- to coarse-grained in part conglomeratic sandstone. Unconformably overlies Moenkopi formation; underlies Chinle formation.

J. H. Stewart, 1957, Am. Assoc. Petroleum Geologists Bull., v. 41, no. 3, p. 442–444, 448 (fig. 4), 449–452. Strata formerly called Shinarump conglomerate in southeastern Utah consist, in places, of a lower sandstone and conglomerate unit, a middle claystone unit, and an upper sandstone and conglomerate unit. The lower and upper units are Shinarump-type deposits whereas middle unit is Chinle-type deposit. Deposits of Shinarump-type and Chinle-type are interstratified and intertonguing. Proposed that the two types be grouped together in Chinle formation and that Shinarump conglomerate be redefined as Shinarump member of Chinle. Lower unit is correlative with strata in southwestern Utah, that are designated as type Shinarump conglomerate, and it is proposed that term Shinarump member be restricted in southeastern Utah to this lower unit. The middle and upper units, although formerly included in the Shinarump conglomerate, are considered separate members of the Chinle; middle unit has been defined as Monitor Butte member of Chinle, and name Moss Back is proposed for upper unit. In southeastern Utah, Shinarump conglomerate included, in places, all of the Shinarump, Monitor Butte and Moss Back Members. In other places, Shinarump conglomerate consisted only of Moss Back member, and in still other parts of southeastern Utah, Shinarump conglomerate consisted of only the Shinarump member. Locally, in San Rafael Swell area, unit now called Temple Mountain member, was included in Shinarump conglomerate. Although this report deals mainly with southeastern Utah, it is believed that term Shinarump member of Chinle should replace term Shinarump conglomerate everywhere. Name Shinarump member should be restricted to strata that can be correlated with reasonable certainty with type Shinarump; where correlations are less certain or where units can be shown to be distinct from Shinarump, other names should be applied. Member has same type area as unit formerly called Shinarump conglomerate. Member ranges in thickness from wedge-edge to 225 feet; commonly not more than 50 feet. Unconformably overlies Moenkopi formation except in few places where it overlies strata possibly correlative with Temple Mountain member; conformably underlies Monitor Butte member. Shinarump member is recognized in many areas outside southeastern Utah. It extends through much of northern and southern Utah and may be present in Nevada and New Mexico. Longwell (1928, U.S. Geol. Survey Bull. 798), Glock (1929, Am. Jour. Sci., 5th, v. 17), and Hewitt (1931, U.S. Geol. Survey Prof. Paper 162) have recognized Shinarump conglomerate (Shinarump member of present report) in southeastern Nevada, but present author considers this a tentative correlation. Unit mapped by Darton (1928, U.S. Geol. Survey Bull. 794) as Shinarump conglomerate on north and west sides of Zuni uplift, west-central New Mexico, lies 400 feet above base of Chinle and was incorrectly called Shinarump. Unit called Shinarump in northeastern Utah by Kinney (1955) and in northwestern Colorado by Thomas, McCann, and Raman (1945, U.S. Geol. Survey Oil and Gas Inv. Prelim. Chart 16) is correlated with strata higher stratigraphically than type Shinarump, and author does not believe that term Shinarump is justified in these areas. Strata, called Shinarump in publications prior to 1952, in southeastern Utah were composed of most of units now called Temple Mountain, Shinarump, Monitor Butte, and Moss Back members of Chinle. Unit called Shinarump conglomerate by Baker (1936), Miser (1924, U.S. Geol. Survey Water-Supply Paper 538; 1924, U.S. Geol. Survey Bull. 751–D), Gregory and Moore (1931, U.S. Geol. Survey Prof. Paper 164), Hunt (1953, U.S. Geol. Survey Prof. Paper 228), and Gregory and Anderson (1939, Geol. Soc. America Bull., v. 50, no. 12, pt. 1) in Monument Valley, Circle Cliffs, and Capital Reef areas is essentially same as Shinarump member of present report. In part of White Canyon and Elk Ridge areas, Shinarump conglomerate of Gregory (1938) is Moss Back member. In these places, Gregory included the Monitor Butte member and Shinarump member, where present, in the Moenkopi. In other places in White Canyon and Elk Ridge areas, the Shinarump conglomerate of Gregory is apparently the Shinarump member, and he included the Monitor Butte and Moss Back members in the Chinle. In area near junction of Green and Colorado Rivers, the Shinarump and Monitor Butte members are absent, and unit mapped as Shinarump conglomerate by Baker (1933, U.S. Geol. Survey Bull. 84; 1946) and McKnight (1940) is the Moss Back. McKnight's Shinarump does not extend as far up the Green River as Moss Back of present report. In San Rafael Swell, Shinarump conglomerate of Gilluly (1929, U.S. Geol. Survey Bull. 806–C), Baker (1946), and Hunt (1953) consists mostly of Moss Back and Monitor Butte members or of Moss Back where Monitor Butte is absent. In San Rafael Swell, these authors included Temple Mountain member in Shinarump in some places; in other places, they included it partly in the Shinarump and partly in the Moenkopi; in still other places, they included it entirely in the Moenkopi. In Moab area, unit called Shinarump conglomerate by Baker (1933) and McKnight (1940) is not considered by present author to be correlative with either Shinarump or Moss Back, but is a stratigraphically higher conglomeratic sandstone at base of Chinle and is arbitrarily assigned to Church Rock member.

Type locality: Shinarump Cliffs, south of Vermilion Cliffs, southern part of Kane County, Utah.

Shinersville Conglomerate (in Pottsville Formation)[1]

Pennsylvanian: Northeastern Pennsylvania.

Original reference: F. Platt, 1880, Pennsylvania 2d Geol. Survey Rept. $G_2$, p. 186–199.

Exposed near Shinersville school house, Sullivan County.

Shingle Hills Formation (in Trinity Group)

Lower Cretaceous: Central Texas.

V. E. Barnes, 1948, Texas Univ. Bur. Econ. Geology Rept. Inv. 2, p. 1, 7 (fig. 2), 8. Proposed to include Glen Rose limestone member (above) and Hensell sand member. Upper formation of group; overlies Travis Peak formation (restricted).

Named for Shingle Hills in western Travis County where entire sequence of Hensell sand and Glen Rose limestone is traversed by road between Hamilton Pool and Shingle Hills.

Shingle Pass Tuff

Tertiary: Eastern Nevada.

E. F. Cook, 1960, Intermountain Assoc. Petroleum Geologists Guidebook 11th Ann. Field Conf., p. 140 (fig. 4). Highly welded, dark red vitric-crystal ignimbrite. Thickness 80 to 130 feet. Occurs above Needles Range formation.

Present in Grant Range.

**Shinumo Quartzite** (in Unkar Group)[1]

Precambrian (Grand Canyon Series): Northern Arizona.

Original reference: L. F. Noble, 1914, U.S. Geol. Survey Bull. 549.

J. H. Maxon, 1949, (abs.) Geol. Soc. America Bull., v. 60, no. 12, pt. 2, p. 1963. Thickness 1,500 feet in Bright Angel quadrangle. Overlies Hakatai shale. Grand Canyon series.

Named for exposures in Canyon of Shinumo Creek, Shinumo quadrangle, Grand Canyon region.

Ship Mountain Granite

Jurassic: California.

O. P. Jenkins, 1938, Geologic map of California (1:500,000): California Div. Mines, sheet 4. Shown on map legend.

Shippensburg Formation

Middle Ordovician (Bolarian): South-central Pennsylvania and western Maryland.

L. C. Craig, 1941, (abs.) Geol. Soc. America Bull., v. 52, no. 12, pt. 2, p. 1963–1964. Name given to beds formerly included in basal part of Chambersburg limestone. Consists of dark-gray limestone, cobbly below and even bedded above. Thickness 500 feet. Underlies Mercersburg formation (new); overlies "Lowville." Shippensburg thins westward from Marion to extinction along Cove and North Mountains. In western belts of outcrop in Cumberland Valley, the Mercersberg and Greencastle converge, the former being separated from the 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), 717–718. Redefined and subdivided. Stratigraphically restricted by assignment of beds at top of formation to Mercersburg formation. Includes five distinct limestone types: dark gray, fine-grained, and cobbly; dark gray, fine grained, and evenly bedded; medium to coarse calcarenite; interbedded dark-gray medium-grained limestone and calcilutite pellet conglomerate; and dove-colored calcilutite. Seven metabentonites recognized in eastern belts of outcrop; not all present in one section. In western belts, includes (ascending) Pinesburg, Fannettsburg and Doylesburg members (all new). In eastern belts, where thickest only Pinesburg and Fannettsburg members are recognized. Thickness 416 feet at type locality; thins to northeast, south, and west. Unconformably overlies "Stones River" limestone; unconformably underlies Mercersburg formation. Upper contact marked by lithologic change and a prominent irregular partially silicified bedding surface; lower contact poorly exposed and marked only by contrasting lithologic character at type section. Geographically extended to Maryland. 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. Mapped in lower part of Chambersburg formation.

Type section: Along Cumberland Valley 2.1 miles southwest of Marion, Franklin County, Pa. Named for exposure at Middle Spring 2.5 miles northwest of Shippensburg, Franklin County.

Shipps Creek Shale Member (of Wautubbee Formation)

Eocene (Claiborne): West-central Mississippi.

E. P. Thomas, 1942, Mississippi Geol. Survey Bull. 48, p. 62–65, pl. 2. Carbonaceous shales complexly interbedded and interlensed with silts and sands. Thickness 43 feet at type section. Underlies Cockfield formation, contact varies from sharply defined to transitional; overlies undifferentiated Wautubbee with contact conformable and highly transitional and arbitrarily drawn at base of section in which carbonaceous shales are predominant facies in southwestern Carroll and northwestern Holmes Counties.

Type section: Along county road south of bridge across Shipps Creek, SE¼NE¼ sec. 28, T. 15 N., R. 3 E., about 4 miles northeast of Lexington, Holmes County.

†Shirley Stage[1]

Upper Jurassic: Southeastern Wyoming.

Original reference: W. C. Knight, 1900, Geol. Soc. America Bull., v. 11, p. 377–388.

Named for Shirley Mountains.

Shiwits shale[1] or sandstones (in Tusayan Series)

Permian: Northwestern Arizona.

Original reference: C. R. Keyes, 1922, Pan-Am. Geologist, v. 38, no. 3, p. 251, 338.

Charles Keyes, 1936, Pan-Am. Geologist, v. 66, no. 3, p. 215 (table). In Tusayan series (new) of Carbonic age. Overlies Yampai shales; unconformably underlies Hermit shales.

In Grand Canyon region.

**Shnabkaib Member** or **Shale Member** (of Moenkopi Formation)[1]

Lower Triassic: 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.

H. E. Gregory, 1950, U.S. Geol. Survey Prof. Paper 220, p. 60, 61. Described in Zion Park region where it is 216 to 476 feet thick; underlies an unnamed upper red member and overlies an unnamed middle red member. Cream-white, pink, and green-white gypsum in regular beds one-eighth to 3 inches thick and deep-red soft arenaceous gypsiferous mud shales; a few thin layers and oolitic aggregates of marine fossiliferous limestone.

Named for Shnabkaib Mesa, 2 miles southeast of town of Washington, on northwestern flank of Washington dome, Washington County, Utah.

**Shoal Gneiss**

Precambrian: Southwestern Virginia.

A. J. Stose and G. W. Stose, 1957, Virginia Div. Mineral Resources Bull. 72, p. 41–43, pl. 1. Fine-grained banded gneiss containing quartz and feldspar porphyroclasts. Sericite schist interlayered with the porphyroclastic gneiss. On uplands schists weather to micaceous clay soil containing sericitic fragments. In places along Beaverdam and Brush Creeks, near Penitentiary Hill and northward, and in Privett Knob, unit is dark-colored biotite mylonite schist. Predominant rock type between New River and U.S. Route 58 and west of Saddle Creek is greenish-gray schist with blue quartz grains and coarse flesh-colored microcline. Schist and augen gneiss facies in region south of Bridle Creek. Mapped as younger than Grayson granodiorite gneiss, older than the associated mylonite.

In extreme southwestern part of Gossan Lead district, Grayson County. Extends from Beaverdam Creek, south of Independence, southwestward to south of New River. Area lies largely south of U.S. Route 58.

Shoal Creek Breccia

Tertiary: Southwestern Utah.

E. F. Cook, 1960, Utah Geol. and Mineralog. Survey Bull. 70, p. 18 (fig. 1), 41, 43 (map 2). Dark massive to rudely bedded deposits of hypersthene-augite-hornblende andesite(?) with maximum thickness of at least several hundred feet. Overlies Rencher formation; underlies Maple Ridge porphyry (new). Name credited to H. R. Blank (unpub. thesis).

Well exposed along Shoal Creek, west of Enterprise, Washington County.

Shoal Creek cyclothem[1] (in McLeansboro Group)

Shoal Creek cyclothem (in Modesto-Bond Formations)

Pennsylvanian: Southern and southeastern Illinois.

Original reference: H. R. Wanless, 1931, Geol. Soc. America Bull., v. 42, p. 801–812.

W. A. Newton and J. M. Weller, 1937, Illinois Geol. Survey Rept. Inv. 45, p. 9, 10–11. In southeastern Illinois, Shoal Creek occurs in the sequence below the Flannigan cyclothem (new) and above the Collinsville cyclothem (new).

H. R. Wanless and Raymond Siever, 1956, Illinois Geol. Survey Circ. 217, p. 7, 11, pl. 1. Underlies Sorento cyclothem. Type locality given.

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 53 (table 2), pl. 1. In Modesto-Bond formations (both new). Above Macoupin cyclothem and below Sorento cyclothem. Presentation of new rock-stratigraphic classification of Pennsylvanian strata in Illinois; cyclical classification is independent of rock-stratigraphic classification.

Type locality: Sec. 34, T. 4 N., R. 3 W., Clinton County. Named from exposures along Shoal Creek.

†Shoal Creek Limestone[1]

Lower Cretaceous (Comanche Series): Central Texas.

Original references: R. T. Hill, 1889, Am. Geologist, v. 3, p. 289; 1889, Am. Jour. Sci., 3d, v. 38, p. 470; 1889, Texas Geol. Survey Bull. 4, p. xiv, xxii.

Named for Shoal Creek at Austin, Travis County.

**Shoal Creek Limestone** (in McLeansboro Group)

Shoal Creek Limestone Member (of Bond Formation)

Shoal Creek Limestone Member (of McLeansboro Formation)[1]

Middle and Upper Pennsylvanian: Central western and southwestern Illinois.

Original reference: H. Engelmann, 1868, Illinois Geol. Survey, v. 3, p. 148, 159–164, 175, 220.

J. M. Weller and W. A. Newton, 1937, Illinois Geol. Survey Rept. Inv. 45, p. 11. Included in Shoal Creek cyclothem.

H. R. Wanless and Raymond Siever, 1956, Illinois Geol. Survey Circ. 217, pl. 1. Rank raised to formation in McLeansboro group.

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 39, 50 (table 1), 67, 73, pl. 1. Rank reduced to member status in Bond formation (new). Basal member of formation. In central and southwestern area, occurs below McWain sandstone member; in southeastern and eastern area, occurs below Mount Carmel sandstone. Thickness 6 to 13 feet. Presentation of new rock-stratigraphic classification of Pennsylvanian strata in Illinois. Cyclical classification retained but is entirely independent of rock-stratigraphic classification.

Type locality: Along Shoal Creek and vicinity T. 3 N., R. 4 W., Clinton County.

**Shoal River Formation** (in Alum Bluff Group)[1]

Shoal River facies (of Alum Bluff Stage)

Miocene, middle: Northwestern Florida.

Original reference: Julia Gardner, 1926, U.S. Geol. Survey Prof. Paper 142, p. 1–3.

H. R. Smith, 1941, Am. Assoc. Petroleum Geologists Bull., v. 25, no. 2, p. 270 (fig. 2), 271 (table 1), 275. Includes Whites Creek beds (new).

C. W. Cooke, 1945, Florida Geol. Survey Bull. 29, p. 167–180. Includes Oak Grove member and two faunal zones, *Yoldia waltonensis* and *Arca rubisiniana,* formerly included in Choctawatchee formation. Overlies Chipola formation; underlies Duplin marl.

Julia Gardner, 1947, U.S. Geol. Survey Prof. Paper 142–H, p. 493. Type locality stated.

H. S. Puri, 1953, Florida Geol. Survey Bull. 36, p. 24–26. Considered facies of Alum Bluff stage. Includes Oak Grove facies in basal part.

Type locality: Shell Bluff, north bank of Shoal River, E½ sec. 4, T. 3 N., R. 21 W., 3½ miles (airline) northwest of Mossyhead and ¾ mile east of Godwin Bridge. Base of shell bed, 42 feet above river and about 135 feet above sea level.

†Shoal River Marl Member[1] (of Alum Buff Formation)

Miocene, middle: Northwestern Florida.

Original reference: G. C. Matson and F. G. Clapp, 1909, Florida Geol. Survey 2d Ann. Rept., p. 91, 104–106, table opposite p. 50.

Named for exposures on Shoal River, Walton County.

Shochary Sandstone (in Martinsburg Group)

Shochary Sandstone Member (of Martinsburg Formation)

Upper Ordovician (lower Maysville): South-central and east-central Pennsylvania and northwestern New Jersey.

Bradford Willard and A. B. Cleaves, 1939, Geol. Soc. America Bull., v. 50, no. 7, p. 1183–1184, 1196. Name proposed for massive sandstone member in upper part of formation. Disconformably underlies Tuscarora sandstone. Lithologically, stratigraphically, and faunally, appears to be correlate of Bassler's Fairview sandstone in south-central sections but it is not traceable through. Carries Pulaski fauna.

Bradford Willard, 1943. Geol. Soc. America Bull., v. 54, no. 8, p. 1069, 1070, 1071–1074, 1118. Further described as unit in Martinsburg group. Upper part, unlike lower, essentially noncalcareous. Throughout, sandstone is medium to fine grained, well sorted, even bedded, and arkosic; conglomeratic beds rare. Dark-gray to gray-brown sandstone occurs in beds up to 4 feet thick. Interbedded with limestone, quartz-pebble, and limestone and shale-chip conglomerates. Thickness 750 feet at type locality. Overlies Dauphin shale (new) of Martinsburg group. No sharp line of separation between unit and underlying shaly or slaty beds of Martinsburg.

W. H. Twenhofel and others, 1954, Geol. Soc. America Bull., v. 65, no. 3, chart 2 (column 20). Geographically extended to New Jersey.

Named for Shochary Ridge in northeastern Berks County and northwestern Lehigh County, Pa.

**Shoemaker Gravel**

Pleistocene: Southern California.

L. F. Noble, 1954, U.S. Geol. Survey Geol. Quad. Map GQ–50. Gravel, sand, and silt; some local beds of caliche a few inches thick near base. More consolidated than older alluvium and dips more steeply. Nature of contact with underlying Harold formation uncertain.

Type locality: Shoemaker Canyon, Valyermo quadrangle. Present only north of San Andreas fault but two small patches occur south of fault 2 miles west of quadrangle.

Shoemaker Limestone[1] Member (of Cass Formation)

Pennsylvanian (Virgil Series): Southeastern Nebraska.

Original reference: G. E. Condra, 1927, Nebraska Geol. Survey Bull. 1, 2d ser., p. 33, 35, 173.

G. E. Condra, 1949, Nebraska Geol. Survey Bull. 16, p. 29–30. Redefined and reallocated to Cass formation. Shoemaker as here redefined is the lower member of "Shoemaker" limestone defined by Condra (1927); that is, the name is now applied to the lower member of the Cass. Member consists of two dense bluish limestones separated by a shale seam. Thickness about 1½ feet. Underlies Little Pawnee shale member (new); overlies Plattford formation.

Type locality: West of Shoemaker Bridge along-side Shoemaker Farm, about 2½ miles northwest of Nehawka, Cass County.

Shohola Formation[1]

Upper Devonian: Northeastern Pennsylvania.

Original reference: B. Willard, 1936, Geol. Soc. America Bull., v. 47, no. 4, p. 571, 585–587.

Bradford Willard, 1937, Pennsylvania Acad. Sci. Proc., v. 11, p. 32. Generalized sequence for the (largely) nonmarine Upper Devonian or northeastern Pennsylvania shows Shohola formation above Delaware River flags and below Damascus red shale. Comprises Barryville member below and Paupack sandstone member above. Included in Catskill facies group.

K. E. Caster, 1938, Jour. Paleontology, v. 12, no. 1, p. 45 (fig. 7). Diagram shows facieological nomenclature of Chemung stage and shows Shohola facies group composed of Barryville and Paupack parvafacies.

Named from Shohola, on Delaware River near mouth of Lackawaxen Creek, Pike County.

Shongalo Greensand (in Claiborne Group)[1]

Eocene, middle: Northwestern Mississippi.

Original reference: E. W. Hilgard, 1860, Mississippi Geol. and Agr. Rept., p. 164–165.

Occurs in railroad cut at Vaiden Station, Shongalo, Carroll County.

**Shongaloo Member** (of Schuler Formation)

Upper Jurassic: Subsurface in northern Louisiana, southern Arkansas, and eastern Texas.

F. M. Swain, 1944, Am. Assoc. Petroleum Geologists Bull., v. 28, no. 5, p. 600–602. Lower member of formation. Includes nearshore facies of red and red-green shales, red and white sandstones and basal conglomerates, and the basinward offshore equivalents of these rocks, which are dark-gray fossiliferous shales, shelly limestones and sandstones, and basal conglomerates, lying beneath the Dorcheat member. In most wells, overlies Bossier formation; in southern Arkansas unconformably overlies Buckner or Smackover formation. In type well, occurs between depths of 8,455 and 9,450 feet. Thickness ranges from featheredge at northern limit to more than 1,000 feet in southern Arkansas and in Morehouse Parish, La. Thins southward in Louisiana to about 500 feet; in east Texas averages about 600 feet.

Type well: Magnolia Petroleum Co.'s Sexton Unit No. 1, SW¼NW¼SE¼ sec. 32, T. 23 N., R. 9 W., Webster Parish, La.; Shongaloo Field.

**Shoo Fly Formation**

Shoofly Formation[1]

Silurian(?): Northern California.

Original reference: J. S. Diller, 1892, Geol. Soc. America Bull., v. 3, p. 370–394.

J. M. Weller and others, 1948, Geol. Soc. America Bull., v. 59, no. 2, p. 132, chart 5, column 14. Fusulinids reported from the Shoofly indicate that [it] is as young as Pennsylvanian. Shown on chart as Pennsylvanian(?).

P. A. Lydon, T. E. Gay, Jr., and C. W. Jennings, 1960, Geologic map of California Westwood Sheet (1:250,000): California Div. Mines. Dark phyllite, slate, quartzite, and graywacke. Pre-Permian. Spelled Shoo Fly.

Named for exposures in road between Shoo Fly Bridge and Spanish Creek, Taylorsville region.

Shoreham Member (of Sherman Fall Formation)

Shoreham Limestone or Formation (in Trenton Group)

Shoreham Limestone Member (of Glens Falls Limestone)

Middle Ordovician: New York and Vermont, and Ontario, Canada.

G. M. Kay, 1937, Geol. Soc. America Bull., v. 48, no. 2, p. 264–267. Member of Sherman Fall formation. Constitutes zone of *Cryptolithus tesselatus* Green, the limestones of lowest Sherman Fall age. In type region, beds comprise upper Glens Falls limestone, overlie lower Glens Falls Larrabee member of Hull age, and underlie Canajoharie shale of later Sherman Fall age. Beds consistently contain *Cryptolithus tesselatus*, which is limited to the member, and *Prasopora orientalis* Ulrich and *Trematis terminalis* (Emmons). This zone persists in the Sherman Fall northwestward to Lennox and Addington County, Ont., in the equivalent beds of northern Lake Champlain, and northeastward to city of Quebec. In type section, lower 36 feet of member is exposed. Along Mohawk Valley, member is composed of 15 to 25 feet of dark-gray calcareous claystones and shales that contrast with subjacent Larrabee member, and are succeeded abruptly by Canajoharie shale. Member has exposed thickness of 30 feet north of McBrides Bay, South Hero Township, Grande Isle County, Vt., with a metabentonite 11 feet from base. Overlying beds are Cumberland Head shaly limestone and Stony Point shale, both of later Sherman Fall age. In New York, underlies Denmark member (new).

G. M. Kay, 1942, Geol. Soc. America Bull., v. 53, no. 11, p. 1611–1612. Referred to as Shoreham limestone. Overlies Hull formation.

G. M. Kay 1943, Am. Jour. Sci., v. 241, p. 597–606. Rank raised to formation. Disconformably underlies Rathbun limestone member (new) of Denmark formation. Overlies Kirkfield limestone. (Term Kirkfield is preferred to term Hull). Thickness 45 feet.

Phillip Fowler, 1950, Vermont Geol. Survey Bull. 2, p. 31, 34. Blue marble that may be Shoreham member of Glens Falls is called Whipple marble (new) in this report [Castleton area]. It cannot be traced northward around Taconic Range into the Glen Falls outcrop in Sudbury, Vt.

P. A. Chenoweth, 1952, Geol. Soc. America Bull., v. 63, no. 6, p. 525–527. Term Shoreham formation extended to include all *Prasopora orientalis* beds from top of coarse-bedded calcarenites of Kirkfield formation to base of *Trocholites* subzone and base of Camp member (new) of Denmark formation. Rathbun member of Denmark is herein removed from the Denmark and placed in Shoreham formation. Maximum thickness 52 feet, Lewis County, N.Y.; minimum thickness 15 feet in Mohawk Valley where it spans Adirondack arch.

R. B. Erwin, 1957, Vermont Geol. Survey Bull. 9, p. 30, 31–32, 81–82, 89–90, pl. 1. Upper member of Glens Falls formation. Thickness about 45 feet on Isle La Motte. Overlies Larabee limestone member. Underlies Head formation.

Named for exposures in Shoreham Township, Addison County, Vt.

Shorehamian Stage or Substage

Middle Ordovician (Trentonian): Eastern North America.

Marshall Kay, 1948, Am. Assoc. Petroleum Geologists Bull., v. 32, no. 8, p. 1414. Middle Trentonian includes rocks equivalent to Shoreham and Denmark limestone of New York or undivided Sherman Fall limestone. The Shorehamian marked by first appearance of *Cryptolithus tesselatus* Green in New York and Ontario has been recognized in lower part of Salona limestone of central Pennsylvania and eastern West Virginia and in Oranda limestone of Cumberland and Shenandoah Valleys, the "*Christiania*" beds of "Chambersburg limestone." There is a possibility that uppermost Eggleston and Collierstown beds are of this age. Lower "Hermitage" limestone of southwestern Virginia and Logana limestone of Kentucky have been included in stage. Shorehamian is of limestone throughout its extent, being generally more argillaceous than subjacent Kirkfieldian, particularly east of Adirondack line.

Marshall Kay, 1960, Internat. Geol. Cong., 21st, Copenhagen, pt. 7, p. 30. Suggested that term Shermian stage be applied to the Shorehamian and Denmarkian.

Name derived from Shoreham Township, Addison County, Vt., for which Shoreham member of Sherman Fall formation was named.

**Short Creek Oolite Member** (of Boone Formation)[1]

Short Creek Oolite Member (of Keokuk Limestone)

Upper Mississippian: Southeastern Kansas, southwestern Missouri, and northeastern Oklahoma.

Original reference: W. S. T. Smith and C. E. Siebenthal, 1907, U.S. Geol. Survey Geol. Atlas, Folio 148.

R. C. Moore, G. M. Fowler, and J. P. Lyden, 1939, Geol. Soc. America Spec. Paper 24, p. 3, 10, pl. 1. Named subdivisions of Keokuk are Short Creek oolite near top and Grand Falls chert near base. Short Creek is light-gray massive oolitic limestone which commonly appears as single bed 4 to 5 feet thick. Appears to be continuous throughout southwestern Missouri and in adjoining States wherever proper stratigraphic horizon is present.

E. B. Branson, 1944, Missouri Univ. Studies, v. 19, no. 3, p. 236. Included in Keokuk in this report with reservation that evidence for including it in Warsaw is equally strong. Occurs either at top of Keokuk or base of Warsaw. Until fauna is thoroughly studied solution of problem of its age cannot be reached.

E. L. Clark and T. R. Beveridge, 1952, Kansas Geol. Soc. Guidebook 16th Field Conf., p. 13 (fig. 1), 46 (fig. 19), 47 (fig. 20); (reprinted as Missouri Geol. Survey and Water Resources Rept. Inv. 13). Shown as member of Keokuk. Osagean.

G. G. Huffman, 1953, Oklahoma Geol. Survey Guidebook 1, p. 7. In northeastern Oklahoma, Boone formation is divided into (ascending) St. Joe, Reeds Spring, and Keokuk members. In Ottawa and northern Delaware Counties, a bed of white oolite, 2 to 10 feet thick, known as the Short Creek is present in upper Keokuk.

C. H. Behre, Jr., and A. V. Heyl, Jr., 1959, Deutsche Geol. Gesell. Zeitschr., v. 110, pt. 3, p. 517 (fig. 2). Chart shows Short Creek member of Boone formation in upper part of formation. Thickness 1 to 3 feet thick. Disconformably underlies Cherokee shale.

Named for exposures along Short Creek, a stream flowing westward between Galena and Empire in Cherokee County, Kans.

Short Mountain facies (of Fort Payne Formation)

Lower Mississippian: Central and southern Tennessee.

H. J. Klepser, 1937, Ohio State Univ. Abs. Doctors' Dissert, 24, p. 182. Named as southern facies of formation in Eastern Highlands Rim area.

P. B. Stockdale, 1939, Geol. Soc. America Spec. Paper 22, p. 53–54. Silty siliceous limestones. Facies is everywhere underlain by Maury formation, contact conformable and district. At places where top of Fort Payne formation grades into impure, cherty limestone of the Warsaw, exact stratigraphic boundary is uncertain. Derivation of name given.

Named from Short Mountain, eastern Cannon County. Extends from central Jackson and Overton Counties to southern limit of the State.

Shorts Ranch Andesite

Tertiary: Southeastern Arizona.

W. H. Brown, 1939, Geol. Soc. America Bull., v. 50, no. 5, p. 734–735, fig. 2, pl. 1. One of the most massive of the series of volcanics in the area and when fresh is light purplish gray. Weathers to reddish purple or, less commonly, brown. Has marked flow structure in southern part of range. Thickness at least 400 feet and probably much thicker. West of Tucson and in area north of Ajo Road it overlies Safford tuff (new).

J. E. Kinnison, 1959, Arizona Geol. Soc. Guidebook 2, p. 149 (fig. 2). Underlies Water Tank conglomerate (new); overlies Ivy May andesite (new).

Type locality: On Shorts Ranch, 10,000 feet northeast of Cat Mountain, Tucson Mountains, Pima County.

Shoshone[1]

Upper Triassic: Western Wyoming.

Original reference: W. C. Knight, 1901, Engr. Mining Jour., v. 72, p. 359.

Wind River Mountains.

Shoshone Group[1]

Upper Cretaceous and Eocene: Montana to New Mexico.

Original reference: W. Cross, 1909, Washington Acad. Sci. Proc., v. 11, p. 27–45.

Map published by Bureau of Ethnology shows district once occupied by Shoshone and Ute Indians.

†Shoshone Falls Andesite[1]

Miocene, 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. 32 (table), 37–38, pl. 5. Exposed thickness about 200 feet; total thickness unknown. Underlies Pillar Falls mud flow, erosional unconformity.

H. T. Stearns, 1955, Geol. Soc. America Bull., v. 66, no. 4, p. 463. Suggested that the typical block-lava top of the andesite is represented by the overlying Pillar Falls mud flow.

Type section: Forms Shoshone Falls and Pillar Falls, in Twin Falls and Jerome Counties. Exposed along Snake River from foot of Twin Falls down as far as Perrine Ranch, a distance of 6 miles.

Shoshoni Limestone[1]

Cambrian: Western Wyoming.

Original reference: E. B. Branson, 1917, Geol. Soc. America Bull., v. 28, p. 347–350.

In Wind River Mountains.

†Shot Pouch Sandstone[1]

Mississippian: Western Kentucky.

Original references: D. D. Owen, 1856, Kentucky Geol. Survey, v. 1, p. 174, pl; 1857, Kentucky Geol. Survey, v. 2, p. 85–88.

Forms cliff at the Tar Spring, Breckinridge County.

Shrewsbury Member (of Redbank Formation)

Upper Cretaceous: Eastern New Jersey.

R. K. Olsson, 1959, Dissert. Abs., v. 19, no. 8, p. 2063. Redbank formation is divided into Shrewsbury and Sandy Hook members.

R. K. Olsson, 1960, Jour. Paleontology, v. 34, no. 1, p. 2, 4 (fig. 2). Consists of slightly glauconitic quartz sand. Overlies Sandy Hook member; underlies Tinton formation.

Occurs in New Jersey Coastal Plain.

**Shriver Chert** (in Oriskany Group)[1]

Shriver Chert Member (of Oriskany Formation)

Lower Devonian: Western Maryland, central Pennsylvania, central western Virginia, and eastern West Virginia.

Original reference: C. K. Swartz and others, 1913, Maryland Geol. Survey Lower Devonian volume, p. 91, table opposite p. 30.

F. M. Swartz, 1939, Pennsylvania Geol. Survey, 4th ser., Bull., G–19, p. 67. In some areas, overlies Mandata shale and chert.

H. P. Woodward, 1943, West Virginia Geol. Survey, v. 15, p. 15 (table), 97, 107, 110. In West Virginia, replaced by Port Ewen and Port Jervis formation.

Ernst Cloos, 1951, Maryland Dept. Geology, Mines and Water Resources Washington County [Rept. 14], p. 86. In Maryland, Oriskany formation is subdivided into two members: Shriver chert below and Ridgeley sandstone above. Thickness of Shriver about 100 feet; may be absent in Washington County.

H. H. Arndt and others, 1959, Geol. Soc. America Guidebook Pittsburgh Mtg., p. 4, 13, 26. Referred to as member of Oriskany formation; underlies Ridgeley member. Overlies Mandata member of Hamilton formation.

Named for Shriver Ridge at Cumberland, Md.

**Shublik Formation**[1]

Lower(?), Middle, and Upper Triassic: Northern Alaska.

Original reference: E. D. Leffingwell, 1919, U.S. Geol. Survey Prof. Paper 109, p. 103, 115, map.

W. W. Patton, Jr., and J. J. Matzko, 1959, U.S. Geol. Survey Prof. Paper 302–A, p. 3, 7–8, figs. 1–3. Composed principally of highly carbonaceous grayish-black shale, chert, and limestone. Comprises three members in Tiglukpuk Creek and upper Kiruktagiak River areas: lower member of black, gray, and greenish-gray shale with minor intercalated dark limestone, about 100 feet thick in upper Kiruktagiak River area but more than 500 feet thick in Tiglukpuk Creek area, with fauna dated as early Middle Triassic; middle member of dark siliceous limestone, black paper shale, and dark calcareous shale; and upper member of dark fossiliferous limestone capped by dark shale. Middle and upper members about same thickness in two areas—130 to 150 feet and 60 to 80 feet respectively—and have a Late Triassic fossil assemblage. Formation mapped and correlated over most of northern Alaska.

U.S. Geological Survey currently designates the age of the Shublik Formation as Lower(?) Middle, and Upper Triassic on the basis of a study now in progress.

Type locality: Shublik Island, on Channing River, at southwestern corner of Shublik Mountains.

**Shubuta 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). Shubuta (clay) member of Yazoo clay (or formation) proposed for 20 to 250 feet of clays and clayey marls, underlain by the Pachuta (marl) member (new) and overlain by the Forest Hill or Red Bluff clay of the Oligocene.

L. D. Toulmin, P. E. LaMoreaux, and C. R. Lanphere, 1951, Alabama Geol. Survey Spec. Rept. 21, p. 122, 126, pl. 3. In Choctaw County, Ala., consists of light-greenish-gray and white highly calcareous clay which weathers to light greenish yellow to white; contains small irregular white lime concretions; in many places it is a white chalky calcareous clay or clayey limestone. Thickness 25 to 35 feet.

G. E. Murray, 1952, Am. Assoc. Petroleum Geologists Bull., v. 36, no. 4, p. 702 (fig. 1), 703. Underlies Mosley Hill formation.

Type locality: East side of Chickasawhay River, just north of U.S. Highway 45 bridge east of Shubuta, SW¼ sec. 3, T. 10 N., R. 16 E., Clarke County, Miss.

Shubuta Hill Clay

Eocene (Jackson): Central Alabama.

R. H. Smith and others, 1944, *in* Southeastern Geol. Soc. [Guidebook] 1st Field Trip, [Geol. section of] Little Stave Creek, Clarke County, Ala. Shown on geologic cross sections and stratigraphic column as a fossiliferous, glauconitic marl with phosphate nodules near top. Stratigraphically above Yazoo clay and below Red Bluff [clay].

O. L. Bandy, 1949, Bulls. Am. Paleontology, v. 32, no. 1, p. 13. Mentioned as a fossil locality in discussion of Little Stave Creek Foraminifera.

Shuksan Formation

Upper Jurassic: North-central Washington.

C. E. Weaver, 1945, Am. Assoc. Petroleum Geologists Bull., v. 29, no. 10, p. 1391, 1392 (table 3). Mentioned as Shuksan formation consisting of marine sediments partly metamorphosed. Upper Jurassic. On table, occurs above Triassic Cultus and below Cretaceous Pasayten. (Plutonics are omitted from table).

R. W. Imlay, 1952, Geol. Soc. America Bull., v. 63, no. 9, p. 977, chart 8C (column 99). Shuksan formation includes sandstone, shales, conglomerates, and cherty beds. Outcrop area noted.

Crops out in valley of North Fork of Shuksan River north of Mount Baker.

Shullsburg 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. Thin-bedded dolomite. Thickness as much as 8 feet. Shown on columnar section as underlying Strawbridge member (new) and overlying Hazel Green member (new).

Occurs in Dixon-Oregon area.

Shultz 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 ranchhouse of Mrs. Winifred Shultz which is on the ledge formed by the outcrop in NE¼ T. & N. O. Railroad Co. Survey 127, 8 miles southeast of Paint Rock, Concho County.

Shumla Sandstone[1] (in Canadaway Group)

Shumla Siltstone Member (of Canadaway Formation)

Upper Devonian: Western New York.

Original reference: J. M. Clarke, 1903, New York State Mus. Handb. 19, p. 25 and chart.

I. H. Tesmer, 1955, New York State Mus. and Sci. Service Circ. 42, p. 10 (fig. 1), 18. Termed siltstone member of Canadaway formation. Underlies Northeast shale member; overlies Westfield shale member. Thickness at type locality about 30 feet.

Exposed at Shumla, Chautauqua County.

Shumway cyclothem (in McLeansboro Group)

Shumway cyclothem( in Mattoon Formation)

Pennsylvanian: Central Illinois.

J. M. Weller and W. A. Newton, 1938, (abs.) Geol. Soc. America Proc. 1937, p. 329. Upper part of McLeansboro formation is divided into (ascending) Merom, Shumway, Woodbury, Gila, Greenup, Newton, Bogota (upper and lower), Cohn, La Salle, Macoupin, Flannigan, and Shoal Creek cyclothems.

J. M. Weller and A. H. Bell, 1941, Illinois Geol. Survey Rept. Inv. 76, p. 7. Youngest complete cyclothem known in Illinois. Includes Shumway limestone.

C. L. Cooper, 1946, Illinois Geol. Survey Bull. 70, p. 13. Studies by Ekblaw in south-central Illinois resulted in tentative recognition of six cyclothems of which the Shumway is sixth in sequence (ascending); occurs above Shelby (new). Subsequent attempts to set up a single standard section based on assumption that Omega and Greenup limestones are equivalent resulted in a series of 13 cyclothems of which the Shumway is the 13th and occurs above the Woodbury. If the Greenup and Omega are not equivalent, section includes 14 cyclothems in which the Shumway and Newton are equivalent and occur below the Greenup and above the Shelby.

H. R. Wanless and Raymond Siever, 1956, Illinois Geol. Survey Circ. 217, p. 12, pl. 1. Included in McLeansboro group. Type locality given.

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 53 (table 2), pl. 1. In Mattoon formation (new). Plate 1 shows Shumway above Omega cyclothem and below Bogota cyclothem. Presentation of new rock-stratigraphic classification of Pennsylvanian strata in Illinois; cyclical classification is independent of rock-stratigraphic classification.

Type locality: SE¼SE¼ sec. 26, T. 9 N., R. 5 E., Effingham County.

Shumway Limestone Member (of Mattoon Formation)

Shumway Limestone (in McLeansboro Group)

Pennsylvanian: South-central Illinois.

J. M. Weller, L. G. Henbest, and C. O. Dunbar, 1942, Illinois Geol. Survey Bull. 67, p. 19 (fig. 4), 28 [1943]. Shumway "middle" limestone is lower of the two marine limestones of Shumway cyclothem. A lenticular discontinuous dark-bluish-gray argillaceous hard massive bed. Maximum thickness 1½ feet. Overlies a thin coal horizon; underlies a persistent black sheety shale and "upper" limestone, 1 to 3 feet thick. Stratigraphically above Omega 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. 40, 51 (table 1), 81, pl. 1. Rank reduced to member status in Mattoon formation (new). Occurs above Omega limestone member and below Effingham limestone member. Thickness about 2 feet at type outcrop. Presentation of new rock-stratigraphic classification of Pennsylvanian strata of Illinois. Cyclical classification is retained but is independent of rock-stratigraphic classification.

Type locality: SE¼SE¼SW¼ sec. 26, T. 9 N., R. 5 E., Effingham County.

Shunganunga Shale[1]

Pennsylvanian: Northeastern Kansas.

Original reference: J. W. Beede, 1898, Kansas Acad. Sci. Trans., v. 15, p. 29.

Named for Shunganunga Creek, Shawnee County.

**Shurtz Sandstone Tongue** (of Navajo Sandstone)

Triassic(?) and Jurassic: Southwestern Utah.

Paul Averitt and others, 1955, Am. Assoc. Petroleum Geologists Bull., v. 39, no. 12, p. 2520, 2521. At type locality, 110 feet thick and consists of fine- to medium-grained moderate reddish-orange sandstone in beds ranging from 2 to 5 feet in thickness. Lies between 410 and 720 feet below of Navajo as mapped by Thomas and Taylor (1946, U.S. Geol. Survey Water-Supply Paper 993) and as accepted in this report. In section along Coal Creek (measured by Thomas and Taylor), the Shurtz tongue is designated as units 26 and 27 of Chinle formation; in section republished by Gregory (1950, Utah Geol. and Mineralog. Survey Bull. 37), tongue appears as units 21 and 22. Although Thomas and Taylor's section shows Shurtz sandstone as separate unit below base of Navajo, Gregory mapped base of Shurtz tongue as base of Navajo, but did not note change on republished section. Interpretation that Shurtz sandstone is more appropriately regarded as tongue of Navajo is based on observations of pronounced thinning of Shurtz from 345 feet in Coal Creek to 110 feet in Shurtz Creek, and to 62 feet in Muries Creek; this abrupt thinning takes place in a distance of 8 miles. Underlies Cedar City tongue (new) of Kayenta formation. Lamb Point tongue (new) of Navajo at Kanab thins abruptly westward as Shurtz tongue at Cedar City thins southward; the possibility exists that the two tongues join somewhere between the two localities.

Type locality: Shurtz Canyon, about 6 airline miles south of Cedar City. Makes up prominent ledge that forms crest of Red Hill east of Cedar City.

†Shutesbury Serpentine[1]

Lower Cambrian: Massachusetts.

Original reference: B. K. Emerson, 1898, U.S. Geol. Survey Mon. 29, p. 55.

Named for exposure 1 mile south of village of Shutesbury, Franklin County.

Shutler Formation[1]

Tertiary, late, and Pleistocene: Central northern Oregon.

Original reference: E. T. Hodge, 1932, Oregon Univ. Pub. Suppl. to Geol. Ser., v. 1, no. 5, p. 6.

W. D. Lowry and E. M. Baldwin, 1952, Geol. Soc. America Bull., v. 63, no. 1, pl. 2. Chart shows age as lower and middle Pliocene:

Well developed near Shutler post office, T. 2 N., R. 21 E., Gilliam County.

**Shuttle Meadow Formation** (in Newark Group)

Upper Triassic: Central Connecticut.

E. P. Lehmann, 1959, Connecticut Geol. and Nat. History Survey Quad. Rept. 8, p. 7, 8 (table 1), 11–12, pl. 1. Proposed for sedimentary rocks overlying Talcott basalt and underlying Holyoke basalt. Unit had been termed lower sedimentary division of Meriden formation by Krynine (1950). Predominant rock type is grayish-red to dark-reddish-brown shale with occasional mudstone of similar color; pale-orange, grayish-orange, grayish-red, and dark-reddish-brown coarse to very fine arkose also present; minor amounts of yellowish-gray and pale-brown coarse- to fine-grained feldspathic sandstone. Shrinkage (mud) cracks, current ripple marks, and crossbedding common; some shales and sandstones very finely laminated; some mudstones massive. Of total calculated thickness of about 310 feet, only about 50 feet are exposed. Contact with underlying Talcott basalt basically conformable, but evidence suggests minor erosion.

R. W. Schnabel, 1960, U.S. Geol. Survey Geol. Quad. Map GQ–134. Described in Avon quadrangle, Connecticut, where it consists of moderate reddish-brown to grayish-red arkosic siltstone and shale with subordinate lenses of fine- to medium-grained arkose. Lies between Talcott below and Holyoke basalts; forms bench between basalt cliffs along west face of Talcott Mountain. Thickness 50 to 100 feet, thinnest at northern end of quadrangle.

Type sections: Shuttle Meadow Reservoir sections as described by Krynine (1950)—that is, southern shore of Shuttle Meadow Reservoir between Meriden and New Britain, Middletown quadrangle. Exposed in narrow belt along southern half of west margin of quadrangle; outcrops few and small in lateral extent.

**Siamo Slate**[1]

Precambrian: Northwestern Michigan.

Original reference: C. R. Van Hise and W. S. Bayley, 1895, U.S. Geol. Survey 15th Ann. Rept., p. 554.

W. T. Stuart, E. A. Brown, and E. C. Rhodehamel, 1954, Michigan Dept. Conserv., Geol. Survey Div. Tech. Rept. 3, p. 11 (table 3). Thickness about 650 feet in Marquette district. Overlies Ajibik quartzite; underlies Negaunee iron-formation. Middle Huronian.

Named for exposures on Siamo Hill, just south of western part of Teal Lake, Marquette district.

Sias Quartzite

*See* Sais Quartzite.

Siberia Limestone (in Chester Group)[1]

Mississippian: Southern Indiana and northern Kentucky.

Original references: C. A. Malott, 1920, Science, new ser., v. 51, p. 521–522; 1925, Indiana Acad. Sci. Proc., v. 34, p. 109–132.

C. A. Malott, 1952, Stratigraphy of the Ste. Genevieve and Chester formations of southern Indiana: Ann Arbor, Mich., The Edwards Letter Shop, p. 7. Replaced by Menard limestone. Local Indiana names of upper Chester are dropped, and formations given names of standard Chester column.

Named for exposures in vicinity of Siberia, Perry County, Ind.

Sicily Island Formation or terrace

Recent: Southwestern Louisiana.

J. A. Doering, 1956, Am. Assoc. Petroleum Geologists Bull., v. 40, no. 8, p. 1822 (table 1), 1829–1830, 1831 (table 2), 1837 (table 3), 1840. 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 Sicily Island as as terrace; hence, it is not clear which use is intended.

Town of Sicily Island is in Tensas Parish on south end of low ridge of the A series, or oldest Sicily Island sediments. Topographic feature averages about 6 miles in width and extends about 80 miles northward up valley, through Winnsboro and Delhi to a point beyond Oak Grove. Elevations rise from 75 feet at Sicily Island to 115 and 120 feet at Oak Grove.

Sidewinder Volcanic Series

Triassic(?): Southern California.

O. E. Bowen, Jr., *in* L. A. Wright and others, 1953, California Jour. Mines and Geology, v. 49, no. 1, pl. 2. Shown on columnar section as rhyolite and dacite flows and pyroclastics about 3,000 feet thick; overlies Fairview Valley formation (new).

O. E. Bowen, Jr., 1954, California Div. Mines Bull. 165, p. 16 (fig. 2), 42–53, pls. 1, 2, 3, 8. Replaces name Sidewinder Valley metavolcanics as used by Miller (1944). Name Sidewinder Valley does not appear on existing maps, and Miller's map does not show its location. Miller's Sidewinder Valley metavolcanics, as mapped, included rocks of several ages; Miller believed series to be interbedded with Oro Grande series and to be Paleozoic in age. As redefined, Sidewinder volcanic series is prodominantly a pyroclastic assemblage subaerially laid onto very irregular topography. Over most of Barstow quadrangle series consists of overlapping interfingering irregularly shaped masses of dacite, quartz latite, latite-andesite, and rhyolite. Unconformably overlies Permian Fairview Valley formation, intruded by Jura-Cretaceous granitic rocks.

Type locality: Sidewinder Mountain, Barstow quadrangle, San Bernardino County. Greatest thicknesses are in Silver Mountain group of hills, Sidewinder Mountain, Stoddard Mountain, and Raven Ridge.

Sidewinder Valley Metavolcanics

Upper Paleozoic: Southern California.

W. J. Miller, 1944, California Jour. Mines and Geology, v. 40, no. 1, p. 73–74, 100–102, pl. 5. Include both original lavas and tuffs which have been highly altered and usually strongly foliated. In type area, consist entirely of schistose metavolcanics with a little interbedded quartz schist and quartzite. In some places, interbedded with late Paleozoic Oro Grande metasediments.

E. O. Bowen, Jr., 1954, California Div. Mines Bull. 165, p. 42. Replaced by Sidewinder volcanic series.

Type area: Eastern half of small mountain just north and west of Victorville-Barstow road. Named for typical occurrences in hills overlooking northeastern end (or head) of Sidewinder Valley, 3½ to 5 miles northeast of Sidewinder Well, Victorville area of Barstow quadrangle, San Bernardino County.

Sidney Gravel or Formation (in Ogallala Group)

Sidney Gravel and Silt Member (of Kimball Formation)

Pliocene, middle to upper: Southwestern Nebraska, northeastern Colorado, and western 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. 1261–1263, 1266 (table 2). At type exposure, consists of crystalline sand and gravel ranging in texture from fine and medium river sand to pebbles and cobbles as much as 4 to 6 inches in diameter. Thickness 15 to 50 feet; at type locality 20 feet. Overlies caliche at top of Ash Hollow formation; underlies Kimball formation (new). Middle to late Pliocene.

C. B. Schultz and T. M. Stout, 1948, Geol. Soc. America Bull., v. 59, no. 6, p. 555–556. Referred to as gravel and silt member at base of Kimball formation; locally unconformable on older beds, but generally affording a transition from latest Ash Hollow sand and gravel channels.

Type exposure: Bluff at north side of town of Sidney, Cheyenne County, Nebr. Widespread in Nebraska, Colorado, and Kansas.

Sidney Shale Member (of Markley Formation)

Eocene, upper: Northern California.

B. L. Clark and A. S. Campbell, 1942, Geol. Soc. America Spec. Paper 39, p. 9–10. Radiolarian-bearing shale occurring a little more than 2,000 feet above base of the Markley. Toward the base, the Sidney is a gray shale which grades downward into the Markley. Thickness about 700 feet; thins rapidly to northwest and wedges out into sands; cut out to southeast as a result of San Pablo (upper Miocene) overlap. Near Kirker Creek, underlies about 500 feet of micaceous gray to yellow-brown sandstone, with intercalated shale included in Markley formation by Clark (1918).

Ralph Stewart, 1949, U.S. Geol. Survey Oil and Gas Inv. Prelim. Chart 34. Unit described and assigned to member rank in Kreyenhagen formation. However, term Sidney is used in quotational sense because name Sidney is preoccupied.

C. V. Fulmer, 1954, (abs.) Geol. Soc. America Bull., v. 65, no. 12, pt. 2, p. 1341. Referred to as Sidney Flat shale member.

Type section: A long narrow outcrop beginning a little west of Kirker Creek, Mount Diablo quadrangle.

Sidney Flat Shale Member (of Markley Formation)

*See* Sidney Shale Member (of Markley Formation)

†Siebert Formation[1] or Lake Beds

Miocene, upper: Southern and central Nevada and southeastern California.

Original reference: S. H. Ball, 1907, U.S. Geol. Survey Bull. 308, p. 27, 32–34, map.

O. P. Jenkins, 1938, Geologic map of California (1:500,000): California Div. Mines. Siebert Lake beds mapped in Inyo County. Pliocene.

Probably named for occurrence in vicinity of Siebert Mountain, Tonapah region, Nevada.

**Siebert Tuff**[1]

Miocene, upper: Central Nevada.

Original reference: J. E. Spurr, 1905, U.S. Geol. Survey Prof. Paper 42, p. 51–55, maps.

Exposed on east slope of Siebert Mountain, Tonopah region.

Sierra limestone[1]

Mississippian: Southwestern New Mexico.

Original reference: C. R. Keyes, 1908, Am. Inst. Mining Engineers Bi-Monthly Bull. 19, p. 7–21.

Sierra County. Derivation of name not given.

Sierra Blanca Limestone[1]

Eocene, middle: Southern California.

Original reference: R. N. Nelson, 1925, California Univ. Pub., Dept. Geol. Sci. Bull., v. 15, no. 10, p. 350, 352–354, pl. 46, map.

B. M. Page, J. G. Marks, and G. W. Walker, 1951, Am. Assoc. Petroleum Geologists Bull., v. 35, no. 8, p. 1745–1749. Described northeast of Santa Barbara. Unconformably overlies undifferentiated Cretaceous shale. In some localities, grades upward into sandstone of Juncal formation (new). Thickness 20 to 50 feet. Lower middle Eocene. At type locality, disconformably overlies Upper Cretaceous Mono shale and grades upward into sandstone and shale of Eocene age. Thickness at type locality 225 feet.

Type locality: On Indian Creek, 10 miles northwest of Pendola Guard Station, Santa Barbara County.

Sierra Blanca Series[1]

Sierra Blanca coal measures[1]

Upper Cretaceous (Benton): Southern central New Mexico.

Original reference: D. R. Semmes, 1920, Am. Jour. Sci., 4th, v. 50, p. 415–420.

Probably named for Sierra Blanca, Lincoln and Otero Counties.

Sierra de Cayey Series

Cretaceous: Puerto Rico.

E. T. Hodge, 1920, New York Acad. Sci. Scientific Survey of Puerto Rico and the Virgin Islands, v. 1, pt. 2, p. 137–142. Series of conglomerates and tuffs. Thickness between 3,000 and 4,000 feet. Overlies Barranquitas-Cayey series; contact sharp; underlies Guayama series.

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. Ildefonso formation (new) includes part of the Río Jueyes, Guayama, and Sierra de Cayey series of Hodge (1920) which could not be recognized in area of present study.

Named for exposures along crest of Sierra de Cayey Mountains, Coamo-Guayama district.

Sierra de Cayey Tuffs[1]

Cretaceous: Puerto Rico.

*See* Cayey Tuffs.

Sierra Grande Andesite 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. 122–124, 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 but stratigraphic position of Sierra Grande, Purvine Mesa, Dunchee Hill, and Gaylord Mountain is not known. Sierra Grande andesite resembles Red Mountain dacite of Collins (1949) and if it is a correlative it is earlier than Clayton basalt of Collins (1949) but in this report it is grouped with Clayton basalts.

Sierra Grande is in Union County.

Sierran[1] (period)

Pliocene and Quaternary: California.

Original reference: J. Le Conte, 1899, Jour. Geology, v. 7, no. 6, p. 525–544.

D. I. Axelrod, 1956, California Univ. Pubs. Geol. Sci., v. 33, p. 23. Incidental mention in discussion of Mio-Pliocene floras from west-central Nevada.

Named for Sierra Nevada region.

Sierra Negra Basalt

Pliocene: Northwestern New Mexico.

A. J. Budding, C. W. Pitrat, and C. T. Smith, 1960, New Mexico Geol. Soc. Guidebook 11th Field Conf., p. 83 (table 1), 85. Name applied to dikes and flows of basaltic composition. Dikes cut El Rito and Abiquiu and Cutler formations. Basalt flow 90 feet thick caps Sierra Negra and overlies Abiquiu tuff.

Present in southern part of Canjilon Southeast quadrangle.

Sierrita Granite

Precambrian: Southeastern Arizona.

W. C. Lacy, 1959, Arizona Geol. Soc. Guidebook 2, p. 186, fig. 44. Coarse-grained oligoclase granite. Forms basement rock and much of core of Sierrita Mountains. Unconformably underlies Bolsa quartzite.

Exposed in long strip in western part of east Sierrita area (eastern side of Sierrita Mountains), Pima County, about 25 miles south of Tucson.

Sierrite Limestone or Formation (in El Paso Group)

Lower Ordovician: Southwestern New Mexico.

V. C. Kelley, 1951, Am. Assoc. Petroleum Geologists Bull., v. 35, no. 10, p. 2201 (table). On table only. Thickness from fraction of a foot to 250 feet. Underlies Bat Cave limestone (new) ; overlies Bliss sandstone.

V. C. Kelley and Caswell Silver, 1952, New Mexico Univ. Pubs. in Geology 4, p. 42–45, fig. 4. Thin- to medium-bedded, the thin beds and laminations result in a distinctive banded appearance. Laminations commonly consist of alternating layers of limestone and chert with latter generally the thinner. Chert laminations are brown weathering, whereas limestone generally weathers medium gray. On fresh surfaces, Sierrite limestone is medium gray to dark gray with slight brownish cast. Most beds are microgranular, but fine- to medium-grained textures are common. Limestone entirely calcite at type locality. Chert is light gray to white on fresh surfaces. Except for chert laminations, formation is almost exclusively limestone. At Molinas Canyon section in southern end of the range, a few thin lentils of brick-red shale present about 35 feet above base of formation. Thickness 167 feet at type locality. Conformable with confining formations. Lower formation of El Paso group. Type section and areal distribution indicated.

Type locality: Exposures on north side of Cable Canyon, Caballo Mountains. Named from Sierrite iron mine on south side of the canyon. Crops out all along west face of Caballo Mountains, in west face of Mud Springs Mountains, and in west face of south Red Hills, at south end of Nakaye Mountain, and in west face of Red House Mountain.

**Siesta Formation**[1] (in Berkeley Group)

Siesta Formation (in Contra Costa Group)

Pliocene: Western California.

Original reference: A. C. Lawson and C. Palache, 1902, California Univ. Pub., Dept. Geol. Bull., v. 2, p. 384–390, map.

N. L. Taliaferro, 1951, California Div. Mines Bull. 154, p. 143. Described as consisting of marsh and lake clays, ostracodal clays and impure ostracodal limestone, banded impure cherts, silts, sandstones, gravels, thin lignitic beds, and beds of volcanic ash. Thickness 700 feet in south part of area; thins to less than 50 feet north of Grizzly Peak. Succeeded by and interbedded with Bald Peak lavas; interbedded with underlying Moraga volcanics. Lower Pliocene.

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 a new group name is proposed (name not given). Sequence (ascending) is Orinda, Moraga, Siesta, Bald Peak, and unnamed formation. Unnamed unit is exposed east of Moraga fault system in fault contact with Siesta and Moraga formations.

C. K. Ham, 1952, California Div. Mines Spec. Rept. 22, p. 15. Lists sequence of Contra Costa group (new) as Orinda, Grizzly Peak, Siesta, Bald Peak, and Mulholland (new) formations.

Named for development in Siesta Valley, Berkeley Hills, San Francisco region.

Signal Hill Beds

Pleistocene, lower: Southern California.

J. E. Eaton, 1943, California Div. Mines Bull. 118, pt. 2, p. 204 (fig. 86) [preprint 1941]. Referred to as coarse, highly deformed, and deeply degraded beds apparently younger than the San Pedro, but their relation to this substage is unknown.

Occurs in Los Angeles Basin.

**Signal Mountain Formation**[1] (in Arbuckle Group)

Upper Cambrian: Southeastern Oklahoma.

Original reference: E. O. Ulrich, 1932, Geol. Soc. America Bull., v. 43, p. 742–747.

C. E. Decker, 1939, Oklahoma Geol. Survey Circ. 22, p. 16 (table 1), 21–22, measured sections. Thickness 114 to 478 feet in Arbuckles. On McKenzie Hill, rests with apparent conformity on Fort Sill limestone, but hiatus probably occurs at this locality, because Royer formation lies between it [Signal Mountain] and Fort Sill in northwestern part of Wichitas and in all of its exposures in Arbuckle Mountains. In latter region, it is overlain by Butterly formation (new) and occupies position between two dolomites, Royer below and Butterly above.

Named for exposures in sec. 8, T. 2 N., R. 12 W., about 1 mile south of Signal Mountain, a prominent peak at eastern end of Wichita Range.

**Signal Point Shale** (in Gizzard Formation)

Signal Point Shale (in Gizzard Group)

Lower Pennsylvanian: 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. 4, 19, pls. 2, 3, 4. Overlies Warren Point sandstone; underlies Sewanee conglomerate of Crab Orchard Mountains group (new). Thickness at type section 52 feet; thins westward to 10 feet at type section of Gizzard group; along eastern edge of Walden Ridge averages about 60 feet; along Western Escarpment commonly very thin and locally completely truncated by Sewanee conglomerate. Pottsville series.

Type locality: On State Highway 8 east of Signal Point and just south of town of Signal Mountain, Chattanooga quadrangle, Hamilton County.

**Siksikpuk Formation**

Lower(?) Permian: Northern Alaska.

W. W. Patton, Jr., 1957, U.S. Geol. Survey Prof. Paper 303–B, p. 41–43. Chiefly of variegated green, gray, and dark red shale and siltstone that locally are notably calcareous, cherty, or ferruginous. Variegated nature and bright yellow and orange weathering of ferruginous beds are distinctive. Thickness of composite section measured in type area totals 354 feet. Everywhere it appears to rest disconformably upon rocks of Lisburne group; disconformably underlies Shublik formation.

Type section is composite of two separate outcrops, approximately 2 miles apart along narrow belt of exposures immediately adjacent to north front of Brooks Range. Basal 62 feet measured in cutbank on east side of Skimo Creek at about lat 68°17′ N. and long 151°53′ W. Remainder of section measured in cutbank on east side of small tributary to Tiglukpuk Creek at about lat 68°17′ N. and long 151°48′ W. Named from Siksikpuk River, to which Tiglukpuk Creek is a major tributary.

**Siletz River Volcanic Series**

Eocene, lower: Northwestern Oregon.

P. D. Snavely, Jr., and E. M. Baldwin, 1948, Am. Assoc. Petroleum Geologists Bull., v. 32, no. 5, p. 806–812. Name proposed for a series of basaltic flows, pillow lavas, flow breccias, and pyroclastic rocks that includes small amounts of water-laid tuffaceous sedimentary rocks that contain a fauna correlative with the Capay shale of California. Base of series not exposed; minimum thickness of 3,000 to 5,000 feet computed for section between Valsetz and forks of Siletz River. Overlain with apparent conformity, except where faulting has produced local angular relationships, by rhythmically bedded micaceous arkosic sandstone of middle(?) Eocene age; in northwestern part of area upper Eocene siltstones unconformably overlap the middle(?) Eocene sandstones and rest directly on the volcanics. Structurally the volcanics are folded into broad anticlinal arches with minor flexures; one arch trends northward along western half of mass, plunging northeast; the other trends north of east and plunges beneath the Willamette Valley near Dallas. Correlated with Umpqua formation and with lower part of Tillamook volcanic series.

P. D. Snavely, Jr., and H. E. Vokes, 1949, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 97. Described in coastal area between Cape Foulweather and Cape Kiwanda where it conformably underlies Burpee formation.

H. E. Vokes, D. A. Myers, and Linn Hoover, 1954, U.S. Geol. Survey Oil and Gas Inv. Map OM–150. In west-central border area of Williamette Valley, includes Kings Valley siltstone member (new) in upper part. Volcanics extend in broad north-east trending belt from northwest corner of Monroe quadrangle into Albany quadrangle where they are well exposed in quarries near Coffin Butte.

Type section: Along Siletz River from Valsetz milldam, sec. 28, T. 8 S., R. 8 W., to the Lower Gorge, sec. 16, T. 9 S., R. 9 W., Lincoln County. Well exposed along Siletz River and its tributaries in Euchre Mountain and Valsetz quadrangles.

Silica Shale, or Formation

Silica Shale (in Traverse Formation)[1]

Middle Devonian: Northwestern Ohio.

Original reference: G. A. Stewart, 1927, Ohio Geol. Survey, 4th ser., Bull. 32, p. 5–9.

G. A. Stewart, 1936, Jour. Paleontology, v. 10, no. 8, p. 739–740. As originally defined, was considered to comprise a single shale unit about 10 feet thick. Herein stratigraphically expanded above and below to include a sequence, approximately 45 feet thick, of blue shales, blue argillaceous limestones, and blue shaly limestones. Of total thickness only basal 16 feet are exposed in quarry at Silica.

G. A. Stewart, 1938, Geol. Soc. America Spec. Paper 8, p. 6, 7. Underlies Tenmile Creek dolomite (new). Separated from underlying Columbus limestone by an 8-foot unit termed Blue limestone. Considered best to discontinue use of term Traverse for upper Middle Devonian units of northwestern Ohio between Columbus limestone and Ohio shale.

G. M. Ehlers, E. C. Stumm, and R. V. Kesling, 1951, Devonian rocks of southeastern Michigan and northwestern Ohio: Ann Arbor, Mich., Edward Brothers, Inc., p. 18–20. Stratigraphically expanded below to include 8-foot unit termed Blue limestone by Stewart (1938). Overlies Dundee limestone ("Columbus limestone" of Ohio geologists). Well records in southeastern Michigan show a northward continuation of several units of the Silica and indicate that formation is thicker than in Ohio.

K. V. Hoover, 1960, Ohio Geol. Survey Inf. Circ. 27, p. 8–16. Stratigraphic position and correlation of Olentangy shale discussed in detail. It is here suggested that the Olentangy, Plum Brook shale, Prout limestone, Silica shale, and Ten Mile Creek dolomite are stratigraphically correlatable, with the reservation that Olentangy is probably Upper Devonian. Olentangy interval is represented by Silica shale and Ten Mile Creek dolomite in northwestern Ohio. Silica formation is series of alternating shales and limestones that are highly fossiliferous and are thin to thick bedded. Basal beds are bluish gray and have been called "Blue" limestone. Field relationships between limestone beds of Silica formation and Ten Mile Creek dolomite are similar. Regional information regarding Silica formation-Ten Mile Creek dolomite has not been worked out. Combined thickness of 93 feet for the two units has been reported in Lucas County exposures.

Named for exposures in quarry of Sandusky Cement Company [now operated by Medusa Portland Cement Company] one-half mile north of Silica, Lucas County.

†Silo Sandstone[1]

Upper Cretaceous: Southeastern Oklahoma.

Original reference: J. A. Taff, 1902, U.S. Geol. Survey Geol. Atlas, Folio 79, p. 6.

Named for Silo, Bryan County.

Silver Shales[1]

Silver Shale Member (of Percha Shale)

Upper Devonian or Lower Mississippian: Southwestern New Mexico.

Original reference: C. R. Keyes, 1898, Am. Inst. Mining Engineers Bi-Monthly Bull. 19, p. 7, 9.

C. R. Keyes, 1942, Pan-Am. Geologist, v. 77, no. 3, p. 228 (table). Assigned to Linnian series.

M. A. Stainbrook, 1947, Jour. Paleontology, v. 21, no. 4, p. 298. Considered lower member of Percha shale. Lower part of Percha also termed Ready Pay member by Stevenson (1944). There is little doubt that the Silver and Ready Pay were proposed for identical division of Percha, and there is little reason to replace earlier name. Percha of early Mississippian age.

Named for Silver City.

**Silverado Formation**

Paleocene: Southern California.

W. P. Woodring and W. P. Popenoe, 1945, U.S. Geol. Survey Oil and Gas Inv. Prelim. Chart 12. Name proposed for Paleocene strata of northwestern Santa Ana Mountains. In type area and nearby, formation consists of a lower nonmarine member and an upper marine member; marine member is thinner than nonmarine and thins and disappears southeastward through gradation into nonmarine deposits. Formation includes Claymont clay bed about 65 to 140 feet above base and Serrano clay bed about 275 feet above the Claymont. Thickness of formation ranges from about 700 feet to 1,475 feet. Underlies Santiago formation; rests disconcordantly on different parts of Upper Cretaceous sequence; on ridge forming divide between Sierra Canyon and Gypsum Creek and Coal Creek, formation rests successively on Pleasants sandstone, Schulz Ranch sandstone, and Holz shale.

R. F. Yerkes, 1957, U.S. Geol. Survey Prof. Paper 274–L, p. 324–325. Formation in El Modeno area, Orange County, consists of five lithologic units (ascending): conglomerate bed, 20 to 40 feet; lower arkosic sandstone about 100 feet; Claymont clay bed, about 2 feet; arkosic sandstone unit as much as 700 feet; and marine sandstone bed, about 300 feet. Underlies Santiago formation; unconformably overlies Cretaceous sedimentary rocks.

Rene Engel, T. E. Gay, Jr., and B. L. Rogers, 1959, California Div. Mines Bull. 146, p. 24, 77, 80, 81, 93, 95, 97, pls. 5, 7. Name "Silverado formation" was used by B. N. Moore (1930, unpub. thesis) to designate most of Triassic rocks on southwest slope of Santa Ana Mountains. These rocks have been correlated with metamorphosed sediments in Elsinore quadrangle [this report], and name "Silverado formation" conflicts with older name "Santa Ana formation." Footnote (p. 77) states that, in the discussion which follows, the rock units referred to as Bedford Canyon formation and Santiago Peak volcanics correspond in general to units referred to as Santa Ana formation and the Jurassic(?) volcanic and hypabyssal rocks respectively in preceding pages of bulletin. Term Silverado formation is used in place of Martinez formation to designate the Tertiary clay-bearing sedimentary rocks. Martinez formation mapped on plate 1. Silverado formation, Paleocene, is mapped on plates 5 and 7.

Type region: Area northeast of Irvine Park, northwestern Santa Ana Mountains, Orange County.

Silver Bell Formation

Tertiary: Southeastern Arizona.

J. H. Courtright, 1958, Arizona Geol. Soc. Digest, p. 7, 8. Composed mainly of angular to subrounded fragments of dark-gray to purplish-hued andesite porphyry enclosed in matrix of gritty andesitic mudstone. Fragments commonly 1 to 6 inches in diameter, but large blocks several feet in diameter occasionally present. Evidence of stratification extremely rare. Thickness from a few feet to possibly 200 feet. Appears to lie unconformably on Cretaceous and older sediments, although actual contacts not observed. Underlies volcanics that closely resemble Cat Mountain rhyolite of Tucson Mountains. Formation regarded as separate from underlying Cretaceous sediments.

Kenyon Richard and J. H. Courtright, 1960, Arizona Geol. Soc. Digest, v. 3, p. 1, 7. Unconformably overlies Claflin Ranch formation (new).

At Silver Bell mine [35 miles northwest of Tucson, in Silver Bell Mountains], Pima County. A formation of considerable extent.

Silver City Granite[1]

Age(?): Southwestern Idaho.

Original reference: A. M. Piper and F. B. Laney, 1926, Idaho Bur. Mines and Geology Bull. 11, p. 15.

Silver City, Owyhee County.

Silver City Monzonite

Eocene, middle or upper: Northern Utah.

D. R. Cook, 1957, Utah Geol. Soc. Guidebook 12, p. 65 (fig. 6). As shown on chart overlies Swansea quartz monzonite.

Area of report is Main Tintic mining district.

Silver Coulee Beds (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, p. 236–237, 238 (table). Proposed for beds, 1,200 to 3,000 feet thick, that occur approximately 2,400 feet above base of formation. Matrix is fine-grained green sandstone. Faunally beds may be called the *Microcosmodon-Phenacodaptes-Litolestes* zone. Stratigraphically above Rock Bench quarry beds (new); and below Clark Fork beds.

Named for Silver Coulee, a tributary of Big Sand Coulee, in Sand Coulee Basin, Park County. Fossil quarry is in sec. 21, T. 57 N., R. 100 W.

Silver Creek Glacial Substage

Silver Creek 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 third of four glacial advances in the area. Marked by terminal and recessional moraines. Followed Gould advance (new), preceded American Lakes advance (new).

D. F. Eschman, 1955, Jour. Geology, v. 63, no. 3, p. 205–206, fig. 2, table 1. Deposits of substage mapped as Silver Creek till. Substage represented by the most extensive and complete morainic system on Michigan River. Till is loose, sandy, and light brown; contains many subrounded cobbles and pebbles; reddish-brown clayey streaks rare; depth of oxidation in till about 20 inches.

Named from Silver Creek, a tributary of South Fork of Michigan River, the valley of which is choked at its lower end with a great amount of drift, Michigan River basin, North Park.

**Silver Creek Limestone Member** (of Sellersburg Limestone)[1]

Silver Creek Formation (in Hamilton Group)

Middle Devonian: Southern Indiana and central northern Kentucky.

Original reference: C. E. Siebenthal, 1901, Indiana Dept. Geology and Nat. Resources 25th Ann. Rept., p. 345.

Guy Campbell, 1942, Geol. Soc. America Bull., v. 53, no. 7, p. 1057, 1061–1063, 1067. Rank raised to formation in Hamilton group. Underlies Swanville formation (new); overlies Deputy formation (new). Close relationship of Silver Creek and Beechwood implied by their treatment as members of the Sellersburg does not exist. Their fossils represent separate time divisions in standard Hamilton scale. Beechwood is separated from Silver Creek by erosional disconformity. The two facies of upper beds of Silver Creek more or less merge in central Clark County and contain layers of bedded chert and chert nodules. New Chapel chert bed proposed by Whitlatch and Huddle (1931) is only local and perhaps of secondary origin; it does not identify bed as whole or at all localities; therefore, term seems unnecessary.

J. B. Patton and T. A. Dawson *in* H. H. Murray, 1955, Indiana Geol. Survey Field Conf. Guidebook 8, p. 42, pl. 1. Indiana Geological Survey considers Silver Creek and Speed as lithofacies of Hamilton rocks. These lithofacies may be used as members in southern part of outcrop belt.

Named for Silver Creek, Clark County, Ind.

†Silver Creek Shale[1]

Upper Devonian: Western New York.

Original reference: D. D. Luther, 1903, New York State Mus. Bull. 69, p. 1019–1029.

Well exposed in Walnut and Silver Creek Ravines, Chautauqua County.

Silver Dyke Breccia[1]

Tertiary: Central Montana.

Original reference: P. A. Schafer, 1935, Montana Bur. Mines and Geology Mem. 13, map.

Occurs west of Silver Dyke mine, Little Belt Mountains.

†Silverheels Porphyry or Porphyrite[1]

Eocene: Northeastern 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, 104–107.

Named from the fact that it forms important intrusive sheets on Mount Silverheels, northeast of Alma, Park County.

**Silver Hill Formation**[1]

Middle Cambrian: Central western Montana.

Original reference: F. C. Calkins and W. H. Emmons, 1913, U.S. Geol. Survey Prof. Paper 78.

W. T. Holser, 1950, Geol. Soc. America Bull., v. 61, no. 10, p. 1058–1059 (table 1). Underlies Hasmark dolomite; overlies Flathead quartzite. Limestone and shale 210 to 350 feet thick.

Named for exposures on steep east face of Silver Hill, south of Silver Lake, Philipsburg region.

Silver Hills facies[1] (of New Providence Formation)

Lower Mississippian: Southern Indiana and northern Kentucky.

Original reference: P. B. Stockdale, 1931, Indiana Dept. Conserv., Div. Geology Pub. 98, p. 77, 96–100.

J. E. Conkin, 1957, Bulls. Am. Paleontology, v. 38, no. 168, p. 110–111, 114–116. Silver Hills facies divided into three members in Jefferson and Bullitt Counties, Ky.: Kenwood sandstone, Button Mold Knob (new), and Coral Ridge (new) members.

Name derived from Silver Hills at southwest side of New Albany, Floyd County, Ind.

**Silverhorn Dolomite**[1]

Middle Devonian: Eastern Nevada.

Original references: L. G. Westgate and A. Knopf, 1927, Am. Inst. Min. and Met. Eng. Trans., no. 1647, p. 7; 1932, U.S. Geol. Survey Prof. Paper 171.

G. A. Cooper and others, 1942, Geol. Soc. America Bull., v. 53, no. 12, pt. 1, p. 1781, chart 4. Age shown on correlation chart as Middle and Upper Devonian.

Named for exposures south of old Silverhorn mining camp, 4 miles northwest of Bristol Pass, Pioche district.

Silveria Formation[1]

Pleistocene: Northwestern Illinois.

Original reference: O. H. Hershey, 1896, Am. Jour. Sci., 4th, v. 2, p. 324–330.

Named for extinct Lake Silveria, in Pecatonica Basin, Stephenson County.

Silver King Dolomite Member[1] (of Bonanza King Formation)

Middle Cambrian: Southeastern California and southern Nevada.

Original reference: J. C. Hazzard and J. F. Mason, 1936, Geol. Soc. America Bull., v. 47, no. 2, p. 236–237.

J. C. Hazzard and J. F. Mason, 1953, Am. Jour. Sci., v. 251, no. 9, p. 651–652. Geographically extended into Goodsprings area, Nevada, where it lies within the Goodsprings dolomite of Hewett (1931). Described as a very dark smoky gray dolomite with inconspicuous bands 6 inches to 10 feet thick; upper part is a transition zone 20 to 25 feet thick in which light-gray beds, averaging 1 foot thick, alternate with darker beds 2 to 3 feet thick. Thickness about 190 feet.

Named for Silver King mine, on east side of Providence Mountains, San Bernardino County, Calif.

Silver King Quartz Monzonite Porphyry

Age not stated: South-central Arizona.

M. N. Short and others, 1943, Arizona Bur. Mines Bull. 151, Geol. Ser. 16, p. 42–43. In the least altered area, the rock is medium-dark-gray quartz diorite porphyry. In vicinity of mineralized area, the porphyry is light brown and highly weathered into spheroidal forms of variable size, mostly more than 1 foot in diameter. A specimen from inside a large spheroidal boulder is medium gray with faintly greenish tint. Rock is fine grained and holocrystalline.

Crops out as a roughly elliptical mass approximately 2,500 feet long from east to west by 1,200 feet wide. Represents the rock in which was developed the Silver King ore body, Superior mining area, northeastern Pinal County.

Silver Lake Group[1]

Pliocene: Central southern Oregon.

Original reference: T. Condon, 1902, The two Islands.

**Silver Lake Shale Member** (of Scranton Shale)[1]

Silver Lake Shale (in Wabaunsee Group)

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

Original reference: J. W. Beede, 1898, Kansas Acad. Sci. Trans., v. 15, p. 30.

R. C. Moore, 1936, Kansas Geol. Survey Bull. 22, p. 49 (fig. 11), 214. Rank raised to formation in Wabaunsee group. Term Scranton abandoned. Overlies Rulo limestone; underlies Burlingame limestone. Average thickness about 25 feet.

L. W. Wood, 1941, Iowa Geol. Survey, v. 37, p. 3090 (fig. 14). Graphic section of Pennsylvanian in western Adams County shows Silver Lake shale underlying Burlingame and overlying Elmo coal which in turn overlies Cedar Vale (Cedarvale) shale.

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 Scranton shale here reintroduced as a formation with stratigraphic span as assigned to it by Haworth and Bennett (1908). Overlies Rulo limestone member; underlies Burlingame limestone member of Bern limestone (new).

H. G. Hershey and others, 1960, Iowa Highway Research Board Bull. 15, p. 13, fig. 5. Bright-gray shale, well-bedded, with some limonitic bands at base. Thickness about 11 feet. Underlies Burlingame limestone; overlies Cedar Vale shale. Rulo limestone which underlies Silver Lake in some areas, not identified in Iowa. Wabaunsee group.

Type locality: Northeast of Silver Lake, Shawnee County, Kans.

Silver Mine Granite

Precambrian: Southeastern Missouri.

H. B. Graves, 1938, Acad. Sci. St. Louis Trans., v. 29, no. 5, p. 119. Medium-grained red granite distinguished from other granites of area [St. Francois Mountains] by its heavy-mineral assemblage. Cut by a number of dikes.

Occurs along southern border of main mass granite in Iron Mountain and Mine La Motte quadrangles.

Silver Mountain Monzonite Porphyry[1]

Eocene(?): Southeastern Colorado.

Original reference: R. C. Hills, 1900, U.S. Geol. Survey Geol. Atlas, Folio 68.

Well exposed in Huerfano Park quadrangle, adjoining Walsenburg quadrangle on west in Huerfano County.

Silver Pass Volcanics

Paleocene or 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. 105–107, pl. 1. Proposed for unit composed mainly of andesite and more felsic volcanic rocks, including flows, tuff, and breccia. Smith and Calkins (1906) included these rocks in their Kachess rhyolite, although they commented on the differences. Silver Pass volcanic rocks include "type area" of Smith's and Calkins' Kachess. In mapped area of this report, rocks called Kachess by Smith and Calkins can be separated into two groups, presumably of different ages: Silver Pass volcanic rocks of post-Swauk and pre-Teanaway age, and rhyolite within Naches formation. At Silver Pass, the volcanic rocks unconformably overlie Easton schist; to the southwest on ridge of French Cabin Mountain, they overlie Swauk formation; near Silver Pass, they are intruded by basaltic dikes presumably of Teanaway dike swarm; farther south, on ridge between Kachess Lake and Silver Creek, they apparently unconformably underlie Teanaway basalt. Unfossiliferous. May be Paleocene or Eocene, but discovery of fossils may alter this interpretation.

Type area: Silver Pass, between Silver Creek and French Cabin Creek, both of which drain region between Kachess and Cle Elum Lakes, central Cascades Mountains.

Silver Peak Andesites

Late Tertiary: Central eastern California.

H. D. Wilshire, 1957, California Univ. Dept. Geol. Sci. Bull., v. 32, no. 4, fig. 1. Named on map legend of Ebbetts Pass region. Younger than Raymond Peak andesites (new).

Ebbetts Pass region is in Alpine County.

†Silver Peak Group[1]

Lower Cambrian: Southwestern Nevada and eastern California.

Original reference: H. W. Turner, 1902, Am. Geologist, v. 29, p. 261–272.

C. R. Longwell, 1952, Washington Acad. Sci. Jour., v. 42, no. 7, p. 210, 211. Discussion of lower limit of Cambrian in Cordilleran region. Silver Peak series is of particular interest because fossils in relative abundance range through large part of its thickness. Beds overlie Campito sandstone. Correlates with Wood Canyon formation. Thickness about 7,000 feet.

Named for exposures in Silver Peak Range, Esmeralda County, Nev.

**Silver Plume Granite**[1]

Precambrian: Central northern Colorado.

Original reference: S. H. Ball, 1906, Am. Jour. Sci., 4th, v. 21, p. 389.

J. M. Bray, 1942, Geol. Soc. America Bull., v. 53, no. 5, p. 768 (fig. 1), 770. Younger than rocks of Pikes Peak group—Boulder Creek granite and Overland Mountain granite (new).

T. S. Lovering and E. N. Goddard, 1950, U.S. Geol. Survey Prof. Paper 223, p. 28, 29, 74, pl. 1. Younger than Pikes Peak and Sherman granites. As used in this report, Cripple Creek granite, Longs Peak granite, and Mount Olympus granites are included in the Silver Plume.

Forms south wall of Clear Creek Canyon at mining town of Silver Plume.

†Silver Reef Sandstone[1]

Upper Triassic: Southwestern Utah.

Original reference: J. B. Reeside, Jr., and Harvey Bassler, 1922, U.S. Geol. Survey Prof. Paper 129–D, p. 62, 73.

P. D. Proctor, 1953, Utah Geol. and Mineralog. Survey Bull. 44, p. 23–25. Reeside and Bassler noted Silver Reef sandstone in section measured on Smiths Mesa, 3 miles north of Virgin City, Utah, and 12 miles east of Silver Reef. According to these authors, Silver Reef sandstone is 260 feet above base of Chinle, yet in Silver Reef area the correlative sandstone is 620 feet above base of Chinle. Reeside and Bassler's "arkosic sandstone" or supposed Silver Reef sandstone, lies about same distance above base of Chinle as that measured in present report [Silver Reef area, Washington County] for arkosic bed in Hartley shales and sandstones (new). Silver Reef sandstone in Silver Reef area is about same horizon as "mauve crossbedded, ripple-marked sandstone" of Reeside and Bassler.

Section measured on Smiths Mesa, 3 miles north of Virginia [Virgin] City, and 12 miles east of Silver Reef, Washington County.

Silver Reef Sandstone Member (of Chinle Formation)

Upper Triassic: Southwestern Utah.

P. D. Proctor, 1950, Geol. Soc. America Bull., v. 61, no. 12, pt. 2, p. 1495. Includes lenselike bentonitic shales.

P. D. Proctor, 1953, Utah Geol. and Mineralog. Survey Bull. 44, p. 23–25, pl. 2. Subdivided into the Leeds sandstone (new) which includes mainly white to buff fine- to medium-grained sandstone beds with interbedded shales; and an overlying lavender, fine- to medium-grained sandstone called Tecumseh sandstone (new). Member is 620 feet above base of formation. Contained all known commercial quantities of silver which were mined in the past in Harrisburg (Silver Reef) mining district. Underlies Duffin sandstone and shale (new) with local unconformities; overlies Trail Hill sandstone (new). The Silver Reef sandstone (of Reeside and Bassler) may be the same zone as the arkosic bed in the Hartley shale and sandstone (new) rather than the lateral equivalent of the Silver Reef sandstone member.

Described from Silver Reef (Harrisburg) mining district, Washington County.

**Silver Run Limestone**

Lower Paleozoic(?) (Glenarm Series): Western Maryland and southeastern Pennsylvania.

A. I. Jonas and G. W. Stose, 1938, Washington Acad. Sci. Jour., v. 28, no. 8, p. 346; A. J. Stose and G. W. Stose, 1946, Maryland Dept. Geology, Mines and Water Resources Carroll and Frederick Counties [Rept. 12], p. 62–63. Blue thin-bedded argillaceous banded finely crystalline limestone in which the argillaceous material forms slaty or muscovite partings. Occurs largely northwest of Wakefield marble (new) and in places seems to grade into the marble and may be equivalent to it; infolded with and underlies Marburg schist and Ijamsville phyllite (both new).

U.S. Geological Survey currently considers the age of the Glenarm Series to be Lower Paleozoic(?).

Named from valley of Silver Run, Carroll County, Md. Also present in Frederick, Md., and York County, Pa.

**Silver Star Granodiorite**

Tertiary: Southwestern Washington.

W. M. Felts, 1939, Ohio Jour. Sci., v. 39, no. 6, p. 297, 302–303, 306–307, 315 (fig. 4). Contains subordinate amounts of augite diorite and quartz diorite near borders. Intrudes Eagle Creek formation and lower parts of Skamania andesites (new). Miocene. J. E. Allen (unpub. thesis) described the granitic rock near Silver Star Mountain as Silver Star Formation.

†Silver Terrace Sandstone[1]

Jurassic(?): Western California.

Original reference: R. Crandall, 1907, Am. Philos. Soc. Proc., v. 46, p. 3–58.

Forms Silver Terrace Hills, in eastern part of San Francisco.

Silvertip Conglomerate Member[1] (of Madison Limestone)

Upper Devonian or Mississippian: Northwestern Montana.

Original reference: C. F. Deiss, 1933, Montana Bur. Mines and Geology Mem. 6, p. 46.

L. L. Sloss and W. M. Laird, 1945, U.S. Geol. Survey Oil and Gas Inv. Prelim. Chart 15. On correlation chart, included in DA unit of Devonian age which underlies Madison limestone.

Named for Silvertip syncline, because it is thickest on Lone Butte, which lies nearly in center of syncline. Known to occur in only three areas—Lone Butte, Spotted Bear Mountain, and Pentagon Mountain [Flathead County].

**Silverton Volcanic Group**

Silverton Volcanic Series[1]

Tertiary, middle and upper: Southwestern Colorado.

Original reference: W. Cross, 1901, U.S. Geol. Survey Bull. 182, p. 29–39.

E. S. Larsen, Jr., and Whitman Cross, 1956, U.S. Geol. Survey Prof. Paper 258, p. 13–14, 75–81, pl. 1. Complex of lavas, tuffs, and agglomerates. Maximum thickness about 3,000 feet. Includes (ascending) Picayune quartz latite, Eureka rhyolite, Burns quartz latite, pyroxene-quartz latite flows, and Henson tuff. Overlies San Juan tuff; older than Potosi volcanic series.

U.S. Geological Survey currently classifies the Silverton as a group and designates the age as middle and late Tertiary on the basis of a study now in progress.

Named after Silverton quadrangle where units have their greatest development. Present extent is about 40 miles east and west and 25 miles north and south.

Silverwood cyclothem (in Tradewater Group)

Pennsylvanian: Western Indiana.

J. W. Alexander, 1943, Illinois Acad. Sci. Trans., v. 36, no. 2, p. 142 (fig. 1), 143. Name applied to cyclothem in which Indiana coal II is developed. Unit is a dark shale 6 feet thick where it attains its maximum thickness. Near base are two limestones, the upper 2 inches thick, and the lower 4 inches thick. Stratigraphically below Middle Delong cyclothem and above Minshall limestone.

Well exposed on Coal Creek just north of route 234 in NE¼SW¼ sec. 36, T. 18 N., R. 8 W., in vicinity of Silverwood, Fountain County.

Silvey Gap Sandstone (in Redoak 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, pls. 2, 3, 4. Maximum thickness 60 feet, at type locality. Separated from underlying Fodderstack sandstone (new) by shale interval that ranges from 45 to 110 feet in thickness; separated from basal shale of Vowell Mountain group (new) by a shale interval and the Pewee coal.

Named from exposures in Silvey Gap, above Windrock, Windrock quadrangle, Anderson County.

Silvies River Beds[1]

Lower Jurassic: Southeastern Oregon.

Original reference: W. D. Smith and E. L. Packard, 1919, Oregon Univ. Bull., v. 16, no. 7, p. 105.

Probably named for Silvies River, Harney County.

Simi Conglomerate[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 occurrence on flanks of Simi Hills, Ventura County.

†Similkameen Formation[1]

Lower Cretaceous: Central northern Washington.

Original reference: I. C. Russell, 1900, U.S. Geol. Survey 20th Ann. Rept., pt. 2, p. 100–137, map.

Exposed throughout a large part of elevated region drained by headwaters of Similkameen River.

Similkameen Granite[1]

Similkameen Granodiorite

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. 9, pl. 1. Mapped as granodiorite.

Exposures in eastern part of Chopaka quadrangle, Okanogan County, Wash., and British Columbia.

Simmler Formation

Oligocene(?) and Miocene, lower(?) : Southern California.

T. W. Dibblee, Jr., 1952, *in* Am. Assoc. Petroleum Geologists, Soc. Econ. Paleontologists and Mineralogists, and Soc. Explor. Geophysicists Guidebook, Joint Ann. Mtg., p. 82, 86. Dark-red sandstone and basal conglomerate 3,000 feet thick. Underlies Miocene Soda Lake formation (new); overlies Eocene(?) marine sandstone and shale. Outcrops noted in road log.

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), 2978 (fig. 3), 2981, 2982–2983. At designated type locality, consists of continuous series of hard pink to dark-grayish-red fine- to medium-grained massive sandstone beds with numerous interbeds of dark maroon and greenish siltstone. Sandstones are biotitic, well laminated, and commonly crossbedded; basal part consists of about 30 feet of conglomerate in dark maroon matrix. Thickness about 3,000 feet. Overlies Pattiway formation (new), with slight angular unconformity; conformably underlies Soda Lake sandstone member (new) of Vaqueros formation. In vicinity of Soda Lake, conformably underlies Soda Lake shale member (new) of Vaqueros formation. In western Cuyama Valley and La Panza Range, consists of maroon-red conglomerate and sandstone resting unconformably on Cretaceous sediments or granitic basement and attains maximum thickness of 3,000 feet. Oligocene(?) and perhaps lowermost Miocene. This formation was mapped as Redrock Canyon sandstone member of Santa Margarita by English (1916, U.S. Geol. Survey Bull. 621–M) and nonmarine Vaqueros by Eaton and others (1941, Am. Assoc. Petroleum Geologists Bull., v. 25, no. 2).

Type locality: Southeastern Caliente Range, T. 10 N., R. 25 W., east of Cuyama Ranch quadrangle. Range is an anticlinal uplift developed in a thick series of Tertiary sediments and is partially overturned and thrustfaulted southwestward toward Cuyama Valley.

†Simmons Bluff Beds[1]

Pleistocene: Southern South Carolina.

Original reference: W. H. Dall, 1897, U.S. Geol. Survey 18th Ann. Rept., pt. 2, p. 336, published in 1897 as House Doc. 5, 55th Cong., 2d sess.

Exposed at Simmons Bluff, about 12 miles below Rantowles, Charleston County.

Simon Limestone[1] (in Mississippian Series)

Carbonic: Southeastern Arizona.

Original reference: C. R. Keyes, 1922, Pan-Am. Geologist, v. 38, p. 243, 251, 338.

Charles Keyes, 1936, Pan-Am. Geologist, v. 66, no. 3, p. 215 (chart). In Mississippian series. Underlies Truxton limestones. Of Carbonic age.

Exposed in face of Chiricahua Mountains and overlooking San Simon bolson, in northeast corner of Cochise County.

**Simon Quartz Keratophyre**[1]

Middle Triassic: Central Nevada.

Original reference: A. Knopf, 1921, U.S. Geol. Survey Bull. 725–H.

Named for Simon mine in Cedar Mountains.

Simons Syenite[1]

Precambrian: New York.

Original reference: H. P. Cushing, 1907, New York State Mus. 60th Ann. Rept., pt. 2, map.

Exposed on shores of Simons Pond, Franklin County.

**Simonson Dolomite**[1]

Middle Devonian: Western Utah and east-central Nevada.

Original reference: T. B. Nolan, 1930, Washington Acad. Sci. Jour., v. 20, no. 17, p. 421–432.

J. C. Osmond, 1954, Am. Assoc. Petroleum Geologists Bull., v. 38, no. 9, p. 1931–1953. Geographically extended into east-central Nevada. Overlies Sevy dolomite. Detailed discussion of unit.

R. W. Rush, 1956, Utah Geol. and Mineralog. Survey Bull. 53, p. 12 (fig. 3), 23 (fig. 2). Described in western Millard County where it is about 460 feet thick, consists of medium-light-gray to medium-gray dolomite, overlies Kings Canyon dolomite (new), and underlies Guilmette limestone.

R. E. Cohenour, 1959, Utah Geol. and Mineralog. Survey Bull. 63, p. 12 (table 1), 84–86, pls. 1, 21. Described in Sheeprock Mountains where it is 450 to 563 feet thick, conformably overlies Sevy dolomite and conformably underlies Victoria-Pinon [Pinyon] Peak formations undifferentiated.

H. J. Bissell, 1959, Utah Geol. Soc. Guidebook 14, p. 145–150. Described in Fivemile Pass and North Boulter Mountains quadrangles where it is 563 feet thick, disconformably underlies Victoria formation and overlies Sevy dolomite. Noah dolomite of Bluebell formation is considered equivalent to Simonson dolomite; suggested that name Simonson be used in central Utah in preference to Bluebell.

Named for exposures in Simonson Canyon, on west side of Deep Creek Range, Gold Hill region, Utah.

**Simpson Group**[1]

Middle Ordovician: Central and southern Oklahoma.

Original reference: J. A. Taff, 1902, U.S. Geol. Survey Geol. Atlas, Folio 79.

C. E. Decker, 1933, Tulsa Geol. Soc. Digest, p. 55, 56–57. Group comprises (ascending) Joins, Oil Creek, McLish, Tulip Creek, and Bromide formations. Overlies Arbuckle group; underlies Viola group, which includes (ascending) Viola proper and Fernvale. Chazy.

C. E. Decker, 1942, Oklahoma Acad. Sci. Proc., v. 22, p. 154 (table 1). Underlies Patterson Ranch group (new).

R. W. Harris, 1957, Oklahoma Geol. Survey Bull. 75, 333p, pls. Group comprises (ascending) Joins, Oil Creek, McLish, Tulip Creek, Bromide, and Corbin Ranch (new) formations. Comprehensive review of Simpson investigation and extensive bibliography of Simpson stratigraphy ; part 2 describes Simpson Ostracoda.

Named for former village of Simpson, just north of Pontotoc, Johnston County.

Simpsonian Series

Ordovician: Central and eastern North America.

A. W. Grabau, 1937, Paleozoic formations in the light of the pulsation theory, v. 3, Cambrovician pulsation, pt. 2, Appalachian, Palaeocordilleran, Pre-Andean, Himalayan, and Cathaysian geosynclines: Peiping, China, Univ. Press. Natl. Univ. Peking, p. 20, 282. Term applied to rocks of Simpson, or Stones River age.

Simsboro Formation (in Wilcox Group)

Simsboro Sands Member (of Rockdale Formation)[1]

Eocene, upper: Central and southern Texas.

Original reference: F. B. Plummer, 1933, Texas Univ. Bull. 3232, p. 530, 586, etc.

H. B. Stenzel, 1953, *in* Am. Assoc. Petroleum Geologists, Soc. Econ. Paleontologists and Mineralogists, and Soc. Econ. Geologists Guidebook, Joint Ann. Mtg., Houston, p. 53 (geol. map). Shown on geologic map as a formation underlying Calvert Bluff formation and unconformably overlying Hooper formation.

Typically exposed at town of Simsboro, Freestone County.

**Sinbad Limestone Member** (of Moenkopi Formation)[1]

Lower Triassic: Central eastern Utah.

Original reference: J. B. Reeside, Jr., and others, 1927, Am. Assoc. Petroleum Geologists Bull., v. 11, no. 5, p. 797.

C. B. Hunt and R. L. Miller, 1946, Utah Geol. Soc. Guidebook 1, p. 10. Generalized section of exposed sedimentary rocks in Henry Mountains structural basin shows Moenkopi formation 250 to 685 feet, including Sinbad limestone member.

Type area: San Rafael Swell.

Singas Formation

Upper Triassic: North-central Nevada.

R. R. Compton, 1960, Geol. Soc. America Bull., v. 71, no. 9, p. 1387–1388, pl. 1. Sequence of phyllites with minor quartzite beds and clastic limestone lenses. Thickness 4,000 to 7,000 feet. Overlies O'Neill formation (new), contact drawn at top of highest O'Neill quartzite bed. Underlies Andorno formation (new).

Name derived from Singas Creek, Santa Rosa Mountains, Winnemucca region. Well exposed on ridge between Wash O'Neill Creek and Provo Canyon. Composes most all of Bloody Run Hills.

Singleshot Member (of Appekunny Argillite[1] or 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. 1885–1886. Lowermost member of Appekunny formation. Thickness 300 to 400 feet. Underlies Appistoki member; overlies Carthew member (new) of Altyn formation. Type locality designated.

Type locality: Singleshot Mountain near St. Mary Lake, Glacier National Park.

Sing Sing Marble[1]

Precambrian: Southeastern New York.

Original reference: C. P. Berkey and J. R. Healy, 1912, Columbia Univ. Contr., v. 20, p. 1907–1912.

In Westchester County.

Sinks Grove Limestone (in Greenbrier Limestone[1] or Series)

Middle Mississippian (Meramecian): Southeastern West Virginia and southwestern Virginia.

Original reference: D. B. Reger, 1926, West Virginia Geol. Survey Rept. Mercer, Monroe, and Summers Counties, p. 451, 484.

Dana Wells, 1950, Am. Assoc. Petroleum Geologists Bull., v. 34, no. 5, p. 903. Denmar formation (new) includes Sinks Grove and Patton limestones of Reger (1926). Age of Denmar, Middle Mississippian (Meramecian series).

D. B. Reger, 1950, Am. Assoc. Petroleum Geologists Bull., v. 50, no. 9, p. 1910–1912. Patton and Sinks Grove do not represent a single stratigraphic unit; in Monroe County, where they were named, they are separated by 10 to 20 feet of plant bearing shale [Patton shale]. Use of term Denmar for these two units is without merit. Middle Mississippian.

Type locality: Along Sinks Grove-Knobs Road, in vicinity of Sinks Grove, Monroe County, W. Va.

Sinosri Formation

Oligocene: Panamá and Costa Rica.

Original reference: D. F. MacDonald and others, 1919, Am. Assoc. Petroleum Geologists Bull., v. 3, p. 364.

Karl Sapper, 1937, Mittelamerika Handbuch der regionalen Geologie: Heidelberg, vol. 8, sec. 4a, no. 29, p. 131, 132, 134 (chart), pl. 9. Chart shows middle Oligocene Senosri limestone below upper Oligocene Uscari formation.

W. P. Woodring *in* R. Hoffstetter and others, 1960, Lexique Strat. Internat., v. 5, Amérique Latine, fasc. 2a, p. 346. Undefined name for deposit of Oligocene age. Sinosri is correct spelling.

Bocas del Toro Province.

Sinsinawa Member (of Wise Lake 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. Thick-bedded dolomite, pure, brown, coarsely crystalline. Thickness 13 feet. Shown on columnar section as underlying Stewartville member (new) of Wise Lake formation and overlying Wyota member (new) of Dunleith formation.

Occurs in Dixon-Oregon area.

Siouan series[1]

Precambrian: Iowa.

Original reference: C. R. Keyes, 1912, Iowa Acad. Sci. Proc., v. 19, p. 147–151.

**Sioux Quartzite**[1]

Precambrian: Northwestern Iowa, southwestern Minnesota, northeastern Nebraska, and southeastern South Dakota.

Original reference: C. A. White, 1870, Iowa Geol. Survey, v. 1, p. 26, 167–171.

Brewster Baldwin, 1949, South Dakota Geol. Survey Rept. Inv. 63, p. 1–25. Consists predominantly of pink-coated fine grains of quartz sand cemented to a nonporous quartzite of silica. Seams and beds of coarse-grained quartzite present locally; also contains some shale and pipestone. Known exposures in South Dakota are in Minnehaha, Lincoln, Turner, McCook, and Hanson Counties. Covers belt some 70 miles long in eastwest direction and about 30 miles in north-south direction. On indirect evidence formation is probably Precambrian. On basis of lithology, absence of fossils, and structures, formation has been correlated with Baraboo quartzite in Wisconsin, which is overlain directly by Upper Cambrian sediments.

Named for exposures in banks of Big Sioux River, Iowa.

Sipe Springs Formation (in Big Saline Group)

Pennsylvanian (Lampasas Series): North-central Texas (subsurface).

M. G. Cheney, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 1, p. 84 (fig. 5), 85. Sequence of limestone and shale. Lies at depth of 3,760 to 3,870 feet in type well. Underlies Eastland Lake formation (new); overlies De Leon formation (new.

Type well: Roxana Petroleum Co. Seaman No. 1, northwest Palo Pinto County. Name derived from town in northern Comanche County.

Sisar Black Shale

Eocene, middle: California.

T. L. Bailey, 1947, Am. Assoc. Petroleum Geologists Bull., v. 31, no. 11, p. 1920 (fig. 3), 1931. Shown on structure section as underlying Topatopa sandstone and overlying Wheeler sandstone.

Exposed in the Santa-Ynez-Topatopa Mountains north of the Santa Clara Valley, [Ventura County].

Siscowit Granite

Age not stated: Southeastern New York and southwestern Connecticut.

D. M. Scotford, 1956, Geol. Soc. America Bull., v. 67, no. 9, p. 1177, pl. 1. Name proposed for medium- to fine-grained massive light-reddish-gray granite weathering dark-reddish-gray to dark-gray. Foliation not pronounced. Formerly considered part of Thomaston granite. Not continuous with type Thomaston and bears little resemblance to it.

Named for reservoir in outcrop area [in Westchester County, N.Y.] Also mapped in Fairfield County, Conn.

Siskiyou Granodiorite[1]

Jurassic: Northwestern California.

Original reference: J. H. Maxson, 1933, California Jour. Mines and Geology, v. 29, nos. 1, 2, p. 131, map.

Del Norte and Siskiyou Counties.

Siskiyou terrane[1]

Pre-Silurian: Northwestern California.

Original reference: N. E. A. Hinds, 1932, California Univ. Pub., Dept. Geol. Sci. Bull., v. 20, no. 11, p. 375–410.

N. E. A. Hinds, 1940, 6th Pacific Sci. Cong. for 1939, v. 1, p. 277–278. Pre-Silurian.

Well exposed in Siskiyou Mountains, [Siskiyou County].

**Sisquoc Formation**[1]

Miocene, upper, and Pliocene, middle: Southern California.

Original reference: W. W. Porter, II, 1932, Am. Assoc. Petroleum Geologists Bull., v. 16, no. 2, p. 135–143.

W. P. Woodring, M. N. Bramlette, and K. E. Lohman, 1943, Am. Assoc. Petroleum Geologists Bull., v. 27, no. 10, p. 1340 (table 1), 1347–1352. Described as including two principal facies: a fine-grained basin facies made up dominantly of diatomaceous strata and a sandstone marginal facies represented at eastern margin of basin. When formation was named, the marginal sandstone facies was emphasized. According to current usage, term Sisquoc formation when unqualified refers to the basin facies, which is more extensive in both outcrop and subsurface sections. Marginal facies is designated Tinaquaic sandstone member; Todos Santos claystone member is applied to porcelaneous claystone forming about the lower half of basin facies in Casmalia Hills. In Purisima Hills, basin facies has exposed maximum thickness of 3,000 feet; in Casmalia Hills, formation is 2,000 to 3,000 feet thick, Todos Santos claystone constitutes about 1,500 feet of lower part. Overlies Monterey shale; underlies Foxen mudstone.

W. P. Woodring and M. N. Bramlette, 1950, U.S. Geol. Survey Prof. Paper 222, p. 26–36, pl. 1. Late Miocene and middle Pliocene.

Named for section on Sisquoc Ranch, on south side of Sisquoc River, in Sisquoc grant, Santa Barbara County. Woodring and others regard the western Purisima Hills as type region of basin facies.

Sites 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 Funks formation and overlying Mills formation (both new).

J. M. Kirby, 1943, Am. Assoc. Petroleum Geologists Bull., v. 27, no. 3, p. 282, 284–285, 291, 293. Described as consisting mostly of massive- to well-bedded or rhythmically banded, concretionary, greenish-gray or light-drab sandstone. Thickness 2,095 to 3,965 feet. Conformably underlies Funks formation; conformably overlies Yolo formation (new name for preoccupied Mills). Derivation of name given.

Named for exposures both north and south of Stone Corral Creek, particularly in E¼ sec. 33 and E½ sec. 28, T. 17 N., R. 4 W., Colusa County.

**Sitgreaves Tuff**[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. 39, map.

Named for Sitgreaves Pass, Oatman district.

**Sitkin Point Formation**

Early Quaternary: Southwestern Alaska.

G. L. Snyder, 1959, U.S. Geol. Survey Bull. 1028–H, p. 175, 177, pl. 23. Waterlaid pyroclastic material; tuffaceous graywacke, dacite-boulder tuff-breccia, andestitic tuff, and pumiceous tuff. On tip of Sitkin Point, formation is of semiconsolidated volcanic wacke or graywacke in beds 2 to 20 feet thick and averaging 4 feet thick. Exposed deposits more than 450 feet thick. Underlies Double Point dacite (new) and overlies Williwaw Cove formation (new) with unconformable contacts. Probably early Quaternary.

Named for deposits exposed at Sitkin Point, Little Sitkin Island, in Rat Islands group of Aleutian Islands.

Sixmile Granite[1]

Precambrian: Central Texas.

Original reference: H. B. Stenzel, 1932, Geol. Soc. America Bull., v. 43, no. 1, p. 144.

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 the already deformed metasediments [Valley Spring gneiss and Packsaddle schist] and was followed by the Oatman Creek granite, Sixmile granite, and Llanite, the latter being the youngest.

Quarried near Sixmile, near Llano, Mason County.

Sixmile Schist

Age not stated: Central Virginia

W. R. Brown, 1951, (abs.) Virginia Jour. Sci., new ser., v. 2, no. 4, p. 347. Incidental mention.

Lynchburg quadrangle.

Six Mile Shale (in Ithaca Shale)

Six Mile Shale Member[1] (of Middlesex Shale)

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. Shale reallocated to lower part of Ithaca shale. Underlies Cascadilla shale; overlies Renwick shale.

Occurs in Ithaca region.

**Sixmile Canyon Formation** (in Indianola Group)

Upper Cretaceous: Central Utah.

E. M. Spieker, 1946, U.S. Geol. Survey Prof. Paper 205–D, p. 122, 128. Succession of coarse-grained gray sandstone and conglomerate containing coal-bearing member of finer grain. In Sixmile Canyon, three members recognizable (ascending): prominent gray conglomeratic sandstone about 2,000 feet thick; coal-bearing member containing gray to cream-colored and white mainly fine-grained sandstone, gray to white shale, carbonaceous shale, and coal, about 300 feet thick; conglomerate and conglomeratic sandstone of which 425 feet are exposed. Uppermost formation in group; overlies Funk Valley formation (new); unconformably underlies Price River formation.

Named for exposures in Sixmile Canyon, south of Manti, Sanpete County.

**Six-Mile Lake Amphibolite** (in Dickinson Group)

Precambrian: Northern Michigan.

H. L. James, 1958, U.S. Geol. Survey Prof. Paper 314–C, p. 30 (table 1), 32. Uppermost formation in group. A massive dark fine- to medium-grained aggregate of hornblende and plagioclase, with strong preferred planar and linear orientation of minerals; amphibolite is basaltic in composition and represents a metamorphosed sequence of flows and possible tuffs; amphibolite grades to the south (across the strike) into a mile-wide zone of banded gray gneiss that is the product of reaction between the amphibolite and post-Dickinson gneissic granite. Thickness about 3,000 feet. Overlies Solberg schist (new).

Named for Six-Mile Lake in sec. 22, T. 42 N., R. 29 W., Dickinson County. Well exposed in low knobs and ridges immediately south of the lake and for several miles to the east and west.

Sixshooter Group

Cretaceous (Comanche Series): Western Texas.

Hugh Hay-Roe, 1957, Texas Univ. Bur. Econ. Geology, Geol. Quad. Map 21; J. P. Brand and R. K. DeFord, 1958, Am. Assoc. Petroleum Geologists Bull., v. 42, no. 2, p. 378–385. Name applied to sequence of limestone lying between Cox sandstone below and the Boquillas flags in Kent quadrangle. Name credited to J. P. Brand and R. K. DeFord (in press). In area of this report (Wylie Mountains and vicinity), group comprises 330 to 350 feet of limestone of a neritic facies; divided into three formations (ascending): Finlay, Boracho (new), and Buda limestones.

Well exposed in southern part of Kent quadrangle along U.S. Highway 80.

Sixth Street 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 (fig. 8), 1708–1709, 1717 (fig. 16). Quaternary section of Texas Coastal Plain between Brazos River and Rio Grande is divided into 11 terraces and terrace deposits. Name Sixth Street is applied to a terrace deposit composed of 5 to 10 feet of dark-gray to reddish silt overlying limestone gravel. Younger than Capitol terrace deposit and lies about 70 feet below surface of Capitol terrace. Downstream along Colorado, the terrace appears to join surface of the Beaumont. Seems desirable to retain name Sixth Street for deposits at Austin since relation of younger terrace deposits, First Street and Riverview, at Austin, to formations near coast has not been completely determined.

Named for occurrence along Sixth Street east of Congress Avenue, Austin, Travis County.

**Siyeh Limestone**[1] (in Piegan Group)

Siyeh Formation (in Piegan Group)

Siyeh 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, 323.

C. L. Fenton and M. A. Fenton, 1937, Geol. Soc. America Bull., v. 48, no. 12, p. 1892–1894. Includes argillites, quartzites, and extensive mud breccias, as well as thick algal deposits. Dominantly dark gray to black; all dolomites weather buff or fawn. Second dominantly calcareo-magnesian formation in Glacier Park facies. Thickness 2,900 to 4,000 feet in Lewis Range; 5,400 feet in Blackfoot Canyon facies. Consists of (ascending) *Collenia symmetrica* zone, Goathaunt member, *Collenia frequens* zone, and Granite Park member in Glacier National Park. Underlies Spokane formation; overlies Grinnell formation. Type locality given.

D. A. Andrews, G. S. Lambert, and G. W. Stose, 1944, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 25, sheet 1. Mapped as Siyeh group. Includes Helena limestone, Spokane formation, Newland limestone, Marsh shale, and Wallace formation in Montana.

C. E. Erdmann, 1944, U.S. Geol. Survey Water-Supply Paper 866–B, p. 48. Consists of two thick, massive bodies of impure limestone or dolomite, separated by thinner westward-lensing body of reddish argillite. Upper member known in various localities as Upper Siyeh, Blackfoot, Helena, or Wallace limestones. Middle member called red band in Siyeh or, where more fully developed, Spokane formation. Lower member called Lower Siyeh or Newland limestone.

C. P. Ross, D. A. Andrews, and I. J. Witkind, 1955, Geologic map of Montana (1:500,000): U.S. Geol. Survey. Limestone mapped in Piegan group.

Richard Rezak, 1957, U.S. Geol. Survey Prof. Paper 294–D, p. 137–139. Siyeh limestone contains three stromatolite zones: *Collenia symmetrica* zone (includes Goathaunt member of Fenton and Fenton); *Conophyton* zone; *Collenia multiflabella* zone (includes Granite Park member of Fenton and Fenton).

C. P. Ross, 1959, U.S. Geol. Survey Prof. Paper 296, p. 19 (table), 33–43, pls. 1, 2. Siyeh limestone (redefined) is main unit of Piegan group (redefined). Argillaceous beds that have been included by some workers at base and top of the Siyeh have been separated from it in present report. Unit termed "greenish calcareous argillite" (up to several hundred feet thick), formerly included in the Siyeh, is herein considered basal part of overlying Missoula group and separates Siyeh limestone from Purcell basalt. Believed that when later detailed mapping is done the Siyeh will be divided into several units of formational rank and name "Siyeh" will be restricted in its application or abandoned. The Siyeh underlies broad areas in median parts of Flathead and Swan Ranges. These areas extend almost entire length of parts of both ranges that are within Flathead region and in Flathead Range persists to foot of Lake McDonald. According to Clapp's map (1932, Montana Bur. Mines and Geology Mem. 4) and Deiss's unpublished geologic map of Ovando quadrangle, the Siyeh is continuously exposed as far south as T. 18 N., R. 15 W., and at intervals beyond this. In Glacier National Park, the Siyeh forms core of mountain mass. It extends from near intersection of long 113°30′ with lat 48°30′ northwestward past Canadian border, widening northward. Thickness 1,800 to 5,000 feet. Overlies Grinnell argillite of

Ravalli group. Rezak's stromatolite zones and their importance discussed.

Type locality: Mount Siyeh, Glacier National Park, Mont.

Skagit Gneiss or Gneisses

Skagit Volcanic Formation[1]

Mesozoic: Southwestern British Columbia, Canada, and central northern Washington.

Original reference: R. A. Daly, 1912, Canada Geol. Survey Dept. Mines Mem. 38, map 15.

Peter Misch, 1952, The Mountaineer, v. 45, no. 13, p. 4 (geol. map), 12–14. Discussion of geology of northern Cascades of Washington. Skagit gneisses originated during time of Mesozoic folding. At least most of the gneisses are probably earlier than Lower Cretaceous sediments. Older than Chilliwack granodiorite (which formed from it); on eastern border of the Skagit is Black Peak granodiorite (new) which apparently formed from the Skagit. Marblemount quartz diorite (new) was earlier than Mesozoic folding.

Extends from first summit west of Skagit River to summit of Custer Ridge, Whatcom County, Wash., the main divide of Skagit Range.

**Skajit Limestone**[1]

Middle(?) and Upper Devonian: Northern Alaska.

Original reference: F. C. Schrader, 1902, Geol. Soc. America Bull., v. 13, p. 238.

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.

W. P. Brosgé, 1960, U.S. Geol. Survey Prof. Paper 400–B, p. B351–B352. Skajit limestone has been referred to the Silurian. In type area on John River, it seems related to limestone that is locally interbedded in the basal part of overlying black slate and phyllite unit that contains fossils of Middle(?) Devonian age. Also fossils of Middle or Late Devonian age have been collected in Western Brooks Range from limestone which had been mapped as Skajit by Smith and Mertie (1930, U.S. Geol. Survey Bull. 815).

Named for Skajit Mountains, Endicott Range.

Skamania Andesites or Andesitic Series

Miocene to Pliocene: Southwestern Washington.

W. M. Felts, 1939, Ohio Jour. Sci., v. 39, no. 6, p. 301–302, 304–306, 315 (fig. 4). Proposed for a thick series of andesites with minor amounts of breccia and other pyroclastics; divisible into two units, an upper and a lower; lower has undergone more folding and metamorphism than upper. Thickness more than 800 feet. Overlie Eagle Creek formation; contact not exposed in mapped area, but to the east in Washougal basin, contact is disconformable. Lower part intruded by Silver Star granodiorite (new). Miocene to Pliocene.

Well exposed near Star Mountain and over wide areas in adjacent parts of Skamania County.

**Skaneateles Shale** (in Hamilton Group)[1]

Middle Devonian: Central and western New York.

Original reference: L. Vanuxem, 1840, New York Geol. Survey 4th Rept., p. 380.

G. A. Cooper, 1930, Am. Jour. Sci., 5th ser., v. 19, p. 214–219. In Chenango and Unadilla Valleys, subdivided into (ascending) Mottville, Delphi, Pompey, Berwyn, and Colgate. West of Cayuga Lake includes Stafford and Levanna members. Overlies Marcellus; underlies Lowville.

G. A. Cooper, 1941, Washington Acad. Sci. Jour., v. 31, no. 5, p. 180–181. Delphi Station (new), Chenango sandstone (new), and Butternut shale (new) replace Delphi shale (Cooper, 1930), Colgate sandstone (Cooper, 1930), and Berwyn (Cooper, 1930), respectively.

G. A. Cooper and others, 1942, Geol. Soc. America Bull., v. 53, no. 12, pt. 1, p. 1772, chart 4. Mottville-Stafford members transferred to the Marcellus.

R. G. Sutton, 1951, Rochester Acad. Sci. Proc., v. 9, nos. 5–6, p. 358–361, pl. 1. Formation crops out from east-central New York to extreme western limits of the State. Thickness about 215 feet in Batavia quadrangle where it is represented by Stafford and Levanna members. Overlies Oatka Creek shale member of Marcellus; underlies Centerfield limestone member of Ludlowville formation.

[G. A. Cooper], 1955, New York State Geol. Assoc. 27th Ann. Mtg., p. [10], 11. Formation comprises (ascending) Delphi Station, Pompey, Butternut, and Chenango members. Thickness 434 feet. Overlies Marcellus, underlies Ludlowville.

Name derived from Skaneateles Lake, Onondaga County.

Skate Creek Laharic Breccia or deposits

Eocene-Oligocene: Northwestern Washington.

R. V. Fisher, 1960, Geol. Soc. America Bull., v. 71, no. 2, p. 127–132. An andesitic volcanic breccia that unconformably overlies dark-gray pebbly volcanic sandstone layer as much as 2 feet thick. Fragments of breccia are porphyritic to dense andesite and angular to subangular (some well rounded) and average about one-half inch in longest dimension. Some scattered water-worn vesicular bomb-shaped fragments present. Scattered nonoriented carbonaceous fragments and one well-preserved spruce cone (*Picea* sp.) observed. These characteristics indicate deposition either by lahars or pyroclastic flows but preclude deposition from air.

Occurs at junction of Skate and Johnson Creeks, eastern Lewis County.

Skeels Corners Formation

Skeels Corners Slate (in Woods Corners Group)

Middle Cambrian: Northwestern Vermont.

B. F. Howell, 1939, (abs.) Geol. Soc. America Bull., v. 50, no. 12, pt. 2, p. 1964. Name proposed for dark-gray shale formerly lower part of Hungerford formation. Underlies Saxe Brook formation (new) disconformably. Middle or Upper Cambrian.

B. F. Howell and others, 1944, Geol. Soc. America Bull., v. 55, no. 8, chart 1 (column 70). Overlies Mill River formation.

Phillip Fowler, 1950, Vermont Geol. Survey Bull. 2, pl. 1. Upper Cambrian.

V. H. Booth, 1950, Geol. Soc. America Bull., v. 61, no. 10, p. 1136, 1153. Thickness unknown. Middle Cambrian. More exact location of type section given.

A. B. Shaw, 1958, Geol. Soc. America Bull., v. 69, no. 5, p. 523 (table 1), 532 (fig. 5), 539–542, pl. 1. Skeels Corners slate includes some beds formerly called Georgia slates by Walcott (1886, U.S. Geol. Survey Bull. 30) and a large part of those referred to Hungerford and Highgate slates by Keith (1932, Washington Acad. Sci. Jour., v. 22), Schuchert (1937), and Raymond (1937, Geol. Soc. America Bull., v. 48, no. 8, p. 1079). Name originally proposed by Howell (1939) to refer to the *Bovicornellum* beds alone, but it is here extended to include all strata above Mill River conglomerate or, in its absence, St. Albans slate, and below Rockledge conglomerate. Typically black slate, with local developments of dolomite, sandstone, dolomite conglomerate, limestone bioherms, limestone, and calcareous shale in minor quantities. Accurate measurement of thickness not possible. Thickness at type locality about 400 feet, estimated 1,200 feet in adjoining Milton quadrangle. Included in Woods Corners group (new). Middle Cambrian.

Typically exposed west of Skeels Corners, 7¼ miles north of St. Albans, Franklin County. Extends northward to point northwest of Highgate Center and southward to vicinity of West Georgia.

Skeene Member (of Whitehall Formation)

*See* Skene Dolomite Member (of Whitehall Formation).

Skelley Limestone (in Conemaugh Formation)[1]

Skelley limestone member

Pennsylvanian (Conemaugh Series): Eastern Ohio.

Original reference: D. D. Condit, 1912, Ohio Geol. Survey, 4th ser., Bull. 17, p. 27.

D. L. Norling, 1958, Ohio Geol. Survey Bull. 56, p. 56–57, geol. map. In Morgan County, Skelley limestone member of Conemaugh series is a nonpersistent bed of gray to brownish-gray fine- to medium-crystalline limestone, commonly nodular to conglomeratic and locally sandy or shaly. Thickness averages 7 to 8 inches. Stratigraphically below Duquesne shale member [not present in Morgan County]; occurs 7 to 12 feet above Gaysport limestone member and from 25 to 33 feet above Ames limestone member.

M. T. Sturgeon and others, 1958, Ohio Geol. Survey Bull. 57, p. 94 (table 11), 146–147. Member of Duquesne cyclothem in report on Athens County. There is a possibility that type Gaysport limestone correlates with type Skelley and that limestone under consideration here is actually without a name. At present, best choice seems to be to use both names until their correlation is shown to be in error. That mistaken field identity of Gaysport and Skelley limestones has been made is indicated by statements by Mark (1912, Ohio Geol. Survey, 4th ser., Bull. 17) and Lamborn (1951, Ohio Geol. Survey, 4th ser., Bull. 49) that Skelley occurs 15 to 35 feet above Ames limestone. In sequence of beds, the Gaysport is almost everywhere overlain by Lower Grafton shale and sandstone, but the Skelley is succeeded upward at numerous places by Birmingham redbed. Thickness commonly less than 12 inches. Overlies Skelley shale and sandstone member; underlies Birmingham redbed member of Elk Lick cyclothem. Conemaugh series.

Named for Skelly Station, on Pennsylvanian Railroad, Jefferson County.

Skelley shale and sandstone member

Pennsylvanian (Conemaugh Series): Eastern Ohio.

M. T. Sturgeon and others, 1958, Ohio Geol. Survey Bull. 57, p. 94 (table 11), 146. Member of Duquesne cyclothem in report on Athens County. Overlies Duquesne coal member and underlies Skelley limestone member. Similar to underlying Lower Grafton. Skelley and Lower Grafton members may replace Duquesne coal, underclay, limestone, and redbed forming continuous sequence of shale and sandstone between Gaysport and Skelley limestone. Average thickness of Skelley shale and sandstone member is 12¾ feet.

Named for association with Skelley limestone.

Skelt Shale (in New River Group)

Skelt Shale (in Pottsville Group)[1]

Pennsylvanian (Pottsville Series): Southern West Virginia.

Original reference: D. B. Reger, 1920, West Virginia Geol. Survey Rept. Webster County, p. 198.

P. H. Price and E. T. Heck, 1939, West Virginia Geol. Survey Greenbrier County, p. 216, 227. Black shale about 6½ feet thick below Guyandot sandstone and above Sewell "B" coal. Included in New River group, Pottsville series.

Named for occurrence on north side of Sugar Creek, one-half mile east of village of Skelt, Webster County.

Skene Dolomite Member (of Whitehall Formation)

Upper Cambrian: Northeastern New York.

R. R. 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. Barren light-gray slightly cherty thin-bedded dolomite grading upward into crossbedded worm-riddled sandstone. Thickness about 120 feet. Overlies Hoyt limestone member; underlies Norton limestone member (new) of Tribes Hill formation. Discussion of revisions in Champlain, Hudson, Mohawk, and St. Lawrence Valleys involving definitions and succession of previously accepted Cambro-Ordovician formations (Potsdam, Theresa, Hoyt, and Little Falls of Upper Cambrian age and the Whitehall, Tribes Hill, and Beekmantown of Lower Ordovician age). Each revised unit is tied in with Divisions A through E of original "Calciferous" formation (Brainerd and Seely, 1890, Am. Mus. Nat. History Bull., v. 3). The Skene is the sandy base of C plus upper part of B.

D. W. Fisher and G. F. Hanson, 1951, Am. Jour. Sci., v. 249, no. 11, p. 795–814. Term Skene dolomite not applicable in Saratoga Springs region because it was defined as Upper Cambrian. Replaced by Gailor dolomite (new). Wheeler (1942) classified Hoyt limestone as basal member of Whitehall formation and Skene as upper member, the latter being a very late Upper Cambrian offlapping unit. It is evident that Wheeler mistook the Ordovician Gailor dolomite for the older Little Falls dolomite, because the Hoyt of his supposed "Little Falls" is in fault contact in his "unfaulted" area, 4 miles west of Saratoga Springs.

Occurs in Skene Mountain section.

**Skiatook Group**

Skiatook Shale[1]

Pennsylvanian (Missouri Series): Northeastern and central Oklahoma.

Original reference: D. W. Ohern, 1910, Oklahoma State Univ. Research Bull. 4, p. 34.

R. C. Moore and others, 1937, Kansas Geol. Soc. Guidebook 11th Ann. Field Conf., p. 39–40. Ohern introduced term Skiatook to apply to beds between Lenapah and Dewey limestones; term was used only in southern part of area mapped by him, and, as shown by his mapping, he mistook Checkerboard limestone for Lenapah. Consequently, original application of Skiatook was really to strata between Checkerboard and Dewey. Term is herein restored to formal nomenclature and rank raised to group. Lower boundary coincides with disconformity that marks base of Missouri subseries; upper boundary is placed at top of Drum limestone, or where Drum is absent, at base of sandstone in lowermost Chanute shale of Ochelata group. Includes (ascending) Seminole sandstone, Checkerboard limestone, Coffeyville shale, Dennis limestone, Cherryvale shale, and Drum limestone.

M. C. Oakes, 1940, Oklahoma Geol. Survey Bull. 62, p. 20–23; 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 4, p. 718 (fig. 2), 720 (table 1), 721–725. Includes (ascending) Seminole formation, Checkerboard limestone, Coffeyville formation, Hogshooter limestone, Nellie Bly formation, and Dewey limestone.

Name derived from Skiatook, Tulsa County.

Skinners Eddy limestone (in Catskill Formation)[1]

Upper Devonian: Northeastern Pennsylvania.

Original reference: I. C. White, 1883, Pennsylvania 2d Geol. Survey Rept. $G_7$, p. 117, 118, pl. X.

Occurs about one-third mile below Skinner's Eddy, on Tuscarora Creek, Braintree Township, Wyoming County.

Skolai Volcanics[1]

Triassic: Eastern Alaska.

Original reference: O. Rohn, 1900, U.S. Geol. Survey 21st Ann. Rept., pt. 2, p. 429–430, pl. 52, map.

Skolai Range.

Skookum Formation (in Newport Group)

Precambrian: Northeastern Washington.

M. C. Schroeder, 1952, Washington Div. Mines and Geology Bull. 40, p. 7 (table), 13–20, pl. 1. Predominantly argillaceous sandstone and quartzite with carbonate rocks and red and dark-gray argillites. Thickness about 13,000 feet. Contains Moon Hill quartzite member (new) near top. Gradationally overlies No Name argillite (new) with transition zone about 400 feet thick; top not exposed. Cut by Marshall diorite (new).

Named after Skookum Peak, Pend Oreille County.

**Skookumchuck Formation**

Eocene, upper: Southwestern Washington.

P. D. Snavely, Jr., and others, 1951, U.S. Geol. Survey Coal Inv. Map C-8, sheet 1. Predominantly massive crossbedded sandstone and thin-bedded siltstone with intercalated beds of coal, bone, and carbonaceous siltstone and shale. Maximum thickness about 2,700 feet. Unconformably underlies Oligocene(?) basaltic sandstone; overlies Northcraft formation (new) with angular unconformity.

P. D. Snavely, Jr., and others, 1958, U.S. Geol. Survey Bull. 1053, p. 26-35, pl. 1. Formation, in Centralia-Chehalis district, consists generally of a lower sandstone unit which is separated from an upper sandstone unit by a westward-thickening wedge that is predominantly siltstone; possibility exists that siltstone unit is older than type Skookumchuck. Formation has maximum thickness of about 3,500 feet and crops out in a broad irregular belt that extends across mapped area from southeast to northwest. Unconformably overlies Northcraft formation; unconformity may be local in extent. Conformably underlies Lincoln formation. Strata referred to Skookumchuck were included in Puget series by Culver (1919, Washington Geol. Survey Bull. 19). Skookumchuck of this report is equivalent to part of Cowlitz formation of Weaver (1937).

Well exposed along banks of Skookumchuck River west of Willamette meridan, particularly near the Wabash Railroad junction on Northern Pacific Railway, 2 miles north of Centralia, Lewis County.

Skooner Gulch Basalt or Formation

Tertiary: Northern California.

C. E. Weaver, 1943, California Div. Mines Bull. 118, p. 629-630. Massive dense fine-grained basalt with alternating flows of vesicular and amygdaloidal rock and intercalated lenslike masses of tuffaceous sandstone; pillow structure. About 900 feet thick. Underlies Gallaway beds; unconformably overlies shales and sandstones of Gualala series.

C. E. Weaver, 1944, Washington [State] Univ. Pubs. in Geology, v. 6, no. 1, p. 4, 20-21, pl. 2. Redescribed as a formation consisting of massive- to medium-grained gritty sandstone with thin interstratified layers of sandy and clayey shales 350 feet thick. Underlies Gallaway formation; overlies Iversen basalt (new).

Exposed in sea cliffs and in the beach at low tide in a belt about 400 feet wide for a distance of 3,000 feet south of Skooner Gulch, Point Arena-Fort Ross area, Mendocino County.

Skrainka diabase[1]

Precambrian: Southeastern Missouri.

Original reference: C. R. Keyes, 1915, Iowa Acad. Sci. Proc., v. 22, p. 253.

Named for old post office at Skrainka, southwest of Mine LaMotte Station, Madison County.

**Skull Creek Shale**

**Skull Creek Shale Member** (of Colorado Shale)

Skull Creek Group

Skull Creek Member (of Omadi Formation)

Skull Creek Shale Member (of Graneros Shale)[1]

Lower Cretaceous: Northeastern Wyoming, Montana, and South Dakota.

Original reference: A. J. Collier, 1922, U.S. Geol. Survey Bull. 736, p. 79, table.

G. E. Condra and E. C. Reed, 1943, Nebraska Geol. Survey Bull. 14, p. 15 (fig. 7). Shown on columnar section as member of Omadi sandstone (new). Overlies Fall River member; underlies Newcastle member.

B. C. Petsch, 1949, South Dakota Geol. Survey Rept. Inv. 65, p. 15; R. E. Stevenson, 1952, South Dakota Geol. Survey Rept. Inv. 69, p. 4. Basal member of Graneros.

C. E. Dobbin and G. H. Horn, 1949, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 103. Lower Cretaceous. Thickness 160 to 200 feet in Weston County, Wyo. Overlies Fall River sandstone of Inyan Kara group; underlies Newcastle sandstone of Colorado group.

A. J. Crowley, 1951, Am. Assoc. Petroleum Geologists Bull., v. 35, no. 1, p. 83–90. Table shows Skull Creek shale at base of Skull Creek group. Newcastle sandstone is at top of Skull Creek group. Skull Creek group overlies Inyan Kara group and underlies Graneros shale. Lower Cretaceous.

R. K. Hose, 1955, U.S. Geol. Survey Bull. 1027–B, p. 57–58. Skull Creek shale, in Johnson County, Wyo., is 165 feet thick at exposure on Muddy Creek. Overlies Cloverly formation, contact placed at top of first resistant siltstone ledge above the 15- to 45-foot basal sandstone of the Cloverly. Underlies Newcastle sandstone. Correlates with that part of Thermopolis shale which underlies Muddy sandstone member in central Wyoming.

Herbert Skolnick, 1958, Am. Assoc. Petroleum Geologists Bull., v. 42, no. 4, p. 791–793. Includes Newcastle sandstone member. Basal formation in Colorado group. Underlies Mowry shale; overlies Fall River sandstone of Inyan Kara group. Lower Cretaceous. Correlated by Foraminifera with rocks in Kansas, Oklahoma, and Texas. 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.

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.

Well exposed along Skull Creek southeast of Osage oil field, Weston County, Wyo.

**Skunk Creek Member** (of Solberg Schist)

Precambrian: Northern Michigan.

H. L. James, 1958, U.S. Geol. Survey Prof. Paper 314–C, p. 30 (table 1), 32. Iron-rich unit about 100 feet thick occurring about 1,000 feet below top of formation. Exposed only in a small outcrop, but the magnetic anomaly caused by the rock has been traced for more than 20 miles and the bed has been drilled in several places. Drill cores show rock to consist of three interlayered types: biotite-hornblende schist with magnetite layers; thin-bedded rock consisting of alternating layers of metachert and magnetite; and various mixtures of hornblende, biotite, grunerite, garnet, and epidote.

Named for Skunk Creek, a tributary of the East Branch of the Sturgeon River, which crosses the member near the SE cor. se. 17, T. 42 N., R. 28 W., Dickinson County.

Skunk Point Sandstone Member (of Frontier Formation)

*See* **Frontier Formation.**

**Skunk Ranch Conglomerate** (in Bisbee Group)

Lower Cretaceous: Southwestern New Mexico.

S. G. Lasky, 1938, Am. Assoc. Petroleum Geologists Bull., v. 22, no. 5, p. 534, figs. 2, 4; 1947, U.S. Geol. Survey Prof. Paper 208, p. 25–26, pl. 1. Consists largely of coarse conglomerate composed of red boulders and pebble in a matrix of red sandstone and shale. Boulders and slabs as much as 20 inches across comparatively common, and average diameter about 4 inches. Lateral gradations from the red bouldery conglomerate to gray and finer grained limestone conglomerate and to coarse-grained sandstone exposed locally. Layers of yellow clay-shale and soft sandstone present at several horizons. Large part of upper half of formation consists of alternating beds of red clay-shale and massive red conglomerate in members 5 to 60 feet in thickness. A 200-foot layer of augite basalt exposed at one place. Maximum exposed thickness 3,400 feet. Topmost part formation covered by Miocene(?) volcanic rocks; overlies Corbett sandstone (new). Trinity age.

Crops out only west and south of Skunk Ranch in Eureka section of Little Hatchet Mountains.

Skunk Springs limestone band

*See* **Chainman Shale.**

**Skunnemunk Conglomerate**[1]

Upper Devonian: Southeastern New York and northern New Jersey.

Original reference: N. H. Darton, 1894, Geol. Soc. America Bull., v. 5, p. 367–394.

Ely Mencher, 1939, Geol. Soc. America Bull., v. 50, no. 11, p. 1786. Skunnemunk conglomerate is an outlier of Middle and Upper Devonian age.

G. A. Cooper and others, 1942, Geol. Soc. America Bull., v. 53, no. 12, pt. 1, p. 1781, chart 4. Consists of conglomerates alternating with red sandstones. Thickness 200 to 2,500 feet. Skunnemunk Mountain, an outlier, believed to be continuation of sequence west of Catskill and represents about same facies as found in that area. From Albany and Catskill, the Hamilton outcrop belt extends seaward rather than parallel to old shore. This is shown by the fact that along Catskill Front the marine facies of Hamilton comes more and more to dominate the section, until entire sequence is marine at Port Jervis. Shoreward continuation of Catskill sequence is believed to be the Skunnemunk outlier and its continuation into New Jersey. Occurs above Bellvale sandstone. Middle Devonian.

Caps Bellvale and Skunnemunk Mountains, Orange County, N.Y.

**Skwentna Group**[1]

Jurassic(?) : Southern Alaska.

Original reference: J. E. Spurr, 1900, U.S. Geol. Survey 20th Ann. Rept., pt. 7, p. 149–152, 180.

R. W. Imlay, 1952, Geol. Soc. America Bull., v. 63, no. 9, p. 981. Listed as Skwentna group. Has been assigned to Lower Jurassic because of stratigraphic position below Tordrillo formation and because it is lithologically similar to Talkeetna formation.

First seen on Skwentna River 10 or 15 miles above junction with Yentna River, then on right bank of the Skwentna some miles below mouth of Haynes River, Cook Inlet region.

Sky Blue Quarry Limestone[1]

Paleozoic(?) or Upper Paleozoic(?) : Southern California.

Original reference: J. W. Daly, 1935, Am. Mineralogist, v. 20, no. 9, p. 638–647, map.

A. O. Woodford, R. A. Crippen, and K. B. Garner, 1941, Am. Mineralogist, v. 26, no. 6, p. 351. Probably Upper Paleozoic.

Named for quarry at Crestmore, Riverside County.

Slagle Trachyte

Quaternary: Northeastern New Mexico.

Helen Stobbe, 1948, (abs.) Geol. Soc. America Bull., v. 59, no. 12, pt. 2, p. 1355. Associated with tinguaites and analcime microfoyaites and usually intrusives.

R. F. Collins, 1949, Geol. Soc. America Bull., v. 60, no. 6, p. 1021 (table 2), 1022, 1033–1034, pl. 1; H. R. Stobbe, 1949, Geol. Soc. America Bull., v. 60, no. 6, p. 1071–1073. Light-tan fine-grained porphyritic rocks with phenocrysts of chalky feldspar and abundant hornblende needles. Weathering produces reddish to brown surface. Flow structure evident. Restricted area of outcrop characteristic of sills and dikes. Age, derivation of name, and geographic distribution given.

Named from exposures in Slagle Canyon, sec. 4, T. 26 N., R. 25 E., Colfax County. Found in only four localities grouped in a 10-mile radius—Slagle Canyon, Red Hill, Joe Cabin Arroyo, and Turkey Mountain, Colfax County.

Slate Creek Limestone Member (of Wellington Formation)

Permian: Central Kansas.

W. A. Ver Wiebe, 1937, Wichita Municipal Univ. Bull., v. 12, no. 5, p. 4, 8–10. Two prominent chalky claystones separated by green and red clays. Thickness 12 feet. Underlies Afton limestone member (new); overlies Highland shale member (new).

Type locality: Along south side of Slate Creek in Wellington Township, T. 32 S., R. 1 W., Sumner County.

Slate Creek Member (of Wood River Formation)

Pennsylvanian (Desmoinesian-Missourian): Central and eastern Idaho.

M. R. Thomasson, 1959, Dissert. Abs., v. 20, no. 3, p. 999. Older than Lake Creek member (new); younger than Hailey conglomerate member (new).

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

Slate Hill Shale[1]

Carboniferous: Southeastern Rhode Island.

Original reference: A. F. Foerste, 1899, U.S. Geol. Survey Mon. 33, p. 320–330, 356, 364.

Exposed at Slate Hill, Middletown Township, Newport County.

**Slater Sandstone Member** (of Mingo 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, 40.

H. R. Wanless, 1946, Geol. Soc. America Mem. 13, p. 99, 102, 104, 150. In Mingo formation between Puckett sandstone (above) and Creech coal.

Named for Slater Fork of Catron Creek, Bell County, Ky.

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. 1, 6, pls. 2, 3, 4, 6. Includes strata between top of Crooked Fork group (new) and base of Indian Bluff group (new). Thickness at type section about 635 feet; throughout most of the outcrop, thickness ranges from 420 to 720 feet; thins northwestward, and in parts of Gobey, Robbins, and Huntsville quadrangles thickness is only 300 feet. Includes (ascending) unnamed shale interval, Stephens sandstone (new), shale interval, Petros sandstones (new), shale interval, Sand Gap sandstone (new), and Newcomb sandstone (new). Jellico coal present at top.

Type locality: Between the Wye and Cross Mountain, Lake City quadrangle. Section begins with the Poplar Creek coal, along the railroad tracks and the road at the Wye, and ends on Militia Hill where Jellico coal occurs at an elevation of 1,445 feet. Named from town of Slatestone, 1 mile west of Briceville, Anderson County.

†Slatington Shale[1]

Silurian: Southwestern Arkansas and southeastern Oklahoma.

Original reference: A. H. Purdue, 1909, Geol. Soc. America Bull., v. 19, p. 557.

Probably named for Slatington, Montgomery County, Ark.

Slaughter Creek 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. 184–187. Consists of a basal glauconitic sand about 5 feet thick overlain locally by 15 to 20 feet of fossiliferous, black lignitic clay in turn overlain by 20 feet of nonfossiliferous sand containing large calcareous concretions; this sequence is followed by the thin Stone Coal Bluff lignite (new), lignitic silts, and Beulah Church sand lentil (new). Overlies Bayou Lenann member (new); underlies High Bluff member (new).

Typically exposed along banks of Slaughter Creek, Sabine Parish, La.; typical section in steep bluff near headwaters of creek in SW cor. sec.

26, T. 6 N., R. 13 W. Traced from vicinity of Geneva, Tex., to Hagewood, Natchitoches Parish, La.

**Slaven Chert**

Middle and Upper(?) Devonian: North-central Nevada.

James Gilluly, 1955, *in* Pacific Petroleum Geologist, v. 9, no. 8, p. 1. Above Elder formation lie over 4,000 feet of the Middle Devonian Slaven chert.

Slesse Diorite[1]

Miocene(?): British Columbia, Canada, and northern Washington.

Original reference: R. A. Daly, 1913, Canada Dept. Int. Rept. Chief Asst., 1910, v. 2, p. 532.

Slide Mountain Conglomerate[1]

Upper Devonian: Eastern New York.

Original reference: G. H. Chadwick, 1933, Am. Jour. Sci., 5th ser., v. 26, p. 480, 482, 483.

G. A. Cooper and others, 1942, Geol. Soc. America Bull., v. 53, no. 12, pt. 1, chart 4. Slide Mountain conglomerate listed on correlation chart. Upper Devonian.

Occurs only on Slide Mountain, highest peak in Catskill Mountains.

**Sligo Formation**

Lower Cretaceous: Subsurface in northwestern Louisiana, southern Arkansas, and eastern and southern Texas.

R. W. Imlay, 1940, Arkansas Geol. Survey Inf. Circ. 12, p. 30–32. Proposed by Shreveport Geological Society for gray to brown shale containing local lenses of sandstone and limestone which represent the lowest beds of the Lower Glen Rose formation; in northern Louisiana, contains locally one or two porous oolitic limestone lentils known as Pettet limestone. Thickness ranges from about 300 feet in Louisiana and Texas to less than 100 feet in Arkansas; thins to north and not represented in outcrop in Arkansas. Base is defined by uppermost red beds of Hosston formation and top by highest of three limestone units which is called the Three Finger limestone.

R. W. Imlay, 1945, Am. Assoc. Petroleum Geologists Bull., v. 29, no. 10, p. 1434–1441. Described in south Texas as mainly gray, yellowish-gray, and brown limestone separated by many partings and thin units of black shale that amounts to about 20 percent of entire formation; lower 40 to 50 feet contains sandy limestone and a few thin beds of sandstone, indicating a transitional relationship with the Hosston, but contact is easily selected within a few feet; contact with overlying shale and sandstone at base of Pearsall formation is abrupt. Shreveport Geological Society recognized term Pettet limestone (sometimes spelled Pettit) as an informal name for local porous limestone lentils within the Sligo; Pettet was not considered acceptable as a formation name because it was commonly used in Arkansas and Louisiana for a zone or zones of porosity; geologists in east Texas suggested Sligo be abandoned in favor of Pettet in order to conform with common usage in that area.

Type locality: Sligo field, Bossier Parish, northwestern Louisiana. Type well not designated, but formation is described in Stanolind Oil and Gas Co.'s Dillon Heirs No. 131 well, located in sec. 14, T. 21 N., R. 15

W., Caddo Parish, La., and in Amerada Petroleum Corp.'s Halff and Oppenheimer No. 8 well, southwest of Pearsall, Frio County, Tex.

**Slim Sam Formation**

Upper Cretaceous: Southwestern Montana.

V. C. DeMunck, 1956, Montana Bur. Mines and Geology Inf. Circ. 13, p. 9. Name mentioned in a discussion of the iron deposits in Montana.

M. R. Klepper, R. A. Weeks, and E. T. Ruppel, 1957, U.S. Geol. Survey Prof. Paper 292, p. 4 (table), 26 (table), 28–31, pl. 1. Described as sequence of coarse-grained clastic rocks. Lower part of sequence consists predominantly of gray, greenish-gray, and yellowish-gray quartz-chert sandstone and upper part of feldspathic quartz- and chert-poor sandstone with abundant beds of tuff and sedimentary tuff near the top. Thickness 800 to 1,200 feet. Underlies Elkhorn Mountains volcanics (new) with local unconformity and overlies Colorado formation. Derivation of name.

Named for exposures along east margin of Slim Sam basin, in sec. 22, T. 6 N., R. 1 W., Broadwater County, about 1 mile east of the map area.

Slippery Creek Greenstone Volcanics (in Evington Group)

Lower Paleozoic(?): South-central Virginia.

W. R. Brown, 1951, (abs.) Virginia Jour. Sci., new ser., v. 2, no. 4, p. 347. Incidental mention.

W. R. Brown, 1953, Kentucky Geol. Survey, ser. 9, Spec. Pub. 1, p. 91 (fig. 1). Dark-green to gray schistose to gneissose lava flows (dacite-andesite?). Amygdaloidal in part. Tuffaceous(?) schist at base. Thickness 1,000 to 3,000 feet. Uppermost unit in Evington group (new). Overlies Mount Athos formation. Paleozoic(?). Type locality designated.

W .R. Brown, 1958, Virginia Div. Mineral Resources Bull. 74, p. 8 (fig. 2), 29 (table 5), 37–38, 49, pl. 1. Age shown on columnar section as Lower Paleozoic(?).

Type locality: Along Slippery Creek 5½ miles east of Lynchburg, Campbell County. Lynchburg quadrangle.

Sloan Formation (in Marble Falls Group)

Sloan Member (of Marble Falls Formation)

Pennsylvanian: Central Texas.

F. B. Plummer, 1944, Texas Univ. Bur. Econ. Geology Mineral Resources Circ. 33, p. 8. Member mentioned in report on limestones suitable for manufacture of rock wool.

F. B. Plummer, 1945, Texas Univ. Bur. Econ. Geology Pub. 4401, p. 65, 66–67, pl. 2. Marble Falls is divided into (ascending) Gibbons conglomerate lentil, Sloan, Big Saline, and Lemons Bluff members. Sloan is distinctly thin bedded; beds are uneven, have rough surfaces, and contain distinctive fossils. Basal bed is commonly a subcrystalline to crystalline dense black cherty limestone 4 to 16 feet thick that commonly carries more than 40 percent black chert. This cherty zone is overlain by 50 to 100 feet of thin-bedded black subcrystalline fossiliferous limestone. In some areas, calcareous shale partings, 2 to 30 inches thick, are inrado River below Marble Falls, just above Barnett formation, from Cherokee Creek across San Saba County to Pontotoc-San Saba Highway in Wallace Creek valley. Present in most synclinal areas in San Saba County; absent on structural highs where it was either never deposited or removed by erosion before deposition of Big Saline and Lemons Bluff members.

F. B. Plummer, 1947, Jour. Paleontology, v. 21, no. 2, p. 142; Jour. Geology, v. 55, no. 3, pt. 2, p. 196 (table 2). Sloan formation underlies Big Saline formation which here includes (ascending) Gibbons, Aylor, Lemons Bluff, and Brister formations.

F. B. Plummer, 1950, Texas Univ. Bur. Econ. Geology Pub. 4329, p. 47, 52–57. Formation included in Marble Falls group. Thickness at designated type section 81½ feet.

Type section: On San Saba River opposite Lemons Camp, San Saba County. Well exposed along San Saba River and its branches on the Sloan, Lemons, and Gibbons Ranches, southwest of San Saba and along Colorado River above Alexander dam site at Marble Falls in Burnet County.

Sloan Canyon Formation[1] (in Dockum Group)

Triassic: Northeastern New Mexico.

Original reference: B. H. Parker, 1930, Kansas Geol. Soc. 4th Ann. Field Conf., p. 132, mimeo; 1933, Jour. Geology, v. 41, p. 38–51.

J. W. Stovall and D. E. Savage, 1939, Jour. Geology, v. 47, no. 7, p. 764, 765, 766. Triassic. Entire section of Triassic in Union County should be included in Dockum group, a conclusion supported by fossil evidence.

Brewster Baldwin and W. R. Muehlberger, 1959, New Mexico Bur. Mines Mineral Resources Bull. 63, p. 35 (table 2), 39-40, pl. 1d. Light-green and red mudstone. Thickness as much as 150 feet. Overlies Travesser formation (new); underlies Sheep Pen sandstone. In Dockum group.

Typically exposed throughout lower part of valley of Sloan Canyon in east-central part of T. 31 N., R. 35 E., Union County.

†Sloans Valley Limestone (in Chester Group)[1]

Mississippian: Southeastern Illinois and western Kentucky.

Original references: A. D. Brokaw, 1916, Illinois Geol. Survey Bull. 35 [preprint]; 1917, Illinois Geol. Survey Bull. 35, p. 12, pl. 1.

Occurs in Saline, Johnson, Pope, Williamson, Union, and Jackson Counties, Ill.

**Slocum Alluvium**

Pleistocene (Illinois or Sangamon): Northeastern Colorado.

C. W. Hibbard and D. W. Taylor, 1960, Michigan Univ. Mus. Paleontology Contr., v. 16, no. 1, p. 33. Incidental mention in discussion of late Pleistocene faunas of southwestern Kansas. Name credited to G. R. Scott (in preparation).

G. R. Scott, 1960, Geol. Soc. America Bull., v. 71, no. 10, p. 1542. Name applied to alluvial deposit that lies 150 feet below older Verdos alluvium (new) and 100 feet above the modern streams. Consists of 10 to 90 feet of moderate reddish-brown, well-stratified, clayey coarse sand with lenticular beds of pebbles and silt. Older than Louviers alluvium (new).

Type locality: Along one face of limestone quarry on Slocum Ranch in SW¼NW¼ sec. 35, T. 6 S., R. 69 W., Kassler quadrangle.

Slollicum Series[1]

Triassic: Central northern Washington, and adjacent British Columbia, Canada.

Original reference: C. H. Crickmay, 1930, Geol. Mag., v. 7, p. 488, 489, map.

Derivation of name not stated.

**Sloway Formation** (in Missoula Group)

Precambrian (Belt Series): Northwestern Montana.

A. B. Campbell, 1960, U.S. Geol. Survey Bull. 1082–I, p. 565–567, pl. 28. Heterogeneous sequence of thin- to medium-bedded argillaceous quartzite, viterous quartzite, quartzose argillite, and argillite; more argillaceous toward top of section. Colors are tints of red, purple, and green ranging from pale to bright. No complete section, but total thickness of about 5,000 feet estimated on basis of several partial sections which constitute type section. Conformably overlies Lupine quartzite (new); conformably underlies Bouchard formation (new).

Type section: Partial sections in secs. 7 and 18, T. 16 N., R. 26 W.; secs. 29, 33, and 34, T. 17 N., R. 26 W.; and secs. 3, 4, 10, 11, 14, and 23, T. 16 N., R. 26 W. Named from exposures in secs. 14, 15, and 16, T. 17 N., R. 27 W., near mouth of Sloway Gulch, St. Regis-Superior area, Mineral County.

**Slow Fork Glaciation**

Pleistocene: South-central Alaska.

A. T. Fernald, 1960, U.S. Geol. Bull. 1071–G, p. 232 (chart). Named on correlation chart. Correlated with Selatna, Healy, and Delta glaciations. Older than Wonder Lake glaciation (new). Name credited to J. C. Reed, Jr.

In Mount McKinley area.

Sly Gap Formation

Upper Devonian: Central southern New Mexico.

F. V. Stevenson, 1941, (abs.) Oil and Gas Jour., v. 39, no. 47, p. 65; 1941, (abs.). Illinois Acad. Sci. Trans., v. 34, no. 2, p. 163. Comprises 114 feet of siltstones, shales, and a few limestones at type locality. Underlies Percha shale. Devonian.

F. V. Stevenson, 1942, New Mexico Bur. Mines Mineral Resources Bull. 18, p. 23. Chiefly thin alternating layers of shale and siltstone, with a few beds of limestone. A zone 8 to 10 feet thick at base is more massive than rest of formation and has red-brown color, which is in contrast to lighter colors of sediments above and below. Shales range from black, fissile, and carbonaceous to light buff or tan. Siltstones and limestones, in general, buff. Thickness averages approximately 100 feet in Sacramento Mountains, 110 to 135 feet in San Andres Mountains, and 80 to 90 feet in westernmost exposure in Mud Springs Mountains near Hot Springs. Overlies Canutillo formation at south end of San Andres Mountains; Fusselman limestone in central part; and Montoya limestone north of Rhodes Pass. Unconformably overlies Canutillo in south and central parts of Sacramento Mountains; and Fusselman in area to the north. Late Devonian.

F. V. Stevenson, 1944, Dallas Digest (Am. Assoc. Petroleum Geologists, Soc. Econ. Paleontologists and Mineralogists, and Soc. Explor. Geophysicists Joint Ann. Mtg.), p. 94–95. Underlies Contadero formation (new).

F. V. Stevenson, 1945, Jour. Geology, v. 53, no. 4, p. 217, 219, 222. Overlies Onate formation (new), formerly identified as "Canutillo formation," in Sacramento and San Andres Mountains.

V. C. Kelly and Caswell Silver, 1952, New Mexico Univ. Pubs. in Geology v, 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. 29–30. Thicknesses of section in San Andres Mountains, excluding the basal beds with an anomalous fauna that may be Middle Devonian in age and which are included in Onate formation, vary from north to south: 57 feet at type section on Sheep Mountain, 31 feet at Rhodes Canyon, 70 feet at Hembrillo Canyon, and 75 feet at Ash Canyon.

Type locality: At Sly Gap, south of Sheep Mountain, in northern extension of San Andres Mountains, sec. 25, T. 11 S., R. 4 E. Crops out the entire length of San Andres Range, and throughout Sacramento and Sierra Caballo Mountains.

**Smackover Formation**

Smackover Limestone

Upper Jurassic: Subsurface in Arkansas, Alabama Louisiana, Mississippi, and Texas.

D. H. Bingham, 1937, Am. Assoc. Petroleum Geologists Bull., v. 21, no. 8, p. 1068, 1072. Smackover limestone encountered at depth of 4,900 feet at north edge of Smackover field. Limestone is 700 feet thick. Age undetermined; thought to be lower than Trinity and younger than Paleozoic.

W. B. Weeks, 1938, Am. Assoc. Petroleum Geologists Bull., v. 22, no. 8, p. 959 (fig. 2), 960 (fig. 3), 964–965. Overlies Eagle Mills formation; underlies Buckner formation. Pre-Comanche.

W. B. Weeks, 1939, Shreveport Geol. Soc. Guidebook 14th Ann. Field Trip, p. 28, 29. In Snow Hill area, Arkansas, Buckner anhydrite is absent and Smackover underlies Cotton Valley.

R. W. Imlay, 1940, Arkansas Geol. Survey Inf. Circ. 12, p. 16–21, cross sections. Termed formation. In southern Arkansas, divisible into two members of which upper consists of oolitic to chalky limestone and lower of dense limestone with argillaceous bands. These limestone facies grade southward in northern Louisiana into an interbedded limestone, shale, and sandstone facies which is included in Smackover formation. Term Smackover limestone is used in this report only in reference to limestone facies. Thickness 502 to about 1,230 feet. Fossils indicate Middle or Upper Jurassic age.

R. W. Imlay, 1943, Am. Assoc Petroleum Geologists Bull., v. 27, no. 11, p. 1437 (table 1), 1440–1451. Detailed discussion with Jurassic formations of Gulf Coast region. Upper Jurassic (Argovian).

R. T. Hazzard, W. T. Spooner, and B. W. Blanpied, [1947], Shreveport Geol. Soc. 1945, Ref. Rept., v. 2, p. 483, 484, 488. Overlies Norphlet formation (new).

First known from Lion Oil Refining Co.'s Hayes No. 9–A, sec. 9, T. 16 S., R. 15 W., Union County, Ark. Named for Smackover field.

Smalls Falls Formation

Age not stated: West-central Maine.

I. E. Furlong, 1960, Dissert, Abs., v. 21, no. 4, p. 848. Characterized by dark maroon-stained thinly bedded highly sulfidic argillaceous rock with minor intercalated arenaceous and calcareous units. Oldest stratigraphic unit in area. Underlies Madrid formation.

Present in Farmington quadrangle.

Smarts Mountain Granite

Smarts Mountain Group

Upper Devonian(?): West-central New Hampshire.

Katharine Fowler-Lunn and Louise Kingsley, 1937, Geol. Soc. America Bull., v. 48, no. 10, p. 1382, pl. 3. Granite included in Oliverian magma series. Intrudes Ammonoosuc volcanics. Upper Devonian in age.

Katharine Fowler-Billings and Louise Kingsley, 1940, Geologic map and structure sections of the Cardigan quadrangle, New Hampshire (1:62,500): New Hampshire Highway Dept. Group consists of fine-grained white to gray weakly-foliated quartz diorite and granodiorite. Age designated probably Upper Devonian.

Mapped in extreme northwestern corner of Cardigan quadrangle.

Smelter Granite[1]

Jurassic: British Columbia, Canada, and northern Washington.

Original reference: R. A. Daly, 1913, Canada Dept. Int. Rept. Chief Ast., v. 2, p. 381.

Smetana Sandstone (in Yegua Group)

Eocene (Claiborne): Eastern Texas.

A. A. L. Mathews, 1950, Texas Eng. Expt. Sta. Research Rept. 14, p. 1–3, geol. map. Name applied to basal unit of group. Characteristically dark-red iron-sandstone with basal conglomerate. Beds are from 1 to 8 inches thick; and in some areas are separated by thin seams of yellow shale. Estimated thickness 138 feet. Underlies Bryan sandstone; unconformably overlies Mount Tabor shales. Stenzel (1940) placed base of Yegua above Mount Tabor shales but included Serbin sand lentil in upper part of Mount Tabor. [It is not clear whether author intended to replace Serbin by Smetana or not.]

Name derived from community of Smetana, 4.4 miles west of B.M. 0900 along Highway 21 at Bryan, Brazos County. Well exposed at Fairview 3.5 miles west of the same bench mark, but name Fairview is preoccupied.

Smethport magnafacies[1]

Devonian or Carboniferous: Northwestern Pennsylvania.

Original reference: K. E. Caster, 1934, Bulls. Am. Paleontology, v. 21, no. 71, p. 27.

K. E. Caster, 1938, Jour. Paleontology, v. 12, no. 1, p. 44–45, 52–53. Shown in faciological diagram of Upper Devonian strata in northern Pennsylvania.

Named from town of Smethport, McKean County.

†Smethport Shale Member (of Knapp Formation)[1]

Devonian or Carboniferous: Northwestern Pennsylvania.

Original reference: K. E. Caster, 1933, Geol. Soc. America Bull., v. 44, pt. 1, p. 203.

Smith Basin Formation

Lower Ordovician: East-central New York.

John Rodgers *in* M. P. Billings, John Rodgers, and J. B. Thompson, Jr., 1952, Guidebook for field trips in New England: Geol. Soc. America, p. 35 (table 2). Described as cherty dolomite with limestone layers below the dolomite. Thickness 90 feet. Underlies Fort Cassin formation. Refers to R. H. Flower (unpub. ms.).

Occurs in Fort Ann quadrangle.

†Smithfield Limestone Member (of Marlboro Formation)[1]

Precambrian: Northeastern Rhode Island.

Original reference: Ebenezer Emmons, 1843, New York Nat. History Agric., v. 1, p. 90–91.

A. W. Quinn, R. G. Ray, and W. L. Seymour, 1948, *in* A. W. Quinn and others, 1948, Rhode Island Port and Indus. Comm. Geol. Bull. 3, p. 10. Name abandoned in Pawtucket area. Marble beds considered part of Mussey Brook schist (new).

Named for occurrence in town of Smithfield; outcrops area subsequently became part of town of Lincoln, Providence County.

**Smith Fork Glaciation**

Smith Fork glacial stage[1]

Pleistocene: Northeastern Utah.

Original reference: W. H. Bradley, 1936, U.S. Geol. Survey Prof. Paper 185.

Ernst Antevs, 1945, Am. Jour. Sci., v. 243–A, table 2. Correlates with Tahoe (Wisconsin).

Name changed to Smith Fork Glaciation to comply with 1961 Stratigraphic Code.

Named for train of lateral moraines left by its glaciers in valley of East Fork of Smith Fork.

†Smith River Lake Beds[1]

Miocene, middle: Central southern Montana.

Original reference: W. H. Weed, 1899, U.S. Geol. Survey Atlas, Folio 56.

Deposited in lake that once filled valley of Smith River, between Little Belt and Big Belt Ranges, Little Belt Mountains region.

Smiths Corner Member (of Lockatong Formation)

Triassic: Southeastern Pennsylvania.

D. B. McLaughlin, 1944, Pennsylvania Acad. Sci. Proc., v. 18, p. 65, 67. Name given to thin red argillite member. Thickness 11 to 50 feet. Occurs between two black hard argillite units of the formation, $A_1$ below and $A_2$ above.

D. B. McLaughlin, 1948, Michigan Acad. Sci. Arts and Letters Papers, v. 32, p. 298, 299. Termed Smith Corner member. Thickens rapidly southwest of Tohickon Creek and merges with lower red shales which have replaced $A_1$.

Exposed in a brook at Smith's Corner, Bucks County, and in bed of Tohickon Creek on both sides of the "loop" south of the "high rocks" and also south of the "big bend."

Smith Valley Beds

Pliocene, middle and upper (Hemphillian-Blancan): West-central Nevada.

D. I. Axelrod, 1956, California Univ. Pubs. Geol. Sci., v. 33, p. 62 (fig. 4), 67. Name applied to beds that contain Smith Valley fauna. Further study may indicate desirability of retaining separate names for Morgan Ranch formation (new) and Smith Valley beds though they now appear to be facies of same basin of deposition.

Exposed along eastern side of Smith[s] Valley and south of Wilson Canyon, near Nevada-California line.

†Smithville Chert Lentil (in Stanley Shale)[1]

Mississippian: Southeastern Oklahoma.

Original reference: H. D. Miser and C. W. Honess, 1927, Oklahoma Geol. Survey Bull. 44, p. 11.

C. C. Branson, 1957. Oklahoma Geology Notes, v. 17, no. 11, p. 102. Abandoned by Oklahoma Geological Survey. Name has not been used if allowed to stand preoccupies well-known name of Lower Ordovician Smithville limestone of Arkansas.

O. B. Shelburne, 1960. Oklahoma Geol. Survey Bull. 88, p. 18. Renamed Battiest chert member of Tenmile Creek formation.

Named for village of Smithville, McCurtain County.

**Smithville Formation**[1]

Lower Ordovician: Northern Arkansas and southeastern Missouri.

Original reference: G. C. Branner, 1929. Geologic map of Arkansas.

W. H. Twenhofel and others, 1954, Geol. Soc. America Bull., v. 65. no. 3, chart 2 (columns 52, 53). Shown on correlation chart above Powell formation and below Black Rock limestone in northern Arkansas and below Everton formation in southeastern Missouri.

First mapped at and around Smithville, Lawrence County, Ark.

**Smithwick Shale** (in Bend Group)[1]

Smithwick Group

Lower and Middle Pennsylvanian: Central Texas.

Original reference: S. Paige, 1911, U.S. Geol. Survey Bull. 450, p. 25.

M. G. Cheney, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 1, p. 66 (fig. 1), 85–86. Smithwick beds are excluded from Morrow and Strawn (Des Moines) series and assigned to intervening Lampasas series (new). Overlies Big Saline group (new); underlies Millsap Lake group in Strawn series. In subsurface, includes (ascending) Eastland Lake, Caddo Pool, and Parks formations (all new).

F. B. Plummer, 1945, Texas Univ. Bur. Econ. Geology Pub. 4401, p. 69–73. Formation in Bend series. At type locality, includes strata above Lemons Bluff beds in Marble Falls formation and below typical Strawn beds.

M. G. Cheney, 1947, Jour. Geology, v. 55, no. 3, pt. 2, p. 207 (chart 1), 209. Chart shows Smithwick formation in Bend group. Formation is restricted above to exclude Caddo Pool and Parks formations which are included in Kickapoo Creek group (new). Overlies Big Saline formation.

F. B. Plummer, 1950, Texas Univ. Bur. Econ. Geology Pub. 4329, p. 77–83. Formation, at type locality, includes strata above Brister Bluff [Brister limestone member] and Lemons Bluff beds in Big Saline formation. Through west and central San Saba County, it includes all shale below Strawn group and above black Marble Falls limestone. In eastern San Saba County near Bend, basal Smithwick is 60 feet above top of limestone and base is marked by first appearance of coral *Hadrophyllum aplatum* Cummins, now named *Cumminsia aplata* (Cummins) by Moore and Jeffords. Thickness at type locality 301 feet. Siltstone, fissile black shale, and conglomerate facies recognized.

Type locality (Plummer): Along Colorado River west of Smithwick, Burnet County. Section measured from Marble Falls limestone outcrop on Wall Ranch eastward to river bank opposite and old Smithwick. Named for town of Smithwick, Burnet County.

**Smoke Creek Glaciation**

Pleistocene (pre-Wisconsin): Northeastern Montana and northwestern North Dakota.

A. D. Howard, 1960, U.S. Geol. Survey Prof. Paper 326, p. 26. Considerations of regional history indirectly support validity of a pre-Wisconsin Smoke Creek glaciation.

Name derived from Smoke Creek, Roosevelt County, Mont.

**Smoky Hill Chalk Member** (of Niobrara Formation)[1]

**Smoky Hill Marl Member** (of Niobrara Formation)[1]

**Smoky Hill Shale Member** (of Niobrara Formation)

Upper Cretaceous: Western Kansas, eastern Colorado, northeastern New Mexico, and southeastern South Dakota.

Original reference: F. W. Cragin, 1896, Colorado Coll. Studies, v. 6, p. 51.

R. L. Griggs, 1948, New Mexico Bur. Mines Mineral Resources Ground-Water Rept. 1, p. 31–33. Described in Colfax County, N. Mex. Here unit is more shale than marl. Approximate thickness 900 feet (based on subsurface data). Overlies Fort Hays limestone member; conformably underlies Pierre shale.

J. C. Frye and A. B. Leonard, 1952, Kansas Geol. Survey Bull. 99, p. 99. In Gove County, Kans., chalk member underlies Pleistocene Grand Island member of Meade formation.

E. J. Bolin, 1952, South Dakota Acad. Sci. Proc., v. 31, p. 190. Geographically extended into southeastern South Dakota. Difficult to distinguish Smoky Hill and Fort Hays members on basis of lithology, but this investigation demonstrated that they can be distinguished on basis of microfossils. Thickness of Smoky Hill 77 to 125 feet.

R. B. Johnson and J. G. Stephens, 1954, U.S. Geol. Survey Oil and Gas Inv. Map OM–146. Marl member described in La Veta area, Huerfano County, Colo. Conformably overlies Fort Hays limestone member and gradationally underlies Pierre shale. Consists of about 500 feet of thin beds of white limestone alternating with much thicker beds of yellow chalk; includes some thin bands of bentonitic claystone. East of Raton Mesa region, grades northward from a gray shale facies into yellow-orange limestone and chalk facies.

M. A. Jenkins, Jr., 1957, Rocky Mountain Assoc. Geologists Guidebook to the geology of North and Middle Parks Basins, Colorado, p. 53, pl. 1.

Described in Red Dirt area, Grand County, Colo., where it is 410 feet thick and predominantly shale. Overlies Fort Hays member and underlies Pierre shale. Believed that names Smoky Hill and Fort Hayes have priority over terms Apishapa and Timpas, and if used they would help standardize Niobrara terminology in west-central Colorado.

D. M. Sheridan and others, 1958, U.S. Geol. Survey Mineral Inv. Field Studies Map MF–179. Referred to as shale member; consists of light-gray to dusty-yellow calcareous shale and two thick shaly chalk beds. Report discusses Ralston Buttes quadrangle, Jefferson County, Colo.

J. M. Jewett, 1959, Graphic column and classification of rocks in Kansas: Kansas Geol. Survey. Shown on chart as Smoky Hill chalk member of Niobrara chalk. Overlies Fort Hays limestone member; underlies Sharon Springs shale member of Pierre shale.

Named for Smoky Hill River, Kans.

Snake Creek Beds[1]

Snake Creek Formation (in Ogallala Group)

Pliocene, middle to upper: Western Nebraska and eastern Wyoming.

Original reference: W. D. Matthew and H. J. Cook, 1909, Am. Mus. Nat. History Bull., v. 26, art. 27, p. 362–363.

A. L. Lugn, 1939, Geol. Soc. America Bull., v. 50, no. 8, p. 1254–1258, 1266 (table 2). Discussion of confusion in use of terms Snake Creek and Sheep Creek formations, both named by Matthew and Cook (1909). Typical "Snake Creek" formation, or at least the so-called "upper Snake Creek," is correlative with some part of upper Ogallala group. Snake Creek has been incorrectly(?) applied to beds, mainly channel fills, as late as Pleistocene and to other beds as old as Miocene. Much of the Miocene "Snake Creek" or perhaps the so-called "lower Snake Creek" seems to be in part not Snake Creek but Sheep Creek channel beds in place and in proper stratigraphic sequence. Some of the Miocene and "Sheep Creek" vertebrate fossils collected from "Snake Creek" channel deposits have come from very large blocks of Sheep Creek formation, which were broken away from banks of Snake Creek streams and lie buried in younger silt and sand, the true Snake Creek sediment, which is always channel-fill material. Original definition of Snake Creek and Sheep Creek formations may be essentially valid, and it is proposed to continue use of these names to apply to correctly differentiated formations. Table 2 shows Snake Creek formation (middle to late Pliocene) in Ogallala group between Sidney gravel above and Ash Hollow formation below. Sheep Creek formation (late upper Miocene) is assigned to Hemingford group.

Named for occurrence on Snake Creek, Sioux County, Nebr.

**Snake Hill Formation[1]**

Snake Hill Shale or Beds

Middle Ordovician: Eastern New York.

Original reference: E. O. Ulrich, 1911, Geol. Soc. America Bull., v. 22, pl. 27.

G. M. Kay, 1937, Geol. Soc. America Bull., v. 48, no. 2, p. 265 (fig. 10), 272–273, pl. 4. Discussion of stratigraphy of Trenton group. Snake Hill formation is discussed under heading of formations of Sherman Fall age. Snake Hill beds were defined to comprise Middle Ordovician silty shales of Hudson Valley that were considered equivalent to Canajoharie shale and had previously been identified with Magog shale of Quebec. Upper and lower contacts of formation are not known, and thickness has been estimated at about 3,000 feet. Formation crops out in belt extending northward along Hudson River from northeastern part of Helderberg Plateau. Similar beds have been described farther south on northwest side of the Highlands—the Reading Prong of New England Upland—in which region they overlie limestones of Black River and low Trenton age. Figure 10 and plate 4 show Snake Hill underlying Schenectady.

Winifred Goldring, 1943, New York State Mus. Bull. 332, p. 47 (table), 89 [1946]. Ordovician system represented in eastern (Levis) trough by Snake Hill shale (at top), Tackawasick limestone and shale, Rysedorph conglomerate, and Normanskill shale. In Hudson Valley, Snake Hill beds form broad belt of shales between Normanskill shales and Wappinger limestone at bank of river to Skunnemunk Mountains and has computed thickness of 1,500 to 2,000 feet in Orange County. Middle Ordovician.

F. M. Swartz, 1948, Am. Assoc. Petroleum Geologists Bull., v. 32, no. 8, p. 1574–1575. Where Mohawk Valley joins Hudson Valley near Albany, upper part of type Canajoharie shale is replaced by 1,500 to 2,000 feet of Schenectady shale. Earlier Canajoharie shales found beneath the western part of the Schenectady, are replaced in Albany area by 1,200 to 2,000 feet of grayish, silty, and sandy Snake Hill shales. Snake Hill shales may have been shifted by Taconic faults of Albany region, and it is not certain that they belong beneath the outcropping Schenectady shales in normal stratigraphic succession.

R. V. Cushman, 1953, New York State Water Power and Control Comm. Bull. GW–33, p. 10 (table 3), 15, pl. 2. Thickness about 600 feet in Washington County. Table 3 shows Snake Hill formation above Walloomsac slate. Middle Ordovician.

Name is from fossiliferous beds at Snake Hill on east side of Saratoga Lake.

**Snake River Group**

Snake River Basalt[1]

Snake River Lava

Pleistocene and Recent: Southern Idaho and southwestern Montana.

Original reference: Waldemar Lindgren, 1900, U.S. Geol. Survey 20th Ann. Rept., pt. 3, pl. 8.

I. C. Russell, 1902, U.S. Geol. Survey Bull. 199, p. 38, 59, map. Name Snake River lava proposed and geographic area described.

C. P. Ross and J. D. Forrester, 1947, Geologic map of the State of Idaho (1:500,000): U.S. Geol. Survey. Quaternary and possible Tertiary.

J. C. Bayless, 1950, Michigan Acad. Sci., Arts, and Letters, Papers, v. 34, p. 219. Lava proposed as general term by which to designate the basaltic rocks that underlie by far the larger part of Snake River Plains and that to a great extent form their actual surfaces. Described in southeastern part of Snake River Plains as mostly gray to black, fine grained, and vesicular, commonly having small feldspar and olivine phenocrysts visible to unaided eye.

Robert Scholten, K. A. Keenmon, and W. O. Kupsch, 1955, Geol. Soc. America Bull., v. 66, no. 4, p. 377, pl. 1. Geographically extended to Beaverhead County, Mont.

R. T. Littleton and E. G. Crosthwaite, 1957, U.S. Geol. Survey Water-Supply Paper 1460–D, p. 158 (table), 165–166. Chiefly olivine basalt flows. Occurs as cap rock on north rim of Snake River Canyon and on buttes immediately south of river, and locally as intracanyon basalt. Thickness 3 to 250 feet. Occurs above Idaho formation. Pliocene to Recent.

U.S. Geological Survey currently classifies the Snake River as a group on the basis of a study now in progress.

Named for occurrence in Snake River area, Idaho.

Snake River Series[1]

Permian(?): Northern Idaho.

Original reference: V. R. D. Kirkham, 1927, Idaho Bur. Mines and Geology Pamph. 24, p. 3–6.

Exposed in Clearwater River Canyon near Asahka [Ahsahka], Clearwater County.

Snake River Stage[1]

Pliocene: Northwestern Nebraska.

Original reference: E. H. Barbour, 1915, Am. Jour. Sci., 4th, v. 39, p. 87.

Occurs along a stream variously termed Snake Creek and Snake River near Burge, Cherry County.

**Sneech Pond 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. 12, 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. Quad. Map [GQ–1]. Chiefly fine-grained gray or greenish-gray quartz-mica schist with relatively thin interbeds of quartzite and conglomerate. Contains beds, sills, and dikes of Hunting Hill greenstone (new) and thin, discontinuous marble beds. Included in Blackstone series.

Named for good exposures on west shore of Sneech Pond and in quarries east of pond, Pawtucket quadrangle, Providence County.

**Sneed Andesite**

Tertiary, middle(?): Southwestern Arizona.

James Gilluly, 1937, Arizona Bur. Mines Bull. 141, Geol. Ser. 9, p. 15 (table 1), 45–46, pl. 1. Chiefly reddish porphyritic lava with phenocrysts of hornblende and white plagioclase in a dense base. Most of the lava consists of andesine and green hornblende phenocrysts in an andesitic groundmass. Some breccias north of Salt Well. Estimated thickness at Tule Well 3,000 feet. Unconformably overlies Locomotive fanglomerate (new), Chico Shunie quartz monzonite (new), and Cardigan gneiss (new) near Tule Well, and probably the Cornelia quartz monzonite (new). Unconformably underlies Daniels conglomerate (new) and Black Mountain andesite (new).

James Gilluly, 1946, U.S. Geol. Survey Prof. Paper 209, p. 9, 41–42, pl. 3 [1947]. Disconformably underlies Batamote andesite at south end of Childs Mountain. Type locality designated.

Type locality: At Sneed Ranch in sec. 5, T. 12 S., R. 6 W., Ajo quadrangle, Pima County. Crops out on northwest slope of Little Ajo Mountains and at south end of Childs Mountain.

**Sneeds Limestone Lentil** (of Everton Limestone)[1]

Middle Ordovician: Northern Arkansas.

Original reference: A. H. Purdue and H. D. Miser, 1916, U.S. Geol. Survey Geol. Atlas, Folio 202.

Occurs in Hemmed-in Hollow, 2 miles south of Compton, Newton County. Typically exposed on Sneeds Creek.

†Sneedville Limestone[1]

Upper Silurian: Eastern Tennessee.

Original reference: J. M. Safford, 1856, Geol. reconn. Tennessee, 1st Rept., p. 157.

Named for Sneedville, Hancock County.

**Sneffels Member** (of San Juan Tuff)[1]

Miocene(?): Southwestern Colorado.

Original reference: W. S. Burbank, 1930, Colorado Sci. Soc. Proc., v. 12, p. 187.

In vicinity of Canyon Creek, Sneffels, and Ouray, Ouray district.

**Snelson Granite**

Precambrian: Central western Georgia.

D. F. Hewett and G. W. Crickmay, 1937, U.S. Geol. Survey Water-Supply Paper 819, p. 26–27, pl. 1. Made up largely of oligoclase, microcline, quartz, and biotite; most of biotite flakes are in rudely parallel layers so that rock has persistent foliation, foliation shows small folds and minute plications, granite is cut by numerous pegmatite dikes. Considered to be younger than Carolina gneiss.

Well exposed near Snelson's Crossroads, 2½ miles east of Harris, Meriwether County. Underlies large area in northwest quarter of Warm Springs quadrangle north of Towaliga fault.

Sniabar Limestone[1] (in Swope Limestone)

Sniabar Limestone Member (of Hertha Formation)

Pennsylvanian (Missouri Series): Northwestern Missouri and eastern Kansas.

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. 85, 90, 97.

R. C. Moore, J. C. Frye, and J. M. Jewett, 1944, Kansas Geol. Survey Bull. 52, p. 193. Uppermost member of Hertha. Overlies Mound City shale member; underlies Ladore shale. Thickness as much as 10 feet; average about 5 feet.

Named for Sniabar Creek just east of Kansas City, Mo.

Sni Mills Limestone[1] Member (of Lenapah Formation)

Pennsylvanian (Des Moines Series): Northwestern Missouri and northeastern Kansas.

Original reference: F. C. Greene *in* R. C. Moore and others, 1936, Kansas Geol. Soc. Guidebook 10th Ann. Field Conf., p. 19, 20.

F. C. Greene and W. V. Searight, 1949, Missouri Geol. Survey and Water Resources Rept. Inv. 11, p. 9. Allocated to member status in Lenapah formation. Uppermost member; overlies Perry Farm shale member; underlies Memorial formation.

L. M. Cline and F. C. Greene, 1950, Missouri Geol. Survey and Water Resources Rept. Inv. 12, p. 25. Name Sni Mills has priority over name Idenbro, and term Idenbro is suppressed as a synonym for Sni Mills.

Named for outcrops at Sni Mills, Jackson County, Mo.

Snipes Conglomerates

Miocene, upper, or Pliocene: Central Washington.

R. C. Treasher, 1937, Geol. Soc. Oregon Country News Letter, v. 3, no. 20, p. 218–220. Name applied to persistent stratum of conglomerate, quartzite-bearing gravels, tuffaceous sandstones, and arkosic sands which overlie Wenas basalt and underlie valley silts. Thickness at type locality 238 feet. The conglomerate unit was included in Satsop formation by Bretz (1917) and placed at base of Ellensburg by other workers.

Type locality: SW¼ sec. 34, T. 10 N., R. 22 E., Yakima County.

**Snitz Creek Formation** (in Conococheague Group)

Snitz Creek 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. Name applied to dolomite sequence that stratigraphically overlies Buffalo Springs member (new); underlies Schaefferstown member (new). Composed of thick-bedded light- to medium-gray dolomite, commonly oolitic, with medium-light-gray limestone or medium-gray shaly limestone interbeds; where coarsely crystalline, dolomite is commonly vuggy; shaly partings, often stylolitic, occur in dolomite; sandstone beds 1 to 1½ feet thick present near top and base, with thinner sandy beds occurring throughout member; dark-gray to grayish-black chert locally abundant. Estimated thickness 350 feet; partial section (type) 62 feet, neither top nor base exposed.

Carlyle Gray and A. A. Socolow, 1959, Geol. Soc. America Guidebook Pittsburgh Mtg., p. 148–150. Upper Cambrian. Member has same stratigraphic position of, and is lithologically similar to, Big Spring Station member (Wilson, 1952) of Conococheague.

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 along Cornwall Railroad tracks about one-half mile south of Midway Church, Lebanon County. No satisfactory type section available in Lebanon County but best partial section has been measured and used as type section.

Snomac Limestone Member (of Ada Formation)

Pennsylvanian (Virgil Series): East-central Oklahoma.

W. F. Tanner, 1956, Oklahoma Geol. Survey Bull. 74, p. 100, 101, pl. 1. Name applied to a sequence of thin dull-white finely crystalline limestone beds that occur in the lowest third of the formation; commonly

only a single limestone is exposed at one locality. Member occurs high in a 45-foot shale interval that overlies the basal Ada sandstone.

Named after Snomac townsite in secs. 10, 11, and 14, T. 7 N., R. 6 E., Seminole County. Member extends from center of sec. 26, T. 8 N., R. 6 E., north of Little River, to secs. 14 and 15, T. 7 N., R. 6 E., south of Little River.

**Snoqualmie Granodiorite**[1]

Miocene and Pliocene, lower: 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. 795, 797 (fig. 2). Probably intermediate in age between lower part of Keechelus andesitic series and the Fifes Peak andesite (new). Map legend shows age as Oligocene(?). Area of report is Mount Aix quadrangle.

R. J. Foster, 1960, Geol. Soc. America Bull., v. 71, no. 2, p. 121–123, pl. 1. Predominantly granodiorite; locally includes both more basic and more felsic rocks. Intrudes Denny (new), Guye (restricted), Naches, and Keechelus formations. Youngest formation intruded is Keechelus which may be Oligocene or Miocene. In area of this report [northern parts of Mount Stuart and Snoqualmie folios], the Snoqualmie is not in contact with any younger rocks, so no upper limit can be placed on its age. Relationship of Keechelus and Snoqualmie in area discussed by Warren (1941) to rocks in area of this study is not known. Age determination of Snoqualmie (using zircon method) is reported to be 60 million years —this is usually considered Paleocene or Eocene.

Named for exposures about headwaters of Snoqualmie River, Snoqualmie quadrangle. Forms peaks and ridges, such as Granite, Denny, and Snoqualmie Mountains.

**Snowbank Granite**[1]

Precambrian (lower or middle Huronian): Northeastern Minnesota.

Original reference: N. H. Winchell, 1899, Minnesota Geol. Nat. History Survey Final Rept., v. 4.

J. W. Gruner, 1941, Geol. Soc. America Bull., v. 52, no. 10, p. 1610. Snowbank granite and Snowbank stock mentioned in report on Knife Lake district.

First described in Vermilion district.

†Snowbank Lake Granite[1]

Precambrian (lower or middle Huronian): Northeastern Minnesota.

Original reference: N. H. Winchell, 1899, Minnesota Geol. Nat. History Survey Final Rept., v. 4.

Occurs in Snowbank Lake and vicinity, Vermilion district.

**Snowbird Group**

Snowbird Formation[1]

Precambrian (Ocoee Series): Western North Carolina and eastern Tennessee.

Original reference: A. Keith, 1904, U.S. Geol. Survey Geol. Atlas, Folio 116, p. 5.

G. W. Stose and A. J. Stose, 1944, Am. Jour. Sci., v. 242, no. 7, p. 390. Keith (in later publications) used names Snowbird formation and

Hiwassee slate for Cambrian rocks below Cochran conglomerate. These two names are names of Ocoee formations and should not be used for Cambrian formations.

G. W. Stose and A. J. Stose, 1947, Am. Jour. Sci., v. 245, no. 10, p. 627. Name Vann quartzite proposed to replace term Snowbird formation as used by Keith in Hot Springs area, North Carolina.

G. W. Stose and A. J. Stose, 1949, Geol. Soc. America Bull., v. 60, no. 2, p. 271–272. Name Hurricane is applied to the graywacke which underlies Great Smoky quartzite and is basal formation of Ocoee series. In Asheville and several other folios, Keith (1904, 1905, 1907, and Mount Guyot folio, 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; hence, name Snowbird is misleading, and new name applied.

S. S. Oriel, 1950, North Carolina Div. Mineral Resources Bull. 60, p. 13 (table 3), 25–30. In this report on Hot Springs area, North Carolina, term Snowbird is retained for unit below Sandsuck. This is area in which Stose and Stose used names Vann quartzite and Hurricane graywacke.

P. B. King and others, 1958, Geol. Soc. America Bull., v. 68. no. 9, p. 953 (fig. 2), 954–957, 963. Rank raised to group in Ocoee series. North of and below Greenbrier fault, includes Metcalf formation (new) in western part of area; in eastern part of area, includes (ascending) Wading Branch formation, Longarm quartzite, Roaring Fork sandstone (all new), and Pigeon siltstone. South of and above Greenbrier fault, includes Wading Branch formation, Longarm quartzite, and Roaring Fork sandstone. At type section, group rests on granitic rocks and is succeeded conformably by Rich Butt sandstone (new). South and above Greenbrier fault, conformably underlies Great Smoky group and overlies granitic and gneissic rocks.

J. L. Stuckey and S. G. Conrad, 1958, North Carolina Div. Mineral Resources Bull. 71, p. 34–35; J. L. Stuckey, 1958, Geologic map of North Carolina (1:500,000): North Carolina Div. Mineral Resources. Mapped as Snowbird formation, Ocoee series, Upper Precambrian. Subdivided into five unnamed units. Thickness over 15,000 feet in vicinity of Snowbird Mountain and Pigeon River.

Type section (group): Along Pigeon River at southwest and south base of Snowbird Mountain, Haywood County, N.C.

**Snow Creek Porphyry**[1]

Post-Cretaceous(?): Central Montana.

Original reference: P. A. Schafer, 1935, Montana Bur. Mines and Geology Mem. 13, p. 10–15, map.

U.S. Geological Survey currently designates the Snow Creek Porphyry as post-Cretaceous(?) on the basis of a study now in progress.

Exposed continuously from vicinity of I.X.L. mine across lower end of Poverty Ridge, a short distance above junction of Snow and Carpenter Creeks, across Carpenter Creek near mouths of Hegener and Mackey Creeks, and extending to divide at heads of those Creeks, Neihart district, Cascade County.

Snowcrest Granite

Eocene: Southwestern Montana.

Robert Scholten, K. A. Keenmon, and W. O. Kupsch, 1955, Geol. Soc. America Bull., v. 66, no. 4, p. 372, pl. 1. Coarse-grained strongly jointed granite that disintegrates into small angular fragments. Snowcrest intrusive cuts through Mississippian rocks and is unconformably overlain by Blacktail Deer Creek formation (new).

Occurs as a small stock that crops out at southwestern end of Snowcrest Range, in sec. 20, T. 13 S., R. 7 W., Beaverhead County.

Snowden Member (of Harpers Formation)

Lower Cambrian: Central Virginia.

R. O. Bloomer and H. J. Werner, 1955, Geol. Soc. America Bull., v. 66, no. 5, p. 596, pl. 1. Distinctive quartzite member which occurs 100–300 feet above bottom of formation. Thickness 50 feet.

Named for exposure on U.S. Highway 501 in James River Gorge about 0.2 mile west of Snowden post office, Amherst County.

Snow Fork Limestone (in Allegheny Formation)[1]

Snow Fork ironstone member

Pennsylvania: Southeastern Ohio.

Original reference: E. Orton, 1878, Ohio Geol. Survey, v. 3, p. 889, 897, pls. facing p. 889, 921.

M. T. Sturgeon and others, 1958, Ohio Geol. Survey Bull. 57, p. 48 (table 7), 69–70. Snow Fork ironstone (Salem limestone) member included in Middle Kittanning cyclothem in report on Athens County. Average thickness about 4 feet. Member is shale with abundant plant fossils and numerous clay ironstones. Allegheny series.

Named for Snow Fork on Monday Creek, Hocking County.

**Snow Hill Marl Member** (of Black Creek Formation)[1]

Upper Cretaceous: Southern North Carolina and eastern South Carolina.

Original reference: L. W. Stephenson, 1923, North Carolina Geol. and Econ. Survey, v. 5, pt. 1, p. 9–10.

H. E. Le Grand and P. M. Brown, 1955, Carolina Geol. Soc. Guidebook Oct. 8–9, p. 7, 24–25. Stop 1 of field trip considered type locality of Snow Hill member. Authors assume this to be fossil locality mentioned by Conrad (1871, Am. Jour. Sci., 3d ser., v. 1, 468–469). At this site, Snow Hill member consists of 5 or 6 feet of drab-black arenaceous and micaceous clays containing abundant assemblage of megafossils. Thickness of exposed section is variable with seasonal fluctuations in river level. Uppermost part of Black Creek formation; underlies Peedee formation.

C. E. Brett, 1959, Elisha Mitchell Sci. Soc. Jour., v. 75, no. 2, p. 69–70. On basis of present study, it is believed that term Snow Hill calcareous member of Black Creek formation should be dropped from literature and that sediments at Snow Hill be included in Peedee formation.

Type locality: On farm of L. C. Daniels along Contentea Creek, about 2 miles below Snow Hill, Greene County, N.C.

Snowshoe 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, 259–263. Consists of approximately 2,800 feet of black shale and fine-grained dark-gray laminated sandstone in the upper part of Izee group. Unconformably underlies Trowbridge shale (new); overlies Hyde formation (new).

W. R. Dickinson, 1960, Dissert. Abs., v. 20, no. 11, p. 4367. Weberg, Warm Springs, and Basey (new) formations are lateral equivalents of Snowshoe formation.

Type area: On southeast limb of Mowich anticline; exposures lie in narrow belt extending from Snow Mountain northeastward across South Fork valley, Crook County. Named for the "Snowshoe country" on headwaters of Silvies River.

**Snowy Range Formation**

Snowy Range Limestone Member (of Gallatin Limestone)

Snowy Range Member (of Boysen 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. 545–547. Formation comprises: lower member of thin sandstones and gray-green fissile shales (average 75 feet thick) with, at top, a few limestone pebble conglomerates and thin persistent horizon (about 10 feet thick) of dense light-gray limestone with distinctive columnar structure; upper member of intercalated gray-green fissile shales and innumerable beds and lenses of glauconitic limestone flat pebble conglomerates (average 150 feet thick). Thickness at type locality 259 feet. Underlies Grove Creek formation (new); overlies Maurice formation (new). Franconia equivalent. Term Gallatin formation not applicable in this area [southern Montana].

Charles Deiss, 1938, Geol. Soc. America Bull., v. 49, no. 7, p. 1093–1094, 1101 (fig. 3), 1105. Rank reduced to member status in Boysen formation (new) in Wind River area, Wyoming. Underlies Grove Creek member; overlies Maurice member. Thickness 308 feet in type section of Boysen.

V. E. Nelson and Victor Church, 1943, Jour. Geology, v. 51, no. 3, p. 145 (fig. 2). Stratigraphic chart of Gros Ventre and northern Hoback Ranges, Wyo., shows Snowy Range as upper member of Gallatin limestone.

Christina Lochman, 1950, Am. Assoc. Petroleum Geologists Bull., v. 34, no. 11, p. 2202 (fig. 1), 2212, 2214 (fig. 2). Formation includes (ascending) Dry Creek shale member and Sage pebble conglomerate member (new). In area of this report [central Montana], overlies Maurice formation and underlies Maywood formation. Thickness 15 to 130 feet.

A. M. Hanson, 1952, Montana Bur. Mines and Geology Mem. 33, p. 19. In part of Montana adjacent to and northeast of Yellowstone Park, strata of same age as Red Lion formation consist of interbedded greenish-gray shales and limestones and lime-pebble conglomerates. This unit has been named Snowy Range by Dorf and Lochman.

P. W. Richards, 1957, U.S. Geol. Survey Bull. 1021–L, p. 397, 400–402. Formation described east and southeast of Livingston, Mont., where it is 175 feet thick and consists of a lower 36 feet of greenish-gray shale, a middle 33 feet of flat-pebble limestone conglomerate overlain by columnar limestone, and an upper 106 feet of interbedded poorly exposed greenish-gray shale and light-gray dense crystalline glauconitic limestone; of these beds, the lower 34 feet are seemingly stratigraphic equivalents of Peale's (1893) Dry Creek shales and remainder of the formation is in part correlative with and in part younger than Peale's Pebbly limestone. Underlies Grove Creek formation; overlies Pilgrim limestone (used here in preference to Maurice).

R. E. Grant, 1958, Dissert. Abs., v. 18, no. 6, p. 2107. Formation consists of (ascending) Dry Creek shale, Sage, and Grove Creek members. Overlies Pilgrim limestone; underlies Maywood unit.

Type locality: On south slope of Castle Rock about 2 miles downstream from Snowy Range Ranch at junction of the East Fork with Mill Creek, Park County, Mont. Section measured in N½SE¼ sec. 13, T. 6 S., R. 9 E.

Snowy Range Series

Precambrian: Southeastern Wyoming.

J. J. Runner, 1928, (abs.) Geol. Soc. America Bull., v. 39, no. 1, p. 202. Proposed for formations described by Blackwelder (1926, Geol. Soc. America Bull., v. 37, p. 622–647) from conglomerate at base of Deep Lake metaquartzite upward and including French slate. Occurs above Centennial series (new). [Formations described by Blackwelder include (ascending) Deep Lake Metaquartzite, Headquarters Schist, Heart Metagraywacke, Medicine Peak Metaquartzite, Lookout Schist, Sugarloaf Metaquartzite, Nash Marble Series, Anderson Phyllite, Ranger Marble, Towner Greenstone, and French Slate.]

C. L. Fenton and M. A. Fenton, 1957, Geol. Soc. America Mem. 67, p. 104–106. Series contains at least 24,000 feet of metamorphosed conglomerates, quartzites, graywackes, shales, and dolomites which reveal no angular unconformities, though minor disconformities are present. Terrestrial environment is indicated by three tillite deposits 125, 25, and 100 feet thick, the first of which appears about 2,000 feet above base of series. Believed to be early Huronian.

Crops out in Medicine Bow Mountains, west of Laramie basin, Wyoming.

Snyder Limestone

Snyder Member (of Benner Limestone)

Middle Ordovician (Bolarian): Central and south-central Pennsylvania, western Virginia, and southern West Virginia.

G. M. Kay, 1941, (abs.) Geol. Soc. America Bull., v. 52, no. 12, pt. 2, p. 1969. Named as member of Benner limestone and described as sublithographic light-colored oolitic and pebbly limestone. Thickness 96 feet at type locality.

G. M. Kay, 1944, Jour. Geology, v. 52, no. 1, p. 15–17. Lower member of Benner. At type section, consists of 98 feet of light-colored detrital limestone, with limestone pebble conglomerate, and white-weathering dense relatively pure sublithographic limestone. Latter type usually present in upper part of unit. Lithology similar throughout central Pennsylvania from Union Furnace, Huntingdon County, to Bedford County; conglomerate with white limestone pebbles particularly characteristic. Contains a thin metabentonite at Oak Hall. Maximum thickness 110 feet; diminishes to extinction in western Cumberland Valley. Conformably underlies Stover member, except in Blacklog and

Path Valleys, Pa., where it underlies Nealmont limestone or Mercersburg limestone. Overlies Hostler member of Hatter formation; often difficult to distinguish the two. Derivation of name and more exact location of type section stated.

Marshall Kay, 1947, (abs.) Geol. Soc. America Bull., v. 58, no. 12, pt. 2, p. 1199. Limestone included in upper Bolarian (Hunterian) series.

W. H. Twenhofel and others, 1954, Geol. Soc. America Bull., v. 65, no. 3, chart 2 (columns 21, 22). Geographic extension; listed in stratigraphic column for Highland County, Va., and Monroe County, W. Va. [Limestone apparently has formational rank in these areas.]

Marshall Kay, 1956, Geol. Soc. America Bull., v. 67, no. 1, p. 74 (table 12), 78, 95, 103. Geographic restriction. New name McGlone limestone proposed for rocks in Virginia previously referred to as Snyder. Termed a formation.

Type section: In Pennsylvania Railroad cut at Union Furnace, Huntingdon County, Pa. Named for Snyder Township, Blair County, Pa., where exposed in southern quarry along Elk Run on southern boundary of township.

**Snyder Creek Shale**[1]

Upper Devonian: Central Missouri.

Original reference: J. A. Gallaher, 1900, Missouri Geol. Survey, v. 13, p. 153.

E. B. Branson, 1944, Missouri Univ. Studies, v. 19, no. 3, p. 145–151. Varies from largely shales through alternating shales and limestones to dominantly limestones. Thickness less than 10 feet to as much as 63 feet. Overlies Callaway limestone, in most places conformably. In most places, overlying formation is Bushberg, and unconformity is distinct. In some places, Chouteau limestone is unconformable on Snyder Creek. Burlington limestone is overlying formation in two or three places and Cherokee shale in one. Lower half of Upper Devonian and may represent lowest part of Upper Devonian.

Named for exposures on Snyder Creek which flows through Snyder Farm, Callaway County.

Snyder Hill Formation[1]

Snyder Hill Group

Permian: Southeastern Arizona.

Original reference: A. A. Stoyanow, 1936, Geol. Soc. America Bull. v. 47, p. 530–532, 536.

J. H. Feth, 1948, Am. Assoc. Petroleum Geologists Bull., v. 32, no. 1, p. 86 (fig. 2), 87, 88–89 (fig. 3), 92–99. Name Snyder Hill formation applied to about 2,223 feet of Permian strata in northern Canelo Hills area.

E. D. Wilson, 1951, Arizona Bur. Mines Bull. 158, Geol. Ser. 19, p. 50. In Empire Mountains, overlies Andrada formation (new) and underlies unnamed Upper Cretaceous interval. Consists of thick-bedded limestone with several quartzite members. Thickness 1,250 to 2,250 feet.

D. L. Bryant, 1955, Dissert Abs., v. 15, no. 7, p. 1224. Rank raised to group. Includes (ascending) Scherrer formation, Concha limestone, and Rainvalley formation (new). This action restricts Naco group at top.

F. S. Sabins, Jr., 1957, Am. Assoc. Petroleum Geologists Bull., v. 41, no. 3, p. 498. Strata assigned to Snyder Hill by Feth (1948) appear to include beds equivalent to Colina, Scherrer, and Concha formations. Suggests term Snyder Hill be suppressed.

Type locality: Snyder Hill, an isolated hill about 10 miles southwest of Tucson, in Whetstone Mountains.

**Snyderville Shale[1] Member** (of Oread Limestone)

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, 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. 126 (fig. 22), 147–148. Snyderville shale member of Oread formation; underlies Leavenworth limestone member; overlies Toronto 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. 26. In Nebraska, overlies Toronto (Weeping Water) limestone member. Type locality stated.

T. L. Welp, L. A. Thomas, and H. R. Dixon, 1957, Iowa Acad. Sci. Proc., v. 64, p. 418 (fig. 1), 419. Thickness 2 feet in measured section near Winterset, Madison County.

H. G. O'Connor, 1960, Kansas Geol. Survey Bull. 148, p. 38–40, pl. 1. In Douglas County, consists chiefly of green and gray argillaceous and silty shale, claystone, and siltstone. Thickness 1 to 45 feet; average 10 or 15 feet.

H. G. Hershey and others, 1960, Iowa Highway Research Board Bull 15, p. 23, fig. 5. Poorly exposed and thin limestone bed occurring at base is difficult to recognize. In Adair County, about 8 feet of shale. slightly silty and red at base, occurs between the Leavenworth and a limestone tentatively called the Toronto.

Type locality: In Heebner Creek valley, east of Snyderville quarry, about 3 miles west and 1¼ miles north of Nehawka, Cass County, Nebr.

**S O Volcanics**

Miocene or Pliocene: Southeastern Arizona.

James Gilluly, 1956, U.S. Geol. Survey Prof. Paper 281, p. 8, 110–115, pl. 5. Thick series of interbedded quartz latite tuffs and hornblende andesite flows. Highly variable both laterally and vertically. Broadly divisible into three members: basal series of quartz latite tuffs, breccias, and minor obsidian flows, with interbedded conglomerates, sandstones, and mudstones also largely of pyroclastic origin—thickness ranges from 1,600 feet on southeast face of Stockton Hill to knife edge just across valley to the south, and is missing within about a mile in that direction; intermediate member of hornblende andesite flows—probably about 1,000 feet thick east of S O Ranch and about 300 feet thick south of Reeves Ranch; and upper member of quartz latite tuff, with a few local intercalations of true rhyolite and hornblende andesite—thickness about 1,100 feet on Hay Mountain, elsewhere much less. Hornblende andesite flow member apparently the most uniform and continuous part of formation. Accumulated upon older erosion surface of considerable relief so that in various localities different members lie at stratigraphic base of formation and overlie various formations including Gleeson quartz monzonite (new) and Bisbee formation. Underlies undeformed late Quaternary alluvium at most localities. Probably not older than Miocene and early Pliocene seems an upper age limit for this volcanism.

Exposed near S O Ranch, from which it is named, in sec. 20, T. 20 S., R. 24 E. Well exposed between south end of Hay Mountain and the hills southwest of Reeves Ranch, about 8 miles to northwest. Other bodies occur south of Cowan Ranch—near Outlaw Mountain, on pediment extending northwest of Outlaw Mountain, and on west side of Dragoon Mountains near Bar O Ranch. Central Cochise County.

**Soap Creek Bentonite Bed** (in Belle Fourche Member of Cody Shale)

**Soap Creek Bentonite Bed** (in Frontier Formation)

Upper Cretaceous: Southeastern Montana and northern Wyoming.

P. W. Richards and C. P. Rogers, Jr., 1951, U.S. Geol. Survey Oil and Gas Inv. Map OM–111, sheet 2. Olive-green bentonite bed 8 feet thick at top of Frontier formation. Locally more than 10 feet thick south of Soap Creek dome.

M. M. Knechtel and S. H. Patterson, 1952, U.S. Geol. Survey Circ. 150, pl. 1. Beds present in Yellowtail district, southeastern Montana and northern Wyoming.

M. M. Knechtel and S. H. Patterson, 1956, U.S. Geol. Survey Bull. 1023, p. 19, 20, pls. 1, 3. Bed in Belle Fourche member of Cody shale. Thickness 12 to 30 feet. Area of report, Hardin district, Montana and Wyoming. In this area, term Belle Fourche replaces Frontier formation as used in previous reports.

Well exposed on east flank of Soap Creek dome, sec. 35, T. 6 S., R. 32 E., Hardin area, Big Horn and Yellowstone Counties, Mont.

**Sobrante Sandstone**[1] (in Monterey Group)

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. 35, p. 69–70, pl. 12. Exposed in Martinez syncline, near Martinez. Thickness about 520 feet. Unconformably overlies San Ramon sandstone; underlies Briones sandstone.

G. C. Lutz, 1951, California Univ. Pubs., Dept. Geol. Sci. Bull., v. 28, no. 13, p. 367–406. Term Sobrante used in redefined and restricted sense of Clark (1918, California Univ. Pub. Dept. Geol. Bull., v. 11, no. 2). Type section designated for Sobrante (restricted). Thickness at type locality about 150 feet. Underlies Claremont shale; overlies Concord formation(?).

G. D. Robinson, 1956, U.S. Geol. Survey Geol. Quad. Map GQ–88. Described in Hayward quadrangle. Usage here is roughly equivalent to Sobrante sandstone (restricted) of Clark (1918) and Lutz (1951). Middle Miocene.

C. A. Hall, Jr., 1958, California Univ. Pubs. Geol. Sci., v. 34, no. 1, p. 15–16, fig. 2, geol. map. Sobrante sandstone in Pleasanton area, Alameda and Contra Costa Counties, overlies Tolman formation (new); underlies Claremont shale. Thickness about 200 feet. Term Monterey group not considered appropriate in this region.

Type section of Sobrante sandstone (restricted): Along Bear Creek Road summit between Oursan Ridge and Lawson Hill, Contra Costa County.

Social Island Limestone Member (of Row Park Limestone)

Middle Ordovician: Central southern Pennsylvania.

F. M. Swartz and R. R. Thompson, 1958, Pennsylvania State Univ. Mineral Industries Expt. Sta. Bull. 71, p. 4, 5. Microcrystalline or vaughanitic limestone. Underlies Browns Mills limestone member (new); overlies Beekmantown dolomite. Name credited to J. G. Palacas (unpub. thesis).

In Franklin County.

Sockanosset Sandstone[1]

Pennsylvanian: Eastern Rhode Island.

Original reference: J. B. Woodworth, 1899, U.S. Geol. Survey Mon. 33, p. 134, 159–163.

Well exposed in Sockanosset Ridge, east and west of reservoir near Providence, Providence County.

Socorran series[1]

Mississippian: Southwestern New Mexico.

Original reference: C. R. Keyes, 1906, Science, new ser., v. 23, p. 921.

Soda Lake Formation

Miocene, lower: Southern California.

T. W. Dibblee, Jr., 1952, *in* Am. Assoc. Petroleum Geologists, Soc. Econ. Paleontologists and Mineralogists, and Soc. Explor. Geophysicists Guidebook, Joint Ann. Mtg., Los Angeles, p. 82, 84. Marine shale and basal sandstone 1,200 feet thick. Underlies Painted Rock formation (new); overlies Simmler formation (new). Outcrops noted in road log. [This appears to be unit that was defined by Hill, Carlson, and Dibblee (1958) as the Soda Lake Shale and Soda Lake Sandstone Members of Vaqueros Formation.]

Occurs in Caliente Range, a low mountainous ridge trending northwesterly for about 30 miles between Cuyama Valley and Carrizo Plain. Range is an anticlinal uplift developed in a thick series of Tertiary sediments and is partially overturned and thrustfaulted southwestward toward Cuyama Valley.

Soda Lake Sandstone Member (of Vaqueros Formation)

Miocene, lower (Zemorrian): Southern California.

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), 2978 (fig. 3), 2982 (fig. 5), 2984. Southeast of Caliente Mountain, the Vaqueros formation consists of three members (ascending): Soda Lake sandstone, Soda Lake shale, and Painted Rock sandstone. At type locality, the sandstone is characteristically gray white, weathering to light buff, massive bedded, fine to medium grained, well sorted, and firmly indurated; commonly crossbedded with foreset beds dipping in westerly direction. Thickness at type section 300 feet; thins westward by probable gradation into Soda Lake shale and toward southeast becomes undifferentiated from overlying Painted Rock sandstone; overlies Simmler formation.

Type locality: T. 10 N., R. 25 W., southeastern Caliente Range, east of Cuyama Ranch quadrangle.

Soda Lake Shale Member (of Vaqueros Formation)

Miocene, lower (Saucesian): Southern California.

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), 2978 (fig. 3), 2984–2986. From Caliente Mountain northwestward, the Vaqueros consists of two members, Soda Lake shale below and Painted Rock sandstone above. Thickness in type area, about 1,200 feet. Overlies Simmler redbeds. On southwest slope of Caliente Mountain, thickness is about 1,100 feet, base concealed; here it was mapped by Eaton and others (1941, Am. Assoc. Petroleum Geologists Bull., v. 25, no. 2) as Oligocene(?) silt and inferred to be correlative with middle Sespe and Gaviota formations of Santa Ynez Mountains; thickness in southeastern part of Caliente Range about 900 feet, this section grades into sandstone as does the 800-foot section in Cuyama Badlands.

Type locality: Northwestern Caliente Range near Soda Lake, T. 31 S., R. 19 E., Simmler quadrangle.

Soda Mountain Formation

Triassic-Jurassic: Southern California.

L. T. Grose, 1956, Dissert. Abs., v. 16, no. 1, p. 100; 1959, Geol. Soc. America Bull., v. 70, no. 12, pt. 1, p. 1526–1529, pl. 1. Thick series of volcanic flow breccia and sandstone. Rocks range from massive andesite flows through flow breccia, pyroclastic rocks, and welded tuff to volcanic sandstone and finally to nearly pure quartzite. Relative abundance of each type varies extremely and unpredictably within short distances vertically and laterally; volumetrically, flow breccia predominates and is followed by volcanic sandstone; massive flows, welded tuff, and pure quartzite are only locally abundant; yellow, gray, red, purple, and green colors common. Displays little bedding, except where interbedded sandstones and pyroclastics occur; hence, over large areas structure is almost unknown; where bedding is visible it is steep, vertical or locally overturned. Formation is generally bound in complex fault-block relations by Upper Paleozoic limestones and is intruded by Upper Mesozoic plutonic rocks. At type location, disconformably overlies Lower Triassic sedimentary rocks. No rocks are known to overlie formation stratigraphically in mapped area or elsewhere in region. Estimated minimum thickness 7,000 feet. On basis of field relations, formation is post-Early Triassic and pre-Cretaceous. Type location is selected but truly representative stratigraphic section is impossible to find (six reasons listed).

Type location: North end of Spectre Spur, northeastern Soda Mountains, San Bernardino County. This section is the most nearly complete, most orderly, and least metamorphosed and intruded of any in Soda Mountains or immediate surroundings.

**Sodus Shale** (in Clinton Group)

Sodus Shale Member (of Clinton Formation)[1]

Middle Silurian: Central and western New York.

Original reference: J. M. Clarke, 1906, New York State Mus. 2d Rept. Dir. Sci. Div. 1905, p. 12.

D. W. Fisher, 1954, Am. Assoc. Petroleum Geologists Bull., v. 38, no. 9, p. 1982 (fig. 3). Sodus shale, 15½ feet thick, overlies Reynales limestone; underlies Williamson shale. Clintonian.

D. W. Fisher, 1959, New York State Mus. Sci. Service Geol. Survey Map and Chart Ser. No. 1. Shown on chart as Lower and Upper Sodus shale. Underlies Wolcott limestone; overlies Wallington limestone (new) which replaces limestone formerly known as Reynales at Rochester and eastward, and Bear Creek gray shale. Clinton group.

Named for town of Sodus, Wayne County.

**Solberg Schist** (in Dickinson Group)

Precambrian: Northern Michigan.

H. L. James, 1958, U.S. Geol. Survey Prof. Paper 314–C, p. 30 (table 1), 32. Middle formation of group. The more northerly (stratigraphically lower) parts of unit are dark fine-grained hornblende and biotite schists; some exposures show banding, parallel or nearly parallel to the steeply dipping foliation that may represent original layering; more southerly exposures are massive gray quartz-mica schist and micaceous quartzite. Aggregate thickness about 3,000 feet. The 100-foot iron-rich Skunk Creek member occurs about 1,000 feet below top of formation. Underlies Six-Mile Lake amphibolite (new); overlies East Branch arkose (new).

Named for Solberg Lake, in secs. 17 and 20, T. 42 N., R. 29 W., Dickinson County. Exposed east of lake in scattered outcrops for about 10 miles in a belt 1 to 2½ miles wide.

**Soldier Creek Shale Member** (of Bern Limestone)

Soldier Creek Shale (in Wabaunsee Group)[1]

Pennsylvanian (Virgil Series): Northeastern Kansas, southwestern Iowa, and southeastern Nebraska.

Original reference: J. W. Beede, 1898, Kansas Acad Sci. Trans., v. 15, p. 30.

L. W. Wood, 1941, Iowa Geol. Survey, v. 37, p. 309 (fig. 14). Graphic section of Pennsylvanian in Adams County shows Soldier Creek shale occurring below Wakarusa limestone and above Burlingame limestone.

G. E. Condra, 1949, Nebraska Geol. Survey Bull. 16, p. 18. Formation contains two quite well defined limestones and three shale members in southeastern Nebraska and adjacent area of Kansas; formerly three limestones and two lower shales were classed with the Burlingame in Nebraska.

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 status in Bern limestone (new). Overlies Burlingame limestone member; underlies Wakarusa limestone member.

H. G. Hershey and others, 1960, Iowa Highway Research Board Bull. 15, p. 13, fig. 5. Gray shale at top and bottom with maroon shale near top; near center is micaceous gray sandstone and siltstone. Thickness about 30 feet. Underlies Wakarusa limestone; overlies Burlingame limestone. Wabaunsee group.

Type locality not designated but presumably on "Big and Little Soldier Creeks about 3 miles from Silver Lake," Shawnee County, Kans.

Soldiers Limestone Member (of Big Saline Formation)

Lower Pennsylvanian: Central Texas.

F. B. Plummer, 1947, Jour. Paleontology, v. 21, no. 2, p. 142, 143, 145; 1947, Jour. Geology, v. 55, no. 3, pt. 2, p. 196 (table 2), 197, 198. Consists of light-gray coarsely crystalline, massively bedded, crinoidal fossiliferous limestone. Thinnest southwest of Rochelle, thickens westward to 75 feet at Brady, and nearly 200 feet at Big Saline Creek, Kimble County. West of Cavern Ridge, overlies Brook Ranch member (new) and, near Cavern Ridge, lies above beds with same lithology as that of Lemons Bluff spiculite at Lemons Bluff. Its stratigraphic position above beds of Lemons Bluff lithology suggests that Soldiers member has stratigraphic position similar to that of Brister member east of Cavern Ridge, although it differs from the Brister.

F. B. Plummer, 1950, Texas Univ. Bur. Econ. Geology Pub. 4329, p. 70–71. Soldiers Hole lentil is massive reeflike series of limestone beds that form upper layers of Big Saline formation in Kimble, Mason, and McCulloch Counties. Extends from Big Saline Creek in Kimble County to Ellenburger ridges south of Hall near San Saba-McCulloch County line. Measured section at Soldiers Hole shows 28 feet of lentil above Lemons Bluff beds.

Soldiers Hole is 6 miles east and 2½ miles north of Brady, McCulloch County.

Soldiers Hole Lentil or Member (of Big Saline Formation)

*See* Soldiers Limestone Member (of Big Saline Formation).

Solduc Formation

*See* Soleduck Formation.

Solebury Member (of Stockton Formation)

[Upper] Triassic: West-central New Jersey.

M. E. Johnson and D. B. McLaughlin, 1957, Geol. Soc. America Guidebook Atlantic City Mtg., p. 39, 53 (table), 61. Thick-bedded to massive coarse quartz-arkose conglomerate with interbedded arkose, red shale, and sandstone. Thickness 387 feet. May or may not include overlying 671 feet of red sandstone and gray arkose, and underlying 720 feet of arkose, red shale, sandstone, and conglomerate [see Stockton formation]. Older than Prallsville member (new).

In area along Delaware River from Stockton northward to 3 miles west of Milford, Hunterdon County.

†Soledad division[1]

Miocene, upper: Southern California.

Original reference: O. H. Hershey, 1902, Am. Geologist, v. 29, p. 349–372.

Named for exposures in Soledad Canyon, near Saugus, Los Angeles County.

Soledad Group[1]

Oligocene or Miocene, lower: Southern California.

Original reference: D. S. Jordan, 1919, Leland Stanford Jr. Univ. Pub., Univ. ser., Fossil fishes of southern California, p. 3–5.

Well developed about Soledad Pass, in extreme northern part of Los Angeles County, about 40 miles north of Los Angeles.

Soledad Rhyolite[1]

Eocene or Oligocene: Central southern New Mexico.

Original reference: K. C. Dunham, 1935, New Mexico School Mines Bull. 11, p. 53, 56.

V. C. Kelley and Caswell Silver, 1952, New Mexico Univ. Pubs. in Geology 4, p. 114 (fig. 14). Eocene or Oligocene on correlation chart.

Type locality: In mountains adjacent to Soledad Canyon, Dona Ana County.

**Soledad Volcanic Conglomerate Member** (of Catahoula Tuff)[1]

Oligocene or Miocene, lower: Southwestern Texas.

Original reference: T. L. Bailey, 1926, Texas Univ. Bull. 2645, p. 65, 80–89, 178–179.

H. H. Cooper, 1937, Am. Assoc. Petroleum Geologists Bull., v. 21, no. 11, p. 1423. Shown on table of formations in Laredo district as Soledad member of Catahoula tuff. Consists of coarse brownish-gray to greenish sandstone and beds of volcanic ash, containing igneous gravel and cobbles; thickness about 600 feet. Underlies Chusa member; overlies Fant member.

Named for occurrence on Soledad Hills, western Duval County.

Soleduck Formation[1]

Cretaceous and Tertiary: Northwestern Washington.

Original reference: A. B. Reagan, 1909, Kansas Acad. Sci. Trans., v. 22, p. 161.

C. E. Weaver, 1937, Washington [State] Univ. Pubs. in Geology, v. 4, p. 17. Name Solduc suggested for non-Tertiary part of original Hoh formation.

C. E. Weaver, 1945, Am. Assoc. Petroleum Geologists Bull., v. 29, no. 10, p. 1399. Rocks of interior Olympic Mountains are known only in general way. They consist of more than 10,000 feet of nonfossiliferous arkosic sandstone named Solduc formation. Middle Miocene sandstones of the Astoria resemble lithologically the sandstones of the Solduc of pre-Tertiary age and at one time were mapped with them as single unit—the Hoh formation. Astoria rocks should be differentiated from Solduc sandstones in future mapping.

W. P. Popenoe, R. W. Imlay, and M. A. Murphy, 1060, Geol. Soc. America Bull., v. 71, no. 10, chart 10e (column 55). Soleduck formation shown on Cretaceous correlation chart with note that formation is mostly Tertiary.

First described from occurrences along Soleduck River, Clallam County.

Solitario Formation[1]

Upper Ordovician(?): Southwestern Texas.

Original reference: W. A. J. M. Van der Gracht, 1931, K. Akad. Wetensch. Amsterdam Verb., Afd. Natuurk, Deel 27, No. 3, table Vc, p. 64.

W. B. N. Berry and H. M. Nielsen, 1958, Am. Assoc. Petroleum Geologists Bull., v. 42, no. 9, p. 2254–2259. Van der Gracht published table of formations in the Solitario (furnished by Baker) in which name Solitario formation was applied to 15 to 20 feet of bright-green siliceous and argillaceous shale between Maravillas and Caballos formations. Sellards (1932) described a green shale, 25 or 50 feet thick, overlying Maravillas chert in the Solitario. King (1937) mentioned a few feet of dark-green shale between the Maravillas and Caballos in the Rough Creek exposure. Wilson (1954) proposed name Persimmon Gap shale for shale between Caballos and Maravillas formations. Thus, Solitario formation of Baker and Sellards and Persimmon Gap shale of Wilson are same rock unit. Caballos novaculite is herein restricted to the two lower members as described by King (1937), and term Santiago revived and applied to upper three members of King's Caballos novaculite; hence, there is no need for names Persimmon Gap shale and Solitario formation.

In vicinity of Solitario Peak, Brewster-Presidio Counties.

Solitario slate[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, 11.

Exposed in Solitario Mountain, northwest of Las Vegas, San Miguel County.

**Solitude Granite**[1]

Upper Cretaceous or lower Tertiary: Central Arizona.

Original reference: F. L. Ransome, 1903, U.S. Geol. Survey Prof. Paper 12.

U.S. Geological Survey currently designates the age of the Solitude Granite as Upper Cretaceous or lower Tertiary on the basis of a study now in progress.

Occurs at head of Solitude Gulch, Globe quadrangle.

Solitude limestone (in Kwaguntan series)

Precambrian: Northern Arizona.

Charles Keyes, 1938, Pan-Am. Geologist, v. 70, no. 2, p. 107 (chart), 113. Massive concretionary bed of limestone, about 25 feet in thickness. Forms prominent projecting ledge amidst shales and soft shaly sandstones associated. Underlies Carbon Butte shales (new); overlies Oveja formation (new).

Well exposed in Chuar Valley sides about opposite Cape Solitude, at mouth of Little Colorado River; Grand Canyon region.

Solomon Formation (in Dakota Group)

Cretaceous (Comanche Series): 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]. Dark-gray and black shale and brown sandstone, mostly marine. Thickness 15 to 100 feet. Includes sandstone at top and Hodgeman sandstone below. Unconformable above Ellsworth formation (new); underlies Graneros shale.

R. C. Moore and K. K. Landes, 1937, Geologic map of Kansas (1:500,000): Kansas Geol. Survey. Mapped with Dakota group.

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 contains stratigraphic units formerly called "Rocktown channel sandstone," "Ellsworth formation," "Solomon formation," "Reeder sandstone," "Marquette sandstone," "Spring Creek clay," and others.

Derivation of name not given. Dakota group is mapped along Solomon River.

Solomon Gypsum (in Sumner Group)[1]

Permian: Central Kansas.

Original reference: G. P. Grimsley, 1899, Kansas Univ. Geol. Survey, v. 5, p. 58–61.

Crops out one-fourth mile south of Dillon mill, 2 miles west of Hope shaft at Solomon gypsum mine, Dickinson County.

**Solomon Schist**[1]

Pre-Ordovician(?): Northwestern Alaska.

Original reference: P. S. Smith, 1910, U.S. Geol. Survey Bull. 433, p. 50–53, maps.

Exposed along Solomon River, Seward Peninsula.

Solomon Creek Member (of Seguin Formation)[1]

Solomon Creek Member (of Wills Point Formation)

Paleocene: Southeastern Texas.

Original reference: F. B. Plummer, 1933, Texas Univ. Bull. 3232, p. 530, 575, 576, 577.

M. W. Beckman and F. E. Turner, 1943, Am. Assoc. Petroleum Geologists Bull., v. 27, no. 5, p. 608–621. Redefined and reallocated to member status in Wills Point formation. As originally defined, the Seguin straddles the Midway-Wilcox boundary; a disconformity occurs within the Solomon Creek member which is here restricted to the beds below the disconformity. Where it is possible to recognize the divisions as redefined, the Solomon Creek should be regarded as a member of the Wills Point formation. Where divisions cannot be differentiated, it may be necessary to continue use of Seguin formation, recognizing that it contains the break between the Midway and the Wilcox.

Type locality: Solomon's Creek, 6 miles southwest of Elgin, Bastrop County.

Solomonsville Beds

Solomonsville Beds (in Gila Conglomerate)

Pliocene to Pleistocene: Southeastern Arizona.

W. L. Van Horn, 1958, Arizona Geol. Soc. Digest, p. 45. Sequence of poorly to medium well consolidated sediments. Consist of lacustrine deposits overlain by terrace gravels and alluvium. Upper beds are post-early Kansan in age.

P. A. Wood, 1959, Arizona Geol. Soc. Guidebook 2, p. 60. In Gila conglomerate. Consist of massive conglomerate which intertongues with and grades into sandy to silty beds toward center of valley. Exposed thickness about 300 feet; total thickness, including subsurface deposits, may be about 2,000 feet. Conformably underlie Frye Mesa beds (new); disconformably overlie Bonita beds (new). Range in age from Pliocene to Pleistocene, possibly into Kansan.

In eastern part of Safford Valley, Graham County.

Solon Limestone[1]

Solon Limestone Member (of Cedar Valley Formation)

Upper Devonian: Central eastern Iowa.

Original reference: W. H. Norton, 1897, Iowa Geol. Survey, v. 6, p. 148.

G. A. Cooper, 1942, Geol. Soc. America Bull., v. 53, no. 12, pt. 1, p. 1751, chart 4. Shown on correlation chart as basal member of Cedar Valley formation. Underlies Rapid limestone member; overlies Wapsipinicon limestone. Middle Devonian. Age of entire Cedar Valley is difficult to establish, and dating of some of its parts presents problems. The Solon (sometimes called Linwood) is linked with the main body of the formation by common presence of crinoid *Sterocrinus*.

M. A. Stainbrook, 1945, Am. Jour. Sci., v. 243, no. 2, p. 157. Independence shale is stratigraphically below the Cedar Valley and above the Wap sipinicon. The Independence, by its fossils, is lower Upper Devonian;

hence, the Cedar Valley limestone is Upper Devonian in age and post-Independence.

Named for Solon, Johnson County.

Solsberry Formation[1]

Mississippian: Southwestern Indiana.

Original reference: F. C. Greene, 1911, Indiana Acad. Sci. Proc. 1910, p. 275, 281.

Named for Solsberry, Greene County.

Solsville Member[1] (of Marcellus Formation)

Middle Devonian: Central New York.

Original reference: G. A. Cooper, 1930, Am. Jour. Sci., 5th, v. 19, p. 133, 219.

[G. A. Cooper], 1955, New York State Geol. Assoc. Guidebook 27th Ann. Mtg., [p. 10, 11]. Thickness 45 to 50 feet. Underlies Pecksport member; overlies Bridgewater member.

Type section: Woods Gully, 2 miles northwest of Solsville, Madison County.

Somerset Member (of Pottsville Formation)[1]

Pennsylvanian: Southern Illinois.

Original reference: T. E. Savage, 1927, Am. Jour. Sci., 5th, v. 14, p. 311–312.

Named for exposures in vicinity of Somerset, Saline County.

**Somerset Shale Member** (of Warsaw Formation)[1]

Somerset Member (of Salem Limestone)

Upper Mississippian: Southeastern Kentucky.

Original reference: Charles Butts, 1922, Kentucky Geol. Survey, ser. 6, v. 7, p. 89, 104.

P. B. Stockdale, 1939, Geol. Soc. America Spec. Paper 22, p. 223, 224, 227, pls. 6, 26. Throughout Kentucky belt, Butts (1922) identified three members of the Warsaw (ascending): Wildie sandstone, Somerset shale, and Garrett Mill sandstone. Somerset shale member of Butts has been traced from southern Indiana to type locality at Somerset, Pulaski County, and is interpreted as being a basal argillaceous phase of the Salem limestone at top of Harrodsburg division of Warsaw. The Wildie sandstone of Butts is included in Wildie siltstone member of Muldraugh formation (new); Garrett Mill of Butts is in upper part of Salem.

Named for Somerset, Pulaski County, where it is well exposed in railroad cut a short distance north of the station.

Somerville Granite[1]

Precambrian: Northeastern Virginia.

Original reference: J. T. Lonsdale, 1927, Virginia Geol. Survey Bull. 30.

Typically developed near Somerville, Fauquier County.

†Somerville Limestone[1]

Pennsylvanian: Southwestern Indiana.

Original reference: M. L. Fuller and G. H. Ashley, 1902, U.S. Geol. Survey Geol. Atlas, Folio 84, p. 2.

F. E. Kottlowski, 1954, U.S. Geol. Survey Coal Inv. Map C–11. Replaced by West Franklin limestone.

Named for Somerville, Gibson County.

†Somerville Slate[1]

Devonian or Carboniferous: Eastern Massachusetts.

Original reference: G. R. Mansfield, 1906, Harvard Coll. Mus. Comp. Zoology Bull., v. 49, geol. ser., v. 8, no. 4, p. 196–197.

Occurs at and around Somerville, Middlesex County.

Sonoita Group

Upper Cretaceous: Southeastern Arizona.

A. A. Stoyanow, 1937, (abs.) Geol. Soc. America Proc. 1936, p. 297 (table). Named on table. Includes Fort Crittenden formation (new). Older than Duncan group (new); younger than Santa Cruz group (new). Early Tertiary.

A. A. Stoyanow, 1949, Geol. Soc. America Mem. 38, p. 59. Great series of sedimentary strata. Consists of two divisions: the lower, Fort Buchanan formation (new), and the upper, Fort Crittenden formation. Late Cretaceous.

E. D. McKee, 1952, Arizona Geol. Soc. Guide Book, Field Trip Apr. 10–14, p. 2. Beds of conglomerate, hard gray and yellow sandstones, and shales of various colors. Thickness in Santa Rita Mountains 4,000 feet. Type [area] cited.

Type area: Sonoita flats near Patagonia.

Sonoma Tuff[1]

Pliocene: Northern California.

Original reference: V. C. Osmont, 1904, California Univ. Pub., Dept. Geol. Bull., v. 4, p. 39–87.

Probably named for exposures in Sonoma Mountains, Sonoma County.

**Sonoma Volcanics[1]**

Sonoma Group[1]

Pliocene: Northern 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. 110 (table 24), 118, 122–128, pls. 6, 7, 10. Name Sonoma volcanics used for a complex series of lava flows and tuff beds that in some areas are interbedded with sandstone, gravel, and conglomerate. Lava flows which constitute more than 60 percent of entire sequence are prevailingly andesitic but in many places approach basalt. Includes St. Helena rhyolite member which forms upper part of sequence. Dickerson (1922) used name Sonoma group to include original Sonoma tuff, Mark West andesite, and St. Helena rhyolite. Detailed studies show that entire sequence beneath St. Helena rhyolite member, including the "Mark West andesite," varies greatly from place to place; hence, the sequence is regarded as a single geologic unit. Lavas and tuffs of the Sonoma volcanics, excluding the St. Helena rhyolite member, are exposed over an area of more than 350 square miles. Thickness in Howell Mountains, exclusive of St. Helena rhyolite, about 1,290 feet. Unconformably overlies San Pablo, Petaluma, and older formations; in some areas, interfingers with Merced formation. Volcanics were involved in folding which preceded Pleistocene deposition. Patches of lava exposed west of Tolay Creek near Lakeville School were regarded as outcrops of Tolay volcanics by Morse and Bailey (1935).

They are here mapped as part of Sonoma volcanics. Area of report is the coast ranges north of San Francisco Bay region.

W. K. Gealey, 1951, California Div. Mines Bull. 161, p. 11 (fig. 2), 22–24, pls. 1, 3. Described in Healdsburg quadrangle as Sonoma group. Includes heterogeneous series of lava flows, agglomerates, and tuffs interbedded with nonmarine conglomerate, sandstone, and clay. Maximum thickness 4,000 feet (on east limb of Windsor syncline). Overlies faulted, folded Mesozoic rocks; nonmarine Sonoma sands and gravels grade into Merced formation.

G. T. Cardwell, 1958, U.S. Geol. Survey Water-Supply Paper 1427, p. 27 (table 6), 35–58, pl. 1. Sonoma volcanics described in Santa Rosa and Petaluma Valleys. Exposures are restricted mainly to eastern part of area where they have been intensely folded and faulted to form Sonoma and Mayacmas Mountains. On southwestern flanks of Sonoma Mountains, volcanics are in depositional contact with underlying Petaluma formation. Underlie and interfinger with Merced formation. In vicinity of Petaluma, the volcanics, for most part, directly overlie Franciscan group, although individual flows may be intercalated with Merced formation. Underlie Glen Ellen formation, locally some interbedding occurs. Where not overlain by Glen Ellen, volcanics dip beneath alluvium at valley margins. Thickness 0 to about 2,000 feet. Includes lower part of Sonoma group of Gealey (1950 [1951]). Tolay volcanics of Morse and Baley (1935) are mapped with Sonoma.

Fred Kunkel and J. E. Upson, 1960, U.S. Geol. Survey Water-Supply Paper 1495, p. 15–25. As defined and exposed in Napa and Sonoma Valleys. Sonoma volcanics constitute thick and highly variable series of continental volcanic rocks, including andesite, basalt, and minor rhyolite flows with interbedded coarse- to fine-grained pyroclastic tuff and breccia, redeposited tuff and pumice, and diatomaceous mud, silt, and sand; also a prominent body of rhyolite flows and tuff with some obsidian and perlitic glass. Unconformably overlie Neroly sandstone of Miocene age, and St. Helena rhyolite member underlies with some unconformity the Huichica formation of supposed Pleistocene age.

Named for typical exposures on west flanks of Sonoma Mountains, Sonoma County.

**Sonoma Range Formation**

Ordovician(?): 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]. Dark chert, dark siliceous argillite and slate, altered andesitic lava, limestone lenses associated with pillow lava, and a little quartzite. Contains interbedded light-gray chert and quartzite. Thickness more than 3,000 feet. Underlies Valmy formation.

Type locality: West flank of Sonoma Range between Clear Creek and Water Canyon.

Sonora Sandstone[1]

Mississippian: Northwestern Illinois and southeastern and central eastern Iowa.

Original reference: C. R. Keyes, 1895, Iowa Geol. Survey, v. 3, p. 320, 344–350.

J. M. Weller and A. H. Sutton, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 5, p. 812. Beds referred to Salem limestone at Warsaw, Ill., consist of 4 to 8 feet of more or less crossbedded yellowish limestone that grades laterally into calcareous sandstone, which has been termed Sonora sandstone.

Named for Sonora quarries on Illinois side of Mississippi River opposite Nashville and below Belfast, Lee County, Iowa.

Sonora shale[1]

Pennsylvanian: Missouri.

Original reference: C. R. Keyes, 1915, Iowa Acad. Sci. Proc., v. 22, p. 252.

Derivation of name not stated.

**Sonsela Sandstone Bed** (in Petrified Forest Member of Chinle Formation)

Upper Triassic: Northeastern Arizona and northwestern New Mexico.

G. A. Kiersch, 1955, Mineral Resources Navajo-Hopi Indian Reservations, Arizona-Utah, v. 2, p. 4 (fig. 1), 5. In eastern exposures of member. Name credited to Harshbarger and others, (in press).

J. P. Akers, M. E. Cooley, and C. A. Repenning, 1958, New Mexico Geol. Soc. Guidebook 9th Field Conf., p. 91 (fig. 3), 93. At type section, comprises two conglomeratic sandstone units separated by a siltstone unit. Lower sandstone is 25-foot ledge-forming unit consisting of very light gray very fine to very coarse grained subrounded to subangular frosted, clear and stained quartz. Upper sandstone forms irregular ledge more than 60 feet high. Threefold division of the Sonsela sandstone bed at its type section is not characteristic of unit in all areas. In most areas, the Sonsela consists of a main sandstone bed and numerous sandstone tongues separated by intervening mudstone units. Thickness 50 to 200 feet depending upon local abundance of sandstone units.

Type section: About 3½ miles north of western Sonsela Butte on east flank of Defiance uplift.

Sonson Limestone

Pleistocene: Mariana Island (Tinian).

Risaburo Tayama, 1952, Coral reefs in the South Seas: Japan Hydrog. Office Bull., v. 11, p. 57, table 4 [English translation in library of U.S. Geol. Survey, p. 68]. Correlated with Chatcha [Chacha] limestone on Saipan, Rota limestone on Rota, and Barrigada limestone on Guam. [Appears to be same unit as Asuncion limestone (Tayama, 1939)].

S. Hanzawa *in* Jacques Avias and others, 1956, Lexique Strat. Internat., v. 6, Océanie, fasc. 2, p. 57. Consists of hard foraminiferal limestone; dips seaward at angle of 10°. Commonly below Mariana limestone; a forereef detrital facies of Mariana. Name credited to M. Kodaira (unpub. ms.). Data on type locality.

Type locality: Pepeinigl, Puerto (Sonson), Tinian. Also well exposed at Tachinya, Tinian.

**Sonyea[1] Formation**

Upper Devonian: Western New York.

Original reference: G. H. Chadwick, 1933, Pan-Am. Geologist, v. 60, no. 2, p. 96, 98.

G. W. Colton and Wallace de Witt, Jr., 1958, U.S. Geol. Survey Oil and Gas Inv. Chart OC-54. Formation includes (ascending) Middlesex shale, Pulteney shale (new), Rock Stream siltstone, and Cashaqua shale members. Underlies Rhinestreet shale member of West Falls formation; overlies West River shale. Thickness 183 feet at reference section (herein designated); 45 feet in exposures along Lake Erie and along Eighteenmile Creek in southwestern Erie County; about 484 feet near Watkins Glen in south-central Schuyler County.

Type exposure (Chadwick): Outcrops on Keshequa Creek southwest of Sonyea in Groveland Township, Livingston County. Reference section: Outcrops on Buck Creek in Mount Morris Township 3 miles northwest of Sonyea.

**Sooke Formation**[1]

Oligocene or Miocene or both: British Columbia, Canada, and northwestern Washington.

Original reference: J. C. Merriam, 1896, California Univ. Dept. Geol. Bull., v. 2, p. 105–108.

C. E. Weaver, 1937, Washington [State] Univ. Pubs. in Geology, v. 4, p. 104, 115–116. Age given as upper Oligocene.

Probably named for occurrence near Sooke, on south coast of Vancouver Island.

†Sopchoppy Limestone[1]

Miocene, lower: Northwestern Florida.

Original reference: W. H. Dall, 1892, U.S. Geol. Survey Bull. 84, p. 119–122, 158, 334.

Named for exposures at Sopchoppy, Wakulla County.

Sopris Coal group (in Vermejo Formation)[1]

Upper Cretaceous: Eastern Colorado.

Original reference: R. C. Hills, 1899, U.S. Geol. Survey Geol. Atlas, Folio 58.

Elmoro region.

**Soquel 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. Consists mainly of massive to moderately well bedded coarse-grained to gritty feldspathic sandstone. Maximum exposed thickness about 2,500 feet. Underlies Yorba member (new) with contact gradational throughout most of Puente Hills; where Yorba member is missing, Sycamore Canyon member rests on Soquel. In Carbon Canyon, the Soquel overlies La Vida member (new), contact gradational; south of Pomona, the Soquel overlaps older rocks and rests directly on the basement complex; south of Santiago Creek, the Soquel is locally unconformable successively on La Vida member, Topanga formation, and Sespe and Vaqueros formations undivided.

Named for the canyon that lies north of Telegraph Canyon and joins Carbon Canyon near the boundary between secs. 10 and 11, T. 3 S., R. 9 W., in southeastern part of Puente Hills. Typical exposures are in Carbon Canyon from Gilman Peak north 1½ miles to vicinity of Carbon Canyon Mineral Springs.

Sorento cyclothem (in Bond Formation)

Sorento cyclothem (in McLeansboro Group)

Pennsylvanian: South-central Illinois.

H. R. Wanless, 1955, Am. Assoc. Petroleum Geologists Bull., v. 39, no. 9, p. 1764 (table 2). Name appears in list of cyclothems in McLeansboro group. Occurs above Shoal Creek cyclothem and below Bunje cyclothem (new).

H. R. Wanless and Raymond Siever, 1956, Illinois Geol. Survey Circ. 217, p. 6. 7, 11, pl. 1. Simon (1946, unpub. thesis) worked out sequence above Shoal Creek limestone in Bond County and proposed terms (ascending) Sorento Bunje and Flat Creek for cyclothemic units in lower half of interval. Type locality given.

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 42, 52 (table 2), pl. 1. In Bond formation (new). Above Shoal Creek cyclothem and below Bunje cyclothem. Presentation of new rock-stratigraphic classification of Pennsylvanian strata in Illlinois; cyclical classification is independent of rock-stratigraphic classification.

Type locality: Edge E½ secs. 6, 7, T. 6 N., R. 4 W., Bond County. Named for village of Sorento, east of type outcrop.

Sorento Limestone Member (of Bond Formation)

Pennsylvanian: Central and southwestern Illinois.

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 39, 50 (table 1), 72–74, pls. 1. Name applied to limestone in lower part of formation. Mainly dark-bluish-gray limestone. Thickness as much as 2 feet. Stratigraphically above McWain sandstone member and below Bunje limestone member (new). Name credited to J. A. Simon, unpub. ms. Presentation of new rock-stratigraphic classification of Pennsylvanian of Illinois. Cyclical classification retained but is entirely independent of rock-stratigraphic classification.

Type locality: NE¼NE¼ sec. 6, T. 6 N., R. 4 W., Bond County. Named for exposures just west of village of Sorento.

Sosa Hill Basalt

Miocene, lower; Panamá Canal Zone.

S. M. Jones, 1950, Geol. Soc. America Bull., v. 61, no. 9, p. 898 (table 2). Listed on correlation chart. Unconformable above La Boca formation, and below Charges alluvium, Charges gravel, and Pacific muck. "Basalt" is used in this paper as field term applied to basic fine-grained igneous rocks including "andesite" and "basalt".

W. P. Woodring *in* R. Hoffstetter and others, 1960, Lexique Strat. Internat., v. 5, Amérique Latine, fasc. 2a, p. 346. Poorly defined name. Miraflores basalt has precedence, should a name be necessary.

Occurs near Balboa, in Pacific area of Panamá Canal Zone.

**Soudan Iron-Formation**[1]

Precambrian (Keewatin): 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.

F. F. Grout and others, 1951, Geol. Soc. America Bull., v. 62, no. 9, p. 1027–1029. Lies near top and partly within Ely greenstone; in some areas, is in plunging folds. Dominant rock type is referred to as "jasper" although only part of it falls strictly under this designation; slate and conglomerate also present. Thickness presumed to be several thousand feet. Probably intruded by pre-Knife Lake granite. Keewatin group.

G. M. Schwartz and I. L. Reid, 1955, Mining Eng., v. 7, no. 3, p. 298. Name Soudan formation has been applied to series of beds and lenses of jasper interbedded with original flows and tuffs of Ely greenstone. In Vermilion district, term jaspilite has been used for interbedded jasper and hematite. According to modern usage these jasper or jaspilite beds do not comprise formation separate from Ely. Soudan beds should be considered member of upper part of Ely greenstone.

Named for occurrence on Soudan Hill, Vermilion district.

Sougahatchee Granite[1]

Age(?): Central eastern Alabama.

Original reference: G. I. Adams, 1933, Jour. Geology, v. 41, p. 168–169.

Named from creek near which it is exposed at many places in southwest border of Dadeville belt, Tallapoosa County.

Sour Dough Limestone[1] (in Telescope Group)

Sour Dough Limestone Member (of Kingston Peak Formation)

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-October 1932, p. 329–356.

B. K. Johnson, 1957, California Univ. Dept. Geol. Sci., v. 30, no. 5, p. 360, 365, figs. 1, 3. Redefined as middle member of Kingston Peak formation. Consists of alternating bands of dark- and medium-gray limestone with well-defined bedding planes that are laterally persistent and spaced at 3 to 30 millimeters. Thickness as much as 170 feet. Underlies South Park member (new); overlies Surprise member. Area of report Manly Peak quadrangle.

Named on basis of exposures in Sour Dough Canyon, near Panamint City, southern part of Panamint Range, Inyo County.

Sourdough Mountain Breccias

*See* Keechelus Andesitic Series.

**Souris River Formation**

Upper Devonian: Subsurface in North Dakota, and Saskatchewan and Manitoba, Canada.

W. M. Laird, 1953, Interstate Oil Compart Quart. Bull., v. 12, no. 2, p. 74. New term for part of Devonian known only in subsurface. Overlies Dawson Bay formation; underlies Duperow formation.

C. A. Sandberg and C. R. Hammond, 1958, Am. Assoc. Petroleum Geologists Bull., v. 42, no. 10, p. 2299 (fig. 2), 2309 (fig. 5), 2310–2313. Souris River was named at February 1953 meeting of Williston Basin Nomenclature Committee of American Association of Petroleum Geologists. Type section designated as California Co.'s Thompson Well 1, Bottineau County, N. Dak. Report of Committee was not published; hence Souris River has not been formally proposed or adequately defined. Standard subsurface section is here proposed. Formation lies between depths of 10,743 and 11,052 feet in standard section. Consists of thin interbedded gray, greenish-gray, and brownish-gray argillaceous dolomite, argillaceous limestone, shale, siltstone, and anhydrite. Upper Devonian.

Standard section: Mobil Producing Co.'s Birdbear Well 1, center SE¼NW¼ sec. 22, T. 149 N., R. 91 W., Dunn County, N. Dak.

South Amboy fire clay[1] (in Raritan Formation)

Cretaceous: Northeastern New Jersey.

Original references: G. H. Cook and J. C. Smock, 1877, Map of clay district of Middlesex County: New Jersey Geol. Survey; G. H. Cook, 1878, New Jersey Geol. Survey Rept., on clays, p. 34.

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. 66, 101. Thickness as much as 25 feet along outcrop. Overlies Sayreville sand member (new); underlies Old Bridge sand member (new).

Middlesex County.

**South Bend Limestone Member** (of Stanton Limestone)[1]

Pennsylvanian (Missouri Series): Southeastern Nebraska, northeastern Kansas, and northwestern Missouri.

Original reference: G. E. Condra and N. A. Bengston, 1915, Nebraska Acad. Sci. Pub., v. 9, no. 2, p. 7, 23.

G. E. Condra and E. C. Reed, 1943, Nebraska Geol. Survey Bull. 14, p. 51. South Bend limestone was named in Nebraska but was named Little Kaw limestone by Newell (1935) from Kaw Valley area, Kansas. On basis of subsequent studies, it is now agreed that original name is valid.

R. C. Moore, 1948, Am. Assoc. Petroleum Geologists Bull., v. 42, no. 11, p. 2031 (fig. 4); 1949, Kansas Geol. Survey Bull. 83, p. 68 (fig. 14), 119. South Bend limestone member of Stanton formation; overlies Rock Lake shale member; underlies Weston shale of Pedee group. This classification was 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. 32. Thickness 8 to 12 feet in Platte and Weeping Water Valleys; 4 to 5 feet in northwestern Missouri; 4 to 6 feet in Kansas. Top of this subdivision in Nebraska exposures is at the post-Missourian contact and shows evidence of shoreline deposition. Type locality stated.

Type locality: In Platte River bluffs 1½ miles northwest of South Bend, Cass County, Nebr.

South Bend Sandstone and Shale (in Graham Formation)[1]

Pennsylvanian: Central northern Texas.

Original references: F. B. Plummer and R. C. Moore, 1922, Jour. Geology, v. 30, p. 24, 31, 37; 1922, Texas Univ. Bull. 2132, p. 127–136.

Typically exposed at South Bend, Young County.

South Bosque Marl[1]

Upper Cretaceous: Central Texas.

Original reference: J. K. Prather, 1902, Texas Acad. Sci. Trans., v. 4, pt. 2, no. 8.

W. S. Adkins and F. E. Lozo *in* F. E. Lozo, 1951, Fondren Sci. Series, no. 4, p. 120–123, fig. 25. Revived and emended to exclude basal 20 feet of original section. So emended, formation consists of upper predominantly clay part and a lower part of platy salmon-colored thin-bedded limestones alternating with "bentonitic" shales. Thickness about 120 feet. Underlies Austin chalk; overlies Bouldin member (new) of Lake Waco formation (new); basal contact characterized by change from platy limestones and "bentonitic" shales to more blocky grayish silty limestones interbedded with dark shales and bentonitic seams.

Type area and section: Bosque escarpment, from Waco westward to South Bosque; typical and well-exposed section is in Universal Atlas Cement Co. shale pit and along Cloice Branch, 1 mile east of South Bosque, McLennan County.

South Boss Marl (in Eagle Ford Group)

Probably lapsus for South Bosque Marl.

South Britain Conglomerate[1]

Upper Triassic: Western Connecticut.

Original reference: W. H. Hobbs, 1901, U.S. Geol. Survey 21st Ann. Rept., pt. 3, p. 40–43, 49–51, 63–64.

Occurs in village of South Britain, New Haven County.

**South Butler Amygdaloid**[1]

Precambrian (Keweenawan): Northern Michigan.

Original reference: B. S. Butler and W. S. Burbank, 1929, U.S. Geol. Survery Prof. Paper 144 (chart compiled by M. G. Wilmarth).

Probably named for its occurrence south of Butler amygdaloid, in Ontonagon County.

**South 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).

Probably named for its occurrence south of Butler amygdaloid, in Ontonagon County.

**South Canyon Creek Member** (of Maroon Formation)

South Canyon Creek Member (of State Bridge Formation)

Permian: Northwestern Colorado.

N. W. Bass and S. A. Northrop, 1950, Am. Assoc. Petroleum Geologists Bull., v. 34, no. 7, p. 1540–1551. Proposed as South Canyon Creek dolomite member. Commonly consists of basal unit of medium-gray very fine-grained dolomite; middle unit of light-gray to light-buff dense dolomite; top unit, 1 foot thick or less, of thinly laminated fossiliferous limestone. Thickness 1½ to 6⅓ feet. Dolomite is 480 feet stratigraphically below base of Entrada sandstone on South Canyon Creek and 380 feet below base of Entrada on Main Elk Creek. Brill (1944, Geol. Soc. America Bull., v. 55, no. 5) assigned limestone here called South Canyon Creek dolomite member to Triassic Dinwoody or Moenkopi formation. Fauna appears to be Permian of Phosphoria age.

K. G. Brill, Jr., 1952, Geol. Soc. America Bull., v. 63, no. 8, p. 823–825. Since Maroon formation is here limited to beds that underlie Schoolhouse tongue of Weber sandstone, south Canyon [Creek] dolomite seems to be member of State Bridge formation.

Named for exposures in South Canyon Creek, which is 4½ miles west of Glenwood Springs. Crops out northwestward for 22 miles.

South Carrollton Limestone[1]

Pennsylvanian: Western Kentucky.

Original reference: C. J. Norwood, 1878, Kentucky Geol. Survey, 2d ser., v. 4, pt. 7, p. 296–301, 319.

Exposed in bluff one-half mile northwest of South Carrollton, Muhlenberg County.

Southern Belle Quartzite[1]

Middle Cambrian: Southeastern Arizona.

Original reference: A. A. Stoyanow, 1933, Geol. America Bull., v. 47, no. 4, p. 476–477, 482.

R. L. DuBois, 1959, Arizona Geol. Soc. Guidebook 2, p. 110. Overlies Santa Catalina formation; underlies Abrigo formation. Thickness 30 feet.

In Peppersauce Canyon, Santa Catalina Mountains.

South Flat Formation

Upper Cretaceous (Montanan): Central Utah.

R. E. Hunt, 1954, Am. Assoc. Petroleum Geologists Bull., v. 38, no. 1, p. 118–128. Sequence of piedmont and flood-plain sediments. Divided into three members, each having differing distributions. Lower member of sandstones, conglomerates, a single limestone, and a discontinuous coal, is 840 feet thick. Sandstones medium-grained to gritty and dominantly gray, tan, and brown. Commonly speckled by white. Conglomerates are gray and brown, containing stones as much as 5 inches in diameter. Middle member of massive red and gray conglomerate and minor sandstones is 600 feet thick. Upper member is coal-bearing sequence of varicolored sandstones, shales, and clays 1,360 feet thick. Dominantly sandstones in middle part of which is 60 feet interval of shales, clays, and coals. Total thickness at type section 2,854 feet. Underlies Price River formation; overlies Indianola group.

Type section: Measured from SW¼ sec. 17, T. 14 S., R. 2 E., in Fourmile Canyon, northeast to South Flat (SW¼ sec. 9), then south to approximately center of sec. 21. Recognized only in northern part of Gunnison Plateau.

South Fork Limestone[1]

South Fork Limestone Member (of Burlingame Formation)

Pennsylvanian (Virgil Series): Southeastern Nebraska, southwestern Iowa, and northeastern Kansas.

Original reference: G. E. Condra, 1935, Nebraska Geol. Survey Paper 8, p. 5, 10.

E. H. Wenberg, 1942, Iowa Acad. Sci. Trans., v. 49, p. 343 (fig. 6). Listed as South Fork limestone in insoluble residue correlations of Missouri and Virgil strata in Iowa.

G. E. Condra and E. C. Reed, 1943, Nebraska Geol. Survey Bull. 14, p. 45–46. In Nebraska, Burlingame limestone includes (ascending) Taylor Branch limestone, Winnebago shale, and South Fork limestone members.

Well exposed in hill on west side of South Fork Valley three-fourths mile southwest of DuBois, Pawnee County, Nebr.

South Fork Mountain schist

Upper Jurassic: Northwestern California.

W. P. Irwin, 1960, California Div. Mines Bull. 179, p. 28–30. Name applied in California to schists that have been referred to as southwestern belt of schists and South Fork Mountain belt of schists by Diller (1903, Am. Jour. Sci., 4th, v. 15), Weitchpec schist by Hershey (1904; 1906, Am. Jour. Sci., 4th, v. 21), and Kerr Ranch schist by Manning and Ogle (1950). In southwestern Oregon, seemingly related rocks were named Colebrooke schist by Diller (1903). Age and formational affiliation of South Fork Mountain schist is not entirely clear, but generally the schist has been considered pre-Devonian, or perhaps Precambrian, and genetically unrelated to adjacent formations. South Fork Mountain schist has most commonly been correlated with Abrams formation of central metamorphic belt of Klamath Mountains arc. However, more than one adjacent formation is at least in part a lithologically suitable prototype for the schist, and one of these, the Galice, appears to grade into the schist near Weitchpec. The schist may represent narrow zone of dynamic metamorphism, and although the metamorphism may have transgressed formational boundaries, most if not all of the schist is likely a metamorphic equivalent of the slaty and phyllitic rocks herein correlated with Galice formation of middle Late Jurassic age. On west slope of South Fork Mountains and northward to near Weitchpec, the schist is in contact with nonmetamorphic rocks of Franciscan formation. Rocks of late Late Jurassic and Cretaceous age are not known to be in depositional contact with South Fork Mountain schist in California. In southwestern Oregon, the younger Mesozoic rocks are in depositional contact with Colebrooke schist, and the Colebrooke is considered correlative with South Fork Mountain schist.

Underlies a continuous even-crested ridge that marks the southern and most of the western boundary of Klamath Mountains provinces. Southwestern boundary of province is South Fork Mountains which trend N. 30° W. for about 50 miles along west side of South Fork by Trinity River.

Southgate Formation (in Eden Group)

Southgate Member (of Eden Formation)

Southgate Member (of Latonia Shale)[1]

Upper Ordovician: North-central Kentucky, southeastern Indiana, and southwestern Ohio.

Original reference: R. S. Bassler, 1906, U.S. Natl. Mus. Proc., v. 30, p. 9.

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 middle formation of Eden group in Indiana. Underlies McMicken formation; overlies Economy formation. Consists of shale 70 to 120 feet thick.

W. C. Sweet and others, 1959, Jour. Paleontology, v. 33, no. 6, p. 1030–1031. Middle member of Eden formation. Overlies Economy member; underlies McMicken member.

Named for Southgate, Campbell County, Ky.

South Hampton Granite[1]

Age(?): Southeastern New Hampshire.

Original reference: E. Hitchcock, 1823, Am. Jour. Sci., 1st, v. 6, p. 3–6.

At South Hampton, Rockingham County.

South Mapleton Andesite[1]

Paleozoic: Northeastern Maine.

Original reference: H. E. Gregory, 1900, U.S. Geol. Survey Bull. 165, p. 113, 169, 173.

Crops out in fields in southern part of Mapleton Township to north and south of Mapleton-Presque Isle Road, Aroostook County.

South Moat Flows[1]

Devonian(?): Northern New Hampshire.

Original reference: M. Billings, 1928, Am. Acad. Arts and Sci. Proc., v. 63, no. 3, p. 72, 92, map.

Typically exposed on South Moat Mountain, North Conway quadrangle, White Mountains.

South Mountain Andesite Flows

Oligocene: Northern Utah.

R. E. Marsell and R. L. Threet, 1960, Geologic map of Salt Lake County, Utah (1:62,500); supp, to Bull. 69 [not yet published]: Utah Geol. and Mineralog. Survey. Named of map legend. Occurs above Rose Canyon latite-andesite volcanics (new) and below Salt Lake group.

Mapped in southern part of Salt Lake County. Largest area mapped surrounds South Mountain.

South Mountain Quartzite[1]

Lower Cambrian: Western Maryland and Pennsylvania.

Original references: C. D. Walcott, 1894, Am. Jour. Sci., 3d, v. 47, p. 37–41; 1896, U.S. Geol. Survey Bull. 134, p. 33.

South Mountain.

South Mountain Slates[1]

Cambrian: Southern Pennsylvania.

Original reference: F. Platt, 1877, Pennsylvania 2d Geol. Survey Rept. $H_2$, p. xxiv.

South Park Member (of Kingston Peak Formation)

Precambrian: Southeastern California.

B. K. Johnson, 1957, California Univ. Dept. Geol. Sci., v. 30, no. 5, p. 360, 365–367, figs. 1, 3. Defined as youngest member of formation. Consists of well-bedded platy quartz-rich sandstones, argillaceous rocks, massive quartzite, cobble conglomerate, and conglomeratic and nonconglomeratic massive subgraywacke. Thickens northward; 285 feet at mouth of Goler Wash; 1,000 feet in South Park Canyon. Overlies Sour Dough member. It is correlative of Middle Park formation, Mountain Girl conglomerate-quartzite, and Wildrose formation of Telescope group as defined by Murphy (1930).

Named for fact it is well exposed near South Park basin in northern part of Manly Peak quadrangle, in southern part of Panamint Range, just west of Death Valley, Inyo County.

†South Pass Group[1]

Pliocene: Northwestern Wyoming.

Original reference: T. B. Comstock, 1874, Rept. of reconn. of northwestern Wyoming, made in 1873 by W. A. Jones, table opposite p. 103.

**South Pewabic Amygdaloid**[1]

Precambrian (Keweenawan): Northern Michigan.

Original reference: A. R. Marvine, 1873, Michigan Geol. Survey, v. 1, pt. 2, p. 52, 76, 77, chart.

Named for occurrence in old South Pewabic mine, Houghton County.

**South 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 old South Pewabic mine, Houghton County.

**South Platte Formation** (in Dakota Group)

Lower Cretaceous: North-central Colorado.

K. M. Waagé, 1955, U.S. Geol. Survey Prof. Paper 274–B, p. 27–34, figs. 10, 17, 19. Upper part of pre-Benton Cretaceous sequence, lying between Lytle formation and Benton shale, is here treated as single unit in northern Front Range foothills and named South Platte formation. It is equivalent to the upper sandstone, upper shale, middle sandstone, and uppermost black shale part of lower shale of Lee's (1927) Dakota group. Formation grades laterally northward from dominantly nonmarine clastic phase in Kassler quadrangle to dominantly marine shale phase in Larimer County. Consists of 200 to 350 feet of alternating units of gray to black shale and brown-weathering sandstone. Sandstone chiefly fine grained, but coarser fractions common locally in nonmarine phase. Individual sandstone units have considerable lateral extent and vary laterally in thickness, nature of bedding, and amount of contained argillaceous matter. Shale units in nonmarine phase consist of hard laminated noncalcareous silty shale that is commonly interlaminated or thinly interbedded with siltstone and fine-grained sandstone. Thin beds of white, yellow, or light-gray claystone common in the shale. Comprises (ascending) Plainview sandstone member (new), third shale, third sandstone, second shale, Kassler sandstone member (new), Van Bibber shale member (new), and first sandstone. Underlies Benton shale and overlies Lytle formation with disconformable contacts. No single exposure typical for unit over its entire area of outcrop. Three localities are designated for standards of reference.

Type exposures: In south end of hogback on north side of gap made by South Platte River, about 0.5 mile north of Kassler in NE¼NW¼SE¼ sec. 27, T. 6 S., R. 69 W., Jefferson County. This is also standard reference section for southern nonmarine phase. Standard reference section for intermediate phase is on west-facing scarp of a local prominence just south of Little Thompson Creek in SW¼NW¼ sec. 2, T. 3 N., R. 70 W. Standard for northern marine phase is located 0.25 to 0.5 mile north of Boxelder Creek in W½NE¼ sec. 9, T. 10 N., R. 69 W., Larimer County. This is about same locality described by Lee (1927) about 2 miles east of Greenacre Ranch along Boxelder Creek. Named for South Platte River. Entire outcrop area of formation in northern foothills lies within drainage basin of South Platte River.

South Prairie Formation[1]

Eocene: Western Washington.

Original reference: B. Willis, 1898, U.S. Geol. Survey 18th Ann. Rept., pt. 3, p. 424–430.

Exposed on South Prairie Creek, Puget Sound region.

South Range Member (of Virginia Formation)

Precambrian: Northeastern Minnesota.

F. F. Grout and J. F. Wolff, 1955, Minnesota Geol. Survey Bull. 36, p. 3, 4, 7, 56, pl. 6. Virginia formation comprises (ascending) lower states, South Range iron-bearing member, and upper slates.

Named for occurrence in South Range, Cuyuna district.

South Ridge Sandstone

Permian (Wolfcampian): East-central Nevada.

Grant Steele, 1960, Intermountain Assoc. Petroleum Geologists Guidebook 11th Ann. Field Conf., p. 93 (chart), 102. Name applied to thick sequence of fine- to medium-grained thin- to thick-bedded tan to yellowish-tan weathering calcareous cemented quartz sandstone with thin interbedded grayish-tan silty limestone. Stratigraphically above Ely limestone (restricted) and below Riepe Spring limestone (new).

Type section: SE¼ sec. 25, T. 17 N., R. 61 E., White Pine County. Named for South Ridge bench mark, NE¼SE¼ sec. 27, T. 17 N., R. 61 E., 2 miles due west of type section.

South Ross Clay (in Golden Valley Formation)

Eocene: Western North Dakota.

Great Northern Railway Co. Mineral Research and Development Department, 1958, Great Northern Railway Co. Mineral Research and Devel. Dept. Rept. 5, p. 2, 3, 12, 14, 15, map. A bed of white clay about 15 feet thick in Golden Valley formation. White Earth, Lakeside, and East Tioga clays occur in same general area.

Occurs in Little Knife River valley, south of town of Ross, Mountrail County.

South Tunnel Bed[1]

Silurian (Niagaran): Western Tennessee.

Original reference: A. F. Foerste, 1901, Geol. Soc. America Bull., v. 12, p. 397, 402.

Named for South Tunnel, Sumner County.

South Tyler Formation

Cretaceous (Comanche Series): Northeastern Texas (subsurface).

R. T. Hazzard, B. W. Blanpied, and W. C. Spooner, [1947], Shreveport Geol. Soc. 1945 Ref. Rept., v. 2, p. 475, 476, 477. Term applied to sand and mottled red and gray shale sequence between base of Dexter sand and top of Buda limestone. Includes Maness shale at base. In discovery well, occurs between depths of 5,675 to 6,065 feet.

Named after south Tyler field in Smith County, where formation is typically developed in wells. Discovery well, Phillips Petroleum No. 1 Mrs. W. T. McMinn well in the M. M. Long Survey.

South Valley Limestone[1]

Triassic: Pennsylvania.

Original reference: J. P. Lesley, 1885, Pennsylvania Geol. Survey Rept. X, map.

†South Valley Hill Slates and Mica Schists[1]

Precambrian (Glenarm Series): Southeastern Pennsylvania.

Original reference: C. E. Hall, 1881, Pennsylvania 2d Geol. Survey Rept. $C_6$, p. 31.

Form prominent ridge on South Valley Hill.

**South Wales Member** (of Perrysburg Formation)

South Wales Shale (in Canadaway Group)

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. Composed of gray silty shale, gray silty mudstone, small amounts of black, brown, and very dark gray shale, and some thin-bedded gray siltstone. Thickness 64 feet near South Wales; thins to minimum of about 20 feet near Dalton in Nunda quadrangle; thickens to about 87 feet near Cameron. At some places, top of member is sharply marked where uppermost siltstone is overlain by black shale of Gowanda member; at other places, contact between the two is gradational; east of Genesee River Valley, member is overlain by Canaseraga sandstone member, into basal part of which upper beds of South Wales grade laterally in places. In area between Lake Erie and Genesee River valley, member is overlain by interbedded black, brown, and very dark-gray shales.

L. V. Rickard, 1957, New York Geol. Soc. Guidebook 29th Ann. Mtg., p. 15, 18. In Wellsville area, term Perrysburg formation is not applied. South Wales shale is considered formation in Canadaway group. Thickness about 20 feet.

Named for exposures on unnamed tributary of east branch of Cazenovia Creek, 3 miles south of South Wales, Erie County. Traced from shore of Lake Erie west of Van Buren Point eastward to vicinity of Cameron in Woodhull quadrangle.

†Southward Bridge Formation (in Chester Group)[1]

Mississippian: Northeastern Mississippi and northwestern Alabama.

Original reference: W. C. Morse, 1928, Jour. Geology, v. 36, p. 31–43.

S. W. Welch, 1958, U.S. Geol. Survey Oil and Gas Inv. Chart OC–58. Name abandoned. Strata included in Sandfall member and Mynot sandstone member of Pride Mountain formation (all new).

Type locality: Southward Bridge, near old village of Mingo, at confluence of Bear Creek and Cedar Creek valleys, Tishomingo County, Miss.

†Southward Pond Formation (in Chester Group)[1]

Mississippian: Northeastern Mississippi and northwestern Alabama.

Original reference: W. C. Morse, 1928, Jour. Geology, v. 36, p. 31–43.

S. W. Welch, 1958, U.S. Geol. Survey Oil and Gas Inv. Chart OC–58. Replaced by Wagnon member of Pride Mountain formation (both new).

Named for exposures in bluffs of Southward (or Cypress) Pond, at Southward homestead, Tishomingo County, Miss.

**Southward Spring Sandstone Member** (of Pride Mountain Formation)

Southward Spring Sandstone (in Chester Group)[1]

Upper Mississippian: Northeastern Mississippi and northwestern Alabama.

Original reference: W. C. Morse, 1928, Jour. Geology, v. 36, p. 31–43.

S. W. Welch, 1958, U.S. Geol. Survey Oil and Gas Inv. Chart OC–58. Rank reduced to member status in Pride Mountain formation (new). Overlies Wagnon member (new); underlies Sandfall member (new).

Named for exposures at Southward Spring, about 3 miles east of Tishomingo, Miss., in SE¼ sec. 18, T. 5 S., R. 11 E.

**South Wells 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 *in* F. E. Lewis, 1941, Am. Assoc. Petroleum Geologists Bull., v. 25, no. 1, p. 92. Cherry Canyon formation is subdivided into (ascending) Getaway, South Wells, and Manzanita limestone members.

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. 36, pl. 3 [1949]. At type locality, consists of several thin black or gray fossiliferous limestone beds in an interval of 75 feet; farther northwest, near base of Reef Escarpment, these change into buff or drab, sandy, dolomitic limestones; locally member grades laterally into sandstones. Lies above Getaway member, or about 600 feet above base of formation; lies about 100 feet below Manzanita member.

Type locality: On both sides of valley near the South Wells of D Ranch, 11 miles southeast of Guadalupe Peak, Culberson County.

**Sowik Limestone**[1]

Ordovician(?): Northwestern Alaska.

Original reference: P. S. Smith, 1910, U.S. Geol. Survey Bull. 433, p. 50, 54.

Occurs near and named for Sowik, Seward Peninsula.

Spadra Felsophyre (in Glendora Volcanics)

Miocene, middle or older: Southern California.

J. S. Shelton, 1955, Geol. Soc. America Bull., v. 66, no. 1, p. 55–56, pl. 1. Referred to as Spadra felsophyre member of Glendora volcanics. Autobreccias constitute at least 80 percent, and laminated flows about 20 percent of the member. Local lenses of limestone up to about 40 feet thick occur along basal contact where felsophyre rests on basement complex. Maximum thickness about 350 feet.

Occurs in isolated area east of Spadra and 2 miles southwest of Pomona, Los Angeles County.

†Spadra Shale[1]

Pennsylvanian: Western Arkansas.

Original reference: A. Winslow, 1896, New York Acad. Sci. Trans., v. 15, p. 51.

Named for Spadra, Johnson County.

Spafford 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. Spafford member shown on correlation chart above Ivy Point member and below Owasco member.

Type section: In first ravine north of Ivy (or Willow) Point on east side of Skaneateles Lake, about three-fourths mile north and slightly west of Spafford Landing, Skaneateles quadrangle.

**Spaniard Limestone Member** (of Savanna Sandstone)[1]

Pennsylvanian (Des Moines Series): East-central Oklahoma.

Original reference: S. W. Lowman, 1933, Tulsa Geol. Soc. Digest, p. 31.

M. C. Oakes and M. M. Knechtel, 1948, Oklahoma Geol. Survey Bull. 67, p. 51–52, pl. 3. Basal member of Savanna. Underlies Sam Creek limestone member; overlies Keota sandstone herein reallocated to member status in McAlester formation.

Named for exposure in Spaniard Creek, south of Muskogee, about center of N½ sec. 11, T. 13 N., R. 18 E., Muskogee County.

†Spanish Formation[1]

Mississippian: Northern California.

Original reference: J. S. Diller, 1892, U.S. Geol. Survey Geol. Atlas, Folio 15, prelim. proofsheet ed.

Named for fact it surrounds northern end of Spanish Peak, Lassen Peak region.

**Spanish Canyon Formation**

Miocene: Southern California.

F. M. Byers, Jr., 1960, U.S. Geol. Survey Bull. 1089–A, p. 22–26, pls. 1, 2. Sandstone, conglomerate, tuff, and basalt flows. About 300 feet thick at type locality but wedges out southwestward within half mile. North of type locality, westward dipping beds of formation extend along west side of Spanish Canyon and Cross Canyon near east boundary of sec. 19, where formation swings eastward around nose of Spanish Canyon anticline; on east side of Spanish Canyon anticline, a fault of large displacement cuts off southern extension of formation. Overlies Alvord Peak basalt (new) and where Alvord Peak is missing rests on Clews on fanglomerate (new). Conformably underlies Barstow formation. Tentatively inferred that Spanish Canyon is of middle Miocene age.

Type locality: Near center sec. 30, west of Spanish Canyon, Alvord Mountain quadrangle, San Bernardino County.

Spanish Valley Stage

Recent: 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, Recent epoch includes (ascending) Castle Valley, Temple Lake, Spanish Valley, and Gannett Peak stages.

Twin Lakes area.

**Spann Limestone Member** (of Pennington Shale)[1]

Upper Mississippian: Southern Kentucky.

Original reference: M. J. Munn, 1914, U.S. Geol. Survey Bull. 579, p. 33.

Named for Spann, Wayne County.

**Sparks Schist**

Precambrian: Central western Georgia.

D. F. Hewett and G. W. Crickmay, 1937, U.S. Geol. Survey Water-Supply Paper 819, p. 27, pl. 1. Includes several varieties of mica schist, biotite gneiss, and quartzite which are so interlayered as not to be separable in areal mapping. Underies Hollis quartzite. Considered oldest rocks in area south of Towaliga fault.

Well exposed along Sparks Creek which flows southward near western border of Warm Springs quadrangle. Confined to belt 3 to 5 miles wide that extends across quadrangle between Pine and Oak Mountains.

Sparksville facies[1] (of Carwood Formation)

Lower Mississippian: Southern Indiana.

Original reference: P. B. Stockdale, 1931, Indiana Dept. Conserv., Div. Geology Pub. 98, p. 77, 172–178.

J. M. Weller and others, 1948, Geol. Soc. America Bull., v. 59, no. 2, p. 127–128, pl. 1. Facies nomenclature discussed. Sparksville facies shown in Carwood formation.

Name derived from village of Sparksville, near White River, in SW cor. NE¼SE¼ sec. 13, T. 4 N., R. 2 E., Jackson County.

Sparland cyclothem (in Carbondale-Modesto Formations)

Sparland cyclothem[1] (in McLeansboro Group)

Pennsylvanian: Western, northern, and southeastern Illinois.

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

H. R. Wanless and Raymond Siever, 1956, Illinois Geol. Survey Circ. 217, p. 11, pl. 1. Type locality given. Shown on chart as overlying Jamestown cyclothem.

H. R. Wanless, 1957, Illinois Geol. Survey Bull. 82, p. 50 (fig. 22), 60, 114–116, 189, 190, pl. 5. Thickness 8 to 80 feet. Includes (ascending) Copperas Creek sandstone, Sparland (No. 7) coal, and Farmington shale. Underlies Gimlet cyclothem; overlies Pokeberry cyclothem (new); believed to be equivalent to Jamestown cyclothem. Derivation of name given.

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 53 (table 2), 56 (table 3), pl. 1. In Carbondale-Modesto (new) formations. Above Jamestown cyclothem and below Gimlet cyclothem. Presentation of new rock-stratigraphic classification of Pennsylvanian strata in Illinois; cyclical classification independent of rock-stratigraphic classification.

Type locality: Sec. 2, T. 12 N., R. 9 E., Marshall County. Named for exposures of Thenius Creek, about 1½ miles north of Sparland.

Spar Mountain Sandstone (in Fredonia Member of Ste. Genevieve Formation)

Mississippian: Southern Illinois.

F. E. Tippie, 1945, Am. Assoc. Petroleum Geologists Bull., v. 29, no. 11, p. 1657 (figs. 2, 3), 1658. Name applied to middle sandstone member of the Fredonia; this unit has been known as a "sub-Rosiclare sandstone." Typically light-gray to greenish calcareous glauconitic sandstone or siltstone grading to very sandy limestone. Thickness 8 to 15 feet.

Named for exposures on south slope of Spar Mountain in secs. 3 and 4. T. 12 S., R. 9 E., Hardin County, about 4 miles northwest of Cave in Rock.

**Sparta Sand**[1]
Sparta Formation } (in Claiborne Group)

Eocene, middle: Northwestern Louisiana, Mississippi, and northeastern Texas.

Original references: W. C. Spooner, 1926, Am. Assoc. Petroleum Geologists Bull., v. 10, no. 1, p. 7; no. 3, p. 220, 224, 227, 237.

H. B. Stenzel, 1939, Texas Univ. Bur. Econ. Geology Pub. 3818, p. 20 (table), 59, 114–120 [1938]. Sparta formation (sand), in Leon County, consists of well-bedded loose sands which are rich in dark grains of chert like most of other Eocene sediments of region. Individual sand beds are separated by thin layers of finer material, shale or silt. Thickness probably varies from 210 to 330 feet. Overlies Weches formation; underlies Stone City formation.

W. E. Belt and others, 1945, Geologic map of Mississippi (1:500,000): Mississippi Geol. Survey. Sparta sand mapped in central Mississippi.

F. S. MacNeil, 1947, U.S. Geol. Survey Oil and Gas Inv. Prelim. Chart 29. Correlation chart shows Sparta sand in Mississippi. Overlies Zilpha clay; underlies Archusa marl member of Cook Mountain formation. Mississippi Geological Survey uses term Kosciusko sand instead of Sparta sand and Wautubbee formation instead of Cook Mountain formation.

Named for development near Sparta, Bienville Parish, La.

†Sparta Sands[1]

Tertiary: Northern Louisiana.

Original reference: T. W. Vaughan, 1895, Am. Geologist, v. 15, p. 225.

Named for development near Sparta, Bienville Parish.

Sparta Shale[1]

Upper Cambrian: Southwestern Wisconsin.

Original reference: W. D. Shipton, 1916, Iowa Acad. Sci. Proc., v. 23, p. 142–145.

In Sparta quadrangle, Monroe County.

**Spaulding Quartz Diorite** (in New Hampshire Plutonic Series)

Upper Devonian(?): Southwestern New Hampshire.

Katharine Fowler-Billings, 1949, Geol. Soc. America Bull., v. 60, no. 8, p. 1250, 1266–1268, pl. 1. Dark-gray medium-grained granodiorite and quartz diorite. Black to brown on weathered surfaces. Larger bodies are massive, smaller ones are foliated. Has distinctive spotted appearance. Younger than Kinsman quartz monzonite; older than Concord granite. Belongs to New Hampshire magma series.

M. P. Billings, 1955, Geologic map of New Hampshire (1:250,000): U.S. Geol. Survey. Included in New Hampshire plutonic series.

Type locality: Spaulding Hill in Dublin Township, Cheshire County. Crops out in central part of Monadnock area.

Spavinaw Granite[1]

Precambrian: Northeastern Oklahoma.

Original reference: N. F. Drake, 1897, Am. Phil. Soc. Proc., v. 36, p. 338–341.

G. G. Huffman and others, 1958, Oklahoma Geol. Survey Bull. 77, p. 14 (fig. 2), 15–18. Base of granite unknown; unconformably overlain by Cotter dolomite. Precambrian.

Named for exposures along Spavinaw Creek, Mayes County.

**Spearfish Formation**[1]

Permian and Triassic: Western South Dakota, northwestern Nebraska, and eastern Wyoming.

Original references: N. H. Darton, 1899, Geol. Soc. America Bull., v. 10, p. 387; 1901, U.S. Geol. Survey 21st Ann. Rept., pt. 4, p. 516.

G. E. Condra, E. C. Reed, and O. J. Scherer, 1940, Nebraska Geol. Survey Bull. 13, p. 2, 6; 1950, Nebraska Geol. Survey Bull. 13–A, p. 9. Redefined to apply to section between Phosphoria group and the Sundance, or at places, the section from the Phosphoria to base of Jelm formation; in places where Dinwoody is present, to the interval between the Dinwoody and the Sundance.

R. W. Imlay, 1947, Am. Assoc. Petroleum Geologists Bull., v. 31, no. 2, p. 235, 237–240. Underlies Gypsum Spring formation, geographically extended into Black Hills area. Contact sharp, apparently unconformable. Gypsiferous facies of Gypsum Spring was included by Darton in top of the Spearfish, but it contains marine Jurassic fossils, interfingers laterally with dolomite and limestone that contains marine fossils. In Fall River County, underlies Nugget(?) sandstone.

W. J. Mapel and M. H. Bergendahl, 1956, Am. Assoc. Petroleum Geologists Bull., v. 40, no. 1, p. 88, 90–93. In Black Hills, the Gypsum Spring rests with sharp undulating contact on sequence several hundred feet thick of red claystone, siltstone, and sandstone assigned to Spearfish formation. Thick deposits of primary gypsum occur in lower part of Spearfish. Measured sections give thickness 30 to 50 feet. Triassic.

N. C. Privrasky and others, 1958, Wyoming Geol. Assoc. Guidebook 13th Ann. Field Conf., p. 48–55. In Powder River basin, the Spearfish is restricted to include only those sediments lying below Sundance formation and above Goose Egg formation. Subsurface data.

S. S. Oriel, 1959, *in* E. D. McKee and others, U.S. Geol. Survey Misc. Geol. Inv. Map I–300, p. 3. In present report [Paleotectonic map of Triassic], all beds between Minnekahta limestone and base of Gypsum Spring formation as used by Mapel and Bergendahl (1956) are included in Spearfish. As thus defined, formation includes rocks of both Permian and Triassic age.

Named for Spearfish, Lawrence County, S. Dak.

**Spearhead Rhyolite**[1]

Pliocene: Southwestern Nevada.

Original reference: F. L. Ransome, 1909, U.S. Geol. Survey Prof. Paper 66, p. 28, 71.

U.S. Geological Survey currently designates the age of the Spearhead Rhyolite as Pliocene on the basis of a study now in progress.

Occurs at and around Spearhead Point, Goldfield district.

Spears Member (of Datil Formation)

Miocene, upper(?): Southwestern New Mexico.

W. H. Tonking, 1954, Dissert. Abs., v. 14, no. 2, p. 340. Quartz latite tuff, agglomerate, breccia, and volcanic sandstone and conglomerate. Underlies Hells Mesa member (new).

W. H. Tonking, 1957, New Mexico Bur. Mines Mineral Resources Bull. 41, p. 26, 27–29, fig. 2, pl. 1 [preprint? 1954]. At Hells Mesa, lower 1,000 feet consist of monotonous sequence of medium-gray to grayish-purple fine- to thick-bedded tuffaceous sandstones, conglomerates, flow breccias, and agglomerates, with intercalated thin beds of silt and clay; overlain by local 18-foot bed of white vitric rhyolite tuff; overlain by 300 feet of reddish-brown volcanic conglomerates and sandstones. Disconformably overlies Baca formation. Type section designated.

D. B. Givens, 1957, New Mexico Bur. Mines Mineral Resources Bull. 58, p. 14–15, pl. 1. Referred to as Spears Ranch member of Datil in Dog Springs quadrangle. Underlies Hells Mesa member.

Type section: Measured approximately 1 mile south of Spears Ranch headquarters, where complete section is exposed. Named for Guy Spears Ranch in sec. 8, T. 1 N., R. 4 W., Puertecito quadrangle, Socorro County.

Spears Ranch Member (of Datil Formation)

*See* Spears Member (of Datil Formation).

**Spechts Ferry Shale Member**[1] (of Decorah Formation)

Spechts Ferry Formation (in Galena Group)

Middle Ordovician: Northeastern Iowa, northwestern Illinois, southeastern Minnesota, and southwestern Wisconsin.

Original reference: G. M. Kay, 1928, Science, new ser., v. 67, p. 16.

A. F. Agnew and A. V. Heyl, Jr., 1946, Am. Assoc. Petroleum Geologists Bull., v. 30, no. 9, p. 1585–1587. Overlies Quimbys Mill member (new) of Platteville formation. Limestone unit included in Quimbys Mill has sometimes been referred to as lithologic facies of the Spechts Ferry.

E. R. Larson, 1951, Am. Assoc. Petroleum Geologists Bull., v. 35, no. 9, p. 2045 (fig. 3), 2064, 2065. Spechts Ferry shale member of Decorah geographically extended into St. Louis County, Mo., where it overlies Macy formation (new) of Plattin group.

J. S. Templeton and H. B. Willman, 1952, Tri-State Geol. Soc. Guidebook 16th Ann. Field Conf., p. 6, fig. 3. Considered basal formation in Galena group in Dixon-Oregon area, Illinois.

A. F. Agnew and others, 1956, U.S. Geol. Survey Prof. Paper 274–K, p. 263 (fig. 36), 268 (fig. 38), 286–289. Spechts Ferry shale member consists of green fossiliferous shale, greenish-buff fine-grained limestone, phosphatic nodules near top; bentonite near base. Thickness at type locality about 8 feet; thins to east, 3 feet at Shullsburg, Wis. Underlies Guttenberg member; near Decorah, Iowa, basal green shale of Spechts Ferry thickens at expense of Guttenberg limestone.

Type locality: Ravine southwest of Chicago, Milwaukee, and St. Paul Railroad station at Spechts Ferry, Dubuque County, Iowa.

Specimen Mountain Volcanics

Age not stated: Colorado.

E. E. Wahlstrom, 1940, (abs.) Geol. Soc. America Bull., v. 51, no. 12, pt. 2, p. 1951. Incidental mention.

No type locality designated and derivation of name not stated.

†Speck Mountain Clay (in Thrifty Formation)[1]

Pennsylvanian: Central Texas.

Original reference: N. F. Drake, 1893, Texas Geol. Survey 4th Ann Rept., pt. 1, p. 387, 407.

D. H. Eargle, 1960, U.S. Geol. Survey Prof. Paper 315-D, p. 71. In Brown and Coleman Counties, Ivan limestone member of Graham formation is separated from overlying Speck Mountain limestone member of Thrifty formation by shale unit called Speck Mountain clay bed by Drake (1893).

Named for Speck Mountain, Coleman County.

**Speck Mountain Limestone Member** (of Thrifty Formation)[1]

Speck Mountain Formation (in Thrifty Group)

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, *in* Wallace Lee and others, Texas Univ. Bur. Econ. Geology Pub. 3801, p. 122, 124-125. Termed Speck Mountain limestone member of Thrifty formation. Thickness 3 to 5 feet. Underlies Lohn shale member; overlies unnamed shale member which Drake (1894 [1893]) called Speck Mountain clay.

M. G. Cheney, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 1, p. 66 (fig. 1), 91. Rank raised to formation in Thrifty group. Underlies Breckenridge formation; overlies Ivan formation. Limestone at top of Speck Mountain has lithographic appearance of Blach Ranch limestone of Brazos River section.

D. H. Eargle, 1958, San Angelo Geol. Soc. Guidebook, Apr. 17-19, p. 50. Shown on composite stratigraphic section as basal member of Thrifty formation. Consists of gray slabby very fine grained limestone; contains fusulinids. In some areas, cut out by overlying Parks Mountain sandstone member; stratigraphically above Ivan limestone member of Graham formation.

D. A. Myers, 1958, Jour. Paleontology, v. 32, no. 4, p. 678 (fig. 1). Member shown on stratigraphic column as occurring below Breckenridge member.

D. H. Eargle, 1960, U.S. Geol. Survey Prof. Paper 315-D, p. 71, 72, pl. 27. Basal member of Thrifty. In eastern Brown and northwestern Coleman Counties, separated from overlying Breckenridge member by shale interval. Separated from underlying Ivan limestone member of Graham formation by shale interval.

Named for Speck Mountain, Coleman County.

**Speeds Limestone Member** (of Sellersburg Limestone)

Speeds Formation (in Hamilton Group)

Middle Devonian: Southern Indiana.

D. G. Sutton and A. H. Sutton, 1937, Jour. Geology, v. 45, no. 3, p. 326, 328. Shaly limestone about 18 inches thick underlying Silver Creek member of Sellersburg at Speeds quarry.

Guy Campbell, 1942, Geol. Soc. America Bull., v. 53, no. 7, p. 1060. Rank raised to formation. In region of fullest development, a hard blue crystalline limestone which weathers to irregular thin layers and spalls. Thickness 1 to 3 feet at Sellersburg, 13 feet at Lexington, and 1 to 3 feet in Jennings County. In some areas, lies between Jeffersonville formation below and Silver Creek formation above; in other areas, underlies Deputy formation (new).

J. B. Patton and T. A. Dawson, 1955, *in* H. H. Murray, Indiana Geol. Survey Field Conf. Guidebook 8, p. 42, pl. 1. Names Speed and Silver Creek are applied to lithofacies of Hamilton rocks; these lithofacies may be used as members in southern part of outcrop belt.

Named for occurrence in Speeds quarry, near Sellersburg, Clark County.

Speers Ferry Formation

Middle Ordovician (Chazyan): Tennessee.

E. O. Ulrich, 1939, Kansas Geol. Soc. Guidebook 13th Ann. Field Conf., p. 106. On correlation chart, Speers Ferry formation of Clinton and Pearisburg troughs of Tennessee is shown stratigraphically below the Pierce (of central Tennessee) and above the Ottosee of Knoxville and Athens troughs of Tennessee.

G. A. Cooper, 1956, Smithsonian Misc. Colln., v. 127, pt. 1, p. 91. No formal description of unit has been published. According to present understanding of Appalachian stratigraphy, the position of the Speers Ferry between the Ottosee below and Pierce formation above is impossible. The Speers Ferry may have been designed for beds now called Wardell.

**Speiser Shale** (in Council Grove Group)[1]

Permian: Southeastern Nebraska, and eastern Kansas.

Original reference: G. E. Condra, 1927, Nebraska Geol. Survey Bull. 1, 2d ser., p. 232, 234.

R. C. Moore and others, 1951, Kansas Geol. Survey Bull. 89, p. 46. As currently defined in Kansas, consists of shale and limestone; upper part is gray fossiliferous shale underlain by fairly persistent limestone bed which is commonly less than 1 foot thick and occurs about 3 feet below Threemile limestone member of Wreford formation; remainder of formation consists of beds of varicolored shale, red being predominant; contains lenticular bed of sandstone near middle, in southern part of State. Thickness 18 feet in northern and central part of State and about 35 feet in southern. Overlies Funston limestone.

Type locality: W½ sec. 35, T. 1 N., R. 13 E., Speiser Township, Richardson County, Nebr.

**Spence Shale Member** (of Ute Limestone)[1]

Spence Shale Member (of Langston Formation)

Middle Cambrian: Southeastern Idaho and northeastern Utah.

Original reference: C. D. Walcott, 1908, Smithsonian Misc. Colln., v. 53, no. 1804, p. 5, 6, 8.

J. S. Williams and G. B. Maxey, 1941, Am. Jour. Sci., v. 239, no. 4, p. 276, 280–281. Spence shale is not properly a member of Ute formation since it is not present in type locality of the Ute. Furthermore, faunal studies indicate that the shale is lateral facies of dolomite found at base of Langston formation at its type locality. Therefore, the shale is considered to be a member low in Langston formation, not the basal member of Ute formation.

H. W. Coulter, 1956, Idaho Bur. Mines and Geology Pamph. 107, p. 11–12. Because of the long history of misapplication of the term Spence shale both in the literature and in general use, the advisability of William's and Maxey's usage is questioned, and it is suggested that it [the term] should be dropped.

Type locality: Spence Gulch, a ravine running up into Danish Flat from Mill Canyon, about 5 miles west-southwest of Liberty, Bear Lake County, Idaho.

Spencer Chert[1]

Upper Ordovician (Richmond) : Central Missouri.

Original reference: G. H. Scherer, 1905, Bradley Geol. Field Sta. Drury Coll. Bull., v. 1, pt. 2, p. 59.

Crops out just north of Decaturville Hotel, in road from Decaturville, Camden County, to Lebanon, Laclede County.

**Spencer Formation**

Eocene: Western Oregon.

F. E. Turner, 1938, Geol. Soc. America Spec. Paper 10, p. 23–24. Name proposed for marine sandstones and shales of undetermined thickness in vicinity of Spencer and Coyote Creeks about 10 miles west southwest of Eugene. Beds along west side of Willamette Valley are also considered a part of the formation. Contact with overlying Comstock formation not directly observable; unconformity indicated.

H. E. Vokes, P. D. Snavely, Jr., and D. A. Meyers, 1951, U.S. Geol. Survey Oil and Gas Inv. Map OM–110. Redefined to include beds Turner (1938) referred to Comstock formation. Subdivided to include Lorane shale member (new) at base. As redefined, Spencer formation has thickness of 2,700 to 3,400 feet; thickness increases southward; lower 600 feet assigned to Lorane shale member. Unconformably overlies Tyee formation; underlies Fisher formation. Upper Eocene.

H. E. Vokes, D. A. Myers, and Linn Hoover, 1954, U.S. Geol. Survey Oil and Gas Inv. Map OM–150. Mapping in Corvallis-Monroe area indicates that Lorane shale member is more closely related to Tyee formation than to Spencer formation.

West and southwest of Eugene, Lane County.

Spencer 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, 94–95. Medium- to dark-gray aphanitic limestone, mottled with red-brown siltstone. Average thickness about 40 feet. Beds comprising basal 20 feet are thick, massive, and cliff forming; next 10 feet is thin bedded and frequently weathers into a slope; uppermost 10 feet resembles bottom part and is also cliff forming. Younger than Sanup Plateau member (new); older than Peach Springs member (new).

A. H. McNair, 1951, Am. Assoc. Petroleum Geologists Bull., v. 35, no. 3, p. 512. Member has shale at its base at Peach Springs Canyon and becomes progressively more shaly towards Fort Rock, where it is a light-green fissile shale containing thin beds of brown miscaceous sandstone and glauconitic limestones.

Extends eastward from Grand Wash Cliffs almost to Diamond Creek; in Grand Canyon.

**Spencer Hill Volcanics** (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]. Includes rhyolite flows with interbedded pyroclastics and conglomerate.

Rhyolite is gray, pink, or purple, fine grained, and porphyritic in part and has well-developed flow structure. Pyroclastic breccia consists of angular rhyolite fragments in rhyolitic matrix. Rhyolite pebbles of various sizes occur in the conglomerate. Intruded by thin sill of Cowesett granite (new). Included in East Greenwich group.

Named for occurrence on Spencer Hill, Kent County, where it is well exposed in roadcut on Route 2 at crest of hill and in nearby fields.

Spergen Formation

†Spergen Limestone (in Meramec Group)[1]

Mississippian (Meramecian): Southern Indiana, southern Illinois, eastern Iowa, western Kentucky, and eastern Missouri.

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

J. M. Weller and A. H. Sutton, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 5, p. 811. Two names, Salem and Spergen, both taken from localities in Washington County, Ind., have been applied to limestone from which Bedford, Ind., building stone is obtained. Name Salem, which was proposed first and has been used consistently by Indiana Geological Survey, is preferable to name Spergen.

J. M. Weller and others, 1948, Geol. Soc. America Bull., v. 59, no. 2, chart 5. Shown on correlation chart in Meramecian series.

C. N. Brown, chm., 1957, Tri-State Geol. Soc. Guidebook 21st Ann. Field Conf., p. 16, 17, 23, 24, 34, 35. Spergen formation described in three outcrops in southeastern Iowa. Predominantly dolomite with some limestone. Thickness 4 to 12½ feet.

U.S. Geological Survey has abandoned the name Spergen Limestone in preference to the Salem Limestone, the more widely accepted term.

Named for Spergen Hill, near railroad station of Harristown, a few miles southeast of Salem, Washington County, Ind.

**Sphinx Conglomerate**[1]

Eocene: Southwestern Montana.

Original reference: A. C. Peale, 1896, U.S. Geol. Survey Geol. Atlas, Folio 24.

W. C. Alden, 1953, U.S. Geol. Survey Prof. Paper 231, p. 6–7. Unconformably overlies volcanic material which Peale correlated with Livingston formation and which, in turn, unconformably overlies upturned and folded Cretaceous strata. Eocene.

Exposed in Sphinx Mountains, a peak in the Madison Range.

Spickert Knob 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, 127–137.

J. M. Weller and others, 1948, Geol. Soc. America Bull., v. 59, no. 2, p. 127–128, pl. 1. Facies nomenclature discussed. In a north to south direction, Locust Point formation comprises Belmont, Nelson Hill, Schooner Hill, and Spickert Knob facies.

Name derived from Spickert Knob of the Knobstone escarpment, located chiefly in NE¼ sec. 21, T. 2 S., R. 6 E., 1 mile northeast of Floyds Knob post office, Floyd County.

Spieden Formation[1]

Lower Cretaceous: Northwestern Washington.

Original reference: R. D. McLellan, 1927, Washington [State] Univ. Pub. in Geology, v. 2, p. 93, 113–118.

W. P. Popenoe, R. W. Imlay, and M. A. Murphy, 1960, Geol. Soc. America Bull., v. 71, no. 10, p. 1533, chart 10e (column 58). Valanginian beds on Spieden Island consist mostly of sandy conglomerate. Thickness more than 2,000 feet.

Present on Spieden Island, Sentinel Island, and Sentinel Rock, San Juan Islands.

Spiller Sand Member (of Cook Mountain Formation)

Spiller Sand Member (of Crockett Formation)

Eocene, middle: Eastern Texas.

H. B. Stenzel, 1938, Texas Univ. Bur. Econ. Geology Pub. 3818, p. 20 (table 1), 125, 149–150. Lignitic argillaceous sands underlying Mount Tabor shale member and overlying Landrum shale member of Crockett formation. Characteristic beds of member are gray or brown, commonly lenticular or crossbedded; thickness of beds a few inches to about 2 feet; shale partings carry lignitized plant fragments. Estimated thickness 105 feet. Overlying and underlying contacts transitional.

H. B. Stenzel, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 9, p. 1664, 1665, 1671 (fig. 3). Reallocated to Cook Mountain formation.

Type locality: Upper reaches of Pine Branch in William Johnson survey, Leon County. Name derived from Spiller's store in southeastern part of County.

Spillway Breccia

Tertiary: Northwestern Arizona and southeastern Nevada.

U.S. Bur. Reclamation, 1950, U.S. Bur. Reclamation, Boulder Canyon Proj. Final Repts., pt. 3, Preparatory Exams., Geol. Inv., Bull. 1, p. 95–96, fig. 34 (geol. map). Intervolcanic deposit of variable character. For the most part, consists of fragments of volcanic rock, principally latite, many of which are more than 2 feet in diameter, whereas masses 6 feet in diameter are not uncommon. Coarse material grades here and there into grits, sandstones, and conglomerate with well-defined regular bedding. Overlies latite flow breccia and underlies basic latite. Younger than Dam breccia (new) and older than Dry Camp breccia (new). Part of younger volcanic series of area. Name credited to F. L. Ransome (unpub. ms.).

Named because of its prominence in Arizona spillway basin, at Hoover Dam, Black Canyon.

†Spiro 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.

C. W. Wilson, Jr., 1937, Oklahoma Geol. Survey Bull. 57, p. 50–51. Described in Muskogee-Porum district. Uppermost member of Savanna formation. Overlies Sam Creek limestone member. Maximum thickness 20 feet.

M. C. Oakes and M. M. Knechtel, 1948, Oklahoma Geol. Survey Bull. 67, p. 50–52. Term Spiro sandstone member, used in Muskogee County, is not applicable in Haskell County.

Caps ridge in secs. 13 and 14, T. 9 N., R. 25 E., just north and northeast of Spiro, Le Flore County.

Spitzenberg Conglomerate[1]

Triassic(?) : Southeastern Pennsylvania.

Original reference: Lawrence Whitcomb and J. A. Engel, 1934, Pennsylvania Acad. Sci. Proc., v. 8, p. 37–43.

Lawrence Whitcomb and J. A. Engel, 1942, Geol. Soc. America Bull., v. 53, no. 5, p. 755–764. Triassic age not definitely proved, but there is strong evidence in its favor. If Spitzenberg is Triassic outlier it becomes highly significant in discussion of Triassic sedimentation in Pennsylvania.

Named for occurrence on top of Spitzenberg, a hill 2½ miles northeast of Lenhartsville, Berks County.

**Split Creek Sandstone Member** (of Katalla Formation)

Split Creek Shale and Sandstone Member[1] (of Katalla Formation)

Oligocene: Southeastern Alaska.

Original reference: N. L. Taliaferro, 1932, Geol. Soc. America Bull., v. 43, no. 3, p. 771–775.

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. 7 (table), 8–9; 1945, Geologic and topographic map and sections of the Katalla area, Alaska: U.S. Geol. Survey War-Minerals Inv. Prelim. Map. Stratigraphically restricted. Composed principally of massive thick-bedded medium- to coarse-grained brownish-gray sandstone and evenly banded fine- to medium-grained thin-bedded sandstone. Banded sandstone cross-bedded locally. Member contains a few thin shale beds. Thickness 700 to 1,400 feet; average of 1,000 feet at head of Split Creek where it is best exposed and shows characteristic lithology. Overlies unnamed shale member; underlies Basin Creek member (new). Unit raised to formational rank (to include Split Creek shale below and Split Creek sandstone above) in unpublished manuscript by oil-company geologists.

Exposed in northern part of Controller Bay region, in drainage to Bering Lake, in very narrow belt along Bering River, and in northern part of ridge between Redwood Creek and Katalla River. Best exposed at head of Split Creek.

Split Mountain Formation

Miocene(?) : Southern California.

L. A. Tarbet and W. H. Holman, 1944, (abs.) Am. Assoc. Petroleum Geologists Bull., v. 28, no. 12, p. 1781. Nonmarine fanglomerates and sandstones intercalated with marine sandstones and shales. Thickness as much as 2,700 feet. Unconformably overlies basement complex. Underlies Alverson Canyon formation (new).

W. E. Ver Planck, 1952, California Div. Mines Bull. 163, p. 30–31, pl. 20. Described in connection with gypsum deposits of Imperial County. In the

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area, Split Mountain formation is divisible into two members, a lower, noticeably red, and an upper that is gray. Above gray member is at least 100 feet of massive gypsum.

T. W. Dibblee, Jr., 1954, California Div. Mines Bull. 170, chap. 2, p. 22 (fig. 1), 23 (fig. 2). Split Mountain formation, 0 to 2,700 feet; underlies Alverson andesite in southwestern Imperial Valley. Overlies pre-Tertiary schist, limestone, gneiss, and granitic intrusives. Split Mountain conglomerate, 0 to 400 feet, underlies Imperial formation in northwestern Imperial Valley.

Occurs on west side of Imperial Valley.

Split-Rock slate[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.

Derivation of name not stated.

Spokane Drift

Spokane Glaciation[1]

Spokane Stage

Pleistocene: Northeastern Washington.

Original reference: J. H. Bretz, 1923, Geol. Soc. America Bull., v. 34, p. 580.

R. F. Flint, 1937, Geol. Soc. America Bull., v. 48, no. 2, p. 222. Three bodies of drift occur in Creston-Spokane district; till on the plateau ("old drift"); rest of plateau drift, chiefly stratified (Spokane drift); and stratified till in deep valleys (Wisconsin outwash). It is possible that drift on plateau dates from glaciation earlier than one responsible for valley fill; it is even possible that all three bodies may be of different glacial ages. Such difference is not demonstrated from facts now known, which point to single common age for all—namely, Wisconsin.

Ernst Antevs, 1945, Am. Jour. Sci., v. 243–A, p. 8. If Spokane drift of eastern Washington is comparable to early Wisconsin drift of eastern Montana, it may be of early Wisconsin (Iowan) age.

W. D. Lowry and E. M. Baldwin, 1952, Geol. Soc. America Bull., v. 63, no. 1, p. 18. Spokane stage of glaciation is older than last or late Wisconsin stage and presumably early Wisconsin; it may prove to be somewhat older.

Named for occurrence in vicinity of Spokane.

**Spokane Shale**[1] or **Formation**[1] (in Missoula Group)

Spokane Formation or Shale (in Piegan Group)

Precambrian (Belt Series): Western and central southern 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. 1897–1898. Formation comprises argillaceous and arenaceous strata lying between calcareo-magnesian formations of Piegan group. Beds range from sandstones and soft shales to quartzites and argillites; dominantly red and green, through brown, buff, and gray also seen. Thickness, 180 to 7,400 feet. Recognized in Glacier National Park; southward, in both Blackfoot Canyon and Meagher facies the formation thickens. In typical Meagher facies, it contains (ascending) Greyson, Prickly Peak (new), and Empire members.

D. A. Andrews, G. S. Lambert, and G. W. Stose, 1944, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 25, sheet 1. Spokane formation shown on map legend as part of Siyeh group.

J. B. Lyons, 1944, Geol. Soc. America Bull., v. 55, no. 4, p. 450. In area of Lewis overthrust, overrides Upper Cretaceous Adel Mountain volcanics (new).

C. P. Ross, D. A. Andrews, and I. J. Witkind, 1955, Geologic map of Montana (1:500,000): U.S. Geol. Survey. Name has been used over a wide area in Montana but in a strict sense can be used safely only in general vicinity of Helena. Provisionally included in Piegan group.

M. R. Klepper, R. A. Weeks, and E. T. Ruppel, 1957, U.S. Geol. Survey Prof. Paper 292, p. 4 (table), 5–6, pls. 1, 2. Thickness as much as 1,700 feet in southern Elkhorn Mountains. Overlies Greyson shale with contact gradational; grades upward into Empire shale. Where Empire is absent, overlain by Flathead quartzite.

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

Type locality: In Spokane Hills, 15 miles east of Helena.

**Spoon Formation** (in Kewanee Group)

Middle Pennsylvanian: Illinois.

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 8 (fig. 1), 26 (fig. 4), 27, 32–33, 45–46 (table 1), pl. 1, geol. sections. Proposed for strata from top of Bernadotte sandstone member of Abbott formation (new) to base of Colchester (No. 2) coal member of Carbondale formation. Maximum thickness about 350 feet in southern Illinois; ranges from a few feet to nearly 100 feet in western Illinois. Members—southeastern Illinois—Bidwell coal (new), New Burnside coal (new), O'Nan coal (new), Granger sandstone (new), Creal Springs limestone, Mount Rorah coal (new), Wise Ridge coal (new), Stonefort limestone, Davis coal, DeKoven coal, Palzo sandstone; southwestern Illinois—Murphysboro, Litchfield, and Assumption coals, Vergennes sandstone, Seahorne limestone, Davis coal, De Koven coal, and Cheltenham clay; western Illinois—Rock Island (No. 1) coal, Seville limestone, Hermon coal (new), Brush coal (new), De Long coal, Seahorne limestone, Wiley coal, Greenbush coal, Isabel sandstone, Abingdon coal, Browning sandstone, and Cheltenham clay; northern Illinois—Cheltenham clay; and eastern Illinois—Seeleyville coal. Presentation of new rock-stratigraphic classification for Illinois. Cyclical classification retained but is independent of rock-stratigraphic classification.

Type locality: Sec. 22, T. 6 N., R. 1 E., Fulton County. Name derived from Spoon River. Formation is exposed in railroad cut of T. P. and W. Railroad about one-fourth mile west of Spoon River.

Spoon Butte Beds[1]

Miocene, upper, and Pliocene, lower: Eastern Wyoming and western Nebraska.

Original reference: O. A. Peterson, 1909, Carnegie Mus. Mem., v. 4, no. 3, p. 74–77.

Named for Spoon Butte, Laramie County, Wyo.

Spoon River Sandstone and Shale (in Pottsville Formation)[1]

Pennsylvanian: Central western Illinois.

Original reference: T. E. Savage, 1927, Am. Jour. Sci., 5th, v. 14, p. 307–316.

Well exposed along Spoon River, Fulton County.

Spotted Bear Limestone Member (of Jefferson Limestone)[1]

Upper Devonian: Northwestern Montana.

Original reference: C. F. Deiss, 1933, Montana Bur. Mines and Geology Mem. 6, p. 44.

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.

Well exposed between elevations of 6,880 and 7,005 feet on northwest slope of Spotted Bear Mountain, in NE¼ sec. 26, T. 25 N., R. 15 W. Also in Pentagon and Monitor Mountains.

**Spotted Ridge Formation**

Pennsylvanian: Central Oregon.

C. W. Merriam, 1942, Jour. Paleontology, v. 16, no. 3, p. 372. Coarse conglomerate, carbonaceous sandstone and indurated mudstone, bedded cherts; in part terrestrial with Pennsylvanian flora. Thickness 1,000 to 1,500 feet. Unconformably underlies Coyote Butte formation (new).

C. W. Merriam and S. A. Berthiaume, 1943, Geol. Soc. America Bull., v. 54, no. 2, p. 151–156. Type locality designated.

S. H. Mamay and C. B. Read, 1956, U.S. Geol. Survey Prof. Paper 274–I, p. 211–223. Studies indicate that on basis of fossil plants alone precise age of Spotted Ridge formation within Pennsylvanian cannot be determined with any great degree of confidence.

Type locality: On west flank of Spotted Ridge, about 15 miles southeast of Paulina, Crook County.

Spottedtail Member (of Sheep Creek Formation)

Miocene (Hemingford): Northwestern Nebraska.

M. K. Elias, 1942, Geol. Soc. America Spec. Paper 41, p. 128–129. Lowermost member of formation. Includes all rocks originally included in Sheep Creek by Matthew and Cook (1909) except uppermost 10 to 20 feet in midst of which is dark-gray volcanic ash. From base up, member is composed of unconsolidated greenish to pinkish sandy clays about 60 feet thick which are similar to Box Butte clays except they do not contain concretions; above clays are pinkish sand and thin layer of light-bluish-gray volcanic ash; uppermost 105 feet is largely unconsolidated silty sands with several hard zones of "mortar beds"; about middle of upper part and about 50 feet below top is a bed of white marl 2 to 3 feet thick, and the sand below it is pinkish brown and above is buff to greenish. Total thickness more than 170 feet. Contains herbaceous flora. Underlies Sand Canyon member (new); overlies eroded surface of Harrison formation.

Type locality: About 15 miles south and 1 mile east of Agate, Sioux County, in West Kilpatrick, Aphelops, and Pliohippus draws at head of Spottedtail Creek which is tributary to North Platte River.

Spout Spring Oolite (in Bangor Limestone)

Mississippian: Northwestern Alabama.

W. B. Jones, 1939, Econ. Geology, v. 34, no. 5, p. 575, 578. Name applied to 50-foot massive-bedded hard gray oolite near base of Bangor limestone. [Appears to be stratigraphically below Rockwood oolite member.]

Occurs at Spout Spring, about 2 miles west of Rockwood, Franklin County.

Spraberry Sandstone

Permian (Leonard): Western Texas (subsurface).

Lamar McLennan, Jr., and W. H. Bradley, 1951, Am. Assoc. Petroleum Geologists Bull., v. 35, no. 4, p. 899–903, 904–908. At type locality, consists of upper sand member about 300 feet thick and lower sand member of about same thickness; the two zones are separated by about 250 feet of shaly gray to brown limestone and streaks of brown calcareous sand. Occurs between depths of 6,400 and 7,290 feet in type well. About 260 feet above Dean sand (new). Lower Leonard.

Type section: Seaboard's Spraberry No. 6–D, sec. 38, Block 34, T. 5 N., in Spraberry field, Dawson County. Depth 6,400 to 6,636 feet not cored in Spraberry 6–D; core description from Robison 6–A substituted for this interval. Named by Seaboard geologists from first well drilled on A. J. Spraberry lease.

Sprague Glacial Substage

Pleistocene (Wisconsin): Southern Rocky Mountains.

L. L. Ray, 1939, (abs.) Geol. Soc. America Bull., v. 50, no. 12, pt. 2, p. 2007; 1940, Geol. Soc. America Bull., v. 51, no. 12, pt. 1, p. 1862–1863. Fifth, or youngest, substage in southern Rocky Mountains. Represented in some cirques by protalus ramparts.

Named for moraine in front of Sprague Glacier in Rocky Mountain National Park.

Sprakers[1]

Sprakers 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 Sprakers shale member of Canajoharie. Overlies Gansevoort shale member; underlies Morphy shale member.

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

**Spring Branch Limestone Member** (of Lecompton Limestone)[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. 44, 47.

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), 152–153; F. C. Greene and W. V. Searight, 1949, Missouri Geol. Survey and Water Resources Rept. Inv. 11, p. 17. Spring Branch limestone member of Lecompton formation; underlies Doniphan shale member; overlies Stull shale member of Kanwaka shale. 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. 24. Average thickness 3 to 5 feet. In Nebraska, Iowa, Missouri, and northeastern Kansas, member was formerly miscorrelated with Oread limestone. Type locality and derivation of name stated.

H. G. Hershey and others, 1960, Iowa Highway Research Board Bull. 15, p. 20, fig. 5. Massive gray cherty limestone separated into two or three beds by thin shales. Thickness 5 to 10 feet. Underlies Doniphan shale member; overlies Kanwaka shale.

H. G. O'Connor, 1960, Kansas Geol. Survey Bull. 148, p. 43, pl. 1. Thickness 8 to 14 feet in Douglas County. Lowest 5 feet is massive light tan or light gray brown in unweathered state but yellow brown where weathered; overlying part made up of shaly limestone, shale, and limestone commonly 3 to 8 feet thick. Underlies Doniphan shale member; overlies Stull shale member of Kanwaka shale.

Type locality: On Spring Branch north of Big Springs, Douglas County, Kans.

Spring Brook Shale Member (of Ludlowville Formation)

Middle Devonian: Western New York.

R. G. Sutton, 1951, Rochester Acad. Sci. Proc., v. 9, no. 5–6, p. 365, 366. Described as shale and impure limestone. Thickness about 20 feet. Overlies Ledyard shale member; underlies Eighteenmile Creek member. Name attributed to G. A. Cooper (unpub. thesis); later included in Wanakah shale member by Cooper [1930].

Exposed in section along Lackawanna Railroad tracks, 3½ miles west of village of East Bethany, Batavia quadrangle.

†Spring Canyon coal group (in Blackhawk Formation)[1]

Spring Canyon Coal Member (of Blackhawk Formation)

Upper Cretaceous: Central eastern Utah.

Original reference: F. R. Clark, 1928, U.S. Geol. Survey Bull. 793.

R. G. Young, 1954, (abs.) Jour. Paleontology, v. 28, no. 4, p. 504. Member about 100 feet thick. Separated from overlying Aberdeen member by thin tongue of Mancos shale; overlies Spring Canyon tongue of Star Point sandstone.

R. G. Young, 1955, Geol. Soc. America Bull., v. 66, no. 2, p. 183–184. Coal group included in newly defined Spring Canyon member of Blackhawk formation.

In Book Cliffs, Castlegate quadrangle, Carbon County.

Spring Canyon 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, figs. 2, 3, pl. 3. Includes strata previously assigned to Spring Canyon coal group (Clark, 1928) above and Spring Canyon sandstone tongue below. Member consists of 60 to 100 feet of coal-bearing shales and sandstones of fresh- and brackish-water origin resting directly upon massive basal sandstone of the Spring Canyon, which has average thickness of about 150 feet in Spring Canyon. Underlies tongue of Mancos shale with slight disconformity. Basal sandstone absent to west and southwest, where member becomes part of undifferentiated coal-bearing rocks of Blackhawk formation. Two massive offshore bar sandstones near Helper occupy almost the entire interval between basal sandstone of overlying Aberdeen member and basal sandstone of Spring Canyon member. Coal-bearing rocks of Spring Canyon member were deposited behind these bars, which mark eastern limits of coal-producing swamps. At least three important coal beds in member; lowest and most important is Hiawatha coal, named for typical occurrence at Hiawatha in Wasatch Plateau; ranges from 8 inches to 7 feet 4 inches in thickness.

Measured in Spring Canyon, Book Cliffs, northern part of Castlegate quadrangle, Carbon County.

Spring Canyon Member (of Frontier Formation)

Lower Cretaceous(?) : Northeastern Utah.

L. A. Hale, 1960, Wyoming Geol. Assoc. Guidebook 15th Ann. Field Conf., p. 136 (chart 1), 138, 139 (fig. 1), 140. Name applied to coaly and carbonaceous sequence overlying Longwall sandstone member (new) and underlying Chalk Creek member (new). Contains five coal beds ranging in thickness from 1 to 3½ feet. Outcrop thickness 350 feet.

Well exposed in Spring Canyon, 3¼ miles southeast of Coalville, Summit County. Also well exposed north of Chalk Creek Narrows, sec. 1, T. 2 N., R. 5 E., Summit County.

**Spring Canyon Tongue** (of Star Point Sandstone)[1]

Spring Canyon Member (of Star Point Sandstone)

Upper Cretaceous: Central eastern Utah.

Original reference: F. R. Clark, 1928, U.S. Geol. Survey Bull. 793.

R. G. Young, 1954, (abs.) Jour. Paleontology, v. 28, no. 4, p. 504. Underlies Spring Canyon coal member of Blackhawk formation.

P. J. Katich, Jr., 1954, Intermountain Assoc. Petroleum Geologists [Guidebook] 5th Ann. Field Conf.. p. 43 (fig. 1). Uppermost member of Star Point. Thickness 50 to 150 feet. Overlies Storrs member; underlies Aberdeen sandstone member of Blackhawk formation.

R. G. Young, 1955, Geol. Soc. America Bull., v. 66, no. 2, p. 183–184. Base of Blackhawk formation is at base of Spring Canyon sandstone of Clark. Spring Canyon sandstone tongue is included in Spring Canyon member (new) of Blackhawk formation.

Forms conspicuous white cliffs in Spring Canyon in Book Cliffs, northern part of Castlegate quadrangle, Carbon County.

Spring 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.

D. A. Zimmerman and G. D. Glover, 1956, Soc. Econ. Paleontologists and Mineralogists Permian Basin Section [Guidebook] Spring Mtg., p. 77. Bluish sandy clay, 300 feet thick, with 50 feet of sandstone near middle. Underlies Cottonwood Creek bed; overlies Brown Creek bed.

D. H. Eargle, 1960, U.S. Geol. Survey, 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 base of Drake's Ricker bed.

Named for Spring Creek, San Saba County.

Spring Creek Clays[1]

Lower Cretaceous (Comanche Series): Central southern Kansas.

Original reference: C. N. Gould, 1898, Am. Jour. Sci., 4th, v. 5, p. 170–174.

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, contains stratigraphic units formerly called "Rocktown channel sandstone," "Ellsworth formation," "Solomon formation," "Reeder sandstone," "Marquette sandstone," "Spring Creek clay," and others.

Named for Spring Creek, 12 miles south of Belvidere, Kiowa County.

Spring Creek deposits

Pleistocene: Western and northwestern Texas.

G. L. Evans and G. E. Meade, 1945, Texas Univ. Bur. Econ. Geology Pub. 4401, p. 495. Name given to lacustrine deposits similar in lithology to, and believed to be equivalent of Tule formation.

Occur along Double Mountain Fork of Brazos River and a tributary stream known as Spring Creek in western Garza and eastern Linn Counties.

**Spring Creek Granite**[1]

Precambrian: Eastern Colorado.

Original reference: W. Cross, 1895, U.S. Geol. Survey 16th Ann. Rept., pt. 2, p. 23.

Occurs only on southwest half of Red Mountain and on hill to south on opposite side of Spring Creek, Cripple Creek district.

†Spring Creek Limestone (in Moorefield Shale)[1]

Mississippian: Northern Arkansas.

Original reference: H. S. Williams, 1895, Am. Jour. Sci., 3d, v. 49, p. 94–101.

Mackenzie Gordon, Jr., 1944, Am. Assoc. Petroleum Geologists Bull., v. 28, no. 11, p. 1631. Moorefield formation in Batesville district, consists of lower member of black calcareous shale and limestone and upper member of dark-gray fissile clay shale; lower member has been known as Spring Creek limestone (name preoccupied) and grades laterally into chert that has been incorrectly mapped as Boone. It is recommended that the Moorefield be restricted to lower member.

Named for Spring Creek, 2 miles west of Batesville, Independence County.

Spring Creek Member (of Stonehenge Limestone)

Lower Ordovician (Canadian): Central Pennsylvania.

A. C. Donaldson, 1960, Dissert. Abs., v. 20, no. 9, p. 3693. Basal member; contains oolites in contrast to overlying Graysville member (new).

Type locality and derivation of name not stated.

**Springdale Sandstone Member** (of Moenave Formation)

Springdale Sandstone Member (of Chinle Formation)

Upper Triassic(?): Southern Utah and northeastern Arizona.

H. E. Gregory and N. C. Williams, 1947, Geol. Soc. America Bull., v. 58, no. 3, p. 223 (table 1), 228, 233; H. E. Gregory, 1950, U.S. Geol. Survey Prof. Paper 220, p. 52 (table), 67, 68, strat. sections. Member of Chinle. Consists of light-red sandstone streaked with white; indistinct lenticular beds 2 to 10 feet thick, separated in places by thin layers of imbricated shale; includes pellets of concretionary limestone and clay; ripple marks common. Thickness 40 to 180 feet. Underlies unnamed sandstone; overlies Petrified Forest member.

Paul Averitt and others, 1955, Am. Assoc. Petroleum Geologists Bull., v. 39, no. 12, p. 2519–2520. Reallocated to member status in Moenave formation. Overlies Dinosaur Canyon sandstone member; underlies Kayenta formation. In Echo Cliffs area, the Springdale and underlying Dinosaur Canyon member were mapped as Wingate sandstone and described separately as the upper and lower parts of the formation (Wanek and Stephens, 1953, U.S. Geol. Survey Oil and Gas Inv. Map OM–145). At Cedar City, in Coal Creek section of Chinle, measured by Thomas and Taylor (1946) and republished by Gregory (1950, Utah Geol. and Mineralog. Survey Bull. 37), the Springdale comprises units 24, 23, and possibly upper part of unit 22 as designated by Thomas and Taylor, and units 19, 18, and possibly upper part of unit 17 as designated by Gregory—not unit 14 as designated by Gregory. Thickness 60 to 225 feet; typically about 175 feet.

J. W. Harshbarger, C. A. Repenning, and J. H. Irwin, 1957, U.S. Geol. Survey Prof. Paper 291, p. 3 (fig. 2), 16–17, 62. Geographically extended into Arizona. In most parts of Navajo country, member is 100 to 150 feet thick, though thickness differs locally owing to lenticular nature of its sandstone units; 221 feet at Lees Ferry; 77 feet at Moenave. Overlies Dinosaur Canyon member, contact commonly gradational; underlies Kayenta formation and in many areas cannot be distinguished from it. In Echo Cliffs area, unit has been referred to as Wingate sandstone by several workers.

Name derived from village of Springdale, Washington County, Utah, where unit forms prominent cliff. Traceable by nearly continuous outcrops, from Kanab, Utah, along Vermilion Cliffs to Lees Ferry, Ariz., and southward along Echo Cliffs.

## Springer Formation[1] or Shale

Springer Group

Mississippian and Pennsylvanian (Chester and Morrow Series): Oklahoma.

Original reference: W. L. Goldston, Jr., 1922, Am. Assoc. Petroleum Geologists Bull., v. 6, no. 1.

R. C. Moore and others, 1944, Geol. Soc. America Bull., v. 55, no. 6, chart 6 (column 37). Group comprises (ascending) "Caney" shale, Rod Club sandstone, Overbrook sandstone, Lake Ardmore sandstone, and Primrose sandstone. Underlies Dornick Hills group. Morrow series.

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), 7–13. Springer group is here defined as including both Goddard formation and Springeran series. Goldston's (1922) original Springer member of Glenn formation likewise included both. Boundary between Mississippian and Pennsylvanian systems probably falls within Springer group as here defined. Group includes maximum of about 4,500 feet of sediments of which Springeran series comprises upper half. Lower half of group contains Goddard formation and upper half three sandstones: Rod Club, Overbrook, and Lake Ardmore. Overlies the Caney; underlies Dornick Hills group.

Lynn Jacobson, 1959, Oklahoma Geol. Survey Bull. 79, p. 27–29. Formation conformably overlies Goddard shale. Consists of about 2,000 feet of dark-gray shale marked by presence of four or six prominent sandstone members. Springer has been widely accepted as early Pennsylvanian age and has been used as type section for Springeran stage by Moore and Thompson (1949) in their revision of Pennsylvanian system. However, no unequivocal paleontologic or stratigraphic evidence as to the age of the Springer is now known.

Well exposed at Springer, Carter County.

Springer Series

Springeran Stage or Age

Lower Pennsylvanian: Midcontinent region.

M. G. Cheney and others, 1945, Am. Assoc. Petroleum Geologists Bull., v. 29, no. 2, p. 140 (chart 2), 142–144. Revision of Goldston's (1922) Springer member to include all Pennsylvanian beds below base of Primrose sandstone, and for elevating Springer division to rank of series will be recommended in forthcoming paper by R. H. Dott. As revised, Springer series is about 4,000 feet thick in type area north of Ardmore. About 2,000 feet of dark shales below Rod Club sandstone are now included in Springer series. These lower Springer shales, heretofore called "Pennsylvanian Caney" have been named Goddard shale. Name Springer is used in preference to Harlton's (1938) Pushmataha series partly because of priority and usage, but chiefly to avoid placing type locality of series in less accessible area where stratigraphic relationships are uncertain owing to complex overthrust faulting and folding. Series in Ouachita basin of southeastern Oklahoma and west-central Arkansas attains estimated thickness of 15,000 feet, on assumption that Hot Springs sandstone, Stanley shale, and Jackfork sandstone are all of post-Chester age, and properly assigned to Pennsylvanian.

R. C. Moore and M. L. Thompson, 1949, Am. Assoc. Petroleum Geologists Bull., v. 33, no. 3, p. 286, 288 (fig. 1). Springeran stage (Age) included in newly defined Ardian series (Epoch).

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. 4–7. Term Springeran series comprises approximately upper half of sediments covered by original definition of series by Cheney (1945). Upper limit is base of Primrose sandstone, uppermost member of Springer formation as defined by Tomlinson (1929, Oklahoma Geol. Survey Bull. 46). Lower limit is base of Rod Club sandstone. Underlying Goddard formation is excluded because it is now believed to be of Chesterian age. As thus limited, Springeran series is coextensive with Tomlinson's (1929) Springer formation where Jolliff conglomerate forms base of overlying Dornick Hills group. Some paleontologists do not recognize Springeran as a series but consider it included in Morrowan series. However, no part of Springeran series as here described is known to be represented by sediments of contemporaneous origin, either in type Morrowan of northwest Arkansas or in type Chesterian of Illinois and Missouri. Springeran series comprises upper half of Springer group as herein defined.

Type locality: Ardmore basin, Oklahoma.

Springfield Clay[1]

Pleistocene: Southwestern Ohio.

Original reference: E. Orton, 1873, Ohio Geol. Survey, v. 1, p. 431, 443.

Named for Springfield, Clark County.

Springfield 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), 66, pl. 1. Assigned member status in Carbondale formation (redefined). Occurs above Covel conglomerate member and below St. David limestone member. Thickness about 5 feet. Coal named by Worthen (1883, *in* Geology and Paleontology, v. 7, Illinois Geol. Survey). Presentation of new rock-stratigraphic classification of Pennsylvanian strata in Illinois.

Type locality: Sec. 16, T. 16 N., R. 4 W., Sangamon County. Named from subsurface exposures in coal mines.

Springfield Conglomerate[1]

Cambrian(?): Southeastern Vermont.

Original reference: C. H. Richardson, 1931, Vermont State Geologist 17th Rept., p. 200–201.

Occurs on east side of Spencer Hollow Road, a few rods east of Spencer Schoolhouse, 1½ miles east of Springfield, Windsor County.

Springfield Granodiorite

Springfield Microcline Gneiss

Age unknown: Southeastern Pennsylvania.

A. W. Postel, 1940, (abs.) Geol. Soc. America Bull., v. 51, no. 12, pt. 2, p. 2004–2005; 1941, Acad. Nat. Sci. Philadelphia Proc., v. 92, p. 125–133. Igneous rocks in Wissahickon schist in Philadelphia region originated in two ways: definite magmatic intrusions into Wissahickon and hydrothermal replacement of Wissahickon by potash and soda-rich solutions. Springfield aplitic granodiorite and Ridley Park granodiorite (new) are products of magmatic intrusion; Springfield porphyroblastic granodiorite is product of hydrothermal reaction. Precise chronological position cannot be assigned to the igneous rocks because age of Wissahickon is in doubt. Relative age sequence is considered to be (oldest to youngest) metagabbro, Springfield porphyroblastic granodiorite, Springfield aplitic granodiorite, and Ridley Park granodiorite.

Chi-shang Ch'ih, 1950, Geol. Soc. America Bull., v. 61, no. 9, p. 925, 926, 929, 937, 949–951. Referred to as Springfield microcline gneiss in discussion of petrology of Wissahickon schist.

A. W. Postel and H. W. Jaffe, 1957, Pennsylvania Acad. Sci. Proc., v. 31, p. 120. Renamed Swarthmore granodiorite. Name Springfield preempted.

Area mapped is roughly rectangular, bounded on northwest by Narbeth, on northeast by Manayunk, and on southwest by Chester and on southeast by Philadelphia. Springfield is in Delaware County.

**Springfield Limestone**[1] or **Dolomite**

Springfield Dolomite (in Durbin Group)

Middle Silurian: Southwestern Ohio.

Original reference: E. Orton, 1871, Ohio Geol. Survey Rept. Prog. 1870, p. 271, 274–277, 301.

C. K. Swartz, 1942, Geol. Soc. America Bull., v. 53, no. 4, chart 3. Shown on correlation chart as dolomite in Durbin group.

R. J. Bernhagen, chm., 1960, Ohio Acad. Sci., Geology Sec., Guidebook 35th Ann. Field Conf., p. 13, 17–18, 21. Silurian section in Yellow Springs region shows Springfield dolomite, 10 feet thick, above Euphemia dolomite and below Cedarville dolomite. Niagaran.

Type locality: Springfield, Clark County.

Springfield Center Member (of Onondaga Formation)

Middle Devonian: East-central New York.

R. E. Stevenson, 1949, New York State Sci. Service Rept. Inv. 3, p. 6–7. Grey to dark-grey medium- to thin-bedded fine- to medium-grained fossiliferous limestone. Massive coral reef within 5 feet of base in most localities. Thickness 3 to 30 feet. Underlies Babcock Hill member (new); overlies Carlisle Center formation. Onondaga is used both as group and formation in this report.

Named for occurrence in vicinity of Springfield Center, Otsego County.

Spring Grove Member (of Wapsipinicon Limestone)[1]

Middle Devonian: Eastern Iowa.

Original reference: A. C. Trowbridge, M. L. Thompson, and E. H. Scobey, 1935, Kansas Geol. Soc. 9th Ann. Field Conf., Guide Book, p. 36, 424, figs. 1, 2.

E. H. Scobey, 1940, Jour. Sed. Petrology, v. 10, no. 1, p. 38 (fig. 1), 41–42. Underlies Davenport member; overlies Kenwood member. In Fayette County, lies unconformably on the Silurian, overlapping lower members of the Wapsipinicon and the Gower formation. Middle Devonian(?).

Type locality: In right bank of Wapsipinicon River in central sec. 24, Spring Grove Township, Linn County.

**Spring Hill 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.

R. C. Moore, 1948, Am. Assoc. Petroleum Geologists Bull., v. 32, no. 11, p. 2031 (fig. 4); 1949, Kansas Geol. Survey Bull. 83, p. 116. Spring Hill limestone member of Plattsburg formation; overlies Hickory Creek shale member; underlies Vilas shale. 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. 33. Consists of two limestones separated by shale. Thickness in Kansas 6 to 40 feet; average 15 feet; 4 to 6 feet in Nebraska. Type locality stated.

Type locality: In railroad cut near center east side of sec. 14, T. 15 S., R. 23 E., southern Johnson County, Kans.

Springler Knob facies[1] (of Edwardsville Formation)

Lower Mississippian: Southern Indiana.

Original reference: P. B. Stockdale, 1931, Dept. Conserv., Div. Geology Pub. 98, p. 76, 222–227.

J. M. Weller and others, 1948, Geol. Soc. America Bull., v. 59, no. 2, p. 127–128, pl. 1. Mississippian facies nomenclature discussed. Springler Knob facies listed in Edwardsville formation.

Name derived from Springler Knob on Knobstone Escarpment near center NE¼ sec. 10, T. 2 S., R. 6 E., 3½ miles southwest of St. Joseph, 5 miles north of New Albany, Floyd County.

Spring Mount Sandstone Member (of Bald Eagle Sandstone)

Upper Ordovician: Central Pennsylvania.

F. M. Swartz, 1957, Pennsylvania State Univ., Dept. Geology Contr. 3, 58 p. Upper member of Bald Eagle in vicinity of Tyrone Gap. [Spring Mount is "ridge making member of Bald Eagle" referred to by Swartz, 1948.] Overlies Centennial School sandstone and shale member (new); to the east, interfingers with Lost Run conglomerate. Underlies Juniata strata. [Swartz refers to his 1955 report *in* Pennsylvania Geologists Guidebook 21st Ann. Field Conf. Compiler was unable to locate this reference.]

Type locality and derivation of name not given.

Spring Mountain[s] Formation

Permian (Wolfcampian-Leonardian): Western Nevada.

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 diagrams and correlation chart, Spring Mountain formation overlies Bird Spring formation and underlies Kaibab formation.

Present in Spring Mountains area.

**Spring Point Greenstone** (in Casco Bay Group)[1]

Pennsylvanian(?): Southwestern Maine.

Original reference: F. J. Katz, 1917, Washington Acad. Sci. Jour., v. 7, p. 198.

Named for exposures at Spring Point, South Portland, Cumberland County.

Spring River Sandstone[1]

Pennsylvanian: Southwestern Missouri.

Original reference: D. White, 1897, Geol. Soc. America Bull., v. 8, p. 288.

Named for Spring River, Jasper County.

†Spring Rock limestone[1]

Pennsylvanian: Eastern Kansas.

Original reference: G. C. Swallow and F. Hawn, 1865, Kansas Geol. Survey Rept. on Miami County, p. 9.

Named for springs which come to surface from crevices in the rock.

†Spring Rock series[1]

Pennsylvanian: Eastern Kansas.

Original reference: G. C. Swallow, 1866, Kansas Geol. Survey Prelim. Rept., p. 21.

Probably named for Spring Rock, the source of many springs.

†Springvale Beds[1]

Mississippian: Southeastern Iowa.

Original reference: H. F. Bain, 1895, Am. Geologist, v. 15, p. 320.

Named for old Springvale mill, 5 miles south of Delta, Keokuk County.

Springvale Sandstone[1] (in Onondaga Limestone)

Middle Devonian: Ontario, Canada and central New York.

Original reference: C. R. Stauffer, 1913, 12th Int. Geol. Cong. Guidebook 4, p. 83–85, 89.

W. A. Oliver, Jr., 1954, Geol. Soc. America Bull., v. 65, no. 7, p. 625, 627, 631 (fig. 2), 632, 635, 641. Chadwick (1919, New York State Mus. Bull. Nos. 207–208) extended name Springvale sandstone into New York. Springvale zone or horizon is recognized at base of Edgecliff member (new) of Onondaga formation.

Well exposed near Springvale, in region around Hagerville, Ontario, Canada.

Spring Valley Limestone (in McLeansboro Formation)[1]

Pennsylvanian: Central western Illinois.

Original reference: G. H. Cady, 1921, Illinois Geol. Survey Cooperative Mining Ser. Bull. 26, p. 36, 38.

Springville Shale[1]

Mississippian (Valmeyer Series): Southwestern Illinois.

Original reference: T. E. Savage, 1920, Am. Jour. Sci., 4th, v. 49, p. 169–178.

C. C. Collinson and A. J. Scott, 1958, Illinois Geol. Survey Circ. 254, p. 1–12. This report, based on study of outcrops and conodont faunas, correlates the two lowermost units of the Springville, as originally defined, with Hannibal shale and Chouteau limestone, both of Kinderhook age, and restricts name Springville to beds overlying the Chouteau. A 15-inch shale at base of the redefined Springville is named State Pond member. There is no definite age concerning top of Springville, but it is overlain by beds that are referred to Burlington-Keokuk formation.

Well exposed in bed and banks of a creek northwest of Springville, SE¼ sec. 13, T. 13 S., R. 1 W., Union County. Best contemporary exposures are west of Jonesboro near north line of sec. 23, T. 12 S., R. 2 W., near State Pond Dam in sec. 14 and along Darty Creek in SW¼ sec. 11, both mentioned in Savage's description.

Sprout Brook Limestone[1]

Precambrian: Southeastern New York.

Original reference: C. P. Berkey, 1907, New York State Mus. Bull. 107, p. 361–378.

Occurs in Westchester and Putnam Counties.

**Spruce Formation** (in Missoula Group)

Precambrian (Belt Series): Northwestern Montana.

A. B. Campbell, 1960, U.S. Geol. Survey Bull. 1082–I, p. 560–563, pl. 28. Thin-bedded fine-grained greenish-gray impure quartzite containing many thick zones of thinly interlaminated greenish-gray quartzose argillite and impure quartzite and a few zones of pale-purplish-gray quartzite. Lower 300 feet and upper 700 to 800 feet partly dolomitic. Weathers buff to brown. Thickness about 3,500 feet. Underlies Lupine quartzite (new); conformably overlies Wallace formation.

Type locality: Spruce Ridge, secs. 32, 33, and 34, T. 17 N., R. 27 W., St. Regis-Superior area. Exposed on north slope Sheep Mountain, secs. 5 and 6, T. 16 N., R. 27 W., St. Regis-Superior area, Mineral County.

Spruce Pine Alaskite

Age not stated: Western North Carolina.

C. E. Hunter and P. W. Mattocks, 1936, TVA Div. Geology Bull. 4, p. 10–11. Extremely coarse-textured granite containing a small amount of biotite locally. Feldspar crystals as much as 2 feet across are quite common.

Outcrops principally over an area around the town of Spruce Pine in Mitchell County and in smaller areas in Brushy Creek and Ingalls sections of Avery County.

**Spud Mountain 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. 21–26, pl. 1. Comprises four lithologic units: andesitic breccia and interbedded tuffaceous sedimentary rocks—maximum outcrop width about 5,500 feet; fine-grained andesitic tuffaceous rocks—maximum outcrop width about 5,000 feet; intercalated andesitic flows—maximum outcrop width 1,000 feet; and interbedded rhyolitic tuff—maximum outcrop width 1,500 feet. Outcrop widths may about equal stratigraphic thickness for local or partial sections. Underlies Iron King volcanics (new) and overlies Indian Hills volcanics (new) with gradational contacts.

Named from exposures on and near Spud Mountain in Jerome area, Yavapai County. Representative section exposed in area from Spud Mountain to the Iron King mine.

**Spurwink Limestone** (in Casco Bay Group)[1]

Pennsylvanian(?) : Southwestern Maine.

Original reference: F. J. Katz, 1917, Washington Acad. Sci. Jour., v. 7, p. 198.

Named for exposures on Spurwink River, in Scarboro and Cape Elizabeth, Cumberland County.

**Squam Granite**[1]

Early Carboniferous: Northeastern Massachusetts.

Original reference: C. H. Clapp, 1910, Igneous rocks of Essex County, Mass, p. 9, 10, 12.

Occurs along Squam River and in Danvers, Essex County.

†Squankum Marl[1]

Eocene: Eastern New Jersey.

Original reference: T. A. Conrad, 1869, Am. Jour. Sci., 2d, v. 47, p. 363–364.

Occurs around Squankum, Monmouth County.

†Squantum Slates[1]

Mississippian(?) : Massachusetts.

Original reference: F. H. Lahee, 1914, Am. Jour. Sci., 4th, v. 37, p. 316.

**Squantum Tillite Member** (of Roxbury Conglomerate)[1]

Squantum Tillite

Devonian or Carboniferous: Eastern Massachusetts.

Original reference: R. W. Sayles, 1914, Harvard Coll. Mus. Comp. Zoology Bull., v. 56, p. 141–170.

M. P. Billings, F. B. Loomis, Jr., and G. W. Stewart, 1939, Geol. Soc. America Bull., v. 50, no. 12, p. 1867, 1868. Tillite overlies Roxbury conglomerate of Carboniferous age.

Named for peninsula of Squantum in Quincy.

**Square Lake Limestone**[1]

Lower Devonian: Northeastern Maine.

Original reference: H. S. Williams, 1900, U.S. Geol. Survey Bull. 165, p. 21, 22, 26, 30–33, 51, 54–78.

J. M. Trefethen, 1947, Maine State Geologist Rept. 1945–1946, p. 70. Gray highly fossiliferous limestone, resembling the younger Ashland limestone in appearance. Devonian.

Named for exposures on west shore of Square Lake (or Sedgwick Lake), Aroostook County.

**Square Peak Volcanics**

Square Peak Volcanic Series

Tertiary: Western Texas.

R. M. Huffington, 1943, Geol. Soc. America Bull., v. 54, no. 7, p. 992 (fig. 2), 1027–1033, 1038–1039. Name Square Peak volcanic series proposed for lavas and pyroclastic rocks, approximately 3,500 feet thick, which constitute single unit covering 16 square miles in center of northern Quitman Mountains. Consist mostly of varicolored rhyolites with alternating flows of trachyte, quartz latite, andesite, and basalt and beds of tuff, flow conglomerate, and volcanic breccia. Volcanic rocks are commonly surrounded by folded sedimentary rocks on the north and west; at south flows are in contact with Quitman quartz monzonite; on northwestern Bug Hill, lavas of series lie on Bluff limestones.

W. N. McAnulty, 1955, Geol. Soc. America Bull., v. 66, no. 5, p. 558. Probably in part equivalent to Buck Hill volcanic series.

Named for Square Peak in Quitman Mountains, southern Hudspeth County.

Squaw Flows

Tertiary: Northwestern Wyoming.

R. D. Krushensky, 1960, Dissert. Abs., v. 21, no. 4, p. 849. Augite-olivine andesites with some minor autobrecciated flows. Overlie Papoose volcanics and underlie Closed volcanics (both new).

Hurricane Mesa area, Park County.

**Squaw Bay Limestone**[1] (in Traverse Group)

Upper 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), 594–595. Described in Thunder Bay region. Thickness at type section 8 feet; subsurface data indicates greater thickness elsewhere. Overlies Thunder Bay limestone; considered top of Traverse group; an overlying shale or "transition zone" is not included in the Traverse.

Type locality: Squaw Bay shoreline of Partridge Point, center south line sec. 11, T. 30 N., R. 8 E., Alpena County. At high stages of Lake Huron, outcrop is covered by water.

Squaw Creek Diatomite Member (of Yakima Basalt)

[Miocene]: South-central Washington.

J. H. Mackin, 1947, (abs.) Northwest Sci., v. 21, no. 1, p. 33. Defined as occurring one flow below top of Yakima basalt. In Squaw Creek syncline, member consists of bed of essentially pure diatomite 7 to 17 feet thick, overlain conformably by lacustine siltstone as much as 10 feet thick.

Occurs in Yakima-Ellensburg area.

Squire Creek Quartz Diorite

Age not stated: Northwestern Washington.

J. W. Mills, 1960, Mining Eng., v. 12, no. 3, p. 274. Light-colored medium- to coarse-grained quartz diorite composed of plagioclase, hornblende, brown biotite, and minor quartz. Cut by fine-grained alplite dikes. Name credited to J. A. Vance (unpub. thesis).

Occurs on Jumbo Mountain, Snohomish County.

†Squirrel Creek Formation[1]

Eocene: Southern Texas.

Original reference: R. A. Liddle, 1921, Texas Univ. Bull. 1860, p. 77, map, columnar section.

Named for its largest exposure on east and west branches of Squirrel Creek, above old Capt. Smith ranchhouse, in Medina County.

**Squirrel Gulch Latite**[1]

Tertiary: Southern Colorado.

Original reference: W. S. Burbank, 1932, U.S. Geol. Survey Prof. Paper 169.

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 the Bonanza latite is replaced by Hayden Peak latite.

Well exposed at upper part of Squirrel Creek and in north-south ridges west of Kerber Creek in sec. 23, Bonanza district, Saguache County.

**Stacy Dolomite 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, pls. 1, 4. In Everett quadrangle, consists of about 130 feet of alternating dark crystalline massive dolomite and less resistant thin-bedded lighter dolomite. Separated from overlying Ore Hill dolomite member by a 400-foot interval referred to as lower sandy Gatesburg member; separated from underlying Warrior limestone by 50 feet of covered strata.

Named for Stacy Hill, a knob 4 miles slightly west of south of Williamsburg, Blair County.

**Staendebach Member** (of Tanyard Formation)

Lower Ordovician: Central Texas.

V. E. Barnes and P. E. Cloud, Jr., 1945, Texas Univ. Bur. Econ. Geology Mineral Resources Circ. 34, p. 2, 19–27. Top member of formation. Thickness at type section 300 feet. Consists of calcitic facies 176 feet thick and dolomitic facies 124 feet. Overlies Threadgill member; underlies Gorman formation (new). Cherokee Creek section, San Saba County described.

P. E. Cloud, Jr., and V. E. Barnes, 1948, Texas Univ. Bur. Econ. Geology Pub. 4621, p. 36, 37, 137, 158, 195, 211–227, pls. 2, 7, 37 [1946]. Thickness at type section 300 feet; elsewhere ranges from 229 feet in western part of Llano uplift to 356 feet in the east. As a rule, upper one- to two-thirds of member is limestone in northeastern part of Llano region and in Riley Mountains of Llano County, but in the southeast and west dolomite predominates and limestone is rare or absent. Member characteristically contains abundance of sparingly dolomoldic porcelaneous to semiporcelaneous chalcedonic to semichalcedonic chert. Type section and local stratigraphy described in detail.

Type section: Part of Cherokee Creek section, Cherokee area, southeastern San Saba County. Name derived from Staendebach survey, a part of the T. H. Young Ranch which includes upper beds of type section. Cherokee area, between towns of Cherokee and San Saba, is approximately bounded by Cherokee and Little Llano River fault zones on east, Simpson Creek fault zone on north, Cherokee-San Saba Road (State Highway 16) on west, and Cherokee-Chappel Road on south.

**Staff Limestone Member** (of Graford Formation)[1]

Staff Limestone (in Graford Group)

Upper Pennsylvanian: Central northern Texas.

Original reference: F. Reeves, 1922, U.S. Geol. Survey Bull. 736–E, p. 120.

Robert Roth, 1956, North Texas Geol. Soc. Guidebook Field Trip May 25–26, fig. 2. Shown on generalized columnar section as limestone in Graford group. Occurs above Wolf Mountain shales and sandstones and below unnamed shale below Winchell limestone. Canyon series.

Named for outcrops near Staff, Eastland County.

Stafford Limestone Member (of Marcellus Formation)

Stafford Limestone Member (of Skaneateles Shale)[1]

Middle Devonian: Western and central New York.

Original reference: J. M. Clarke, 1894, New York State Museum 47th Ann. Rept., p. 342, 351.

G. A. Cooper and others, 1942, Geol. Soc. America Bull., v. 53, no. 12, pt. 1, p. 1772, chart 4. Reallocated to Marcellus formation. West of Cayuga Lake continuous with Mottville. Overlies Oatka Creek black shale; underlies Levanna black shale.

Named for development at Stafford, Genesee County.

Stafford Store Quartz Monzonite[1]

Post-Ordovician: Northeastern Virginia.

Original reference: J. T. Lonsdale, 1927, Virginia Geol. Survey Bull. 30, p. 40.

Typically developed near Stafford Store post office, Stafford County.

Staghorn Point Submember[1] (of Otisco Member of Ludlowville Formation)

Middle Devonian: Central New York.

Original reference: Burnett Smith, 1935, New York State Mus. Bull. 300, p. 46–47.

W. A. Oliver, Jr., 1951, Am. Jour. Sci., v. 249, no. 10, p. 707, 708, 713–716, fig. 6 (facing p. 724). Consists of mass of closely packed rugose coral skeletons; interstices filled with same shaly sediment as that constituting body of Otisco member. Interfingers laterally with surrounding shales; upper and lower contacts sharply defined except in fringing areas where complete gradation into normal shales may occur. Thickness few inches to 12 feet. Greatest in central part.

Typically shown just south of Staghorn Point on east side of Skaneateles Lake, about 1⅕ miles northwest from Spafford Landing, Skaneateles quadrangle. Traced over 15 miles from Skaneateles Lake to east of Tully quadrangle.

†Staked Plains Formation[1]

Pliocene: Northwestern Texas.

Original reference: R. T. Hill, 1890, Am. Assoc. Adv. Sci. Proc., v. 38, p. 243.

On the Staked Plains or Llano Estacado.

Stallard Limestone

Middle Ordovician: Southwestern Virginia.

Marshall Kay, 1956, Geol. Soc. America Bull., v. 67, no. 1, p. 103. Listed in glossary of stratigraphic units. Attributes name to [B. N.?] Cooper (unpub. rept.).

Type locality: In Lee County.

**Stambaugh Formation** (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. Iron-rich rocks that range from chlorite mudstone and slate to laminated cherty siderite-magnetic rock; only formation that is consistently magnetic over most of district. Underlies Fortune Lakes slate (new); overlies Hiawatha graywacke (new).

Named for town of Stambaugh, Iron County. Hill on which town is built is in large part underlain by the formation (here compressed into a tight complex syncline).

**Stamford Granite Gneiss**[1]

Precambrian: Southwestern Vermont and western Massachusetts.

Original reference: C. H. Hitchcock, 1861, Rept. geology Vermont, v. 2, p. 601.

Named for exposures at Stamford, Bennington County, Vt.

Stanaker Formation

Stanaker Member (of Ankareh Formation)

Upper Triassic: Northeastern Utah.

H. D. Thomas and M. L. Krueger, 1946, Am. Assoc. Petroleum Geologists Bull., v. 30, no. 8, pt. 1, p. 1260 (fig. 2), 1266 (fig. 5), 1271–1275. Formation name applied to basal conglomerate and overlying varicolored shales and sandstone which were included in the Nugget by Boutwell (1912, U.S. Geol. Survey Prof. Paper 77) and classed as Ankareh(?) by Sears (1924, U.S. Geol. Survey Bull. 751–G). Basal conglomerate is here named Gartra grit member. Main body of formation comprises alternation of shales which vary from maroon to red, pink, lavender, ocher, and green, and sandstones which are gray, red, purple, or yellow. Thickness of Gartra 18 to 88 feet; thickness of upper part of Stanaker, exclusive of Gartra, 120 to 394 feet. Underlies Nugget or Navajo sandstone; at type section, overlies Woodside shale; in western Uinta and central Wasatch Ranges, overlies Ankareh formation.

Bernhard Kummel, 1954, U.S. Geol. Survey Prof. Paper 254–H, p. 166 (fig. 18), 180. Rank reduced to member status in Ankareh formation.

W. F. Scott, 1959, Intermountain Assoc. Petroleum Geologists Guidebook 10th Ann. Field Conf., p. 102, 103 (fig. 2), 104 (fig. 3). Units Stanaker and Gartra grit as used by Thomas and Krueger (1946) are included in units referred to in this report as Chinle and Shinarump(?).

Type section: At point where Vernal-Manila Highway crosses Brush Creek, about 10 miles north of Vernal, in north part sec. 6, T. 3 S., R. 22 E., Uintah County. Name derived from Stanaker Draw which lies in eastern part of T 3 S., R. 21 E., Uintah County.

**Standing Pond Volcanics**

Standing Pond Amphibolite Member (of Memphremagog Formation)

Standing Pond Amphibolite Member (of Waits River Formation)

Middle Ordovician(?): Eastern Vermont and western New Hampshire.

C. G. Doll, 1945, Vermont State Geologist 24th Rept., p. 16, 17, pl. 4. Named as member of Memphremagog formation. Fine- to medium-grained greenish-gray or black needle amphibolite with thin layers of banded hornblende schist. Thickness 10 to 300 feet. Occurs either entirely within the limestones or along their contact with the mica schists of the Memphremagog. Middle Silurian. Plate 4 shows age also as probably Lower Devonian.

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

J. B. Lyons, 1955, Geol. Soc. America Bull., v. 66, no. 1, p. 108, 109, pl. 1. Rank reduced to member of Waits River formation. Transgresses from near top of Waits River into overlying Gile Mountain formation.

J. G. Dennis, 1956, Vermont Geol. Survey Bull. 8, p. 27, pls. 1, 3. Referred to as Standing Pond lava of Waits River formation [plate 1] and as Standing Pond volcanics [plate 3]. Lower to Middle Devonian(?).

L. M. Hall, 1959, Vermont Geol. Survey Bull. 13, p. 19–27, 38–39. Age of Waits River Silurian(?) and (or) Devonian.

Named from exposures impounding waters of Standing Pond at its west end, Strafford quadrangle, Vermont.

†Standish Flagstone (in Genesee Group)[1]

Upper Devonian: West-central New York.

Original reference: J. M. Clarke and D. D. Luther, 1904, New York State Mus. Bull. 63, p. 29.

I. W. Fox, 1932, Am. Assoc. Petroleum Geologists Bull., v. 16, no. 7, p. 681–683. Consists of two distinct divisions: sandstones below and shales above. Subdivided to include Crosby sandstone at base and Keuka flagstone about midway between upper and lower divisions.

W. H. Bradley and J. F. Pepper, 1938, U.S. Geol. Survey Bull. 899–A, p. 11, pl. 3. Unit, along with West River shale, occupies interval between Middlesex shale above and Genundewa limestone lentil of Geneseo shale below. Complementary to West River shale; thickens eastward and latter thickens westward. Near base at south end of Seneca Lake is a 2-foot bed of dense massive fine-grained muddy sandstone or siltstone. Northwestward near Keuka Lake, base is marked by dense massive flagstone. Included in Genesee group.

W. L. Grossman, 1944, Geol. Soc. America Bull., v. 55, no. 1, p. 44, 63, 64, 66, 73. Term abandoned. Not recognized as stratigraphic unit distinct from West River shale in type area. Lenses originally defined as Standish do not correlate with Starkey tongue (new) of Sherburne formation or Milo tongue (new) of West River shale, both of which have erroneously been called Standish.

Wallace de Witt, Jr., and G. W. Colton, 1959, Am. Assoc. Petroleum Geologists Bull., v. 43, no. 12, p. 2819. Standish flagstones of Clark and Luther (1904) included in West River shale, redefined as member of Genesee formation. The Standish flags are insufficiently different lithologically to warrant separation from the West River.

Named for Standish Gully, town of Italy, Yates County.

**Standpipe Limestone Member** (of Arroyo Formation)

Standpipe Limestone Member (of Clear Fork Formation)[1]

Permian (Leonard Series): North-central Texas.

Original reference: M. G. Cheney, 1929, Texas Univ. Bull. 2913, p. 27, pl. 1.

M. G. Cheney, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 1, p. 66 (fig. 1). Shown on chart as uppermost member of Arroyo formation. Overlies Lytle limestone member; lies stratigraphically below Bullwagon dolomite member of Vale formation.

Type locality: At base of hill upon which is located standpipe in eastern part of Abilene, Taylor County.

Standpipe Sandstone (in Elmdale Formation)[1]

Pennsylvanian: Central northern Oklahoma.

Original reference: F. C. Greene, 1928, Oklahoma Geol. Survey Bull. 40CC.

In Pawnee County.

**Stanford Conglomerate**[1]

Probably Tertiary, upper: Central northern Montana.

Original reference: W. H. Weed, 1899, U.S. Geol. Survey Geol. Atlas, Folio 55.

Occurs in very prominent hills rising above flat prairie near Stanford, Judith Basin County.

**Staniukovich Shale**[1]

Upper Jurassic: Southwestern Alaska.

Original reference: W. W. Atwood, 1911, U.S. Geol. Survey Bull. 467, p. 25, 38.

R. W. Imlay, 1952, Geol. Soc. America Bull., v. 63, no. 9, p. 978. Of Portlandian (Upper Jurassic) age.

Exposed on Herendeen Bay, also on Staniukovich Mountain, and east to Port Moller; Alaska Peninsula.

**Stanley Shale**[1]

Stanley Group

Mississippian: Central southern and southeastern Oklahoma and western Arkansas.

Original reference: J. A. Taff, 1902, U.S. Geol. Survey Geol. Atlas, Folio 79.

H. D. Miser, 1920, Geol. Soc. America Bull., v. 31, p. 125. Includes Hatton tuff lentil (new).

N. H. Stearn *in* J. M. Hansell and J. C. Reed, 1935, Am. Inst. Mining Metall. Engineers Trans., v. 115, p. 245; N. H. Stearn, 1936, Econ. Geology, v. 31, no. 1, p. 12–16. Thickness of shale about 2,500 feet in Little Missouri River part of Arkansas quicksilver district. Includes Parker Hill and Gap Ridge members (both new) in lower part.

B. H. Harlton, 1938, Am. Assoc. Petroleum Geologists Bull., v. 22, no. 7, p. 854 (fig. 1), 856, 864–878. Rank raised to group. Divided into (ascending) Ten Mile Creek, Moyers, and Chickasaw Creek formations (all new). Maximum thickness about 7,000 feet. Underlies Jackfork group. Basal group of Pushmataha series (new) which is included in the Bendian.

R. C. Moore and others, 1944, Geol. Soc. America Bull., v. 55, no. 6, chart 6 (column 35). Stanley shale shown on correlation chart above Hot Springs sandstone and below Jackfork sandstone. 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).

B. H. Harlton, 1947, Tulsa Geol. Soc. Guidebook Field Conf., May 9 and 10, p. 41. Includes Albion shale (new).

W. H. Hass, 1950, Am. Assoc. Petroleum Geologists Bull., v. 34, no. 7, p. 1578. On basis of conodont studies, it is believed that some part of Stanley shale—including Hatton tuff lentil and barite deposits of Arkansas—is Mississippian (Meramec) in age and correlative with Caney shale of Oklahoma and Barnett formation of Texas.

H. D. Miser and others, 1954, Geologic map of Oklahoma (1:500,000): U.S. Geol. Survey. Shale mapped as Mississippian and Pennsylvanian.

L. M. Cline, 1960, Oklahoma Geol. Survey Bull. 85, p. 22–41, pl. 1. Group attains best development in central Ouachitas where it comprises about 11,000 feet of strata, prevailingly shaly but with sandstone becoming prominent in upper 1,500 feet. Includes (ascending) Tenmile Creek, Moyers, and Chickasaw Creek formations. Underlies Jackfork group. Mississippian, Meramecian.

H. D. Miser and T. A. Hendricks, 1960, Am. Assoc. Petroleum Geologists Bull., v. 44, no. 11, p. 1829–1834. Age Mississippian. Presentation of brief summary of development of different age interpretations that have been given for Stanley shale, Jackfork sandstone, and Johns Valley shale.

Named for Stanley, Pushmataha County, Okla.

Stansbury Formation

Devonian-Mississippian(?): Northwestern Utah.

W. L. Stokes and D. E. Arnold, 1958, Utah Geol. Soc. Guidebook 13, p. 135–148; J. K. Rigby, 1958, Utah Geol. Soc. Guidebook 13, p. 36–39, geol. map. Includes clastic section which underlies Pinyon Peak limestone and overlies pronounced Late Devonian unconformity. Varies rapidly in facies and thickness from place to place. Pebble and cobble conglomerate characterize formation at its northern outcrops near Flux. Southward, in Mining Canyon, formation is predominantly siltstone and vitreous sandstone with minor thin beds of platy dark-gray limestone and dolomite; quartzitic sandstone overlies entire unit with some angularity within the formation. Along the southern and western side of the range consists of minor conglomerate beds with interbedded limestone and dolomite. Thickness about 1,700 feet at northern end of range. Overlies Simonson(?) dolomite. Devonian-Mississippian(?).

J. K. Rigby, 1959, Utah Geol. Soc. Guidebook 14, p. 14 (fig. 1), 29 (fig. 9), 30–31, pl. 1. Described in southern Oquirrh Mountains where it is 10 to 190 feet thick; underlies Gardner dolomite and overlies Opex dolomite. Upper Devonian.

Type section: Well exposed and continuous outcrop lying partly in sec. 6, T. 2 S., R. 6 W., and continuing westward into sec. 1, T. 2 S., R. 7 W. No one section is entirely "typical," but all constituent lithologic types are best exposed in Stansbury Mountain section. Name taken from Stansbury Range, Tooele County.

Stanton facies (of New Providence Formation)

Lower Mississippian: Central Kentucky.

P. B. Stockdale, 1939, Geol. Soc. America Spec. Paper 22, p. 77, 121–125. Southernmost facies of formation. Merges with Boone Gap facies (new) to the west and with Bluestone facies (new) to the northeast. Consists almost entirely of clayey shale, generally blue gray or drab with persistent, though thin, Clay City siltstone member (new) near base. Thickness ranges from 275 to 300 feet or more. Underlies Christy Creek member of Brodhead formation, Morehead facies (all new); overlies Sunbury black shale.

Typical exposure: Along secondary road leading from Stanton to Hatcher Creek Church and School, at north side of Red River, 1 mile north-northeast of Louisville and Nashville Railroad Station at Stanton, Powell County. Named for city of Stanton.

**Stanton Limestone** (in Lansing Group)[1]

Stanton Limestone Member (of Lansing Formation)[1]

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

Original reference: G. C. Swallow and F. Hawn, 1865, Kansas Geol. Survey Rept. on Miami County, p. 6.

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), 117; F. C. Greene and W. V. Searight, 1949, Missouri Geol. Survey and Water Resources Rept. Inv. 11, p. 14. Stanton formation in Lansing group; overlies Vilas shale; underlies Weston shale of Pedee group;

includes (ascending) Captain Creek limestone, Eudora shale, Stoner limestone, Rock Lake shale, and South Bend limestone members. 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. 24, fig. 5. Uppermost formation of Lansing group. Present only in western Madison, eastern Adair, and southern Ringgold Counties. In Ringgold County, consists of 13 feet of light- to dark-gray thinly bedded argillaceous limestone containing shale partings and many white brachiopod and gastropod sections. In Adair and Madison Counties, unit is 8 feet thick and commonly is a sequence of three gray and black nodular limestones separated by shales. Upper shale is gray and fossiliferous with brachiopod and crinoid fragments. Lower shale is black and carbonaceous. Overlies Vilas shale; underlies Douglas-Pedee group.

Type locality: In roadcut near SE cor. sec. 3, T. 13 S., R. 21 E., and adjacent area along Captain Creek. Named for Stanton, Miami County, Kans.

†Stanton limestone series[1]

Pennsylvanian: Eastern Kansas.

Original reference: G. C. Swallow, 1866, Kansas Geol. Survey Prelim. Rept., p. 20.

Probably named for its topmost member, the Stanton limestone.

Stapp Conglomerate Member (of Union Valley Formation)

Pennsylvanian (Morrow Series): Southeastern Oklahoma.

B. H. Harlton, 1938, Am. Assoc. Petroleum Geologists Bull., v. 22, no. 7, p. 890, 893–895. Proposed for the conglomerate occurring at base of formation. Consists of rounded pebbles and boulders of chert and limestone, ranging in thickness from fraction of an inch to masses 3 feet in diameter; bedding planes absent; intercalated thin lenses of sandstone and conglomeratic sandstone show crossbedding; near top is thin black shale which is overlain by coarse loosely consolidated conglomerate. Overlies Wesley formation (new). Unit formerly considered as base of the Atoka.

Well exposed in Kansas City Southern Railway cut, 1 mile south of Stapp in SW¼SW¼ sec. 7, T. 3 N., R. 26 E., Le Flore County.

†Staran series[1]

Upper(?) Triassic: Nevada.

Original reference: C. R. Keyes, 1923, Pan-Am. Geologist, v. 40, p. 52, 59.

Named for exposures in Star Peak Mountain, Humboldt County.

Starbo altered tuffs

*See* Keechelus Andesitic Series.

**Stark Complex**

Precambrian: Northeastern New York.

A. F. Buddington, 1948, Geol. Soc. America Mem. 28, p. 24, 25–28. Quartz syenitic complex. Attitudes of foliation, arrangement of various lithologic facies of the complex, and structural relationships to country rock are all consistent with hypothesis that Stark, Loon Lake (new), and Jennings Mountain (new) complexes are all exposed on core of domes or anticlines which are either closely folded or isoclinally overturned. Pyroxene quartz syenite is exposed on core of each, and hornblende quartz syenite and hornblende granite overlie it.

Forms elongate mass extending southwest from Santa Clara, Franklin County. Complex is about 45 miles long and underlies about 275 square miles.

**Stark Shale[1] Member** (of Dennis Limestone or Formation)

Stark Shale Member (of Hogshooter Formation)

Upper Pennsylvanian (Missouri Series): Eastern Kansas, southwestern Iowa, western Missouri, and northern Oklahoma.

Original reference: R. C. Moore, 1932, Kansas Geol. Soc. Guidebook 6th Ann. Field Conf., p. 91, 97.

M. C. Oakes, 1940, Oklahoma Geol. Survey Bull. 62, p. 43; 1952, Oklahoma Geol. Survey Bull. 69, p. 59. In Oklahoma, considered member of Hogshooter formation. Overlies Canville limestone member; underlies Winterset limestone. Thickness 3 to 10 feet.

R. C. Moore, 1948, Am. Assoc. Petroleum Geologists Bull., v. 32, no. 11, p. 2031 (fig. 4). Shale member of Dennis formation. Overlies Canville limestone member; underlies Winterset limestone member. This is classification agreed upon by State Geological Survey 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. 11–12. Galesburg formation redefined to exclude Canville limestone and Stark shale. Latter units included in Dennis formation.

T. L. Welp, L. A. Thomas, and H. R. Dixon, 1957, Iowa Acad. Sci. Proc., v. 64, p. 421. Thickness about 4 feet near Winterset, Iowa.

H. G. Hershey and others, 1960, Iowa Highway Research Board Bull. 15, p. 27, fig. 5. Member of Dennis limestone. Dark gray and fossiliferous at top; black fissile at base. Thickness 1.8 to 2.9 feet in Madison County; 5 feet in cores from Pottawattamie County. Overlies Canville limestone member; underlies Winterset limestone member.

Type locality: Near Stark, Neosho County, Kans.

Starkey Tongue (of Sherburne Formation)

Upper Devonian: West-central New York.

W. L. Grossman, 1944, Geol. Soc. America Bull., v. 55, no. 1, p. 66–68. Name proposed for interbedded medium quartz siltstone flags, gritty micaceous blue-gray and dark-gray shales, and some black shales; flags become thinner westward. Thickness 140 feet in type area; maximum 240 feet. In type locality, top is marked by Keuka flagstone lentil, and base is placed at Crosby lentil; first appearance of heavy and closely spaced flags identifies base in area to the east where Crosby not recognized. Penetrates West River shale between Penn Yan tongue (new) below and Milo tongue (new) above. Unit erroneously termed Standish; highest calcareous crinoidal bed was erroneously designated Parrish limestone, and a black shale band was incorrectly called Rhinestreet shale.

Wallace de Witt, Jr., and G. W. Colton, 1959, Am. Assoc. Petroleum Geologists Bull., v. 43, no. 12, p. 2825 In vicinity of Keuka and Seneca

Lakes, Ithaca member of Genesee formation of this report was named Starkey tongue of Sherburne formation by Grossman. However, this sequence of silty rocks is lateral extension of Ithaca member from its type area and is not tongue of Sherburne as Grossman believed.

Type locality: Crosby Gully on east side of Keuka Lake. Named from Starkey Township, Yates County, on west side of Seneca Lake. Extends from Cayuga Lake area to within few miles of east shore of Canandaigua Lake.

Starmount Limestone[1]

Middle Cambrian: Western central Montana.

Original reference: W. H. Weed, 1901, U.S. Geol. Survey 22d Ann. Rept., pt. 2, p. 434, 435, map.

Named for Starmount mine, Elkhorn mining district, Elkhorn region.

Star Mountain Rhyolite (in McCutcheon Volcanic Series)

Tertiary: Southwestern Texas.

G. K. Eifler, Jr., 1951, Geol. Soc. America Bull., v. 62, no. 4, p. 345, pl. 1. Named applied to thick rhyolitic lavas overlying Huelster formation (new) and underlying Seven Springs formation (new). Rock is typically black to brownish black, but some parts, particularly the lower, are green, greenish gray, and purplish lavender. Thickness at type locality 496 feet; thins to northeast; north of Jeff Ranch it is 262 feet thick.

Type locality: Star Mountain, Barrilla Mountains, Reeves County.

**Star Peak Formation**[1]

**Star Peak Group**

Middle and Upper Triassic: Northern Nevada.

Original references: C. King, 1876, U.S. Geol. Expl. 40th Par. Atlas, map 5; 1878, U.S. Geol. Expl. 40th Par., v. 1, p. 267–278, 544.

H. E. Wheeler, 1940, 6th Pacific Sci. Cong. Proc., v. 1, p. 369, 373 (fig. 2) [preprint 1939]. Middle Triassic. Overlies Weaver rhyolite.

R. E. Wallace and others, 1959, U.S. Geol. Survey Mineral Inv. Field Studies Map MF–220. Rank raised to group. Includes Prida formation below and Natchez Pass formation. Overlies Weaver rhyolite of Koipato group with angular unconformity. Underlies Grass Valley formation, possible disconformity. Middle and Upper Triassic.

Named for development at Star Peak Mountain in West Humboldt Range.

**Star Point Sandstone** (in Mesaverde Group)[1]

Star Point Sandstone

Upper Cretaceous: Central eastern Utah.

Original reference: E. M. Spieker and J. B. Reeside, Jr., 1925, Geol. Soc America Bull., v. 36, p. 442.

R. G. Young, 1955, Geol. Soc. America Bull., v. 66, no. 2, p. 182–183, fig. 2, pl. 3. Redefined in area to north and east of Spring Canyon, keeping base as base of Panther sandstone, but placing upper boundary at top of Storrs sandstone. Spring Canyon tongue reassigned to overlying Blackhawk formation. Change of upper boundary impractical to the west and south in Wasatch Plateau where Spring Canyon, Storrs, and Panther sandstones unite to form single massive littoral marine tongue. Dated as medial Montana. Not included in Mesaverde group—a term no longer used in Book Cliffs. Present only in western part of Book Cliffs.

Named from Star Point, a striking headland of Gentry Mountain southwest of Price, and about 3 miles west of southwest corner of Castlegate quadrangle, Carbon County. In Wasatch Plateau and Book Cliffs.

†Starr Conglomerate[1]

†Starrs Conglomerate[1]

Lower Cambrian: Southeastern Tennessee.

Original reference: C. W. Hayes, 1895, U.S. Geol. Survey Geol. Atlas, Folio 20, p. 2.

John Rodgers, 1953, Tennessee Div. Geology Bull. 58, pt. 2, p. 29. Starr conglomerate is a synonym of Cochran conglomerate and should be abandoned.

Named for exposure near Starr Mountain, Monroe County.

Starrs Cave Formation (in North Hill Group)

Mississippian (Kinderhook Series): Southeastern Iowa and northwestern Illinois.

L. E. Workman and Tracey [Tracy] Gillette, 1956, Illinois Geol. Survey Rept. Inv. 189, p. 8 (fig. 1), 31, pl. 1. Proposed for a buff to light-brownish-gray coarsely oolitic limestone that is locally dolomitic and contains small amounts of silt. Thickness 2⅔ feet; in six wells in Hancock County, Ill., 2 to 12 feet. Conformably overlies Prospect Hill siltstone; unconformably underlies Burlington limestone. Name credited to Charles Collison.

Type section: Flint River bluff near Starrs Cave, NW¼NW¼ sec. 19, R. 2 W., T. 70 N., Des Moines County, Iowa.

Starrucca Sandstone[1]

Upper Devonian: Northeastern Pennsylvania.

Original reference: C. S. Prosser, 1894, U.S. Geol. Survey Bull. 120, p. 78.

Starrucca Shale (in Catskill or Chemung Formation)[1]

Starrucca (Starucca) Shale (in Cayuta monothem)

Upper Devonian: Northeastern Pennsylvania.

Original reference: I. C. White, 1881, Pennsylvania 2d Geol. Survey Rept. $G_5$, p. 59, 70, 73.

K. E. Caster, 1938, Jour. Paleontology, v. 12, no. 1, p. 45 (fig. 7), 47, 50. Starruca shale was originally differentiated by White (1881) from overlying New Milford red shale and from underlying "Chemung," but draftsman apparently included it by mistake with New Milford red shale. Just where Willard would draw boundary of his Kingsley, which is White's New Milford under new geographic name, is not clear. It is herein considered that the Starruca is a distinct unit, which comes at about proper position to constitute top of Cayuta shale monothem.

Well exposed along Jefferson Branch Railroad above Starucca [Starrucca] Bridge, also near mouth of Starucca Creek, Susquehanna County.

State Bridge Siltstone

State Bridge Siltstone Member (of Maroon Formation)

Permian(?): Northwestern Colorado.

C. F. Bassett, 1939, Geol. Soc. America Bull., v. 50, no. 12, pt. 1, p. 1853, 1864. Upper member of Maroon formation. Overlies Rock Creek member (new). Chiefly thin-bedded micaceous brick-red siltstone, shale, and fine limy sandstone. Thickness 525 feet. Name credited to H. F. Donner (unpub. thesis).

K. G. Brill, Jr., 1942, Am. Assoc. Petroleum Geologists Bull., v. 26, no. 8, p. 1392–1393. Donner's manuscript name State Bridge is used as formation and applied in Gore area to upper Pennsylvanian or Permian sediments which lie between Battle Mountain formation and the Triassic. Thickness on North Fork of Piney River 225 feet; 750 feet on Red and White Mountain. Donner's type locality stated; there formation is 525 feet thick, conformably overlies McCoy formation, and disconformably underlies Shinarump conglomerate.

K. G. Brill, Jr., 1952, Geol. Soc. America Bull., v. 63, no. 8, p. 823–825. Permian (Guadalupian). On eastern side of McCoy area, State Bridge overlies Maroon formation, but on western side, Schoolhouse tongue of Weber sandstone lies between Maroon and State Bridge. Since Maroon formation is here limited to beds that underlie Schoolhouse tongue, unit termed South Canyon [Creek] dolomite member of Maroon (Bass and Northrop, 1950), in vicinity of Glenwood Springs appears to be member of State Bridge formation.

Type section: South slope of Yarmony Mountain, 0.3 mile north of State Bridge, Eagle County.

State Farm Gneiss

Precambrian: Central Virginia.

C. B. Brown, 1937, Virginia Geol. Survey Bull. 48, p. 13–14. Relatively uniform even-banded gneiss with well-developed foliation. Light to dark gray and medium grained. Shows only limited amount of folding in any single outcrop; and shows numerous divergences in structure from regional trend.

Type locality: State Farm quarries on Chesapeake and Ohio Railway, Goochland County. Named from typical outcrops near State Farm.

†State Line Serpentine[1]

Precambrian: Northeastern Maryland and southeastern Pennsylvania.

Original reference: F. D. Chester, 1889, Pennsylvania 2d Geol. Survey Ann. Rept. 1887, p. 93–105.

Named for fact it occurs fully 16 miles along boundary between Pennsylvania and Maryland.

Staten Island Serpentine[1]

Precambrian(?): Southeastern New York and New Jersey.

Original reference: F. J. H. Merrill, 1898, New York State Mus. 15th Ann. Rept. v. 1, p. 21–31.

Forms elevated part of Staten Island, N.Y., and the Knob at Castle Point, in Hoboken, Hudson County, N.J.

State Pond Member (of Springville Shale)

Mississippian (Valmeyer): Southern Illinois.

Charles Collinson and A. J. Scott, 1958, Illinois Geol. Survey Circ. 254, p. 1, 3, 4, 5. Proposed for unit of soft shale at base of redefined Springville shale. Lower part is greenish and calcareous; upper 1½ inches consists of dark-green to black phosphate nodules. Thickness 14 to 15 inches. Overlies Chouteau formation; underlies hard tannish to greenish-gray poorly laminated shale characteristic of upper part of Springville.

Exposed in south bank of stream below spillway of State Pond Dam in NW¼SE¼ sec. 14, T. 12 S., R. 2 W., Union County.

**State Quarry Limestone**[1]

Upper Devonian: Central eastern Iowa.

Original reference: S. Calvin, 1897, Iowa Acad. Sci. Proc., v. 4, p. 16–21.

G. A. Cooper and others, 1942, Geol. Soc. America Bull., v. 53, no. 12, pt. 1, p. 1783, chart 4. Occupies erosion pockets in Cedar Valley limestone in limited area. Fauna suggests a position low in Upper Devonian, and formation has been placed at top of Genesee group; possibly it should be placed higher in Naples stage (Ithaca).

Named for State quarry (or North Ben quarries), Penn Township, Johnson County.

†State Road Conglomerate[1]

Precambrian (lower Huronian): Northwestern Michigan.

Original reference: C. R. Van Hise and C. K. Leith, 1911, U.S. Geol. Survey Mon. 52, p. 257.

Occurs north of Mud Lake and along an old road known as State Road in Marquette district.

**Staunton Formation**[1]

Middle Pennsylvanian: Southwestern Indiana.

Original reference: E. R. Cumings, 1922, Handb. Indiana Geology, pt. 4, Sep. Pub. 21, p. 408, 525, 529, chart.

R. C. Moore and others, 1944, Geol. Soc. America Bull., v. 55, no. 6, chart 6 (column 25). Shown on correlation chart as including Velpen limestone.

C. E. Wier, 1950, U.S. Geol. Survey Coal Inv. Map C–1. Described in Clay, Greene, and Sullivan Counties. As defined by Cumings contained Coals III, IIIa, and IV. Stratigraphic break is present above Coal III and Staunton is here restricted to rocks above this break and unconformity above Coal II. Restricted Staunton comprises sandstone and shale, and averages about 85 feet in thickness. Remainder of Staunton as originally defined is assigned to Linton formation (new). Overlies Brazil formation (not exposed in area of this report, Jasonville quadrangle).

Named for Staunton, Clay County.

Stayton Lavas[1]

Miocene, middle: Northwestern and central northern 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. 15, p. 8–9, fig. 1. Stayton lavas overlie Illahe formation in Salem Hills and have been traced eastward continuously to crest of Mehama anticline. Maximum thickness about 400 feet in Salem Hills; increase in thickness toward the northeast; less than 200 feet thick east and southeast of Stayton. Unconformable above Illahe and Mehama formations Stayton lavas may be marginal flows of Columbia River basalt and are tentatively correlated with them. Middle Miocene.

W. D. Lowry and E. M. Baldwin, 1952, Geol. Soc. America Bull., v. 63, no. 1, p. 5. Columbia River basalts in vicinity of Salem and Stayton, Oreg., were named Stayton lavas by Thayer (1939) because Columbia River basalt had not yet been traced southward into that area. However, it seems advisable to drop name Stayton lavas in preference to Columbia River basalt, and except for intervening alluvial fill of Willamette River, exposures would be continuous.

R. E. Corcoran and F. W. Libbey, 1956, Oregon Dept. Geology and Mineral Industries Bull. 46, p. 7–8, pl. 1. In Salem Hills area. Eugene formation is overlain unconformably by series of basalts called Salem lavas in Salem quadrangle by Mundorff (1939, unpub. thesis) and Stayton lavas in that general region by Thayer (1939). Salem-Stayton lavas are time-rock equivalents of Columbia River basalt, if not actually part of same series of flows.

I. S. Allison and W. M. Felts, 1956, Geology of the Lebanon quadrangle, Oregon (1:62,500): Oregon Dept. Geology and Mineral Industries. Thickness 500 to 600 feet in Lebanon quadrangle. Unconformably overlies Eugene formation.

Forms Salem Hills, southwest of Salem and also Stayton Basin east of Salem, Marion County.

**Steamboat Limestone**[1]

Middle Cambrian: Northwestern Montana.

Original reference: C. F. Deiss, 1933, Montana Bur. Mines and Geology Mem. 6, p. 37.

Charles Deiss, 1938, Geol. Soc. America Bull., v. 49, no. 7, p. 1089–1090. Middle Cambrian section in Lewis and Clark Range redefined. Steamboat limestone has proved to be part of upper Dearborn limestone which was repeated in Dearborn section by low angle overthrust. Therefore, rocks to which name Steamboat was applied do not exist, and this name is herein applied to limestone and shale formerly designated Gordon Mountain limestone which lies betwen Pagoda or Pentagon and overlying Switchback formation. Thickness about 216 feet.

Charles Deiss, 1939, Geol. Soc. America Spec. Paper 18, p. 45. Overlies Pentagon shale in northern sections and Pagoda limestone in central and southern sections. Thickness 216 feet near Pentagon Mountain; 353 feet on ridge between Kid and Gordon Mountains. Type section described in detail.

Type locality: Crest of Prairie Reef from 54 feet below top of peak northwestward to base of Switchback shale. Name taken from Steamboat Mountain, which lies just north of Dearborn River [Lewis and Clark County].

**Steamboat Hills Rhyolite**

Pliocene or Pleistocene: Central western Nevada.

G. A. Thompson, 1956, U.S. Geol. Survey Bull. 1042–C, p. 58–59, pl. 3. Described as extrusive domes of fresh pumiceous rhyolite, containing very sparse phenocrysts of sanidine, quartz, plagioclase, and biotite. Some of the rhyolite is perlite and very little is obsidian. Younger than Lousetown formation in Virginia City quadrangle.

Named for occurrence in Steamboat Hills, 2½ miles west of Virginia City quadrangle. Also occurs in two widely separated areas within quadrangle, one along west base of Virginia Range, northeast of Steamboat Hills, and other at Sutro Springs, on east side of Flowery Range.

Stearns Magma Series

Precambrian (middle Keweenawan) : Central Minnesota.

M. S. Woyski, 1949, Geol. Soc. America Bull., v. 60, no. 6, p. 1001, 1002, 1005–1009, pl. 1. Includes (ascending) Crystal Gray quartz monzonite, quartz latite porphyry, porphyritic granite, Rockville quartz monzonite, and St. Cloud Red granite.

Occurs in parts of Stearns, Wright, Sherburne, Benton, and Mille Lacs Counties.

**Stearns Shale** (in Council Grove Group)[1]

Permian: Southeastern Nebraska and eastern Kansas.

Original reference: G. E. Condra, 1927, Nebraska Geol. Survey Bull. 1, 2d ser., p. 230, 233, 234, 235, 237.

R. C. Moore and others, 1951, Kansas Geol. Survey Bull. 89, p. 46; K. L. Walters, 1954, Kansas Geol. Survey Bull. 106, p. 48, pl. 1. Contains minor amount of impure limestone; mostly gray to olive but red shale occurs in middle and lower parts; locally contains thin coal bed in Lyon and Morris Counties, Kans. Thickness ranges from about 7 feet in southern Kansas to about 20 feet in northern part of State. Underlies Eiss limestone member of Bader limestone; overlies Morrill limestone member of Beattie limestone. Wolfcamp series.

Type locality: South of Stearns School, 1½ miles northeast of Humboldt, Richardson County, Nebr. Type section now obscured, but member typically exposed along a north-south road, 6 miles south and 1½ miles east of Humboldt.

**Steele Shale** (in Montana Group)[1]

Upper Cretaceous: Eastern and central Wyoming.

Original reference: N. H. Darton, Eliot Blackwelder, and C. E. Siebenthal, 1910, U.S. Geol. Survey Geol. Atlas, Folio 173.

C. J. Hares and others, 1946, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 51. Stratigraphic section [northeastern part of Wind River basin and adjacent areas in central Wyoming] shows that term Cody shale replaces terms Carlile shale, Niobrara shale, and Steele shale as used in this area by Hares (1916, U.S. Geol. Survey Bull. 641–I).

G. H. Horn, 1955, U.S. Geol. Survey Oil and Gas Inv. Map OM–164. Thickness in Sussex and Meadow Creek oil fields, Johnson and Natrona Counties, 2,240 feet, a little more than one-half of formation exposed. Includes (ascending) Shannon sandstone member and Sussex sandstone member (both exposed). Underlies Parkman member of Mesaverde formation; overlies Niobrara formation.

J. M. Parker, 1958, Wyoming Geol. Assoc. Guidebook 13th Ann. Field Conf., p. 90, 98. Stratigraphic unit terms Lewis, Mesaverde, Steele, Cody, Ferguson, and Ash Creek are believed to be misnomers and should not be used in Powder River basin.

J. R. Bergstrom, 1959, Rocky Mountain Assoc. Geologists 11th Field Conf., Symposium, p. 114 (columnar section). In southeastern Wyoming, underlies Allen Ridge formation (new).

Type locality: Fort Steele on North Platte River, Carbon County.

Steele Valley Granodiorite[1]

Upper Jurassic(?): Southern California.

Original reference: P. H. Dudley, 1935, California Jour. Mines and Geology, v. 31, no. 4, p. 491, 502, map.

E. S. Larsen, Jr., 1948, Geol. Soc. America Mem. 29, p. 76. Rocks called Steele Valley granodiorite by Dudley (1935) belong to Woodson Mountain granodiorite, which is considered Cretaceous.

Occurs in Steele Valley, in southern part of Perris-Elsinore area, Riverside County.

Steels Knob chert facies (of Muldraugh Formation)

Lower Mississippian: Central Kentucky.

P. B. Stockdale, 1939, Geol. Soc. America Spec. Paper 22, p. 75, 201–211. Characterized by bedded chert, in layers up to 4 feet thick, which constitutes as much as 50 percent of the formation at places. Thickness 60 to 75 feet. Underlies Harrodsburg limestone; overlies Floyds Knob formation. Merges with West Point facies (new) on the west and Maretburg facies (new) on the east.

Well exposed along State Highway 49, Casey County, at steep hill from plateau to valley of Martins Creek, around Steels Knob. Name taken from topographic promontory in Casey County known as Steels Knob.

**Steens Basalt**[1]

Pliocene, middle: Southeastern Oregon.

Original reference: R. E. Fuller, 1931, Washington Univ. Pub. Geol., v. 3, no. 1, p. 7–130.

A. M. Piper, 1936, Oregon Country Geol. Soc. News Letter, v. 2, no. 8, p. 10. Steens basalt unconformably overlies siliceous extrusives in marginal upland along eastern half of Harney basin. Maximum thickness 3,000 feet. Underlies Danforth formation (new).

A. M. Piper, T. W. Robinson, and C. F. Park, Jr., 1939, U.S. Geol. Survey Water-Supply Paper 841, p. 26 (table), 49–51, pl. 2. Basalt series named Steens Mountain basalt by Fuller (1931) is here designated Steens basalt. At type section, series is more than 3,000 feet thick and comprises many layers whose thickness varies but averages about 10 feet. Underlies Danforth formation; in type area, overlies an andesitic series. Miocene.

Howel Williams, and R. R. Compton, 1953, U.S. Geol. Survey Bull. 995–B, p. 24 (table), 29–30, pl. 9. Described as cliff-forming flows of olivine basalt with rare partings of tuff. Overlies Steens Mountain volcanic series; in the High Steens, a distinct unconformity separates the two units, but below Smith Flat the two series are either conformable or their divergence of dip is so slight as to be imperceptible. Middle Pliocene.

Type section: Along highest part of east face of Steens Mountain, about 20 miles east of head of Donner and Blitzen Valleys, Harney County.

†Steens Mountain Basalt[1]

Miocene: Southeastern Oregon.

Original reference: R. E. Fuller, 1931, Washington [State] Univ. Pub. in Geology, v. 3, no. 1, p. 7–130.

A. M. Piper, T. W. Robinson, and C. F. Park, Jr., 1931, U.S. Geol. Survey Water-Supply Paper 841, p. 49. Basalt series named Steens Mountain basalt by Fuller (1931) is here designated Steens basalt.

Exposed almost continuously for 100 miles on east scarp of Steens and Pueblo Mountains.

Steens Mountain Formation[1]

Pliocene: Southeastern Oregon.

Original reference: W. D. Smith, 1926, Oregon Univ. Commonwealth Rev., v. 8, p. 207–214.

Typically exposed on Steens Mountain, Harney County.

**Steens Mountain Volcanic Series**

Steens Mountain Andesitic Series[1]

Pliocene, lower: Southeastern Oregon.

Original reference: R. E. Fuller, 1931, Washington [State] Univ. Pub. in Geology, v. 3, no. 1, p. 7–130.

Howel Williams and R. R. Compton, 1953, U.S. Geol. Survey Bull. 995–B, p. 24 (table), 28–29, pls. 8, 9. Described as Steens Mountain volcanic series. Consists of olivine and augite basalts and amygdaloidal andesites rich in zeolites. Locally thick sheets of dacite and rhyolite cap the basic lavas. Pyroclastic interbeds rare and thin. Total thickness more than 3,000 feet in Southern Steens and Pueblo Mountains. Underlies Steens basalt; unconformably overlies Pike Creek volcanic series. Early Pliocene.

Occurs in area of Steens Mountain, Harney County.

**Steep Gully 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. 59–60. Comprises basal deposits of Foley penetrated below a depth of 200 feet by water wells and oil-test wells in vicinity of Elizabeth. Consists of a sequence of medium- to fine-grained sands interbedded with light-gray, gray-green, and blue structureless to thinly laminated clays. Beds dip south-southwestward at rates ranging from about 60 to 80 feet per mile; estimated that bottom of formation is at a depth of about 2,500 feet at Mamou, about 18 miles downdip from [Oakdale]. Underlies Mamou member (new) with contact gradational.

Named from Steep Gully Branch near town of Elizabeth in T. 2 S., R. 4 W., in Allen Parish, about 8 miles northwest of Oakdale. Most reliable records of member were obtained during drilling wells at Oakdale.

**Steilacoom Gravel**[1]

Pleistocene (Wisconsin): Western Washington.

Original reference: B. Willis, 1898, Geol. Soc. America Bull., v. 9, p. 111.

Type section: The Steilacoom Plains, which extend for many miles south and southwest from Tacoma, Puget Sound region.

Steins Mountain Quartz Latite Porphyry

Tertiary: Southwestern New Mexico.

Elliot Gillerman, 1958, New Mexico Bur. Mines Mineral Resources Bull. 57, p. 69, table 1, pl. 1. Columnar jointed flows and devitrified tuffs. Rock is pinkish-gray porphyritic-aphanitic, with quartz and feldspar phenocrysts and numerous lithic and vitric fragments, many of which are flattened and elongated, imparting an eutaxitic structure to the rock. Conformably overlies unnamed basalt. No rock overlies unit in mapped area, but it is intruded by latite porphyry dikes.

Mapped in north-central part of Peloncillo Mountains, Hidalgo County, where it forms upper part of Steins Mountain and the hills to the east. North and northwest of mapped area it is extensively exposed.

Stennett Limestone (in Shawnee Formation)[1]

Pennsylvanian: Southwestern Iowa.

Original reference: S. W. Beyer and I. A. Williams, 1907, Iowa Geol. Survey, v. 17, p. 480.

Typically developed at Stennett, Montgomery County.

**Stensgar Dolomite** (in Deer Trail Group)

Stensgar Dolomite Member[1] (of Deer Trail Argillite)

Precambrian (Belt Series): Northeastern Washington.

Original reference: C. E. Weaver, 1920, Washington Geol. Survey Bull. 20, v. 57, map.

W. A. G. Bennett, 1941, Washington Div. Geology Rept. Inv. 5, p. 7. Termed a dolomite in Deer Trail group.

Ian Campbell and J. S. Loofbourow, Jr., 1946, (abs.) Geol. Soc. America Bull., v. 57, no. 12, pt. 2, p. 1250. Named as next to youngest of five formations in Deer Trail group. Overlies McHale slate (new); underlies Buffalo Hump formation (new).

Occurs near Stensgar Mountain, Stevens County.

Stephens 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 phases. Near Stephens siding, consists of about 40 feet of laminated silty sandstone with an alternation of dark- and light-colored fine sand and silt. Separated from underlying Crooked Fork group (new) by shale interval 30 to 140 feet thick; separated from overlying Petros sandstones (new) by shale interval 40 to 240 feet thick that contains Coal Creek coal.

Named from exposures along State Highway 62, south of Stephens siding, Petros quadrangle, Morgan County.

†Stephensport Bed (in Chester Group)[1]

Mississippian: Northwestern Kentucky and southwestern Indiana.

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

Named for Stephensport, Breckinridge County, Ky.

Stephensport Group[1]

Mississippian (Chester Series): Western Kentucky, Illinois, and southern Indiana.

Original reference: E. R. Cumings, 1922, Indiana Dept. Conserv. Pub. 21, pt. 4, p. 514 (footnote).

H. H. Gray, R. D. Jenkins, and R. M. Weidman, 1960, Indiana Geol. Survey Bull. 20, p. 36 (table 5), 37–44, pl. 1. Cumings (1922) suggested name Stephensport as a group to include formations now known as Glen Dean, Hardinsburg, Golconda, and Big Clifty. Term was little used. Proposed here to revive Cuming's group name, Stephensport. As here redefined consists of (ascending) Beech Creek limestone, Big Clifty formation, Golconda limestone (restricted), Hardinsburg formation, and Glen Dean limestone (restricted). Thickness 128 to 158 feet. Overlies West Baden group (redefined); unconformably underlies Mansfield formation.

Named for town of Stephensport, Breckinridge County, Ky., in vicinity of which all formations of group are exposed.

Stepovak Series[1]

Eocene: Southwestern Alaska.

Original reference: Charles Palache, 1904, Harriman Alaska Expedition, v. 4, p. 74.

G. C. Kennedy and H. H. Waldron, 1947, U.S. Geol. Survey Alaskan Volcano Inv. Rept. 2, pt. 2, p. 12. "Lower beds" of series exposed in vicinity of Chichagof Peak, about 85 miles northeast of Belkofski Bay, described as pyroclastics of early Eocene age.

Occupies most of area studied about Chicagof Cove, Stepovak Bay, on Alaska Peninsula.

Steptoean series[1]

Lower Ordovician: Nevada.

Original references: C. R. Keyes, 1923, Pan-Am. Geologist, v. 40, p. 53; 1924, Pan-Am. Geologist, v. 41, p. 78.

Named for development in Egan Mountains, which faces Steptoe Valley.

**Sterling Granite Gneiss**[1]

Carboniferous or post-Carboniferous: Eastern Connecticut and Rhode Island.

Original reference: H. E. Gregory, 1906, Connecticut Geol. Nat. History Survey Bull. 6, p. 115, 131–136, 152, 154, 155, map.

W. G. Foye, 1949, Connecticut Geol. Nat. History Survey Bull. 74, p. 56–65, pl. 1. Discussed as an orthogneiss. Variety of granitic rocks associated with unit. Pre-Permian.

A. W. Quinn, 1951, Bedrock geology of the North Scituate quadrangle, Rhode Island: U.S. Geol. Survey Quad. Map [GQ–13]. Geographically restricted from eastern Rhode Island. Since unit has been assigned a late Carboniferous or post-Carboniferous age, it seems desirable to give a new name, Scituate granite gneiss, to pre-Pennsylvanian granite gneiss mapped in North Scituate quadrangle.

G. E. Moore, 1958, U.S. Geol. Survey Geol. Quad. Map GQ–105. Unit herein named Ten Rod granite gneiss was included in Sterling granite gneiss by Gregory (1906).

C. B. Sclar, 1958, Connecticut Geol. Nat. History Bull. 88, p. 126–128, geol. map. Results of a study of bedrock geology of 55 square miles in eastern part of New London County, Conn. Bedrock consists of a group of metamorphic foliates known collectively as Putnam gneiss, a basic magmatic intrusive mass known as Preston gabbro, and gneisses of granitic composition referred to as Sterling granitic gneisses. Sterling consists of two mappable units, a granitic augen gneiss and an alaskitic to microalaskitic gneiss.

Crops out in Sterling Township, Windham County, Conn.

Sterling Station iron ore[1]

Silurian: Central 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. 49. Hematitic limestone horizon occurring at top of Reynales on Salmon Creek and in Wolcott core and, in upper part of Bear Creek shale is remarkably persistent. Chadwick (1918) named the horizon Sterling Station iron ore. The objection to considering it as a formation is its thinness and the fact that it occurs as stringers imbedded in uppermost part of underlying formation and not as a distinct unit in itself.

Named for occurrence at Sterling Station, Cayuga County.

Stetson Brook Limestone (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 Hill Ridge biotite schist (new); younger than Thorncrag limy gneiss (new).

Occurs in Lewiston area, Androscoggin County.

Steuben Limestone Member (of Cobourg Formation)

Middle Ordovician (Mohawkian): East-central New York.

G. M. Kay, 1943, Am. Jour. Sci., v. 241, no. 10, p. 598, 601, 602. Name proposed for upper member of formation in Utica quadrangle and vicinity. Described as coarse-textured calcite sandstone. Maximum thickness about 60 feet; 26 feet exposed above dam on Steuben Creek. Overlies newly defined Rust limestone member; underlies Holland Patent shale.

Marshall Kay, 1953, New York State Mus. Bull. 347, p. 61. Disappears by unconformity west of Poland. Outcrop areas described.

Typically exposed in small quarries and along streams south of road south of Steuben Creek for a mile from its mouth. Named from creek where exposed above dam at Prospect Bridge, Oneida County.

Steussy Shale Member (of Lazy Bend Formation)

Steussy Shale 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.

Leo Hendricks, 1957, Texas Univ. Bur. Econ. Geology Pub. 5724, p. 16–17, pl. Steussy shale member of Lazy Bend formation defined as those beds occurring between Meek Bend limestone bed of Hill Creek member and lower Brannon Bridge limestone member. Total thickness 180 feet. Lower 90 feet of shale are overlain by 40 feet of sandstone. Upper 30 feet are intermittently exposed along Steussy scarp below capping Brannon Bridge limestone. Origin of name Steussy not clear in original description. Upper part of shale is exposed on scarp northwest of Rocky Creek west of Brazos River. This feature is called Steussy Scarp in original reference, giving the impression that the geological name is after topographic feature bearing that name. Type section designated.

Type section: Exposures on west side of hill (located on southeast side of Rocky Creek) and in cuts of ranch road crossing Steussy Scarp to north, Parker County. Rocky Creek flows from southwest into Brazos River just north of Lazy Bend.

Stevens Series[1]

Silurian: Northeastern Washington.

Original reference: C. E. Weaver, 1920, Washington Geol. Survey Bull. 20, p. 49, map.

W. W. Mallory, 1953, Am. Assoc. Petroleum Geologists Bull., v. 37, no. 11, p. 2495. Silurian.

As originally defined, included the following units: Addy quartzite, Boundary argillite, Cedar Creek argillite, Chewelah argillite, Clugston limestone, Colville quartzite, Deep Lake argillite, Deer Lake argillite. Deer Trail argillite, Eagle Mountain quartzite, Fish Creek argillite, Lead Point argillite, Mission argillites, Old Dominion limestone, Red Top limestone, and Republican Creek limestone. Most of these units have been redefined or are no longer used.

Named for occurrence in Stevens County.

Stevens Creek Limestone (in Borden Group)[1]

Mississippian: Southeastern Indiana.

Original reference: C. A. Malott, 1922, Indiana Dept. Conserv. Pub. 21, pt. 2, p. 193.

Exposed in middle of the Borden in Stevens Creek and in Brummets Creek, Norman upland, Monroe County.

Stevens Creek Slates[1]

Precambrian: Northwestern South Carolina.

Original references: E. Sloan, 1908, Repts. and resolutions of General Assembly of South Carolina, regular sess., commencing Jan. 14, 1908, v. 1, p. 648–651; 1908, South Carolina Geol. Survey, ser. 4, Bull. 2, p. 414–417.

Probably named for exposures on Stevens Creek, Edgefield County.

Stewarts Landing facies[1] (of Edwardsville Formation)

Lower Mississippian: Southern Indiana and northern Kentucky.

Original reference: P. B. Stockdale, 1931, Indiana Dept. Conserv., Div. Geology Pub. 98, p. 76, 228–230.

J. M. Weller and others, 1948, Geol. Soc. America Bull., v. 59, no. 2, p. 127–128, pl. 1. Mississippian facies nomenclature discussed. Stewarts Landing facies listed in Edwardsville formation.

Name derived from Stewarts Landing, southeastern Harrison County, Ind.

†Stewartsville Group[1]

Eocene: Western California.

Original reference: B. L. Clark, 1918, Geol. Soc. America Bull., v. 29, p. 94.

†Stewart Valley Limestone

Mississippian: Southern California.

J. C. Hazzard, 1937, California Jour. Mines and Geology, v. 33, no. 4, p. 275 (fig. 3), 332–334. A unit about 1,180 feet thick in which three unnamed members are recognized. The lowest, about 690 feet, is predominantly light- to dark-gray limestone in beds averaging 1 to 5 feet thick; the middle, 240 feet thick, is a dense light-creamy-gray limestone with porcelainlike texture, interbeds of dark-gray limestone in lower and upper parts; the upper, 50 feet thick, is a fossiliferous dark-gray limestone and dolomite. Unconformably underlies Monte Cristo(?) limestone; overlies Sultan dolomite.

J. C. Hazzard, 1954, Am. Assoc. Petroleum Geologists Bull., v. 38, no. 5, p. 881. Name abandoned. Unit originally described as Stewart Valley is now known to include beds of both Devonian and Mississippian age. Suggestion made that Mississippian beds previously ascribed to Stewart Valley be assigned to Dawn limestone member of Monte Cristo limestone, and the Devonian beds be assigned to Crystal Pass and Valentine members of Sultan limestone.

Present on both western and eastern slopes of Nopah Range, Inyo County. Beds crop out to east of Devonian rocks and form major part of cliffs along northern range summit.

**Stewartville Member** (of Galena Dolomite)

Stewartville Dolomite[1]

Stewartville Member (of Wise Lake Formation)

Middle Ordovician: Southeastern Minnesota, northwestern Illinois, and northeastern Iowa.

Original reference: E. O. Ulrich, 1911, Geol. Soc. America Bull., v. 22, pl. 27.

C. R. Stauffer and G. A. Thiel, 1941, Minnesota Geol. Survey Bull. 29, p. 88–90. Uppermost member of Galena formation. Overlies Prosser member; underlies Dubuque member of Maquoketa formation. Ulrich did not designate type locality. It is probable that name was taken from town of Stewartville and that outcrop there is to be considered the type. Thickness 50 to 55 feet; about 30 feet where typically exposed at old quarry one-half mile west of Stewartville. Mohawkian.

J. S. Templeton and H. B. Willman, 1952, Tri-State Geol. Soc. Guidebook 16th Ann. Field Cong., fig. 3. In Dixon-Oregon area, Illinois, considered upper member of Wise Lake formation (new). Overlies Sinsinawa member (new); underlies Dubuque formation.

A. F. Agnew, 1956, U. S. Geol. Survey Prof. Paper 274–K, p. 261, 297–298. Middle member of the Galena. Overlies Prosser member; underlies Dubuque member. In Zinc-lead district, consists of yellowish-buff thick-bedded vuggy dolomite with *Receptaculites* in lower part. Thickness 37 to 47 feet.

M. P. Weiss, 1957, Geol. Soc. America Bull., v. 68, no. 8, p. 1029 (fig. 1), 1039–1040. Considered uppermost member of Galena formation in this report [Fillmore County, Minn.]. Member is dolomitic limestone, pale yellowish- gray to grayish yellow, which weathers to yellowish orange. Thickness about 85 feet, where completely exposed at Mahood's Creek, near Greenleafton. Overlies Prosser member; underlies Dubuque formation.

Probably named for exposures near Stewartville, Olmsted County, Minn. Typical exposure measured at Old Quarry, north bank of Root River one-half mile above dam at Stewartville.

Stice cyclothem (in Cheorokee Group)

Pennsylvanian (Des Moines Series): Southeastern Kansas.

R. C. Moore, 1949, Kansas Geol. Survey Bull. 83, p. 40 (fig. 9), 45. Approximately 45 feet of beds occurring above Bevier cyclothem are here designated Stice cyclothem. Strata underlie persistent, relatively prominent sandstone called "Squirrel", which is interpreted as part of Breezy Hill cyclothem.

Derivation of name not given. Stice coal occurs in upper Cherokee shale in eastern Labette County.

**Stiles Phyllite**[1]

Lower Cambrian: Southwestern Vermont.

Original reference: A. Keith, 1932, Washington Acad. Sci. Jour., v. 22, p. 360, 400.

Named for occurrence at Stiles Mountain, 4 miles southwest of Brandon, in Brandon quadrangle, Rutland County.

Stillaguamish Group

Middle to Upper Permian: Northwestern Washington.

R. S. Yeats, 1958, Dissert. Abs., v. 19, no. 4, p. 775. Argillites, ribbon cherts and volcanic rocks.

On Mount Baring, Gunn Peak, and Merchant Peak, in Skykomish area in northwestern Cascade Mountains, 45 miles east of Seattle.

**Stillaguamish Sand Member** (of Vashon Drift)

Pleistocene: Northwestern Washington.

R. C. Newcomb, 1952, U.S. Geol. Survey Water-Supply Paper 1135, p. 26, 27, pl. 1. An outwash deposit consisting largely of fine sand and clay with coarser material near top. Thickness about 300 feet. Underlies Arlington gravel member (new).

Area: Snohomish County; contains Tps. 26 to 32 N. of the Willamette base line.

Stillman 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., figs. 3, 15A. Shown on columnar section as underlying Clement member (new) and overlying Walgreen member (new). Thickness 4 to 7 feet.

Occurs in Dixon-Oregon area.

Still Ridge Formation (in Bisbee Group)

Lower Cretaceous: Southwestern New Mexico.

Elliot Gillerman, 1958, New Mexico Bur. Mines Mineral Resources Bull. 57, p. 50–52, table 1, pl. 1. Silty and sandy limestone, sandstone, calcareous sandstone, and limestone pebble conglomerate. The limestone pebble conglomerate, which is prominent in the sequence, consists of black limestone pebbles which weather light gray in a dark-gray to black limestone matrix which weathers brown. Interbedded volcanic rocks. Thickness 658 feet on south slope of Still Ridge and 575 feet on east side of ridge in Rs. 20 and 21 W., T. 25 S. Underlies Johnny Bull sandstone (new) and overlies Carbonate Hill limestone (new) with conformable contacts.

Named from exposures on Still Ridge, just north of Carbonate Hill mine. Excellently exposed on south side of Still Ridge; likewise on crest and upper slopes of small ridge in Rs. 20 and 21 W., T. 25 S., Peloncillo Mountains, Hidalgo County.

**Stillwater Complex**[1]

Precambrian: Montana:

Original reference: J. W. Peoples, 1933, Pan-Am. Geologist, v. 60, p. 152.

H. H. Hess, 1960, Geol. Soc. America Mem. 80, p. 1–230, plates. Complex is intrusion of lopolithic form. Floor and about 16,000 feet of layered rocks are exposed on East Boulder plateau. Estimated that another 40 percent of complex and its roof are hidden beneath cover of Paleozoic rocks. A quantitative mineralogical study. Comparisons with Bushveld complex, Great Dyke, and Skaergaard intrusion.

W. R. Jones, J. W. Peoples, and A. L. Howland, 1960, U.S. Geol. Survey Bull. 1071–H, p. 281–340, pls. 23, 24, 25. An upturned and previously beveled edge of Stillwater complex, a Precambrian stratiform sheet about 18,000 feet thick, crops out in belt 30 miles long on northeast margin of Beartooth Mountains. As subdivided in this report, complex consists of four zones: basal, 200 feet thick, of medium-grained noritic rocks; ultramafic zone, 4,000 to 6,000 feet, a succession of layers of bronzitite, granular, harzburgite, poikilitic harzburgite, and chromite; banded zone and upper zone, aggregate thickness 14,000 feet, of layers of norite, anorthosite, troctolite, and gabbro. Flathead sandstone is basal Cambrian unit throughout Beartooth Mountains except at contact of Cambrian with the complex where the overlying Wolsey is the basal unit. Tectonic structures and igneous activity discussed.

Named for exposures in Stillwater River area.

Stillwater Formation[1]

Permian: Central and northern Oklahoma.

Original reference: C. N. Gould, 1901, Kansas Acad. Sci. Trans., v. 17, p. 181.

D. A. Green, 1937, Am. Assoc. Petroleum Geologists Bull., 21, no. 12, p. 1519 (fig. 1). Shown on graphic section as occurring in interval between Herington limestone above and Cottonwood limestone below. Falls within Wanette time division of the Permian.

Typically exposed near Stillwater, Payne County.

**Stillwater Formation**[1]

Eocene: Southeastern Alaska.

Original reference: G. C. Martin, 1908, U.S. Geol. Survey Bull. 335, p. 24, 30.

Arthur Troutman, ed., 1958, The Alaskan oil and gas handbook: Austin Tex. Oil Frontiers, p. 43 (strat. section). Stillwater formation believed to thin eastward forming marine tongue in coal-bearing Kushtaka formation. Eocene.

Occupies entire valley of Stillwater Creek and extends for some distance up valleys of Trout and Clear Creeks.

Stillwater Glacial Stage

Pleistocene (Illinoian): North-central Colorado.

R. L. Ives, 1937, (abs.) Colorado Univ. Studies, v. 25, no. 1, p. 75. Oldest of four ice advances recognized in Monarch Valley. Older than River glacial stage (new). Evidenced by terminal moraine.

R. L. Ives, 1938, Geol. Soc. America Bull., v. 49, no. 7, p. 1056, 1062. Time covered by deposition of outer series of moraines in Monarch Valley, mapped as moraine one.

Moraines of Stillwater age forced Colorado River to adopt new channel, part of which took over valley of Stillwater Creek, Monarch Valley, Grand County.

†Stillwater Sandstone (in Conemaugh Formation)[1]

Pennsylvanian: Eastern Ohio.

Original reference: J. S. Newberry, 1874, Ohio Geol. Survey, v. 2, p. 131, pl. opposite p. 81.

Named for Big Stillwater Creek, Tuscarawas County.

Stillwater Creek Member (of Cowlitz Formation)

Eocene, upper: Southwestern Washington.

Named as basal member of Cowlitz. Underlies Pe Ell volcanics member. D. A. Henriksen, 1954, Dissert, Abs., v. 14, no. 12, p. 2316.

D. A. Henriksen, 1956, Washington Div. Mines and Geology Bull. 43, p. 36–37, 38–45, pl. 1. Consists largely of soft to indurated laminated to massive marine shales, siltstone, silty sandstones, and mudstones, together with massive to crossbedded or laminated friable to compact fine-grained arkoses, feldspathic sandstone. and sandy siltstones; locally includes thin interbedded basalt flows, pyroclastic material, and tuffaceous and basaltic sandstones. Pe Ell volcanics member is intercalated in lower part of Stillwater Creek member. Minimum thickness 2,100 to 2,600 feet near Pe Ell; maximum thickness 5,400 feet along Stillwater Creek. Overlies Metchosin volcanic series with contact gradational.

Type section: A section across widest part of roughly shaped belt of outcrop around northern and eastern margins of Willapa Hills [Lewis County]. Exposed along Stillwater Creek from contact with Metchosin Volcanic Series about 3 miles west of Ryderwood eastward to mouth of Brim Creek, 3½ miles northeast of Ryderwood.

**Stine Shale Bed** (in Hamlin Shale Member of Janesville Shale)

Stine Shale[1]

Permian: Southeastern Nebraska and northeastern Kansas.

Original reference: G. E. Condra, 1927, Nebraska Geol. Survey Bull. 1, p. 83, 84, 89.

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.

Named for exposures south of Stine, Nemaha County, Nebr.

Stinking Water Formation

Miocene, middle: Oregon.

Jane Gray, 1956, (abs.) Geol. Soc. America Bull., v. 67, no. 12, pt. 2, p. 1768. Incidental mention in note on fossil green algae from the Miocene of the Columbia Plateau.

**Stirling Quartzite**[1]

Precambrian: Southeastern Nevada and eastern California.

Original reference: T. B. Nolan, 1928, Am. Jour. Sci., 5th, v. 17, p. 461–472.

J. C. Hazzard, 1937, California Jour. Mines and Geology, v. 33, no. 4, p. 278–279, 306–307. Geographically extended into Nopah-Resting Springs Mountains, Calif., where it is 2,593 feet thick, underlies Wood Canyon formation and disconformably overlies Johnnie(?) formation.

H. E. Wheeler, 1948, Nevada Univ. Bull., Geology and Mining Ser., no. 47, p. 19. Considered synonym for Prospect Mountain quartzite.

W. H. Easton and others, 1953, Am. Assoc. Petroleum Geologists Bull., v. 37, no. 1, p. 146 (fig. 2). On correlation chart of recommended revision of stratigraphic units in Great Basin region, Stirling quartzite replaces Prospect Mountain quartzite in Death Valley, Providence Mountains, and Nopah-Resting Springs Mountains.

B. K. Johnson, 1957, California Univ. Pubs. Geol. Sci., v. 30, no. 5, p. 375–377, 378 (fig. 7), figs. 1 (geol. map), 2 (columnar section). Described in Manly Peak quadrangle where it conformably overlies Johnnie formation. Thickness (incomplete section) about 1,000 feet. Late Precambrian or Algonkian.

Named for exposures on Mount Stirling, about 5 miles east of Johnnie mine, Spring Mountains, Clark County, Nev.

**Stissing Dolomite**[1]

Lower and Middle Cambrian: Southeastern New York.

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

E. B. Knopf, 1946, (abs.) Geol. Soc. America Bull. 57, no. 12, pt. 2, p. 1212. Light-colored dolomites carrying *Hyolithellus micans* Billings in four localities. Upper dark dolomites carry *Paterina stissingensis* Dwight and *Prozacanthoides stissingensis* Dwight in two localities. Indicates late early Cambrian age. Thickness 500 feet. Underlies Pine Plains formation (new). Overlies Poughquag quartzite.

E. B. Knopf, 1956, (abs.) Geol. Soc. America Bull., v. 67, no. 12, pt. 2, p. 1817. Lithologic and palentologic study indicate five characteristic lithologic zones in Stissing dolomite of Early and Middle Cambrian age. Thickness 500 feet. Overlies Poughquag quartzite; underlies Upper(?) Cambrian Pine Plains formation. Top of Stissing marked by dark beds that carry *Prozacanthoides stissingensis* Dwight and *Paterina stissingensis* Dwight.

Named from Stissing Mountain, northern Dutchess County.

†Stissing Quartzite[1]

Cambrian(?): Eastern New York.

Original reference: J. M. Clarke, 1903, New York State Mus. Handb. 19, chart.

Occurs on south and east slopes of Stissing Mountain, Dutchess County.

Stobo Limestone Lens (in Borden Group)[1]

Mississippian: Southwestern Indiana.

Original reference: A. B. Reagan, 1904, Indiana Acad. Sci. Proc. 1903, p. 214.

Occurs in SE¼ sec. 33, T. 9 N., R. 1 E., and NE¼ sec. 4, T. 8 N., R. 1 E., near old Stobo post office, 6½ miles east of Bloomington, Monroe County.

**Stockade Beaver Shale Member** (of Sundance Formation)

Stockdale Beaver Shale Member (of Rierdon Formation)

Upper Jurassic: Southwestern South Dakota and northwestern Wyoming.

R. W. Imlay, 1947, Am. Assoc. Petroleum Geologists Bull., v. 31, no. 2, p. 251–255, geol. sections. Medium- to dark-gray soft fissile calcareous shale which ranges in thickness from about 5 to 85 feet; average thickness about 50 feet; at type locality 63 feet. Overlies Canyon Springs member (new) and underlies Hulett sandstone member (new). Locally overlies Gypsum Spring formation or Spearfish formation.

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: West side of Stockdale Beaver Creek about 5 miles northeast of Newcastle in sec. 18, T. 45 N., R. 60 W., Weston County, Wyo.

**Stockbridge Limestone[1] or Group**

Stockbridge Marble

Cambrian and Ordovician: Western Massachusetts, western Connecticut, eastern New York, and southwestern Vermont.

Original reference: Ebenezer Emmons, 1842, Geology New York, pt. 2, div., 4, Geology of 2d dist., p. 135–164.

R. V. Cushman, 1950, New York State Water Power and Control Comm. Bull. GW–21, p. 9 (table 2), 11, pl. 2. In Rensselaer County, Stockbridge limestone directly underlies Walloomsac slate; overlies rocks of Lower Cambrian age. Thickness not known.

John Rodgers and others, 1956, Preliminary geological map of Connecticut: Connecticut Geol. Nat. History Survey. Referred to as marble in Connecticut.

J. W. Clarke, 1958, Connecticut Geol. Nat. History Survey Quad. Rept. 7, p. 18. In this report [Danbury quadrangle], unit mapped as Inwood marble was called Stockbridge limestone on State Geological Map of 1906. Moore (1935, Connecticut Geol. Nat. History Survey Bull. 56) used term Stockbridge series.

Norman Herz, 1958, U.S. Geol. Survey Geol. Quad. Map GQ–108. Stockbridge limestone as formerly used is equivalent to at least seven formations of west-central Vermont that range in age from Early Cambrian to Early Ordovician. Stockbridge is raised to group to include (ascending) Kitchen Brook dolomite (new), Clarendon Springs dolomite, Shelburne marble, and Bascom formation. Overlies Cheshire quartzite; underlies Berkshire schist. Report is Cheshire quadrangle, Massachusetts.

Named for prominent development and quarries around Stockbridge and West Stockbridge, Berkshire County, Mass.

Stockstill 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, 11, pls. 2, 3, 4. In some areas, massive; in other areas, poorly cemented. Thickness 20 to 80 feet. Separated from overlying Indian

Fork sandstone (new) by shale interval that ranges in thickness from 25 to 100 feet; separated from underlying Seeber Flats sandstone (new) by shale interval that ranges in thickness from 40 to 120 feet.

Exposed on State Highway 116 between Petros and Armes Gap, Morgan County. Named for Stockstill Creek.

**Stockton Formation** (in Newark Group)[1]

Stockton lithofacies (of Newark Group)

Upper Triassic: New Jersey, New York, and southeastern Pennsylvania.

Original references: H. B. Kummel, 1897, New Jersey Geol. Survey Ann. Rept. State Geologists, 1896, p. 35–40; 1897, Jour. Geology, v. 5, p. 543–544.

M. E. Johnson and D. B. McLaughlin, 1957, Geol. Soc. America Guidebook Atlantic City Mtg., p. 52–53 (table), pl. 1. Stratigraphic section shows Stockton formation includes (ascending) arkose, red shale, and sandstone, 720 feet; thick-bedded to massive coarse quartz-arkose conglomerate (Solebury member, new), 387 feet; thick-bedded gray arkose, 224 feet; red sandstone, 447 feet; thick-bedded white and yellow arkose (Lower Prallsville member, new), 474 feet; red and brown sandstone, 136 feet; thick-bedded medium to coarse arkose (Upper Prallsville member, new), 205 feet; red and brown sandstone and red shale, 373 feet; medium to coarse thick-bedded arkose with interbeds of red-brown sandstone (Cutalossa member, new), 232 feet; red and gray sandstone and red shale, 787 feet; massive medium to coarse white and gray arkose (Raven Rock member, new), 293 feet; and red and brown sandstone, 724 feet. Underlies Lockatong formation; overlies Paleozoic limestone.

D. B. McLaughlin, 1959, Pennsylvania Geol. Survey, 4th ser., Bull. C–9, p. 62–77. Lithofacies discussed in detail in report on Bucks County. Term lithofacies used rather than formation because of intertonguing nature of units which prevents drawing distinct boundaries.

N. M. Perlmutter, 1959, New York State Water Power and Control Comm. Bull. GW–42, p. 7–9, 15–16, pls. 2, 3. Present in Rockland County, N.Y.

Named for exposures in quarries near Stockton, Hunterdon County, N.J.

Stockton Shale (in Kanawha Formation)[1]

Pennsylvanian: Southern West Virginia.

Original reference: I. C. White, 1903, West Virginia Geol. Survey, v. 2, p. 326–327.

Probably named for fact that the coal was mined by Mr. Stockton.

Stockton Slate (in Kanawha 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. 152, 409–410.

**Stockwether Limestone Member** (of Pueblo Formation)[1]

Stockwether Formation (in Pueblo Group)

Permian (Wolfcamp Series): Central northern Texas.

Original reference: N. F. Drake, 1893, Texas Geol. Survey 4th Ann. Rept., pt. 1, p. 387, 417.

M. G. Cheney, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 1, p. 66 (fig. 1). Rank raised to formation in the Pueblo here given group status. Includes Coon Mountain sandstone member. Underlies Camp Colorado formation; overlies Saddle Creek formation.

R. C. Moore, 1949, U.S. Geol. Survey Oil and Gas Prelim. Map 80, sheet 2. Described in Colorado River valley as limestone member of Pueblo formation. Typically fine-grained limestone containing numerous thin clear calcite veinlets and white porcelainlike foraminiferal remains; beds are uneven, to medium in thickness, and weather slabby. Thickness 5 to 30 feet, average 20 feet. Underlies Salt Creek Blend shale member; overlies Camp Creek shale member.

P. T. Stafford, 1960, U.S. Geol. Survey Bull. 1801-G, p. 268-269. Stockwether member geographically extended into Brazos River valley. Thickness ½ to 3 feet. Overlies Camp Creek shale member; underlies Salt Creek Bend shale member.

Named for Stockwether Ranch, on Bull Creek, Coleman County.

Stoddard Member (of Oneota Formation)

Lower Ordovician: Southwestern Wisconsin.

G. O. Raasch, 1952, Illinois Acad. Sci. Trans., v. 45, p. 90-91, 94. At type locality lower part comprises 37 feet of massive gray crystalline-granular cherty dolomite; virtually without bedding planes, vuggy and traversed by irregular porous areas. Above is 6-foot thickness of thin-bedded cryptocrystalline dolomite. If member is restricted to strata between thin beds of dolomite above and Genoa member (new) below, thickness would range from more than 50 feet in the northwest to about 25 feet in the southwest part of quadrangle. Conversely, on basis of high level chert float of Oneota type, member may reach thickness of more than 130 feet.

Type locality: Quarry and Mississippi bluff in NW¼NE¼ sec. 33, T. 14 N., R. 7 W., Stoddard quadrangle, 1 mile south of Stoddard, Vernon County.

Stoddard Canyon Quartz Monzonite

Age unknown: Southern California.

K. J. Hsu, 1955, California Univ. Dept. Geol. Sci. Bull., v. 30, no. 4, p. 301-302, geol. map. A fine-grained massive light-gray plutonic rock. Occurs as dikes and small irregular-shaped bodies ranging from a few to several hundred feet or more in width, in El Dorado Ridge-Stoddard Canyon pluton, cutting across gneissosity of El Dorado Ridge quartz diorite (new). Intrudes Rainbow Flat group (new).

Exposed in Cucamonga quadrangle, San Bernardino County.

†Stokes Sandstone (in Cheyenne Sandstone)[1]

Lower Cretaceous (Comanche Series): Central southern Kansas.

Original reference: F. W. Cragin, 1895, Am. Geologist, v. 16, p. 361, 367.

Named for Stokes Draw, which proceeds from foot of Stokes Hill and south of Lanphier Draw, in southeastern corner of Kiowa County.

†Stokes Hill Sandstone[1]

Lower Cretaceous (Comanche Series): Central southern Kansas.

Original reference: W. H. Twenhofel, 1924, Kansas Geol. Survey Bull. 9, p. 13.

Named for Stokes or Black Hill, a few miles west of Sun City, Barber County.

Stonberger Shale

Ordovician: 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. Underlies Antelope Valley formation.

Toquima Range, Nye County.

†Stonebreaker Limestone Member (of Buck Creek Formation)[1]

Pennsylvanian (Virgil Series): Central northern Oklahoma.

Original reference: K. C. Heald, 1918, U.S. Geol. Survey Bull. 686–K, p. 130–131.

U.S. Geological Survey has abandoned the Buck Creek Formation and the Stonebreaker Member.

Named for Stonebreaker Ranch, Pawhuska quadrangle, Osage County.

Stone Cabin Tuff

Tertiary: Eastern Nevada.

E. F. Cook, 1960, Intermountain Assoc. Petroleum Geologists Guidebook 11th Ann. Field Conf., p. 140 (fig. 4). Crystal-vitric ignimbrite; upper two-thirds moderately to highly welded pale purple, grading down abruptly into highly welded red-purple zone which in turn gives way downward to cavernous lightly welded to nonwelded tuff at base. Thickness 540 to 690 feet. Occurs below Currant tuff.

Present in Grant Range.

Stone City Beds or Formation (in Claiborne Group)[1]

Stone City Member (of Crockett Formation)

Eocene, middle: Eastern Texas.

Original reference: H. B. Stenzel, 1935, Texas Univ. Bull. 3501, p. 267–279.

H. B. Stenzel, 1938, Texas Univ. Bur. Econ. Geology Pub. 3818, p. 20, 120–124 [1939]. Formation underlies Wheelock member (new) of Crockett formation; overlies Sparta formation. Thickness 80 to 120 feet.

G. D. Harris, 1941, Texas Univ. Bur. Econ. Geology Mineral Resources Survey Circ. 33, p. 13, 15. Rank reduced to member status in Crockett formation. Thickness about 19 feet in Lee County.

H. B. Stenzel, E. K. Krause, and J. T. Twining, 1957, Texas Univ. Bur. Econ. Geology Pub. 5704, 237 p. Thickness 61.1 feet at type locality. Overlies Sparta sand; underlies Wheelock member of Cook Mountain formation. Includes Moseley limestone of Renick and Stenzel (1931), Term Moseley no longer used. Pelecypod fauna described. Middle Eocene.

Type locality: Stone City bluff on Brazos River, Burleson County. Beds traceable to Atascosa County in southwestern Texas and to Sabine River at Texas-Louisiana boundary.

Stone Coal Bluff Lignite (in Slaughter Creek Member of Pendleton Formation)

Eocene, lower: Northwestern Louisiana.

Richard Wasem and L. J. Wilbert, Jr., 1943, Jour. Paleontology, v. 17, no. 2, p. 184 (fig. 4), 187. Occurs about 50 feet above base of member. Thickness varies from 1 to 6 feet. Occupies constant stratigraphic position and has been traced for 14 miles along strike of formation.

Named for its outcrop at Stone Coal Bluff on Sabine River, Sabine Parish.

**Stone Corral Formation** (in Sumner Group)

Stone Corral Dolomite (in Enid Formation)

Stone Corral[1] Member (of Harper Sandstone)

Permian: Central Kansas.

G. H. Norton, 1935, (abs.) Am. Assoc. Petroleum Geologists Program 20th Ann. Mtg., March 21, 22, p. 17. Dolomitic limestone, 6 feet maximum thickness at its northern limit in Rice County; can be traced southward about 50 miles, splitting into two or three thin layers and finally disappearing as a distinct unit north of Oklahoma line and identifiable only as zone of huge halite casts. Occurs in middle part of Harper sandstone.

E. A. Koester, 1935, Am. Assoc. Petroleum Geologists Bull., v. 19, no. 10, p. 1410. Name Stone Corral used in table where it is placed in Cimarron series.

R. C. Moore and K. K. Landes, 1937, Geologic map of Kansas (1:500,000): Kansas Geol. Survey. Mapped as dolomite member of Enid formation. Cimarron series.

G. H. Norton, 1937, Am. Assoc. Petroleum Geologists Bull., v. 23, no. 12, p. 1774–1781. Middle member of Harper sandstone. Overlies Ninnescah shale member (new); underlies Chikaskia sandstone member (new).

G. H. Norton, 1939, Am. Assoc. Petroleum Geologists Bull., v. 23, no. 12, p. 1774–1781. Harper sandstone restricted below to exclude Stone Corral dolomite and Ninnescah shale. Overlies Runnymede sandstone member (new) of Ninnescah shale. Included in Cimarron series. Type locality stated.

J. M. Jewett, 1941, Kansas Geol. Survey Bull. 39, p. 91. Sumner group comprises Wellington shale, Ninnescah shale, and Stone Corral dolomite. Leonard series.

J. M. Jewett, 1959, Graphic column and classification of rocks in Kansas: Kansas Geol. Survey. Chart shows Stone Corral formation at top of Sumner group. Underlies Chikaskia siltstone. Member of Harper siltstone; overlies Runnymede siltstone member of Ninnescah shale.

Type locality: Sec. 11, T. 20 S., R. 6 W., Rice County. Named for exposures near historic Stone Corral Fort, where wagon trains of pioneers forded Little Arkansas River on Santa Fe Trail.

Stone Creek Member (of Brallier Shale)

Upper Devonian: Central Pennsylvania.

R. R. Conlin and others, 1957, Geol. Soc. America Guidebook Atlantic City Mtg., p. 274, 276. Incidental mention only as basal member.

Forms first foothills of Allegheny Front along northwesterly margin of alluvial plain of Bald Eagle Creek, between Harrisburg and Tyrone.

Stonefort cyclothem (in Spoon Formation)

Stonefort cyclothem (in Tradewater Group)

Pennsylvanian: Southeastern Illinois.

J. M. Weller, L. G. Henbest, and C. O. Dunbar *in* C. O. Dunbar and L. G. Henbest, 1942, Illinois Geol. Survey Bull. 67, p. 15 (fig. 2) [1943]. Stonefort cyclothem occurs below Davis cyclothem and above Macedonia cyclothem. Includes Curlew sandstone, Bald Knob coal, and Stonefort limestone.

H. R. Wanless and Raymond Siever, 1956, Illinois Geol. Survey Circ. 217, p. 5, 9, pl. 1. Includes (ascending) Curlew sandstone, Bald Hill coal, Stonefort coal, and Stonefort limestone; underlies Colbert cyclothem (formerly termed Davis). Type locality designated.

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 42, 53 (table 2), pl. 1. In Spoon formation (new). Above Macedonia cyclothem and below Colbert cyclothem. Type locality given; Wanless (1956) reference in error. Presentation of new rock-stratigraphic classification of Pennsylvanian strata in Illinois; cyclical classification independent of rock-stratigraphic classification.

Type locality: NE¼SE¼ sec. 25, T. 10 S., R. 4 E., Williamson County.

**Stonefort Limestone Member** (of Spoon Formation)

**Stonefort Limestone Member** (of Tradewater Formation)[1]

Stonefort Limestone (in Tradewater Group)

Middle Pennsylvanian: Southeastern Illinois and western Kentucky.

Original reference: L. G. Henbest, 1928, Jour. Paleontology, v. 2, p. 70–71.

J. M. Weller, L. G. Henbest, and C. O. Dunbar, 1942, *in* C. O. Dunbar and L. G. Henbest, Illinois Geol. Survey Bull. 67, p. 15 (fig. 2), 18 (table), 21–22 [1943]. Stonefort limestone in Tradewater group is a persistent bed 1 to 2 feet thick that is medium gray, weathers brownish, and is sparingly fossiliferous. Occurs in midst of succession of thin beds including several coals. A thin limestone without marine fossils occurs locally a few feet above the Stonefort, which is the first marine horizon above Curlew limestone. Included in Stonefort cyclothem.

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 32, 33, 46. Included in Spoon formation (new). Overlies Wise Ridge coal member; underlies Davis coal member. Type locality corrected. Presentation of new rock-stratigraphic classification of Pennsylvanian strata in Illinois. Cyclical classification retained but is independent of rock-stratigraphic classification.

U.S. Geological Survey has discontinued the use of the term Tradewater in Illinois.

Type locality: In roadcut and in ravines east of road in NE¼SE¼ sec. 25, T. 10 S., R. 4 E., Williamson County, Ill. Name derived from town of Stonefort, Saline County.

**Stonehenge Limestone** (in Beekmantown Group)

Stonehenge Limestone Member (of Beekmantown Limestone)[1]

Lower Ordovician: Central and central southern Pennsylvania, western Maryland, and northwestern Virginia.

Original reference: G. W. Stose, 1908, Jour. Geology, v. 16, p. 703.

B. N. Cooper, 1936, Virginia Geol. Survey Bull. 46–L, p. 138–139. Formation described in Marion area, Virginia, where it is dove-gray massive vaughanite about 25 feet thick. Conformable with underlying Chepultepec; in some areas, contact is "welded" in a single bed. Canadian system.

H. P. Woodward, 1951, West Virginia Geol. Survey, v. 21, p. 53–54, 58–59. Term Stonehenge has priority over Chepultepec in event the names are judged to be completely synonymous; however, term Chepultepec-Stonehenge is used in this report. Chepultepec-Stonehenge not included in Beekmantown group.

W. J. Sando, 1956, Geol. Soc. America Bull., v. 67, no. 7, p. 935–936. Basal formation in Beekmantown group. Comprises two unnamed members of approximately equal thickness: a lower division of dominantly algal limestone and an upper division of thin-bedded silty mechanical limestone. Underlies Rockdale Run formation (new); overlies Conococheague limestone. Base of formation is placed at contact of massive limestone of lower member with thin-bedded limestones that form persistent lithologic unit at top of Conococheague limestone. Inasmuch as *Symphysurina* and *Clelandia* have been recovered 30 feet below top of Conococheague, at least uppermost 30 feet of this formation is of Early Ordovician age; hence, Stonehenge-Conococheague contact does not exactly coincide with Cambrian and Ordovician systems. Type section designated.

W. J. Sando, 1957, Geol. Soc. America Mem. 68, p. 18–21, 60, 76–78, pl. 1. Thickness at Maryland reference section 726½ feet. Thickness at reference section of Beekmantown group 909 feet.

J. P. Hobson, Jr., 1957, Am. Assoc. Petroleum Geologists Bull., v. 41, no. 12, p. 2713–2715, 2716–2717 (fig. 3). Formation, in Berks County, Pa., consists of 250 feet of thick- to thin-bedded limestone and dolomite. In reference section (herein designated), divided into three members: upper or calcilutite member, middle or calcirudite member, and lower interbedded limestone and dolomite member. Underlies Rickenbach formation (new). In southern Pennsylvania and Maryland, contact between Stonehenge limestone and Conococheague limestone has been placed between relatively pure limestone of lower Stonehenge and more impure beds of the Conococheague. This contact appears to be similar to the relatively sharp lithological break between upper and middle members of Stonehenge as mapped in this report. Clastic beds beneath this contact in central Berks County are more similar lithologically and paleontologically to the Beekmantown than to the highest exposed Conococheague-Elbrook limestones as indicated on Geologic Map of Pennsylvania (Stose and Ljungstedt, 1932). An unmetamorphosed section in uppermost 300 feet of exposed part of Conococheague in vicinity of Reading was examined. A covered interval with apparent stratigraphic thickness of 500 to 600 feet overlies this section and is persistent throughout Berks County. Beds overlying the concealed interval throughout Berks County are included in Stonehenge limestone.

W. J. Sando, 1958, Geol. Soc. America Bull., v. 69, no. 7, p. 837–841, geol. sections. Described near Chambersburg, Pa. Base of Stonehenge was originally placed at contact of pure fine-grained massive limestones with underlying sandy conglomeratic thin-bedded limestone included in upper part of Conococheague formation. Cambrian-Ordovician boundary was placed at this contact. The lower thin-bedded limestones form persistent stratigraphic unit in southern Pennsylvania, Maryland, and West Virginia and bear diagnostic Lower Ordovician trilobite assemblage. These beds are here named Stoufferstown member of Stonehenge. Upper member of Stonehenge as used in this paper is equivalent to upper and lower members of Maryland (Sando, 1957). Underlies Rockdale Run formation. Thickness about 1,000 feet; Stoufferstown member 217 feet in its type section.

A. C. Donaldson, 1960, Dissert. Abs., v. 20, no. 9, p. 2693. In central Pennsylvania, subdivided into (ascending) Spring Creek, Graysville, Baileyville, and Logan Branch members. Thickness 430 to 485 feet. Larke dolomite subdivided into four unnamed members which are lateral extensions of members in the Stonehenge.

Type section: On Hoover Farm just north of U.S. Route 30, 2 miles southeast of center of Chambersburg, Franklin County, Pa. Reference section (Maryland): Section begins in pasture northeast of barn on Forsythe Farm located 1 mile S. 5° E. of St. Paul's Church, Washington County.

Reference section (Pennsylvania): Along northwest bank of Schuylkill River in borough of Glenside, a suburb of Reading, Berks County.

Stonehengian division (of Ozarkian Series)

Lower Ordovician: Eastern United States.

A. W. Grabau, 1937, Paleozoic formations in the light of the pulsation theory, v. 3, Cambrovician pulsation, pt. 2, Appalachian, Palaeocordilleran, Pre-Andean, Himalayan, and Cathaysian geosynclines. Peiping, China, Univ. Press, Natl. Univ. Peking, p. 10, 13 (table), 15, 282 (table). The Stonehenge and Tribeshill (its Mohawk Valley partial equivalent) represent essentially the Tremadoc of the Caledonian geosyncline, and for them the same Stonehengian is proposed. The Stonehenge and Tribeshill represent the last of the transgressive series from the southern Appalachian geosyncline.

Stone Mill Member (of Ludlowville Formation)

Middle Devonian: Central New York.

G. A. Cooper and A. S. Warthin, 1941, Washington Acad. Sci. Jour., v. 31, no. 6, p. 259. Name proposed for thin bed of limestone consisting mostly of crinoidal and fragmentary shell material with considerable sand. Thickness 1 to 3 feet.

G. A. Cooper and others, 1942, Geol. Soc. America Bull., v. 53, no. 12, pt. 1, p. 1783, chart 4. Underlies shaly sandstone of the formation; overlies Chenango sandstone.

Type section: In bed and banks of Stone Mill Brook 4½ miles (airline) southeast of Lebanon and about 1½ miles northwest of Earlville, Madison County. Exposed on both sides of Chenango Valley in Morrisville quadrangle.

Stone Mountain Granite

Permian(?): Northwestern Georgia.

T. L. Watson, 1902, Georgia Geol. Survey Bull. 9-A, p. 114–119. Name applied to granite quarried at Stone Mountain. An even-textured medium-grained light-gray biotite-bearing muscovite 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. 29–32, 55–61. Stone Mountain granite (Permian?) was introduced during a late stage of the Appalachian orogeny. Intrudes Lithonia gneiss.

Named for occurrence at Stone Mountain, DeKalb County.

**Stoner Limestone Member** (of Stanton Limestone)[1]

Pennsylvanian (Missouri Series): Southeastern Nebraska and eastern Kansas.

Original reference: G. E. Condra, 1930, Nebraska Geol. Survey Bull. 3, 2d ser., p. 11, 26, 27, 31, 33, 34.

R. C. Moore, 1949, Kansas Geol. Survey Bull. 83, p. 68 (fig. 14), 118–119. Overlies Eudora shale member; underlies Rock Lake shale member (this is classification agreed upon by State Geological Surveys of Iowa, Kansas, Missouri, Nebraska, and Oklahoma, May 1947). Thickness along Kansas River and elsewhere in northeastern Kansas 11 to 15 feet; in parts of southern Kansas about 50 feet.

G. E. Condra, 1949, Nebraska Geol. Survey Bull. 16, p. 32. In Nebraska, includes (ascending) Dyson Hollow limestone zone (new), Kiewitz shale zone, and unnamed limestone. Thickness at type locality 15 or 16 feet.

Type locality: On Stoner Farm, northwest of South Bend, Cass County, Nebr.

**Stones River Group[1] or Limestone[1]**

Middle Ordovician: Tennessee, western Maryland, northeastern Mississippi, southern Pennsylvania, western Virginia, and northeastern West Virginia.

Original reference: J. M. Safford, 1851, Am. Jour. Sci., 2d v. 12, p. 353, 354–356.

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., studied in detail, and revised stratigraphic nomenclature proposed. Study revealed inconsistencies in use of names Stones River, Murfreesboro, Mosheim, Lenoir, Blount, Holston, Ottosee, Lowville, and Moccasin. Succession of beds described is post-Beekmantown. Boundary between Chazy and Black River is not clearly defined in Tazewell County. The Chazy of southern Appalachian Valley and Ridge province is, according to Ulrich, composed of Stones River and Blount groups (possibly also Ulrich's Speers Ferry group). According to Ulrich, Murfreesboro limestone is oldest formation of Stones River group which is lower Chazy. In Tazewell County, part of Ulrich's Blount group (upper Chazy) occurs beneath beds containing fauna of Murfreesboro limestone of Central basin of Tennessee. Such anomalies result from an erroneous determination of stratigraphic succession used by Ulrich in setting forth relations of Stones River and Blount groups. Neither group name should now be used. In revised terminology proposed herein, the succession of beds is grouped into eight formations. Series and group classification of the formations described in this report can be made only after regional studies between New York localities and Tazewell County have been completed.

B. N. Cooper, 1945, Jour. Geology, v. 53, no. 4, p. 263–275. Discussion of Stones River equivalents in Appalachian region. Commonly accepted correlation of Stones River group of central Tennessee with Chazy of New York and with beds immediately succeeding the Beekmantown or Knox dolomite in Appalachian Valley—the Stones River and overlying Blount—was based upon mistaken identification of formations. Both the stratigraphic position of Stones River equivalents in Appalachian region and character of Stones River faunas indicate that entire Stones River group is post-Chazyan. "Stones River" as a general time-rock term should no longer be used, nor should name be revived if a post-Chazyan, pre-Black River group is recognized. Report gives detailed history of usage of name and table of classifications of Stones River group as used through 1929.

L. C. Craig, 1949, Geol. Soc. America Bull., v. 60, no. 4, p. 715–717, geol. sections. Discussion of lower Middle Ordovician of south-central Pennsylvania. Limestone beds overlying Beekmantown and underlying the Chambersburg in Franklin County, were called Stones River by Stose (1906, Jour. Geology, v. 14; 1908, Jour. Geology, v. 16). Cooper (1945) has shown that beds in Appalachian region of Virginia have been consistently miscorrelated with true Stones River of central Tennessee. Correlation from south-central Pennsylvania to Virginia indicates that term Stones River was misused in Chambersburg area and that equivalents of true Stones River are probably within Shippensburg formation. Term "Stones River" is used in this report for limestone underlying Shippensburg formation.

C. W. Wilson, Jr., 1949, Tennessee Div. Geology Bull. 56, p. 24–75. Proposed in this report to return Carters limestone to top of Stones River group, thus making group consists of (ascending) Murfreesboro, Pierce, Ridley, Lebanon, and Carters limestones in accordance with Safford's original definition of Stones River in 1851. Contact between Carters and Hermitage formations is by far most pronounced stratigraphic break in this part of Ordovician section. Underlies Nashville group (redefined).

R. B. Neuman, 1951, Geol. Soc. America Bull., v. 62, no. 3, p. 267–324. Term St. Paul group introduced as substitute for "Stones River" group as mapped through West Virginia, Maryland, and Mercersburg-Chambersburg quadrangles in Pennsylvania. Need for substitution has been apparent since Cooper and Prouty (1943) demonstrated that central Tennessee Stones River was younger than Appalachian "Stones River."

John Rodgers, 1953, Tennessee Div. Geology Bull. 58, pt. 2, p. 87, pls. For purposes of present map, term "unit 1" of Chickamauga limestone replaces (in belts northwest of Whiteoak Mountain and Hunter Valley faults) the term Stones River of middle Tennessee.

G. A. Cooper, 1956, Smithsonian Misc. Colln., v. 127, pt. 1, p. 91–92. Term Stones River group is appropriate to Central basin of Tennessee and possibly parts of Alabama but not to most parts of the Appalachians to which it has already been applied. For years this term has been used for lower or "Chazyan" part (Lenoir through Lincolnshire) of Appalachian section from Pennsylvania to Alabama. It was also just as inappropriately applied to parts of Minnesota section. Identification of Carters formation of the Central basin as Lowville, because of presence of *Tetradium cellulosum*, was chief factor in declaring subjacent beds, Lebanon through Murfreesboro, as Chazyan in age. Similar error was made in Appalachians in identifying all formations below *Cryptophragmus* and *Tetradium cellulosum*-bearing "Lowville" as Chazyan in age. This threw the lower formations of the Appalachians into correlation with Stones River formations. Thus, because of common presence of *Maclurites* and the position in relation to "Mosheim" rocks, Lenoir and Ridley were correlated, and from these false premises many other errors were brought about. Examination of fossils of Stones River formations of Central basin of Tennessee shows that affinities of this group are with the old Black River-Trenton (Wilderness stage, new) assemblage of formations rather than with the Chazy (Marmor stage, new). Stones River as group term should be dropped from the Appalachians.

Named for exposures on Stones River near Nashville, Tenn.

**Stones Switch Sandstone Member** (of Whitsett Formation)

Stones Switch Sand[1]

Eocene, upper: South-central Texas.

Original reference: A. C. Ellisor, 1933, Am. Assoc. Petroleum Geologists Bull., v. 17, no. 11, p. 1302, 1314.

D. H. Eargle, 1959, Am. Assoc. Petroleum Geologists Bull., v. 43, no. 11, p. 2624 (fig. 1), 2626 (table 1), 2632. Basal member of Whitsett as defined in this paper. Underlies Dubose member; overlies Conquista clay member (new) of McElroy formation (redefined). Chiefly crossbedded sandstone containing borings of marine crustacean(?) *Halymenites major* and, locally, marine or brackish-water fossils, as well as thin lenses of carbonaceous shale and bentonitic clay. Uppermost bed is generally an indurated plant-root-bearing sandstone, or, in some places, an oyster-shell bank. Note on derivation of name.

Named for railroad siding (now abandoned) from which a spur track led to a quarry on bluff overlooking Atascosa River 2½ miles north of Whitsett Bluff and 4.4 miles S. 5° W. of Campbellton, Atascosa County.

Stoneville Member (of Fox Hills Sandstone)

Upper Cretaceous: Western South Dakota.

W. V. Searight, 1934, South Dakota Geol. Survey Rept. Inv. 22, p. 4, 5, 8–11; E. P. Rothrock, 1944, South Dakota Geol. Survey Bull. 15, p. 83, 84. A succession of clay, sandstone, and coal beds in upper one-third of formation. Thickness 10 to 45 feet. Underlies unnamed upper sandstone member and overlies unnamed lower sandstone member.

Named for exposures near Stoneville, Meade County.

Stoneville Flats Limestone (in Greenhorn Formation)

Upper Cretaceous: Southeastern Montana and northeastern Wyoming.

M. N. Bramlette and W. W. Rubey *in* R. C. Moore, 1949, Geol. Soc. America Mem. 39, p. 27 (fig. 18). In lower chalk marl facies of formation. Older than Crow Creek sandy limestone; younger than Bull Creek sandy limestone (new).

Carter County, Mont., and Crook County, Wyo.

**Stonewall Formation**

**Stonewall Quartz Diorite**[1]

Jurassic(?): Southern California.

Original reference: F. S. Hudson, 1922, California Univ. Pub., Dept. Geol. Sci. Bull., v. 13, no. 6, p. 181, 191–193, map.

Richard Merriam, 1946, Geol. Soc. America Bull., v. 57, no. 3, p. 230–232, pl. 1. Described in Ramona quadrangle as Stonewall formation. Unit subdivided into Stonewall granodiorite and Stonewall quartz diorite. Each mapped separately. Shown as older than San Marcos gabbro.

E. S. Larsen, Jr., 1948, Geol. Soc. America Mem. 29, p. 43. Probably pre-Triassic.

D. L. Everhart, 1951, California Div. Mines Bull. 159, p. 61–65, pls. 2, 3, 4, 5. A typical granodiorite, megascopically medium- to coarse-grained, with subhedral granular texture. Younger than Julian schist. Gives historical summary of name. Terms formation and granodiorite have both been applied to unit.

Richard Merriam, 1958, California Div. Mines Bull. 177, p. 11, pl. 1. Term Stonewall quartz diorite used in this report [Santa Ysabel quadrangle] though unit as mapped includes a variety of rock types. Younger than Julian schist; older than San Marcos gabbro.

H. W. Jaffe and others, 1959, U.S. Geol. Survey Bull. 1097–B, p. 86. Lead-alpha age 96 million years.

Named after Stonewall Peak, which is composed of this rock. Cuyamaca region, San Diego County.

Stonewall Creek Shale Member (of Lykins Formation)

Permo-Triassic: Northern Colorado.

T. L. Broin, 1958, Dissert. Abs., v. 19, no. 1, p. 114. Underlies Park Creek limestone member (new); overlies Poudre limestone member (new).

Stonington Beds[1] or Member (of Richmond Formation)

Upper Ordovician: Northern Michigan.

Original reference: R. C. Hussey, 1926, Michigan Univ. Mus. Geol. Contr., v. 2, no. 8, p. 113–150.

R. C. Hussey, 1952, Michigan Dept. Conserv. Geol. Survey Div. Pub. 46, Geol. Ser. 39, p. 14 (table), 42, 44, 52. Predominantly argillaceous limestones. Includes Bay de Noc member below and Ogontz beds [member] above. [Reference refers to Ogontz beds which lie above the Stonington but also states that "this member" was deposited under relatively clear water conditions.] Underlies Big Hill beds [or member]; overlies Bills Creek beds [or member] (restricted).

Named for exposures 1 mile north of Stonington post office, on east side of Little Bay de Noc, Delta County.

Stonington Gneiss[1]

Pre-Triassic: Southeastern Connecticut.

Original reference: L. H. Martin, 1925, Connecticut Geol. Nat. History Survey Bull. 33.

John Rodgers and others, 1956, Preliminary geological map of Connecticut (1:253,440): Connecticut Geol. Nat. History Survey. Described as gray, rarely pink, fine- to medium-grained gneiss. Many inclusions of biotite and hornblende gneiss and schist. Pre-Triassic. Derivation of name stated.

W. G. Foye, 1949, Connecticut Geol. Nat. History Survey Bull. 74, p. 61, pl. 1. Same as Mamacoke gneiss and mapped as latter.

Named for town of Stonington, New London County.

Stony Brook Beds (in Chemung Formation)[1]

Upper Devonian: Northeastern Pennsylvania.

Original reference: I. C. White, 1883, Pennsylvania 2d Geol. Survey Rept. $G_7$, p. 68–73, 216–217.

Well exposed at cutting along road where it crosses Stony Brook, Orange Township, Columbia County.

Stonybrook Quartzite[1]

Precambrian: Eastern Massachusetts.

Original reference: W. E. Hobbs, 1899, Am. Geologist, v. 23, p. 110.

Named for exposures at Stonybrook, Middlesex County.

Stony Clove Sandstone Member (of Katsberg Redbeds)

Stony Clove Sandstones

Upper Devonian (Senecan): Southeastern New York.

G. H. Chadwick, 1940, New York State Geol. Assoc. 16th Ann. Mtg. Field Guide Leaflets, p. 2. Listed in table of formations as sandstones. Consists of continental gray flags and shale. Thickness 900 feet. Underlies Katsberg redbeds; overlies Onteora redbeds.

G. H. Chadwick, 1944, New York State Mus. Bull. 336, p. 130–135, 136. Included in Katsberg redbeds as basal member for mapping purposes. Possibly unit belongs with Onteora redbeds. Underlies Wittenberg conglomerate member. Considered continuation of Kattel gray flagstones. Outcrop area described.

Exposed in Stony Clove, a pass in Kaaterskill quadrangle.

Stony Creek Basalt

Pliocene: California.

O. P. Jenkins, 1938, Geologic map of California (1:500,000): California Div. Mines, sheet 4. Shown on map legend.

Stony Creek Granite Gneiss[1] or Granite

Pre-Triassic: South-central Connecticut.

Original reference: H. E. Gregory, 1906, Connecticut Geol. Nat. History Survey Bull. 6, p. 115, 147, 152, map.

John Rodgers and others, 1956, Preliminary geological map of Connecticut (1:253,440): Connecticut Geol. Nat. History Survey. Unit referred to as a granitic gneiss. Described as medium- to very coarse-grained variably foliated red or pink gneiss or granite. Large phenocrysts and porphyroblasts of potash feldspar. Inclusions of dark hornblende and biotite gneiss common. Grades through a lit-par-lit or migmatitic zone into Middletown gneiss. Pegmatite very common. Part of East Haven granitic body, a structural unit.

H. M. Mikami and R. E. Digman, 1957, Connecticut Geol. Nat. History Survey Bull. 86, p. 7–12, 24–25, pl. 1. Stony Creek granite and Branford quartz monzonite compose Branford-Stony Creek massif. Normal Stony Creek granite is pink to reddish and is speckled by black biotite flakes. Name credited to Kemp (1899, Geol. Soc. America Bull., v. 10, p. 369–370). [Kemp referred to Stony Creek types and granites at Stony Creek. Two varieties, Stony Creek red, and Stony Creek gray.]

Named for occurrence at Stony Creek, a town in Branford Township, New Haven County.

**Stony Gap Sandstone Member** (of Hinton Formation)[1]

Stony Gap Sandstone (in Hinton Group)

Stony Gap Sandstone Member (of Pennington Formation)

Upper Mississippian: Southeastern West Virginia, northeastern Kentucky, and southwestern Virginia.

Original reference: D. B. Reger, 1926, West Virginia Geol. Survey Rept. Mercer, Monroe, and Summers Counties, p. 298, 371.

P. H. Price and E. T. Heck, 1939, West Virginia Geol. Survey, Greenbrier County, p. 255, 261–262. Basal formation in Hinton group, Mauch Chunk series.

Charles Butts, 1940, Virginia Geol. Survey Bull. 52, pt. 1, p. 398, 399. Basal member of Pennington formation in Greendale syncline.

R. H. Wilpolt and D. W. Marden, 1949, U.S. Geol. Survey Oil and Gas Inv. Prelim. Chart 38, sheet 1. Basal member of Hinton formation. Underlies middle red member of formation; overlies Bluefield formation. Occurrences in Kentucky noted.

Type locality: At village of Stony Gap, Mercer County, W. Va., on both sides of Bluefield-Princeton Road. Identifiable from Pennington Gap, Va., to Princeton, W. Va., and from Pineville, Ky., northeastward on Pine Mountain to Osborn Gap, Ky.

Stony Hills Formation[1]

Permian: Southern Kansas and western Oklahoma.

Original reference: F. W. Cragin, 1897, Am. Geologist, v. 19, p. 358, 363.

C. C. Branson, Oklahoma Geology Notes, v. 17, no. 11, p. 103. Abandoned by Oklahoma Geological Survey.

Named for Stony Hills, east of Watonga, Blaine County, Okla.

Stony Hollow Member (of Marcellus Formation)

Middle Devonian: Southeastern New York and northeastern Pennsylvania.

G. A. Cooper, 1941, Washington Acad. Sci. Jour., v. 31, no. 5, p. 179–180. Chiefly fine-grained calcareous sandstone 75 to 100 feet thick. Underlies Mount Marion formation of Grabau at its type section. Beds formerly classified as "Marcellus" shale (Bakoven of Chadwick) immediately underlie Stony Hollow member and are now proved to be equivalent of Union Springs member. Southwest of Albany, layers of limestone appear in upper part of sandstone which has thinned to 24 feet; west of Onesquethaw Creek, these limestones of the Stony Hollow become the Cherry Valley limestone as exposed in Stony Creek, Schoharie Valley.

G. A. Cooper and others, 1942, Geol. Soc. America Bull., v. 53, no. 12, pt. 1, p. 1783, chart 4. Age given on correlation chart as Middle Devonian.

Type section: At bend of New York State Highway 28 and along railroad opposite bend at entrance to valley leading up to settlement of Stony Hollow, 1¾ to 2 miles northwest of bridge over Esopus Creek on west side of Kingston, Ulster County. Also present along U.S. Highway 209 near Echo Lake, Pa.

Stony Lonesome Bed[1]

Devonian or Carboniferous: Northwestern Pennsylvania.

Original reference: G. H. Chadwick, 1935, Geol. Soc. America Bull., v. 46, no. 2, p. 334, 337–339.

Stony Lonesome, east of Warren, Warren County.

Stony Mountain Diorite

Miocene: Southwestern Colorado.

McClelland Dings, 1941, Geol. Soc. America Bull., v. 52, no. 5, p. 698 (fig. 1), 712–714. Name applied to diorite in Stony Mountain stock which penetrated Miocene volcanic rocks of San Juan, Silverton and Potosi series. Younger than Governor diorite (new).

Vertically exposed for 1,320 feet on east side of Stony Mountain, about 5 miles southwest of Ouray in San Juan Mountains.

**Stony Mountain Formation**[1] (in Bighorn Group)

Upper Ordovician: Surface and subsurface in Manitoba and Saskatchewan, Canada, and subsurface in Montana, North Dakota, and Wyoming.

Original reference: D. B. Dowling, 1901, Canada Geol. Survey Ann. Rept., new ser., v. 11, p. 46F.

V. H. Kline, 1942, Am. Assoc. Petroleum Geologists Bull., v. 26, no. 3, p. 339, 360–361. Geographically extended into subsurface in North Dakota.

R. J. Ross, Jr., 1957, U.S. Geol. Survey Bull. 1021–M, p. 446 (fig. 88), 447–448, pl. 44. Discussion of Ordovician fossils from wells in Williston Basin, Mont. Stony Mountain formation, which comprises a lower shale member and an upper dolomitic member, is upper formation in Bighorn group in subsurface. Overlies Red River formation.

M. R. McCoy, 1958, Wyoming Geol. Assoc. Guidebook 13th Ann. Field Conf., p. 27 (fig. 1), 29. Discussion of Ordovician rocks of northern Powder River basin and Black Hills uplift areas, Montana, Wyoming, and South Dakota. Correlation chart shows Stony Mountain in northern Powder River basin, Williston basin, and northern Big Horn Mountains. In first two areas, overlies Red River formation, and in Big Horn Mountains, overlies Bighorn [dolomite].

Named for exposures at Stony Mountain, near Winnipeg, Manitoba, Canada.

Stony Point Shale[1] (in Trenton Group)

Middle Ordovician: Northeastern New York and western Vermont, and Quebec, Canada.

Original reference: R. Ruedemann, 1921, New York State Mus. Bull. 227, 228, p. 112, 115–116.

G. M. Kay, 1937, Geol. Soc. America Bull., v. 48, no. 2, p. 275. Discussed under heading of formations of Sherman Fall age in Trenton group. Overlies Cumberland Head shaly limestone, and has exposed thickness of 215 feet in section on Hero Island, Vt. It is prevalent black shale in northern Lake Champlain region, and in southern Quebec is overlain by Iberville shale of questionably Utica age. About 500 feet thick in type area. Overlies Lacolle conglomerate in Quebec.

David Hawley, 1957, Geol. Soc. America Bull., v. 68, no. 1, p. 58–62, pl. 1. Formation described in northern Champlain Valley, Vt., where it is predominantly calcareous shale in lower part, grading upward to predominantly quartz-silty argillaceous limestone. Thickness 1,000 to 1,500 feet. Overlies Cumberland Head formation; underlies Iberville formation. Trentonian.

Named for occurence at Stony Point, 1½ miles south of Rouses Point, Clinton County, N.Y.

Storm King Granite[1]

Precambrian: Southeastern New York.

Original reference: C. P. Berkey, 1907, New York State Mus. Bull. 107 p. 364, 377.

K. E. Lowe, 1950, Geol. Soc. America Bull., v. 61, no. 3, p. 144–148, 157–188, pls. 1, 2, 3. In vicinity of Bear Mountain, occupies core of syncline in earlier crystalline complex here termed Hudson Highlands complex. It is part of a larger synclinal pluton whose accordance with the northeast-plunging structure is shown by conformable contacts and mineral alignment in both the granite and the country rocks. Storm King represents last major invasion of magmatic origin in Hudson Highlands area. In contrast to great variety of rock types in Hudson Highlands complex and their involved field relations, this granite occurs in large masses of rather uniform character; hence, it is the most distinct lithologic unit in the crystallines of the Hudson Highlands area.

Named for occurrence on Storm King Mountain, Putnam and Orange Counties.

Storm King Mountain Gneissoid Granite[1]

Precambrian: Southeastern New York.

Original reference: C. P. Berkey, 1911, New York State Mus. Bull. 107, p. 364, 377.

Constitutes whole of Storm King mountain and larger part of Crows Nest on west side of Hudson River; also forms chief rock of Bull Hill and Breakneck Ridge in Putnam and Orange Counties.

Stormont Limestone Member (of Pierson Point Shale)

Pennsylvanian (Virgil Series): Northeastern Kansas.

H. G. O'Connor, 1953, Kansas Geol. Survey [Reports], v. 12, pt. 1, p. 18–19, pl. 1. Name applied to the lowest of three limestones near middle of Pierson Point shale. Member is variable in character but generally is sandy or silty and nonresistant to weathering; fossiliferous. Thickness averages 1 to 4 feet. At type locality, occurs about 12 feet below Maple Hill limestone and 13½ feet above Tarkio limestone. Occurs 12 to 18 feet above Tarkio limestone where Tarkio is present and about 10 to 20 feet above the Elmont where the Tarkio is absent. Because of its position between the Elmont and Maple Hill limestones, it has been erroneously called the Tarkio in parts of Lyon County where the Tarkio is absent.

Type locality: Along road and in ravines in NW¼ sec. 9, T. 14 S., R. 14 E., about 1 mile northwest of former Stormont post office, Osage County, where overlying Maple Hill and underlying Tarkio are also typically exposed.

Stormville Conglomerate[1]

Stormville Sandstone[1]

Stormville Sandstone Member (of Coeymans Limestone)

Lower Devonian: Northern New Jersey and northeastern Pennsylvania.

Original references: (Conglomerate) I. C. White, 1882, Pennsylvania 2d Geol. Survey Rept. $G_6$, p. 76, 132–133; (Sandstone) S. Weller, 1900, New Jersey Geol. Survey Ann. Rept. State Geologist 1899, p. 3–46.

F. M. Swartz, 1939, Pennsylvania Geol. Survey, 4th ser., Bull. G–19, p. 51–53. At Nearpass quarries in New Jersey, the Coeymans contains no appreciable amount of sand. In eastern Monroe County, Pa., 8 to 10 feet of calcareous sandstone occur at top of the Coeymans. I. C. White (1882) named this sandstone the Stormville conglomerate from exposures at that village about 3 miles southwest of Stroudsburg, where the sandstone is pebbly and 17½ feet thick, according to White's measurements. White also reported pebbles in parts of the 30 feet of limestone underlying main body of pebbly sandstone at Stormville. White applied name Stormville not only to this sandstone but also to underlying limestones and overlying shales of diverse ages. Name must be modified or discarded. Believed that name will be useful if restricted to above described sandstone member of Coeymans.

C. K. Swartz and F. M. Swartz, 1941, Geol. Soc. America Bull., v. 52, no. 8, p. 1158–1160. White's (1882) section at Stormville reexamined. Section is much concealed. Its lower part crosses minor anticline. It terminates above a sharp syncline. Stormville conglomerate is correlated with upper part of Coeymans limestone.

Named for occurrence in vicinity of Stormville, Monroe County, Pa.

Stormville Hydraulic Cement Bed[1]

Stormville Water Lime[1]

Lower Devonian: Northeastern Pennsylvania.

Original reference: I. C. White, 1882, Pennsylvania 2d Geol. Survey Rept. $G_6$, p. 136–137.

C. K. Swartz and F. M. Swartz, 1941, Geol. Soc. America Bull., v. 52, no. 8, p. 1160, 1171. White's Stormville hydraulic cement rock ("pethstone") included in Rondout limestone.

Named for occurrence in vicinity of Stormville, Monroe County.

Stormville Limestone[1]

Lower Devonian: Northeastern Pennsylvania and northern New Jersey.

Original reference: I. C. White, 1882, Pennsylvania 2d Geol. Survey Rept. $G_6$, p. 76, 133–135.

F. M. Swartz, 1939, Pennsylvania Geol. Survey, 4th ser., Bull. G–19, p. 51–53. At Nearpass quarries in New Jersey, the Coeymans contains very little sand. In eastern Monroe County, Pa., 8 to 10 feet of calcareous sandstone occur at top of the Coeymans. White (1882) named this sandstone the Stormville conglomerate. White applied name Stormville not only to sandstone (conglomerate) but also to underlying limestones and overlying shales of diverse ages. Name must be modified or discarded. Believed that name Stormville is appropriate if restricted to sandstone which is here termed member of Coeymans limestone.

C. K. Swartz and F. M. Swartz, 1941, Geol. Soc. America Bull., v. 52, no. 8, p. 1160. White's (1882) Stormville section reexamined. Stormville limestone correlated with Manlius limestone.

Named for occurrence in vicinity of Stormville, Monroe County, Pa.

Stormville Shale[1]

Lower Devonian: Northern New Jersey and northeastern Pennsylvania.

Original reference: I. C. White, 1882, Pennsylvania 2d Geol. Survey Rept. $G_6$, p. 76, 131–132.

F. M. Swartz, 1939, Pennsylvania Geol. Survey, 4th ser., Bull. G–19, p. 51–53. White (1882) applied name Stormville not only to sandstone (conglomerate) but also to underlying limestones and overlying shales of diverse ages. Name must be modified or discarded. Believed that name Stormville is appropriate if restricted to sandstone which is here termed member of Coeymans limestone.

C. K. Swartz and F. M. Swartz, 1941, Geol. Soc. America Bull., v. 52, no. 8, p. 1158–1160. White's (1882) section at Stormville reexamined. Section is much concealed. Its lower part crosses minor anticline. It terminates above sharp syncline. Stormville conglomerate is overlain by Stormville shale to which White assigns thickness of 160 feet. Latter is succeeded by Oriskany sandstone. Stormville shale crops out in belt nearly 1,000 feet wide, measured perpendicular to strike. It is largely concealed, and its strikes and dips are unknown. It is bounded by beds with high dips. Evidently thickness of these beds cannot be as little as 160 feet, unless there is much concealed minor folding. Six miles east of Stormville, this interval is occupied by four geologic horizons—New Scotland, Becraft, Port Ewen, and Oriskany—with combined thickness of about 300 feet. Stormville shale is correlated with Oriskany shale.

Named for exposures at Stormville, Monroe County, Pa.

**Storrs Tongue** (of Star Point Sandstone)[1]

Upper Cretaceous: Central eastern Utah.

Original reference: F. R. Clark, 1928, U.S. Geol. Survey Bull. 793.

R. G. Young, 1955, Geol. Soc. America Bull., v. 66, no. 2, p. 183, fig. 2. Has sharply defined top and grades downward from thick-bedded medium-grained sandstone into sandy shale and shale. About 30 feet thick at Storrs and thins to the east, disappearing about 1 mile east of Kenilworth. Separated from underlying Panther and overlying Spring Canyon sandstone tongues by westward-pointing tongues of Mancos shale. Of Montana age.

Named from exposure at Storrs, in Castlegate quadrangle, Carbon County, where it forms prominent cliff.

Story Formation (in 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, 65–66. Name proposed for upper 58½ feet of type section of Hansonburg group (new). Formation includes 19½ feet of reddish brown shale, arkosic and micaceous sandstone, and gray shale at base; upper 38 feet is light-gray massive to massively bedded fossiliferous limestone. Underlies Del Cuerto formation (new); overlies Burrego formation (new).

Type locality: Northeast side of Oscura Mountains, Socorro County. Name derived from Story Tank, about 3 miles west of west-central front of Oscura Mountains.

**Stotler Limestone** (in Wabaunsee Group)

Pennsylvanian (Virgil Series): East-central Kansas.

R. C. Moore and M. R. Mudge, 1956, Am. Assoc. Petroleum Geologists Bull., v. 40, no. 9, p. 2274 (fig. 1), 2275. Defined to include strata underlying Root shale (new) and overlying Pillsbury shale (new). Thickness ranges from 5 to 35 feet; average 14 feet. Includes (ascending) Dover limestone, Dry shale, and Grandhaven limestone members.

Type section: In spillway and along south side of pond in SE¼ sec. 13, T. 16 S., R. 12 E., Lyon County, about 2 miles west of Miller. Name derived from old Stotler post office which was in SW¼ sec. 10, T. 16 S., R. 13 E.

**Stoufferstown Member** (of Stonehenge Limestone)

Lower Ordovician: Central southern Pennsylvania, western Maryland, and West Virginia.

W. J. Sando, 1958, Geol. Soc. America Bull., v. 69, no. 7, p. 838 (fig. 2), 839, 846, 847. Thin-bedded limestone at base of Stonehenge. Thickness 217 to 224 feet. Underlies upper member (unnamed); overlies Conococheague formation. In Maryland, beds called upper member of Conococheague by Sando (1957, Geol. Soc. America Mem. 68) are now referred to Stoufferstown member.

Named for occurrence in vicinity of Stoufferstown, Chambersburg area, Franklin County, Pa.

**Stovall Limestone Member** (of Winfield Limestone)

Stovall Limestone (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. 49.

R. C. Moore and others, 1951, Kansas Geol. Survey Bull. 89, p. 44. Member of Winfield limestone. Consists of dense gray limestone with an abundance of steel-gray flint where thin in northern Kansas; becomes thicker and noncherty in central and southern parts; fossils rare. Thickness commonly about 1 foot. Underlies Grant shale member; overlies Gage shale member of Doyle shale. Wolfcamp series.

Type locality: In bluffs of Doyle Creek valley, southeast of Stovall elevator and farm, 7 miles southwest of Florence, Marion County, Kans.

Stover Limestone

Stover Member (of Benner Limestone)

Middle Ordovician (Bolarian): Central and south-central Pennsylvania, western Virginia, and southern West Virginia.

G. M. Kay, 1941, (abs.) Geol. Soc. America Bull., v. 52, no. 12, pt. 2, p. 1969. Member of Benner limestone. Described as dark heavy ledged limestone Thickness 93 feet at type locality.

G. M. Kay, 1944, Jour. Geology, v. 52, no. 1, p. 17–19. Upper member of Benner. Described at type section as 91 feet of dark principally dense heavy ledged limestone. Ledges have thin stylotitic partings and fucoidal mottling. One thick metabentonite exposed in several sections. Thickness decreases southeastward. Overlies Snyder member. Underlies Valley View member of Curtin limestone in northern Centre, Clinton, and Lycoming Counties; southeastward disconformably underlies Nealmont limestone. Derivation of name and more exact location of type section stated.

Marshall Kay, 1947, (abs.) Geol. Soc. America Bull., v. 58, no. 12, pt. 2, p. 1199. Limestone included in upper Bolarian (Hunterian) series.

W. H. Twenhofel and others, 1954, Geol. Soc. America Bull., v. 65, no. 3, chart 2, columns 21, 22. Geographic extension; listed in stratigraphic column for Highland County, Va., and Monroe County, W. Va. [Limestone apparently has formational rank in these areas.]

Marshall Kay, 1956, Geol. Soc. America Bull., v. 67, no. 1, p. 74 (table 12), 78, 95, 103. Geographic restriction. New name McGraw limestone proposed for rocks in Virginia previously referred to as Stover. Termed a formation.

Type section: In Pennsylvania Railroad cut at Union Furnace, Huntingdon County, Pa. Named for station of Stover northeast of Nealmont, Blair County, Pa., where well exposed in quarries.

**Stowe Formation**

Upper Cambrian(?) and Lower Ordovician(?): Central Vermont.

P. H. Osberg, 1952, Vermont Geol. Survey Bull. 5, p. 65–66, 116. Described as pale-green albite-quartz-chlorite-muscovite schist. Includes Brackett member along eastern border of Rochester area. Thickness cannot be measured, possibly about 3.000 feet in this area. Underlies Moretown formation; overlies Ottauquechee formation. Lower Cambrian. Name attributed to Cady.

W. M. Cady, 1956, U.S. Geol. Survey Geol. Quad. Map GQ–79. Ordovician. Derivation of name given.

A. L. Albee, 1957, U.S. Geol. Survey Geol. Quad. Map GQ–102. In Hyde Park quadrangle, underlies Umbrella Hill formation (new). Ordovician.

W. M. Cady, 1960, Geol. Soc. America Bull., v. 71, no. 5, pl. 5. Upper Cambrian(?) and lower Ordovician(?).

Occurs on summits of Braintree Mountain and extends eastward beyond eastern border of Rochester quadrangle. Named for typical occurrence in southeastern part of Stowe Township, Lamoille County.

**Straight Cliffs Sandstone**[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, Utah Geol. and Mineralog. Survey Bull. 37, p. 26 (table), 46–50. Generally in southern Utah, wherever recognized subdivisions of Cretaceous are clearly defined, Tropic formation is overlain in turn by Straight Cliffs sandstone and Wahweap sandstone. In this report [Iron County], the Straight Cliffs is recognizable and Wahweap is probably present but no plane of separation could be noted; hence, the two are described together. Combined thickness 700 to 1,150 feet.

H. E. Gregory, 1950, U.S. Geol. Survey Prof. Paper 220, p. 105–107, 128–129, pl. 5. Westward from type locality, formation changes rapidly. In Kaiparowits Plateau, consists of massive thick buff-gray sandstones, subordinate sandy shales, and coal including beds 3 to 10 feet thick. Along base of Paunsaugunt Plateau, number of thick sandstone beds decreases, the thin ones increase, and coal beds decrease in number, thickness, and purity. In Zion Park region, sandstones more than 10 feet thick make up about 50 percent of the beds; thinner sandstone beds, 45 percent; calcareous and argillaceous shale, 5 percent; coal is represented by earthy lignite or carbonaceous shale. In Santa Clara Valley, both shale and coal are absent. Conformably underlies Wahweap sandstone but in some the two units cannot be differentiated; overlies Tropic formation. Thickness of Straight Cliffs and Wahweap 1,406 feet in Zion Park region.

Named from Straight Cliffs in Escalante Valley, Utah.

**Straight Ridge Sandstone Member** (of Pottsville Formation)[1]

Lower Pennsylvanian: Central Alabama.

Original reference: C. Butts, 1927, U.S. Geol Survey Geol. Atlas, Folio 221.

Named for fact it forms Straight Ridge, which extends along west side and south end of Yellowleaf Basin, in Vandiver quadrangle.

Strain Shale Member (of Lykins Formation)

Triassic: North-central Colorado.

L. W. LeRoy, 1946, Colorado School Mines Quart., v. 41, no. 2, p. 31, 42–44, fig. 7. Red arenaceous shales and mudstones and fine argillaceous red sandstones with the shales and mudstones predominating. Thickness ranges from 290 to 320 feet. Overlies Glennon limestone member (new); underlies Ralston formation (new).

Named from Strain Gulch, which enters Bear Creek just east of town of Morrison, Jefferson County.

Strange Formation (in Arbuckle Group)

Lower Ordovician: Southwestern Oklahoma.

C. E. Decker, 1939, Geol. Soc. America Bull., v. 50, no. 8, p. 1313, 1319, table 1; 1939, Oklahoma Geol. Survey Circ. 22, p. 15, 24–25. Name proposed for dolomite beds exposed in only four outcrops on south side of Wichita Mountains. Thickness 60 to 80 feet. Occurs below Cool

Creek formation and above McKenzie Hill formation. Name substituted for preoccupied Wolf Creek dolomite (Decker, 1933).

C. C. Branson, 1957, Oklahoma Geology Notes, v. 17, no. 11, p. 103. Abandoned by Oklahoma Geological Survey. Dolomitization is localized within McKenzie Hill, and the dolomite facies is not stratigraphically significant.

Type section: Caps top of McKenzie Hill in sec. 8 and extends down its southeast slope. Name taken from Strange Ranch on which two outcrops occur in secs. 8 and 9, T. 2 N., R. 12 W., Comanche County.

**Stranger Formation**[1] (in Douglas Group)

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.

F. C. Greene and W. V. Searight, 1949, Missouri Geol. Survey and Water Resources Rept. Inv. 11, p. 15–16. In Missouri, formation includes Tonganoxie sandstone, Vinland shale, and Haskell limestone members. Underlies Lawrence formation; overlies Iatan limestone.

G. E. Condra, 1949, Nebraska Geol. Survey Bull. 16, p. 29–30. Stranger beds are exposed in three small areas in Table Rock-Richfield anticline in Cass and Sarpy Counties, Nebr. Stranger section in Cass County is (descending) Robbins shale, Cass formation, and Plattford formation.

H. G. O'Connor, 1960, Kansas Geol. Survey Bull. 148, p. 29–33. Formation includes (ascending) Tonganoxie Sandstone, Westphalia Limestone, Vinland Shale, Haskell Limestone, and Robbins Shale Members. Maximum thickness about 160 feet (Douglas County). Overlies Weston Shale; underlies Lawrence Shale.

Typically exposed along east side of sec. 3, T. 12 S., R. 21 E., Leavenworth County. Named from Stranger Creek near Tonganoxie, Kans.

Strasburg cyclothem

Pennsylvanian (Allegheny Series): Southeastern Ohio.

Incidental mention in road log: N. K. Flint, 1949, Ohio Acad. Sci. [Guidebook] 24th Ann. Field Conf., p. 14.

N. K. Flint, 1951, Ohio Geol. Survey, 4th ser., p. 47–48, table 1, geol. map. Includes (ascending) Strasburg shale and (or) sandstone, 10 feet; Oak Hill clay, 7 feet; and Strasburg coal. Occurs below Middle Kittanning cyclothem and above Lower Kittanning 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), 64–68. Includes (ascending) Strasburg shale and (or) sandstone member, Hamden limestone member, Oak Hill underclay member, and Strasburg coal member. Occurs above Lower Kittanning cyclothem and below Middle Kittanning cyclothem. In this report [Athens County], the Allegheny series is described on a cyclothemic basis; 13 cyclothems are named. [For complete sequence see Brookville cyclothem.]

Town of Strasburg is in Tuscarawas County.

Strasburg Formation or Limestone

Middle Ordovician (Chazyan): Tennessee.

E. O. Ulrich, 1939, Kansas Geol. Soc. Guidebook 13th Ann. Field Conf., p. 106. On correlation chart, Strasburg formation of Clinton and Pearisburg troughs of Tennessee is shown stratigraphically below Holston formation and above Lenoir formation of Knoxville and Athens troughs of Tennessee.

B. N. Cooper and G. A. Cooper, 1946, Geol. Soc. America Bull., v. 57, no. 1, p. 75. Name Strasburg limestone was introduced without definition by Ulrich (1939) for a part of succession herein identified as Lincolnshire. Since name Strasburg has received no precise definition or description at time Lincolnshire was introduced (1943), Strasburg is considered invalid.

G. A. Cooper, 1956, Smithsonian Misc. Colln., v. 127, pt. 1, p. 92. No formal description of unit has been published. Because Strasburg appears on Ulrich's chart between Lenoir below and Holston above, it is in position of Lincolnshire formation.

Occurs in Shenandoah Valley.

Strasburg Shale

Strasburg shale and (or) sandstone member

Pennsylvanian (Allegheny Series): Eastern Ohio.

R. E. Lamborn, C. R. Austin, and Downs Schaaf, 1938, Ohio Geol. Survey, 4th ser., Bull. 39, p. 118 (table), 145–160. Overlying Lower Kittanning coal horizon and extending up to next persistent and widely distributed member, Middle Kittanning clay, is series consisting chiefly of shale with ironstone concretions known as Strasburg shale, but also containing sandstone, limestone, coal, and clay of more or less widespread but patchy distribution. Where complete series occurs, succession is (ascending) Hamden limestone, shale, Oak Hill clay, Strasburg coal, shale, and Salem limestone. Upper and lower limits of Strasburg shale member are clearly defined across State. Thickness of horizon variable but averages about 20 feet. Allegheny series.

N. K. Flint, 1951, Ohio Geol. Survey, 4th ser., Bull. 48, p. 47, 48, table 1. Strasburg shale and (or) sandstone included in Strasburg cyclothem (new). Table shows sequence (ascending) Strasburg shale and (or) sandstone, Oak Hill clay, and Strasburg coal.

M. T. Sturgeon and others, 1958, Ohio Geol. Survey Bull. 57, p. 48 (table 7), 64–66. Strasburg shale and (or) sandstone member of Strasburg cyclothem in report on Athens County. Average thickness about 14 feet. At base of cyclothem; underlies Hamden limestone member. Allegheny series.

Town of Strasburg is in Tuscarawas County.

**Stratford Formation**[1] (in Pontotoc Group)

Permian: Central southern Oklahoma.

Original reference: G. D. Morgan, 1924, Oklahoma Bur. Geology Bull. 2, p. 137–140, pls. 3, 27, map.

H. D. Miser and others, 1954, Geologic map of Oklahoma (1:500,000): U.S. Geol. Survey. Permian. Includes Hart limestone member at base in Pontotoc, Garvin, and Murray Counties.

Named for exposures at and around Stratford, Garvin County.

Strathearn Formation

Upper Pennsylvanian and Permian (Missourian-Wolfcampian): Northeastern Nevada.

R. H. Dott, Jr., 1955, Am. Assoc. Petroleum Geologists Bull., v. 39, no. 11, p. 2249–2255, figs. 2, 5. Quartz-silty limestones and thin commonly crossbedded chert-granule and pebble conglomerate. Poorly exposed except where topography is rugged. Crinoidal calcarenite important constituent. Few individual units exceed 20 feet in thickness, except near base where some limestone units are as thick as 40 feet. Stratification indistinctly thin- to thick-bedded in purer limestone, but more distinct and thinner in sandy or conglomeratic units. Grayish yellow-weathering, calcareous quartz siltstones common and characteristically contain fusulinids. At type section, lower 200 to 300 feet fairly pure limestone, middle 500 to 800 feet contain most of typical chert-granule beds interspersed with impure limestone, and upper few hundred feet have thicker limestones and siltstones with some associated conglomerate. In type area, composite section is 1,200 to 1,500 feet thick. Thickness at Carlin Canyon and Buckskin Mountain at least 800 to 1,000 feet. Overlies older formations with angular discordance.

T. G. Fails, 1960, Am. Assoc. Petroleum Geologists Bull., v. 44, no. 10, p. 1693, 1695 (fig. 1). In Carlin Canyon, conformably underlies Buckskin Mountain formation (new).

Grant Steele, 1960, Dissert. Abs., v. 20, no. 12, p. 4635. Underlies Jakes Creek formation (new).

Type section: At west side of head of lower canyon of South Fork of Humboldt River, 4 miles southeast of Strathearn Ranch and northeast of Grindstone Mountain (SW¼ sec. 19, T. 33 N., R. 55 E., and along south line of sec. 24, T. 33 N., R. 55 E). Supplementary section containing higher strata occurs 1½ miles farther south, and on east side of river at mouth of the upper canyon of South Fork (NW¼ sec. 31, T. 33 N., R. 55 E.). Named for Strathearn Cattle Co. which owns ranch in Humboldt Valley, 3½ miles north of Grindstone Mountain and 2 miles east of Moleen (sec. 8, T. 33 N., R. 54 E.).

Stratton-Kennebago Granite

Upper Devonian(?) to Lower Mississippian(?): Central western Maine.

R. J. Willard, 1959, Dissert. Abs., v. 19, no. 11, p. 2918. Calci-alkalic granite.

In Kennebago Lake quadrangle.

**Straven Conglomerate Member** (of Pottsville Formation)[1]

Pennsylvanian: Central Alabama.

Original reference: Charles Butts, 1927, U.S. Geol. Survey Geol. Atlas, Folio 221.

H. E. Rothrock, 1949, Alabama Geol. Survey Bull. 61, pt. 1, p. 29–30. Mentioned in discussion of age relation of subdivisions of Pottsville formation. Straven conglomerate, thickness about 2,000 feet, lies immediately above Thompson coal bed, which Butts (1926, Alabama Geol. Survey Spec. Rept. 1) includes with "middle Pottsville" strata. Beds of "upper Pottsville" age occur a short distance above Straven conglomerate member.

Named for Straven, in Montevallo quadrangle, Shelby County.

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Strawbridge 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. Dolomite, cherty, medium bedded. Thickness 2½ to 4½ feet. Shown on columnar section as underlying Garnavillo member (new) of Guttenberg formation (Spechts Ferry formation absent) and overlying Shullsburg member (new) of Quimbys Mill formation.

In copy of guidebook used by compiler, in figure 9, name Garnavillo has been crossed out and name Garnet written in. The compiler had no way to determine what change, if any, had been made in other guidebooks.

Occurs in Dixon-Oregon area.

**Straw Hollow Diorite**[1]

Upper Paleozoic(?): Northeastern Massachusetts.

Original reference: B. K. Emerson, 1917, U.S. Geol. Survey Bull. 597, p. 219–220, map.

W. R. Hansen, 1956, U.S. Geol. Survey Bull. 1038, p. 46–47, pl. 1. Described in Hudson quadrangle as chiefly medium-gray medium-grained diorite. In part is a finer grained rock of same composition. Commonly exhibits linear structure. Rarely shows foliation. Contact with Gospel Hill gneiss (new) appears sharp. Late Paleozoic(?).

Type locality: Straw Hollow in Northboro, Worcester County.

**Strawn Group**[1]

Strawn Formation

Strawn Series

Middle Pennsylvanian: Central and northern Texas.

Original reference: E. T. Dumble, 1890, Texas Geol. Survey 1st Ann. Rept., pl. 3, p. lxvi.

N. F. Drake, 1893, Texas Geol. Survey 4th Ann. Rept., pt. 1, p. 373–387. Strawn division comprises following beds (ascending): Lynch Creek, Burnt Branch, Elliott Creek, Shadrick Mill, Bed no. 8, Fox Ford, Horse Creek, Bull Creek, Big Valley, Brown Creek, Spring Creek, Cottonwood Creek, Hanna Valley, Rough Creek, Buffalo Creek, Wilbarger Creek, Comanche Creek, Antelope Creek, Indian Creek, and Ricker. Underlies Canyon division with Coral limestone bed at base.

C. O. Nickell *in* Wallace Lee and others, 1938, Texas Univ. Bur. Econ. Geology Pub. 3801, p. 91–94, pl. 8. In this report [Brown and Coleman Counties], Capps limestone is treated as member of Mineral Wells formation, upper formation of Strawn group.

M. G. Cheney, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 1, p. 66 (fig. 1), 87–89. Proposed to use term Strawn series for deposits occurring above unconformity at top of Smithwick group and related beds of Lampasas series (new) and below unconformity or disconformity which separates Lake Pinto sand (Canyon series) from East Mountain shale at Mineral Wells. This places upper boundary above highest occurrence of *Mesolobus* and *Fusulina*, which characterize the Des Moines but are absent in overlying Missouri series of northern mid-continent. This upper boundary falls within Mineral Wells formation of earlier reports. Term Mineral Wells formation dropped. As defined herein, series comprises Millsap Lake and Lone Camp (new) groups.

M. G. Cheney, 1947, Jour. Geology, v. 55, no. 3, pt. 2, p. 206–211. Lampasas-Strawn series boundary placed at disconformity between Dennis Bridge limestone and overlying conglomerate. As thus restricted, Strawn series of Brazos River section is about 2,000 feet thick. Comprises Millsap Lake group below and Lone Camp group above. Overlies Kickapoo Creek group (new) of Lampasas series.

R. J. Cordell and D. A. Zimmerman, 1954, Abilene Geol. Soc. Guidebook Field Trip, Nov. 19–20, p. 46 (fig. 38), 47–48. Concluded that lower Brownwood of Brown County is probably of late Strawn age and upper Brownwood is early Canyon. Hence, base of conglomerate separating these two parts of Brownwood shale should be regarded as Canyon-Strawn contact. This would increase Strawn interval in Brown County by about 125 feet at expense of the Canyon. Believed that Canyon-Strawn contact in Palo Pinto County should be at base of Turkey Creek sandstone. Turkey Creek sandstone is immediately overlain by Keechi Creek shale near top of which *Triticites* (post Strawn age) has been found.

J. W. Shelton, 1958, Geol. Soc. America Bull., v. 69, no. 12, pt. 1, p. 1515–1524. Strawn-Canyon boundary, placed at prominent surfaces as paleontologic evidence allows, is drawn at top of Capps limestone in Colorado River valley, at top of Village Bend limestone ("boulder beds") in Comanche and Eastland Counties, and at base of Lake Pinto sandstone in northeastern part of Brazos River valley. Zonation based on fusulinids is best criterion for defining boundary. Strawn series is characterized by genus *Fusulina*, Canyon series by *Triticites*.

D. H. Eargle, 1960, U.S. Geol. Survey Prof. Paper 315–D, p. 58–62, pl. 27. Sandstone and shale beds that constitute Strawn group in Colorado River valley were first called Richland sandstone by Tarr (1890, Texas Geol. Survey 1st Ann. Rept.). These and correlative beds in Brazos River valley were called Richland-Gordon sandstones by Dumble (1890). Drake (1893) separated these rocks into 20 units or "beds" and numbered those of Strawn group, from bottom to top, 4 to 23. Only Drake's name for upper unit, the Ricker, is in common use today, but that name has been restricted to prominent sandstone at base of Drake's Ricker bed. Drake referred these units to Strawn division of Cummin's (1891, Texas Geol. Survey 2d Ann. Rept.) which he considered to include all rocks above Bend division and below his Coral limestone bed, the Capps limestone of later authors. Plummer and Moore (1921, Texas Univ. Bull. 2132) considered Strawn in Colorado River valley to be equivalent to their Mineral Wells and Millsap formations of Brazos River valley. They limited Strawn group to rocks that overlie Smithwick shale of Bend group and underlie Rochelle conglomerate. This placed Drake's Coral limestone bed, named Capps limestone lentil by Plummer and Moore, in Canyon group. The Capps was thought to overlie Rochelle conglomerate and was regarded as part of Brownwood shale member of Graford formation. Sellards (1933, Texas Univ. Bull. 3232, v. 1) transferred Capps back to Strawn group and considered it upper member of Mineral Wells formation. Rocks of Strawn group in Brazos River valley have been studied in detail and classified into units. Strawn group in present report [Brown and Coleman Counties, Colorado River valley] represents only upper part of group elsewhere. Term Strawn group is used herein 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 not used in this area. The Strawn becomes thinner from central Brown County, where it is reported to be 1,100 feet thick in wells, to 500 feet in north-central Coleman County, and from 1,235 feet in northern Brown County to about 250 feet in southwestern Brown County and southeastern Coleman County. Group includes (ascending) Ricker Station limestone of Cheney (1949), Ricker sandstone member of Nickell (1938) and Capps limestone lentil of Plummer and Moore (1921).

Named for Strawn, Palo Pinto County.

†Strawn Limestone[1]

Pennsylvanian: Eastern Kansas.

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

Named for Strawn, Coffey County.

Street Road Limestone[1]

Cambrian: Southeastern Pennsylvania.

Original reference: T. D. Rand, 1900, Philadelphia Acad. Nat. Sci. Proc. 1900, pt. 1.

**Strelna Formation[1]**

Mississippian: Southeastern Alaska.

Original reference: F. H. Moffit and J. B. Mertie, Jr., 1923, U.S. Geol. Survey Bull. 745, p. 18–19, 21–28, table opposite p. 28, 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 legends.

Named for occurrence in valley of Strelna Creek, Kotsina-Kuskulana district, Copper River region.

**Stribling Formation**

Lower or Middle Devonian: Central Texas.

V. E. Barnes and P. E. Cloud, Jr., 1945, Texas Univ. Bur. Econ. Geology Mineral Resources Circ. 34, p. 31. Limestone—microgranular, medium-gray to reddish-buff, beige, and ivory; chert—chalcedonic to subchalcedonic and brownish to grayish in lower part, occurring as irregular lenses and false joint fillings; some lenticles of yellowish siliceous limestone about 1 to 2 feet above base; basal 1 foot noncherty. Thickness 10 feet. Overlies Honeycut formation (new); underlies unnamed chert breccia. Section described is at Honeycut Bend, Blanco County.

V. E. Barnes, P. E. Cloud, Jr., and L. E. Warren, 1946, Texas Univ. Bur. Econ. Geology Pub. 4301, p. 169–174, 175 (fig. 46), pl. 6 [1945]. Thickness at designated type locality 11 feet. Here a pocket of Devonian rocks filling a cave in limestone of Ellenburger group may be a correlative of Pillar Bluff limestone.

V. E. Barnes, P. E. Cloud, Jr., and Helen Duncan, 1953, Am. Assoc. Petroleum Geologists Bull., v. 37, no. 5, p. 1031, 1033. In Llano uplift, overlies Burnam limestone (new) and in some parts of area overlies Honeycut formation.

Type locality: Five mlies due east of Johnson City, at foot of bluff on south bank in reach of Pedernales River known as Honeycut Bend. Located in Peter Jackson survey and is on Clayton and Olla Stribling (7L) Ranch.

Strickler Limestone (in Sumner Group)[1]

Strickler Limestone 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 formation. Of the 10 subdivisions listed, the Strickler limestone and Newbern shale members of the Donegal limestone (Moore, 1936) are not very persistent; name Donegal limestone is not well founded.

Type locality and derivation of name not stated.

†Stringtown Shale[1]

Lower and Middle(?) Ordovician: Southeastern Oklahoma.

Original reference: J. A. Taff, 1902, U.S. Geol. Survey Geol. Atlas, Folio 79.

Named for Stringtown, Atoka County.

**Striped Peak Formation**[1] (in Missoula Group)

Precambrian (Belt Series): Northeastern Idaho and northwestern Montana.

Original reference: F. L. Ransome, 1905, U.S. Geol. Survey Bull. 260, p. 277–285.

F. L. Ransome and F. C. Calkins, 1908, U.S. Geol. Survey Prof. Paper 92, p. 44, pl. 11. Sandstones, siliceous, generally flaggy to shaly; mostly green and purple; characterized by shallow-water features, such as ripple marks and sun cracks. Top removed by erosion. Thickness about 1,000 feet. Overlies Wallace formation.

Russell Gibson, 1948, U.S. Geol. Survey Bull. 956, p. 16–17, pl. 1. Described in Libby quadrangle, Montana, where it is 2,000 to 2,500 feet thick, underlies Libby formation (new) and overlies Wallace formation.

C. P. Ross, 1949, (Abs.) Washington Acad. Sci. Jour., v. 39, no. 3, p. 113. Included in Missoula group.

J. W. Hosterman, 1956, U.S. Geol. Survey Bull. 1027–P, p. 730, pl. 57. Described in Shoshone County, Idaho. Youngest unit of Belt series. In northern exposure, conformably overlies Wallace formation and in southern exposure is bounded by two faults. Consists of grayish-purple to dark-red impure quartzite in beds that range from 1 to 4 inches in thickness.

Named for extensive development near Striped Peak, Idaho.

**Striped Rock Granite**

Precambrian: Southwestern Virginia.

A. J. Stose, 1942, (abs.) Am. Geophys. Union Trans., 23d Ann. Mtg., pt. 2, p. 342. An injection complex of early Precambrian age is exposed in Elk Creek anticline in Grayson County. There, sedimentary rocks and diorite have been intruded by the Striped Rock and Carsonville granites.

A. J. Stose and G. W. Stose, 1957, Virginia Div. Mineral Resources Bull. 72, p. 26–32, pl. 1. Predominantly biotite granite, fine-grained aplite, and pegmatite; contains garnet in places; locally, as near Peach Bottom Church, contains xenolithic inclusions. A syenite facies forms a narrow body within southern part of main granite area where it parallels the strike of the main granitic mass; syenite is bordered in places by narrow bands of Saddle gneiss which separate the syenite from the Striped Rock granite. There are small inclusions and shred of Saddle gneiss and Cattron diorite in the Striped Rock. Bordered on the northern and northeastern sides and intruded by Carsonville granite.

Named from Striped Rock, a smooth-faced cliff of granite 300 feet high on spur of Point Lookout Mountain. Granite forms an elliptical area 8 miles long by 3 miles wide on southeast side of Point Lookout and Buck Mountains. Main area extends from near Pilgrims Rest Church southwestward to Saddle Creek; its greatest width is northwest of Independence.

Strites Pond Formation[1] or Limestone

Upper Cambrian or 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. Overlies Rock River dolomite; underlies Wallace Creek limestone. Thickness about 400 feet. Philipsburg series. Beekmantown.

Exposed from northern part of St. Albans quadrangle, Vermont, across the international border for about 20 miles into Quebec.

†Strong Flint (in Chase Group)[1]

Permian: Central Kansas.

Original reference: C. S. Prosser, 1895, Jour. Geology, v. 3, p. 771–786, 799.

Named for Strong City, Chase County.

†Strong City Beds[1]

Permian: Central Kansas.

Original reference: L. C. Wooster, 1905, The Carboniferous rock system of eastern Kansas.

Probably named for Strong City, Chase County.

**Stronghold Granite**

Eocene(?) to lower Pliocene(?): Southeastern Arizona.

D. J. Cederstrom, 1946, Am. Jour. Sci., v. 244, no. 9, p. 610–611. In most places, is white where fresh and light yellow where weathered, medium- to coarse-grained texture, and may be described as porphyritic, although porphyritic character not everywhere readily apparent in hand specimens. Intrusive into Mesozoic rocks and considered to have been implaced during Laramide Revolution.

James Gilluly, 1956, U.S. Geol. Survey Prof. Paper 281, p. 9 (table), 106–108, pl. 5. Three major facies recognized: Main facies, rather coarse-grained granite ranging from light gray to light pink and weathers buff; border facies, porphyritic, though not conspicuously so; and aplitic facies, differs only slightly from border facies though it seems to contain even less biotite. Youngest major intrusion in region. Cuts Dragoon thrust sheets in many places, and at one place or another it is in intrusive contact with representatives of all rocks from Pinal schist to Bisbee formation. Younger than Cochise Peak quartz monzonite. Mapped as Eocene(?) to lower Pliocene(?).

Makes up Cochise Stronghold mass, a natural fortress within northern part of Dragoon Mountains, and extends southward as narrow bands in the Dragoon Mountains, Cochise County.

Strongsville Member (of Cuyahoga Formation)

Lower Mississippian (Kinderhookian): Northern Ohio.

E. J. Szmuc, 1957, Dissert. Abs., v. 18, no. 6, p. 2109. Silty shale unit intercalated between two siltstones. Underlies Meadville member; overlies Sharpsville member.

In Cuyahoga, Summit, Medina, and Lorain Counties.

Stroudsburgian Stage

Middle Devonian: Eastern Pennsylvania.

Bradford Willard *in* Bradford Willard, F. M. Swartz, and A. B. Cleaves, 1939, Pennsylvania Geol. Survey, 4th ser., Bull. G-19, p. 131 (footnote).

Name proposed to include Onondaga group, including so-called Esopus. Ulsterian stage of New York, which includes Onondaga and Schoharie, not applicable here since it does not include the Esopus, and the Schoharie is not recognized in Pennsylvania.

Named from Stroudsburg, Monroe County, where best observed.

Stuart Glacial Stage

Stuart Till

Pleistocene: Central Washington.

B. M. Page, 1939, Jour. Geology, v. 47, no. 8, p. 785, 805-814. Latest of three successive stages of valley glaciation in Leavenworth area. Characterized by deposition of Stuart till. Followed Leavenworth stage and has lingered almost to present time. Probably equivalent to all or part of Wisconsin stage.

Evidence of the stage present in vicinity of Mount Stuart, especially at junction of Rat Creek and Icicle Creek, Chelan County.

Stuart Shale[1] (in Cabaniss Group)

Pennsylvanian (Des Moines Series): Central southern and eastern Oklahoma.

Original reference: J. A. Taff, 1901, U.S. Geol. Survey Geol. Atlas Folio 74.

M. C. Oakes, 1953, Am. Assoc. Petroleum Geologists Bull., v. 37, no. 6, p. 1525. Assigned to Cabaniss group (new).

Named for Stuart, Hughes County. Town is located on outcrop of formation.

**Stuck Drift, Till, Glaciation**

Pleistocene, middle(?): Northwestern Washington.

D. R. Crandell, D. R. Mullineaux, and H. H. Waldron, 1958, Am. Jour. Sci., v. 256, no. 6, p. 385, 390, 391-392. Consists chiefly of till and sand and gravel of northern derivation; where typically exposed, includes an unoxidized or only slightly oxidized till sheet 5 to 20 feet thick, which is overlain and underlain by oxidized sand and gravel 10 to 20 feet thick; pebble-sized fraction of till typically includes 10 to 15 percent of northern rock types and the rest is of Cascade origin; upper part of drift contains lacustrine sand and silt; locally lacustine sediments include lenticular masses of glacial sand and gravel and scattered glacial boulders, and in places beds are tilted and faulted. Separated from underlying Alderton formation (new) by erosional unconformity; underlies Puyallup formation. In sequence, Stuck glaciation followed Orting glaciation and preceded Salmon Springs glaciation (new).

Typically exposed in west wall of Puyallup-Duwanish Valley in gullies under transmission line of Bonneville Power Administration in center sec. 1, T. 19 N., R. 4 E., about one-half mile southwest of Alderton, Pierce County. Name derived from Stuck River which joins Puyallup River near Sumner.

**Stull Shale Member** (of Kanwaka Shale)[1]

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

Original reference: R. C. Moore, 1932, Kansas Geol. Soc. 6th Ann. Field Conf. Guidebook, p. 94, 96 (table).

G. E. Condra, 1949, Nebraska Geol. Survey Bull. 16, p. 24. Thickness 4 feet in Weeping Water valley, Cass County.

F. C. Greene and W. V. Searight, 1949, Missouri Geol. Survey and Water Resources Rept. Inv. 11, p. vii, 17. Columnar section shows Stull shale member at top of Kanwaka formation. [Text does not discuss unit in Missouri.]

R. C. Moore and others, 1951, Kansas Geol. Survey Bull. 89, p. 62 (fig. 23), 67. Yellowish-brown sandy shale, locally one or more coal beds; sandstone containing land plant remains and partly filling channels occurs in upper part in northern Kansas; much or all of Elgin sandstone in southern part of State may belong in this division. Thickness about 25 to at least 45 feet. Overlies Clay Creek limestone member; underlies Spring Branch limestone member of Lecompton limestone.

Type locality: SE cor. sec. 26, T. 12 S., R. 18 E., near village of Stull, Douglas County, Kans.

**Stump Sandstone**[1]

Upper Jurassic: Southeastern Idaho and western Wyoming.

Original reference: G. R. Mansfield and P. V. Roundy, 1916, U.S. Geol. Survey Prof. Paper 98, p. 76, 81.

L. S. Gardner, 1944, U.S. Geol. Survey Bull. 944–A, p. 7. Section in Irwin quadrangle, Teton basin, shows Stump sandstone, 140 feet thick; overlies Preuss sandstone; underlies Ephraim conglomerate of Gannett group.

H. D. Thomas and M. L. Krueger, 1946, Am. Assoc. Petroleum Geologists Bull., v. 30, no. 8, p. 1269 (fig. 6), 1276 (fig. 8), 1278–1279, 1280 (fig. 10). Name Stump is used in this report [Uinta Mountains] in Weber River, Duchesne River, and Lake Fork areas so that southeastern Idaho Jurassic terminology is uniformly used in all western sections; east of Lake Fork, name Curtis is used. Thickness 223 feet, Weber River area; 210 feet, Duchesne River area; and 130 feet, Lake Fork area. Overlies Preuss sandstone; unconformity in some areas; underlies Morrison.

H. L. Foster, 1947, Am. Assoc. Petroleum Geologists Bull., v. 31, no. 9, p. 1538 (strat. column), 1566–1567. In Teton County, Wyo., is about 350 feet thick and consists of greenish sandstones with some interbedded siltstone and shale. Underlies Cloverly formation; overlies Twin Creek limestone, the Preuss sandstone, which overlies Twin Creek farther west, not definitely recognized in area of this report.

E. R. Cressman, 1957, U.S. Geol. Survey Mineral Inv. Field Studies Map MF–118. As mapped in Snowdrift Mountain quadrangle, Caribou County, Idaho, overlies Preuss sandstone and underlies Bechler and Ephraim conglomerates undifferentiated. Thickness 400 to 500 feet.

Named for Stump Peak, east head of north fork of Stump Creek about center of T. 6 S., R. 45 E., Boise meridian, Freedom quadrangle [Caribou County], Idaho.

**Stump Arroyo Member** (of Crooked Creek Formation)

Pleistocene: Southwestern Kansas.

C. W. Hibbard, 1949, Michigan Univ. Mus. Paleontology Contr., v. 7, no. 4, p. 69 (fig. 1), 71–73. Name applied to basal part of Crooked Creek formation. Consists of coarse sand, reddish to light tan, and well sorted, containing white quartz pebbles; grades upward into finer more poorly sorted sand, with calcareous nodules at top. Thickness a little more than 10 feet. Unconformably overlies Missler member (new) of Meade formation (redefined). In some areas where the Crooked Creek is not extensively developed, Pearlette Ash member rests directly on the Stump Arroyo.

C. W. Hibbard, 1958, Am. Jour. Sci., v. 256, no. 1, p. 55 (fig. 1), 57. Underlies Atwater member (new).

Type locality: Sec. 21, T. 33 S., R. 28 W., Meade County. Gravels of member form high surface rubble in sec. 10, T. 33 S., R. 29 W., along tributary of Stump Arroyo north of the Deer Park and west of the northwest corner of Deer Park. Name derived from tributary of Crooked Creek which flows through Meade County State Park and empties into Crooked Creek in sec. 29, T. 33 S., R. 28 W.

**Stuntz Conglomerate Member** (of Knife Lake Group)[1]

Precambrian (pre-Huronian) : Northeastern Minnesota.

Original reference: A. Winchell, 1888, Minnesota Geol. Nat. History Survey 16th Ann. Rept., p. 350.

Named for exposures in vicinity of Stuntz Bay of Vermilion Lake in Vermilion district.

†Stuntz Island Agglomerate[1]

Precambrian: Minnesota.

Original reference: N. H. Winchell and H. V. Winchell, 1890, Minnesota Geol. Nat. History Survey Bull. 6.

**Sturgeon Quartzite**[1] (in Chocolay Group)

Precambrian (Animikie Series) : Northern Michigan.

Original reference: H. L. Smyth, 1889, U.S. Geol. Survey 19th Ann. Rept., pt. 3, p. 105.

F. J. Pettijohn and F. A. Hildebrand, 1941, (abs.) Geol. Soc. America Bull., v. 52, no. 12, pt. 2, p. 1927. Overlies Fern Creek formation (new).

H. L. James, 1958, U.S. Geol. Survey Prof. Paper 314–C, p. 30 (table 1), 35. Assigned to newly defined Chocolay group.

Named for exposures along Sturgeon River, Iron County.

Sturm Limestone (in Lawrence Shale)[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.

Well exposed near Sturm's Schoolhouse, sec. 12, T. 10 N., R. 12 E., and along North Branch of Weeping Water Creek, 2 to 4 miles north of Nehawka, Cass County.

**Stuver Member** (of Kanayut Conglomerate)

Stuver Series[1]

Upper Devonian: Northern Alaska.

Original reference: F. C. Schrader, 1902, Geol. Soc. America Bull., v. 13, p. 240.

A. L. Bowsher and J. T. Dutro, Jr., 1957, U.S. Geol. Survey Prof. Paper 303–A, p. 3, 5, 11–13, figs. 2–4, pl. 2. Schrader gave name Stuver series to conglomeratic sequence beneath Lisburne formation in central Brooks Range. Although name Stuver later fell into disuse, it is herein reestablished and applied to top member of Kanayut conglomerate (new). In Shainin Lake area [this report], member restricted to upper part of Kanayut conglomerate because these beds most closely resemble those exposed on Mount Stuver from which Schrader took the name. Consists of about 860 feet of orthoquartzite, gray, red, and green shale, and conglomerate. Overlies unnamed middle conglomerate member; underlies Kayak shale (new).

Type locality of member: On ridge 0.7 mile south of Mount Wachsmuth, Shainin Lake area, central Brooks Range. Named for Mount Stuver, east of Anaktuvuk River.

Stuyvesant Beds

Primordial: Southeastern New York.

S. W. Ford, 1884, Am. Jour. Sci., 3d ser., v. 28, no. 165, p. 206. Mentioned in discussion of age of the glazed and contorted slaty rocks in vicinity of Schodack Landing, Rensselaer County. A fault intervenes between these beds and the slaty rocks which resemble Hudson River group.

Occurs near Stuyvesant, Columbia County.

†sub-Blairsville red shale member (of Chemung Formation)[1]

Upper Devonian: Western Pennsylvania.

Original reference: M. R. Campbell, 1904, U.S. Geol. Survey Geol. Atlas, Folio 110.

Named for occurrence in wells in vicinity of Blairsville, Indiana County.

†sub-Clarksville Sand[1]

Upper Cretaceous (Gulf Series): Northeastern Texas and Southwestern Arkansas.

Original reference: A. C. Veatch, 1906, U.S. Geol. Survey Prof. Paper 46, p. 24–25, table opp. p. 16.

C. L. McNulty, Jr., 1954, Am. Assoc. Petroleum Geologists Bull., v. 38, no. 2, p. 336–337. Lake Crockett formation (new) includes at base, a gray sand that is equivalent to former sub-Clarksville of east Texas basin.

Named for development in wells at Clarksville, Red River County, Tex.

Sublett Member (of Wells Formation)

Pennsylvanian (Desmoinesian-Virgilian): Idaho.

H. J. Bissell, 1960, Am. Assoc. Petroleum Geologists Bull., v. 44, no. 8, p. 1427 (chart). Name appears on chart accompanying preliminary statement on eastern Great Basin Permo-Pennsylvanian strata. Underlies Indian Fork member (new); overlies Heglar Canyon member (new).

Present in Sublett Mountain area.

†Sucarnooche Clay (in Midway Group)[1]

Eocene, lower: Southwestern Alabama.

Original reference: E. A. Smith, 1892, Sketch of geology of Alabama, pam., 36 p., Birmingham, Ala., Roberts and Son.

F. S. MacNeil, 1946, U.S. Geol. Survey Strat. Minerals Inv. Prelim, Rept. 3-195, p. 10. Name Sucarnooche clay, formerly used for entire Porters Creek clay of western Alabama as well as for calcareous clay east of Tombigbee River, is abandoned.

Named for exposures on Sucarnooche Creek at Black Bluff, Sumter County.

Sucker Creek Beds, sediments, deposits

Miocene: Eastern Oregon.

D. W. Scharf, 1935, Carnegie Inst. Washington Pub. 453, p. 98-118. Description of a Miocene mammalian fauna from Sucker Creek. The Sucker Creek beds are directly related to Payette formation as shown by the flora and such comparison as can be made between the fossil mammals obtained at Sucker Creek and those from type section of the Payette. Future geologic mapping may show that Sucker Creek beds are an integral part of Payette formation. The beds carrying the fossils consist of fine- to medium-grained pyroclastics, varying from white to green and brown. Presence of fish vertebrae and ostracod shells indicates deposition of at least part of the sediments in body of water.

Occur along lower course of Sucker Creek in eastern Malheur County. Important collecting localities are about 9 miles north of Rockville, Oreg., and about 5 miles west of Oregon-Idaho border.

**Sudbury Marble**[1]

Middle Ordovician (Chazy): Southwestern Vermont.

Original reference: A. Wing, 1877, Am. Jour. Sci., 3d, v. 13, p. 334-347, 404-419.

Crops out in town of Sudbury, northwest end of Taconic Range, in Rutland County.

†Suffolk Porphyry[1]

Precambrian (Keweenawan): Northern Michigan.

Original reference: R. D. Irving, 1883, U.S. Geol. Survey Mon. 5, p. 81, 176, 177.

Occurs on Old Suffolk mining location, Praysville, Keweenaw Point.

Sugar Creek Shale in (Bethany Falls Limestone)[1]

Pennsylvanian: Missouri-Kansas.

Original reference: C. O. Dunbar and G. E. Condra, 1932, Nebraska Geol. Survey Bull. 5, 2d ser., p. 17.

In vicinity of Kansas City.

Sugar Hill Quartz Monzonite[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. 502, 508, pl. 12. New Hampshire magma series represented in Littleton-Moosilauke area by Moulton diorite, Bethlehem gneiss, Kinsman quartz monzonite, Remick tonalite, Sugar Hill quartz monzonite, French Pond granite, Moody Ledge granite, Pond Hill granite, and Scrag granite. Relative ages of units not determined for in few places are they in contact with one another.

Mapped on Ore Hill, southeast of Sugar Hill, in northeastern corner of Moosilauke quadrangle.

Sugarloaf Andesite

Miocene or Pliocene: Central Washington.

Mentioned as being a remnant of a lava cap: B. M. Page, 1940, Stanford Univ. Abs. Dissert., v. 15, p. 119.

Occurs in Entiate Mountains, near Wenatchee, Chelan County.

**Sugar Loaf 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. Davis *in* Jacques Avias and others, 1956, Lexique Strat. Internat., v. 6, Océanie, fasc. 2, p. 131–132. Voluminous lava flow of melilite-nepheline basalt; contains many pegmatoid veinlets; locally columnar joint. Commonly 40 feet thick. Overlies reef limestone of plus 25–foot (Waimanalo) stand of sea. Probably simultaneous with Tantalus basalt.

Named for Sugar Loaf (Puu Kakea), the cinder cone at vent from which it issued. Well exposed in Moiliili quarry. Covers about 1 square mile in lower end of Manoa Valley, on south side of Koolau Range about 11 miles west of Makapuu Head.

**Sugarloaf Formation**

Sugarloaf Arkose (in Newark Group)[1]

Upper Triassic: Central Massachusetts and central Connecticut.

Original references: B. K. Emerson, 1891, Geol. Soc. America Bull., v. 2, p. 452; 1898, U.S. Geol. Survey Geol. Atlas, Folio 50.

G. W. Bain, 1941, Am. Jour. Sci., v. 239, no. 4, p. 266, 267. Underlies Holyoke lava flow in Holyoke Range, Mass. Thickness approximately 4,000 feet.

M. E. Willard, 1951, Bedrock geology of the Mount Toby quadrangle, Massachusetts: U.S. Geol. Survey Geol. Quad. Map [GQ–8]. Redefined as formation which includes Sugarloaf arkose of Emerson (1898) and that part of Emerson's Mount Toby conglomerate which underlies lava and is gradational with arkose. Red arkose grades laterally into coarse arkosic conglomerate toward southeast.

Named for occurrence at Sugarloaf Mountain, Deerfield Township, Franklin County, Mass.

Sugarloaf Metaquartzite[1] (in Snowy Range Series)

Precambrian: Southeastern Wyoming.

Original reference: E. Blackwelder, 1926, Geol. Soc. America Bull., v. 37, p. 620, 623, 635.

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 consists of Anderson phyllite, Deep Lake metaquartzite, French slate, Heart metagraywacke, Headquarters schist, Nash marble series, Seminoe formation, and Towner greenstone.

Exposed on northeast side of Sugarloaf Peak, Medicine Bow Mountains.

**Sugarloaf Quartz Latite**

Cretaceous or Tertiary: Southeastern Arizona.

James Gilluly, 1956, U.S. Geol. Survey Prof. Paper 281, p. 90–93, pls. 5, 12. Rocks generally light gray or dense white, with slightly pinkish-gray hue on fresh fractures. In some areas, contains phenocrysts of biotite, quartz, and chalky feldspar that range up to 2 mm and average 1 mm in length. Groundmass is aphanitic. Estimated thickness at Sugarloaf Hill about 1,500 feet. Nearly all contacts with other formations are faults. Accordingly, a complete section would be still thicker. At no other point in area is a thickness of more than 500 feet exposed.

Type locality: At Sugarloaf Hill, about 1 mile southeast of Gleeson, in central Cochise County. Recognized in Courtland-Gleeson area.

Sugarloaf Sandstone[1] or Quartzite

Lower Cambrian: Central northern Maryland.

Original reference: C. R. Keyes. 1891, Geol. Soc. America Bull., v. 2, p. 306, 320–322.

A. I. Jonas and G. W. Stose, 1938, Washington Acad. Sci. Jour., v. 28, no. 8, p. 347. Name replaced by Sugarloaf Mountain quartzite because name Sugarloaf arkose, of Triassic age, has become established formation name in Massachusetts.

Ernst Cloos and C. W. Cooke, 1953, Geologic map of Montgomery County and the District of Columbia (1:62,500): Maryland Dept. Geology, Mines and Water Resources. Massive light quartzite composed of round white or blue quartz grains. Layers below more schistose and interbedded with shale or purple phyllite. Series consists of four prominent beds with phyllite interbeds. Underlies Harpers phyllite. Mapped as Cambrian.

At Sugarloaf Mountain, Frederick County.

Sugarloaf Series

Cenozoic: Southeastern Arizona.

H. E. Enlows, 1951, Tulsa Geol. Soc. Digest, v. 19, p. 106 (fig. 1). Comprises (ascending) pink to gray rhyolite—thickness 140 feet; soft gray rhyolite tuff—80 feet; brownish red rhyolite—30 feet; gray rhyolite tuff—20 feet; and black to gray, vesicular augite dacite—220 feet. Overlies Rhyolite Canyon series (new).

Section measured in Rhyolite Canyon, Chiricahua National Monument, Cochise County.

**Sugarloaf Mountain Quartzite**

Cambrian(?): Western Maryland.

A. I. Jonas and G. W. Stose, 1938, Washington Acad. Sci. Jour., v. 28, no. 8, p. 347. Consists of massive white quartzite about 200 feet thick, which caps Sugarloaf Peak, lower massive quartzite, 100 to 150 feet thick, which makes prominent cliffs and ledges on upper slopes of peak and forms summits of most of the lower peaks and ridges, and thinner bedded quartzites about 150 feet between the two massive ledges. Overlies Urbana phyllite (new). Lower Cambrian(?). Formation was named Sugarloaf sandstone by Keyes (1891) but because name Sugarloaf arkose, of Triassic age, has become established formation name in Massachusetts, name Sugarloaf Mountain is applied for Maryland formation.

A. J. Stose and G. W. Stose, 1946, Maryland Dept. Geology, Mines and Water Resources [Rept. 12] Carroll and Frederick Counties, p. 71–74. Beds similar to Sugarloaf Mountain quartzite, which crop out at Park Mills, on Brush Creek and Linganore Creek, and south of Libertytown, have been placed in Urbana phyllite and may be Sugarloaf Mountain quartzite. Sugarloaf Mountain is synclinal and fold is overturned toward northwest.

D. M. Scotford, 1951, Geol. Soc. America Bull., v. 62, no. 1, p. 48. Quartzites on Sugarloaf Mountain were considered Lower Cambrian and therefore Weverton by such early workers as J. P. Lesley, G. H. Williams, and C. R. Keyes. Jonas and Stose (1938) mapped these rocks as Sugarloaf Mountain quartzites and assigned them to probable Lower Cambrian. These rocks are here considered equivalent of Lower Cambrian Weverton quartzite because Sugarloaf Mountain is an anticline rather than a syncline, as reported by Stose and Stose (1946).

Named for occurrence on Sugarloaf Mountain, Frederick County.

**Sugarlump Tuffs**

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 appears on legends for maps of parts of southwestern New Mexico. Called latitic tuffs.

W. E. Elston, 1957, New Mexico Bur. Mines Mineral Resources Bull. 38, p. 17 (table 1), 23–25, pl. 1. Latite and rhyolite tuffs, sandy tuffs, tuffaceous sandstones, ignimbrites, and conglomerates. Some units only local, others widespread. Usually green or white, with occasional pink or brown layers. Thickness 50 to 1,400 feet. Reach maximum thickness around Sugarlump Mountain and thin toward the south, north, and northwest. Overlies Rubio Peak flows. Derivation of name.

Named after hill in NE¼ sec. 5, T. 19 S., R. 10 W., Dwyer quadrangle.

Suicide Grit

Upper Triassic: Northeastern Utah.

J. S. Williams, 1945, Am. Jour. Sci., v. 243, no. 9, p. 474–475. Manuscript name used by R. E. Marsell to apply to grit in Ankareh formation as defined by Boutwell (1912 U.S. Geol. Survey Prof. Paper 77). Eastward this grit is recognized as typical Shinarump conglomerate and northward is identical with Higham grit.

Well exposed at mouth of Parleys Canyon east of Salt Lake City along roadcut of Wasatch Boulevard and in Suicide Rock.

†Suisun Marble[1]

Age(?): Western California.

Original reference: J. D. Whitney, 1865, California Geol. Survey, v. 1, p. 104.

Probably named for Suisun, Solano County.

Sulfur Creek Formation

Upper Jurassic[?]: Northern California.

J. E. Lawton, 1956, Dissert. Abs., v. 16, no. 10, p. 1885. Lowermost formation in area studied. Underlies Blue Ridge member of Crack Canyon formation (both new): Overlies an unnamed group of sediments, volcanics, and associated igneous and metamorphic rocks. The 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.

Sulfur Well facies (of Lexington Formation)

*See* Sulphur Well Member (of Cynthiana Formation).

Sully Member (of Pierre Formation)

Upper Cretaceous: Central South Dakota.

W. V. Searight, 1937, South Dakota Geol. Survey Rept. Inv. 27, p. 21–34, pls. 2, 3. Defined to include body of shales lying between chalk beds of upper Gregory member (new) and base of bentonitic beds at base of Virginia Creek member (new). Includes (ascending) Agency shale of Russell (1930), Oacoma, and Verendrye shale zones. Thickness 134 to about 315 feet.

W. V. Searight, 1938, Iowa Acad, Sci. Proc., v. 45, p. 135–137; A. L. Moxon and others, 1938, Am. Jour. Botany, v. 25, no. 10, p. 795 (chart 1), 796. Redefined and stratigraphically extended at base to include a fourth zone, Gregory marl. As thus redefined, overlies Sharon Springs member.

J. P. Gries and E. P. Rothrock, 1941, South Dakota Geol. Survey Rept. Inv. 38, p. 5 (pl. 1), 14–38. Redefined. Name Gregory marl dropped and term Crow Creek marl substituted for basal zone. As thus redefined, overlies Gregory member and underlies Virgin Creek member. Thickness 126 to 365 feet.

D. R. Crandell, 1950, Am. Assoc. Petroleum Geologists Bull., v. 34, no. 12, p. 2340 (table 1), 2343–2345. Abandoned. Crow Creek and Verendrye zones raised to member rank; Agency-Oacoma zones redefined as DeGrey member of Pierre.

Named for exposures along both sides of Missouri River in and opposite western Sully County. Typical exposures occur at the Little Bend opposite site of old Fort Bennett and few miles north of one of sites of Fort Sully.

**Sulphur Canyon Sandstone Member** or **Bed** (in Neslen Formation)

Sulphur Canyon Sandstone Bed (in Price River Formation)[1]

Upper Cretaceous: Central eastern Utah.

Original reference: D. J. Fisher, 1935, U.S. Geol. Survey Bull. 852.

W. A. Cobban and J. B. Reeside, Jr., 1952, Geol. Soc. America Bull., v. 63, no. 10, chart 10b (column 39). Shown on correlation chart as uppermost member of Neslen formation. Overlies Thompson Canyon sandstone member; underlies Farrar formation.

D. J. Fisher, C. E. Erdmann, and J. B. Reeside, Jr., 1960, U.S. Geol. Survey Prof. Paper 332, p. 17. Referred to as bed in Neslen formation.

Named for Sulphur Canyon, T. 9 S., R. 100 W. Traced from Buck Canyon to Colorado line.

†Sulphur Creek Group[1]

Upper Cretaceous: Southwestern Wyoming, northwestern Colorado, and northeastern Utah.

Original reference: J. W. Powell, 1876, Geology of eastern portion of Uinta Mountains, p. 40, 50, 154.

Occurs in hills near Hilliard, Uinta County, Wyo.

**Sulphur Springs Formation[1]**

Sulphur Springs 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.

A. G. Unklesbay, 1952, Missouri Geol. Survey and Water Resources, 2d ser., v. 33, p. 39–57. In classification in Boone County, Sulphur Springs is listed as group including Grassy Creek, Bushberg, and Chouteau formations. Kinderhookian.

M. G. Mehl, 1960, Denison Univ. Jour. Sci. Lab., v. 45, art. 5, p. 75–76. It must be assumed that Ulrich meant type locality to be vicinity of Sulphur Springs. This is a station on Missouri Pacific Railroad along Mississippi River bluff in Jefferson County, Mo. Choice of name was unfortunate because in the place of the best exposures, 0.3 mile north of station, there is no evidence of strata that may be assigned to the Glen Park, and the sandstone at the "base of the Kinderhook" does not fit Ulrich's description of the Bushberg. It is likely that it was the shale of this locality that led to Ulrich's stated maximum thickness of 15 feet for the bottom shale member of the Sulphur Springs. The shale here, about 15 feet thick, includes a black fissile shale at the top containing sporangites and conodonts of Upper Devonian age. The lower several feet of the shale section is Maquoketa (Ordovician): Neither the Bushberg nor the Glen Park are coextensive with widespread upper Devonian black shales of Missouri; the Bushberg is unconformable on the Glen Park. It appears incongruous to group Devonian black shale with the Glen Park and Bushberg sandstone as a formation or as members of a group. Recommended that term Sulphur Springs as a group or formation name be dropped from Missouri stratigraphic column.

Named for exposures at Sulphur Springs, Jefferson County, Mo.

**Sulphur Springs Mountain Andesite**

Tertiary(?): Northwestern California.

C. E. Weaver, 1949, Geol. Soc. America Mem. 35, p. 110 (table 24), 116–117, pl. 12. Fine-grained greatly altered reddish andesite that occurs as small intrusive masses which have penetrated serpentines associated with the Franciscan on Sulphur Springs Mountain and shales and sandstones of Knoxville formation in upper Sulphur Springs Valley.

Mapped in Carquinez quadrangle, Solano County.

Sulphur Well Member (of Cynthiana Formation)

Ordovician: Central Kentucky.

A. C. McFarlan, 1943, Geology of Kentucky: Lexington, Ky., Kentucky Univ., p. 11 (footnote), 20–22. Proposed for beds below Greendale member of formation.

A. C. McFarlan and W. H. White, 1948. Am. Assoc. Petroleum Geologists Bull., v. 32, no. 8, p. 1643. Sulfur Well member (pre-Greendale) is recognized as facies of the upper Lexington; contains a Cynthiana fauna.

Named for Sulphur Well, 4 miles southeast of Nicholasville, Jessamine County. Exposures are along Kentucky River fault.

**Sultan Limestone**[1]

Middle and Upper Devonian: Southeastern Nevada and eastern California.

Original reference: D. F. Hewett, 1931, U.S. Geol. Survey Prof. Paper 162, p. 10, 13.

J. C. Hazzard, 1937, California Jour. Mines and Geology, v. 33, no. 4, p. 276 (fig. 3b), 328–331. Geographically extended into Nopah and Resting Springs Mountains, Inyo County, Calif., where it is about 890 feet thick, underlies Stewart Valley limestone and overlies unnamed Silurian(?).

J. C. Hazzard, 1954, Am. Assoc. Petroleum Geologists Bull., v. 38, no. 5, p. 881, 884 (fig. 3). Thickness in Nopah Range, 1,720 feet. Herein suggested that name Stewart Valley limestone be abandoned and that Devonian beds previously ascribed to it be assigned to Crystal Pass and Valentine limestone members of Sultan. Underlies Dawn limestone member of Monte Cristo limestone. Middle Devonian.

D. F. Hewett, 1956, U.S. Geol. Survey Prof. Paper 275, p. 40–41. Described in Ivanpah quadrangle, California and Nevada. Ironside dolomite, Valentine limestone, and Crystal Pass limestone members appear to be present throughout region in which formation is recognized. Thickness 250 to 640 feet. Underlies Monte Cristo limestone.

Ben Bowyer, E. H. Pampeyan, and C. R. Longwell, 1958, U.S. Geol. Survey Mineral Inv. Field Studies Map MF–138. Mapped as Middle and Upper Devonian.

Well exposed in vicinity of Sultan mine, Goodspring quadrangle, Nevada.

Sumas Shales (in Chuckanut Formation)

[Eocene]: Northwestern Washington.

S. L. Glover, 1941, Washington Div. Mines and Geology Bull. 24, p. 308–311. A series of interbedded shales, sandstones, and conglomerates in basal part of Chuckanut formation near Sumas. Predominantly bright-red plastic shales, turquoise-blue flint clays, and clear-colored bluish-gray fire clays. Total area covered by series not known. Deposited upon pre-Tertiary argillites and quartzites; above well-marked unconformity is massive basal conglomerate overlain by shales and sandstones.

Exposed in prospect pit or tunnels at several places near Sumas, Whatcom County.

Sumay Limestone

Pliocene or Pleistocene: Mariana Islands (Guam).

Risaburo Tayama, 1952, Coral reefs in the South Seas: Japan Hydrog. Office Bull., v. 11, p. 55, table 4 [English translation in library of U.S.

Geol. Survey, p. 66]. Very similar to and correlated with Naftan (Nafutan) limestone.

S. Hanzawa *in* Jacques Avias and others, 1956, Lexique Strat. Internat., v. 6, Océanie, fasc. 2, p. 58. Pleistocene.

Type locality: Sumay, Guam.

Summer Formation[1]

Recent: Central southern Oregon.

Original reference: W. D. Smith, 1926, Oregon Univ. Commonwealth Rev., v. 8, p. 207–214.

Type locality: On east side of Summer Lake, Lake County.

†Summerfield Limestone (in Conemaugh Formation)[1]

Pennsylvanian (Conemaugh Series): Eastern Ohio.

Original reference: D. D. Condit, 1912, Ohio Geol. Survey, 4th ser., Bull. 17, p. 20, 23.

D. L. Norling, 1958, Ohio Geol. Survey Bull. 56, p. 61. Ohio Geological Survey has abandoned term Summerfield limestone in favor of term Lower Pittsburgh limestone and shale member (Conemaugh series).

Named for Summerfield, Noble County.

**Summerhill Sandstone Member** (of Conemaugh Formation)[1]

Upper Pennsylvanian: Western Pennsylvania.

Original reference: C. Butts, 1905, U.S. Geol. Survey Geol. Atlas, Folio 133.

Crops out in bold ledge, about 50 feet thick, high in bluff east of Summerhill, Cambria County.

Summers Member (of Mesaverde Sandstone)

Upper Cretaceous: Northeastern Arizona.

G. K. Sirrine, 1959, Dissert. Abs., v. 19, no. 8, p. 2064. Incidental mention:

Springerville-St. Johns area, Apache County.

Summers Series

Pennsylvanian (post-Chester, pre-Morrow): West Virginia.

C. L. Cooper, 1946, Illinois Geol. Survey Bull. 70, p. 19. Future work may demonstrate presence in Appalachians and in Midcontinent of a post-Chester-pre-Morrow series to which names Pushmataha (in the west) and possibly Summers (in the east) can be applied.

Named for Summers County, where the upper Mauch Chunk formations are well exposed.

**Summerville Formation** (in San Rafael Group)[1]

Upper Jurassic: Southeastern Utah, northeastern Arizona, southwestern Colorado, and northwestern New Mexico.

Original reference: J. Gilluly and J. B. Reeside, Jr., 1926, U.S. Geol. Survey Press Bull. 6064, March 30.

James Gilluly and J. B. Reeside, Jr., 1928, U.S. Geol. Survey Prof. Paper 150–D, p. 79–80, table. At type section, includes 163 feet of thin alternating beds of chocolate-colored gypsiferous mudstone and well-laminated sandstone with some red clays toward base. Thickens southward for some distance; 285 feet at Horn Silver Gulch; 331 feet at Drunk Man's Point. Overlies Curtis formation with boundary gradational; underlies Morrison formation.

J. W. Harshbarger, C. A. Repenning, and R. L. Jackson, 1951, New Mexico Geol. Soc. Guidebook 2d Field Conf., p. 97–98. In Navajo country, Summerville formation, Bluff sandstone member, and Recapture shale member of Morrison grade laterally southwestward into distinct sand facies here named Cow Spring sandstone.

W. L. Stokes, 1952, Utah Geol. and Mineralog. Survey Bull. 46, p. 9 (table 1), 10–11, pl. 1. In Thompson area, Grand County, averages about 50 feet in thickness, overlies Entrada sandstone and underlies Morrison formation (Salt Wash member).

C. B. Hunt, Paul Averitt, and R. L. Miller, 1953, U.S. Geol. Survey Prof. Paper 228, p. 38 (table), 63–64, 66, 67, 69 (figs. 14, 15), 73–75. Described in Henry Mountains region where it is 40 to 250 feet thick. Consists generally of evenly bedded reddish-brown sandstone and sandy shale with minor amounts of greenish-white sandstone, gypsum, and limestone. Uppermost formation of group; overlies Curtis formation; underlies Morrison formation.

L. W. Kilgore, 1955, Four Corners Geol. Soc. Guidebook [no. 1], p. 20, cross section. Shown on cross sections of Animas River valley, Colorado, as underlying Junction Creek sandstone and overlying Todilto formation.

J. W. Harshbarger, C. A. Repenning, and J. H. Irwin, 1957, U.S. Geol. Survey Prof. Paper 291, p. 3 (fig. 2), 39–42, strat. sections. Described in Navajo country. Throughout the area it is divisible into an upper sandy facies and a lower silty facies, similar to type locality. Overlies Entrada sandstone in central part of area and Todilto limestone in eastern part. In some places, underlies Bluff sandstone (here considered upper formation of San Rafael group); in eastern, northern, and western parts of area, tongues and grades laterally into Cow Springs sandstone. Thickness 57 to 213 feet. Unit here assigned to Summerville has been assigned to Wanakah by other workers. Correlation of Summerville from San Rafael Swell to Bluff, Utah, is well established. From Bluff, the formation is traceable throughout eastern part of Navajo country and is here correlated with the "buff shale and brown-buff sandstone members of Morrison formation" (Kelley and Wood, 1946, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 47) in Laguna-Lucero area of New Mexico.

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 consists of flat- and thin-bedded brick-red argillaceous sandstone and siltstone 120 to 130 feet thick. Underlies Junction Creek sandstone with contact gradational; overlies Entrada sandstone. San Rafael group. Upper Jurassic.

Named for exposures at Summerville Point, southeast of head of Summerville Wash, in north end of San Rafael Swell, southeastern Utah.

Summit Conglomerate

Miocene and Pliocene: Central Washington.

B. M. Page, 1940, Stanford Univ. Abs. Dissert., v. 15, p. 119. Name applied to fluviatile sediments capping Mount Natapoc.

C. L. Willis, 1953, Am. Jour. Sci., v. 251, no. 11, p. 796, fig. 1. Consists of approximately 200 feet of horizontal beds of andesite stream-laid gravel.

Area described is northwest of Wenatchee, Chelan County.

Summit Gabbro

Paleozoic(?) or Mesozoic(?): Southern California.

W. J. Miller and R. W. Webb, 1940, California Jour. Mines and Geology, v. 36, no. 4, p. 353–354, 378 (fig. 31), pl. 2. Typically medium to fine grained with occasional coarse-grained facies. Intrudes Kernville series and is intruded by Sacatar quartz diorite (new).

Named because of prominent exposures along crest of the Sierra in northwestern part of Kernville quadrangle, Kern County.

Summit Limestone (in Cherokee Shale)[1]

Pennsylvanian: Northeastern Missouri.

Original reference: W. J. McGee, 1892, St. Louis Acad. Sci. Trans., v. 5, p. 331.

Occurs in Macon County.

†Summit Limestone (in Conemaugh Formation)[1]

Pennsylvanian: Western Pennsylvania.

Original reference: I. C. White, 1879, Pennsylvania 2d Geol. Survey Rept. $Q_2$, p. 25–26.

Occurs in high knobs of Perry Township, Lawrence County. Named for Summit cut on P. F. W. & C. Railroad in northwestern part of Beaver County.

†Summit Series (in Allegheny Formation)[1]

Pennsylvanian: Western Pennsylvania.

Original reference: E. V. d'Invilliers, 1895, Pennsylvania 2d Geol. Survey, v. 3, pt. 2, p. 2377.

Occurs in northern part of Clarion County.

Summit Springs Evaporite Member (of Pequop Formation)

Permian (Leonardian): East-central Nevada (subsurface).

Grant Steele, 1960, Intermountain Assoc. Petroleum Geologists Guidebook 11th Ann. Field Conf., p. 106. Middle Leonardian evaporite sequence drilled at 4,400 to 5,400 feet. Underlies an evaporite dated lower Guadalupian and assigned on basis of stratigraphic position and faunal control, to Loray formation (new). Little surface expression of this member.

Recognized in Standard of California-Continental's Summit Springs Unit No. 1, NW¼ sec. 30, T. 20 N., R. 60 E., White Pine County.

†Summitville Andesite (in Potosi Volcanic Series)[1]

Miocene: Southwestern Colorado.

Original reference: E. S. Larsen, 1917, Colorado Geol. Survey Bull. 13, p. 20, 35–38.

Named for extensive development in vicinity of Summitville, Rio Grande County.

Summum Coal Member (of Carbondale Formation)

Pennsylvanian: Illinois.

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 34, 35, 36, 47 (table 1), 66, pl. 1. Assigned member status in Carbondale formation (redefined). In southern area, occurs above Roodhouse coal member and below Hanover limestone member; in western and northern area occurs above Kerton Creek coal member and below Hanover limestone member; in eastern area, occurs above Shawneetown coal member and below Harrisburg (No. 5) coal member. About 3 inches thick. Coal named by Wanless (1931, Illinois Geol. Survey Bull. 60). Presentation of new rock-stratigraphic classification of Pennsylvanian strata in Illinois.

Type locality: Northeast of Summum, NE¼ sec. 3, T. 3 N., R. 2 E., Fulton County.

Summum cyclothem (in Carbondale Formation)

Summum cyclothem[1] (in Carbondale Group)

Pennsylvanian: Western, central, and southern Illinois.

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

H. B. Willman, 1942, Illinois Geol. Survey Bull. 66, p. 106 (fig. 50), 107–118. Commonly between 20 and 25 feet thick. Includes Pleasantview sandstone (at base), Hanover limestone, Covel conglomerate, and intervening unnamed units. Directly overlies Lowell cyclothem (new) where latter is present, and Liverpool cyclothem where Lowell is absent or unrecognized; despite this seeming overlap it is apparently conformable with both because Pleasantview sandstone seems to grade into underlying uppermost sandy shales of both cyclothems; apparently conformable with overlying St. David cyclothem.

H. R. Wanless, 1957, Illinois Geol. Survey Bull. 82, p. 50 (fig. 22), 61–62, 94–102, 204–205, pl. 5. In Beardstown-Glasford-Havana-Vermont area, cyclothem is as much as 85 feet thick, maximum thickness in channel areas of basal Pleasantview sandstone. Separated from underlying Liverpool by one of most prominent erosional unconformities in Illinois Pennsylvanian. Type locality and derivation of name given.

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 42, 53 (table 2), pl. 1. In Carbondale formation (redefined). Above Lowell cyclothem and below St. David cyclothem. Type locality given; reference in Wanless (1957) in error. Presentation of new rock-stratigraphic classification of Pennsylvanian strata in Illinois; cyclical classification is independent of rock-stratigraphic classification.

Type locality: NE¼ sec. 3, T. 3 N., R. 2 E., Fulton County, near Summum.

Summum Sandstone (in Carbondale Formation)[1]

Pennsylvanian: Northwestern Illinois.

Original reference: T. E. Savage, 1930, Illinois Acad. Sci. Trans., v. 22, p. 498.

**Sumner Group**[1]

Permian: Eastern Kansas.

Original reference: F. W. Cragin, 1896, Colorado Coll. Studies, v. 6, p. 3, 9, 48.

J. M. Jewett, 1941, Kansas Geol. Survey Bull. 39, p. 91–93. Sumner group lies between Herington limestone and Harper sandstone. Comprises Wellington shale, Ninnescah shale, and Stone Corral dolomite. Leonard series.

R. C. Moore, J. C. Frye, and J. M. Jewett, 1944, Kansas Geol. Survey Bull. 52, pt. 4, p. 159–160. Group comprises about 1,000 feet of strata at outcrop. Predominantly gray shale with beds of red and green shale and deposits of dolomite, limestone, gypsum, and anhydrite. Underlies Harper sandstone of Nippewalla group; overlies Nolans limestone of Chase group.

Named for Sumner County, Kans.

†Sumpter Epoch[1]

†Sumter Epoch[1]

Miocene and Pliocene: Eastern South Carolina.

Original reference: J. D. Dana, 1863, Manual of Geology, p. 506, 511, 522, 798.

Named for development in Sumter district, Sumter County.

†Sunbeam Monzonite[1]

Post-Eocene: Central northern Utah.

Original reference: G. W. Tower, Jr., and G. O. Smith, 1899, U.S. Geol. Survey 19th Ann. Rept., pt. 3, p. 644, 656–657, pls. 75, 77.

Named for Sunbeam mine, Tintic district.

†Sunbury calciferous sandrock[1]

Devonian(?) and Mississippian: Central Ohio.

Original reference: L. E. Hicks, 1878, Am. Jour. Sci., 3d v. 16, p. 216, 220–222.

Named for Sunbury, Delaware County.

**Sunbury Member** (of Orangeville Shale)

**Sunbury Shale**[1]

Mississippian: Ohio and northeastern Kentucky.

Original reference: L. E. Hicks, 1878, Am. Jour. Sci., 3d, v. 16, p. 216, 220.

Wallace de Witt, Jr., 1951, Geol. Soc. America Bull., v. 62, no. 11, p. 1163. Member of Orangeville shale. Underlies Aurora siltstone member; overlies Berea sandstone. In central and eastern Cuyahoga County, Ohio, where Sunbury shale is separated from Orangeville by local siltstones, the Sunbury can be regarded as distinct formation. This separation is impossible in much of northern Ohio where Orangeville consists of very dark gray and black shales and local siltstones are absent. Therefore, Sunbury is treated as member of Orangeville as far east as the typical zone of *Orbiculoidea herzeri* and *Lingula melie* can be found. This zone of fossils disappears from section in vicinity of Andover in eastern Ashtabula County, and Sunbury member is not recognized across State line in Pennsylvania.

Named for Sunbury, Delaware County, Ohio.

Sun Creek Dacite Flow

Pleistocene to Recent: Southwestern Oregon.

J. S. Diller and H. B. Patton, 1902, U.S. Geol. Survey Prof. Paper 3, p. 34–35. Discussion of geology and petrography of Crater Lake National Park. Mount Mazama is name given to prominent peak that once stood on what is now rim of Crater Lake. Lavas in Mount Mazama were of three types—andesites, dacites, and basalts. Immediate rim of Crater Lake is made up wholly of andesites and dacites, chiefly the former; basalts are limited to outer slope. Dacite flows named are Sun Creek, Cloud Cap, Grouse Hill, Llao Rock, Wineglass, Cleetwood Cove, and Rugged Crest. [For basalt flows see Timber Crater Basalt Flow.] Canyon of Sun Creek below falls has on the west a number of cliffs and terraces due to successive dacite flows, exposing total thickness of about 600 feet. At 6,300 feet east of Crater Peak, cliffs begin. First 200 feet is solid dacite flow. Nut terrace, at 5,900 feet, exposes perlitic and spherulitic banded rhyolite and forms bluff 75 feet in height. At 5,700 feet is a plain of fine material, filling the valley to width of three-fourths mile. Sun Creek has cut canyon 200 feet deep in this soft material. Layer of pumice covers nearly everything beyond canyon, so that nature of underlying rock is a matter of doubt. Sun Creek dacite is the oldest about Crater Lake.

Sun Creek Flows

Pleistocene to Recent: Southwestern Oregon.

Howel Williams, 1942, Carnegie Inst. Washington Pub. 540, p. 89. Sun Creek flows were result of glowing avalanches of pumice and scoria that discharged through Sun Notch on southern slope of Mount Mazama. Avalanches deposited their load after they passed beyond snout of Sun Creek glacier 1½ miles below the notch. Glowing avalanches were part of final activity of Mount Mazama and followed what is termed main pumice fall.

Sun Creek flows southward from Crater Lake.

**Sundance Formation**[1]

Sundance Group

Upper Jurassic: Southwestern South Dakota, central northern Colorado, central southern Montana, northwestern Nebraska, and southwestern Wyoming.

Original reference: N. H. Darton, 1899, Geol. Soc. America Bull., v. 10, p. 387-393.

R. W. Imlay, 1947, Am. Assoc. Petroleum Geologists Bull., v. 31, no. 2, p. 229, 232-234, 238 (fig. 2), 239 (fig. 3), 244-264, strat. sections. Formation, in Black Hills area, South Dakota and Wyoming, subdivided into (ascending) Canyon Springs sandstone, Stockade Beaver shale, Hulett sandstone, Lak, and Redwater shale members (all new). Thickness 200 to 350 feet. Overlies Gypsum Spring formation; underlies Morrison formation. Outcrops near Sundance, which is actually 18 miles southwest of Belle Fourche quadrangle, restudied and considered inadequate to serve as type section. Standard reference section of Sundance is 327 feet thick and includes all members except Canyon Springs. Represents Callovian and Oxfordian stages.

G. N. Pipiringos, 1953, Wyoming Geol. Assoc. Guidebook 8th Ann. Field Conf., p. 34-37; 1957, Wyoming Geol. Survey Bull. 47, p. 6-8, 9 (table 1), 11-13, 19-25. Formation described in Laramie basin, Wyoming. Comprises following members (ascending): Canyon Springs, Stockade Beaver, Hulett, Lak, unnamed member B, Redwater, and unnamed member A. Member A is persistent sandstone unit, 4 to 30 feet thick, that bevels from north to south all underlying members except the Canyon Springs. This unit is distinct from other members of Sundance but is also distinct from overlying Morrison and for convenience is placed in Sundance. Overlies Nugget formation.

J. A. Peterson, 1954, Am. Assoc. Petroleum Geologists Bull., v. 38, no. 4, p. 464 (table 1), 465-500. Proposed that, in eastern Wyoming and western South Dakota, Sundance formation be raised to rank of group comprising two units of formational rank which are correlated with Swift and Rierdon formations of Ellis group of Montana. Because of historical significance, term Sundance should be retained, and, despite its correlation with upper units of Ellis group, term Sundance group is here applied to marine Upper Jurassic rocks of the Black Hills and vicinity, northernmost part of Colorado, subsurface of northwestern Nebraska, and all but westernmost Wyoming.

R. K. Hose, 1956, U.S. Geol. Survey Bull. 1027-B, p. 54–55, pl. 6. Described in Johnson County, Wyo., where it is approximately 285 feet thick and consists of sandstone, shale, and minor amounts of oolitic limestone. Underlies Morrison formation; unconformably overlies Gypsum Spring formation, and locally overlies Crow Mountain sandstone member of Chugwater formation.

J. C. Stewart, 1958, Geology of the Dryhead-Garvin Basin, Bighorn and Carbon Counties, Montana (1:63,360): Montana Bur. Mines and Geology. As mapped, group includes Piper, Rierdon, and Swift formations.

J. D. Love, 1958, Wyoming Geol. Assoc. Guidebook 13th Ann. Field Conf., p. 64–68. Formation described in southern part of Powder River basin where it consists of a lower and an upper unit. Canyon Springs member questionably present locally. Underlies Morrison formation; overlies Gypsum Spring formation, Nugget sandstone, and members of Chugwater formation.

T. P. Storey, 1958, Alberta Soc. Petroleum Geologists Jour., v. 6, no. 4, p. 90–104. Discussion of Jurassic of Williston basin and adjacent areas. On basis of regional extent and significance of sub-Swift and sub-Rierdon unconformities, a different stratigraphic interpretation is presented. The Swift is divided into Lower, Middle, and Upper units. Lower Swift is so designated because it is considered to be lithologically similar to and regionally conformable with Middle and Upper Swift which correspond to type Swift of western Montana. Lower Swift of Williston basin and equivalent Stockade Beaver and Hulett members of Lower Sundance in Black Hills are considered to lie unconformably on the Rierdon and therefore to be younger than the Rierdon and older than the Swift as designated by Cobban. This correlation is offered in lieu of the more general belief that Lower Sundance and Rierdon are equivalent in age. Thus, Lak and Redwater members of the Sundance are considered equivalent to type Swift of western Montana.

Type locality: Above Sundance which is 18 miles southwest of Belle Fourche quadrangle, South Dakota. Reference section: About one-fourth mile north-northeast of center of Spearfish in sec. 3, T. 6 N., R. 2 E., Lawrence County, S. Dak.

## Sunday Quartzite[1]

Precambrian (Animikie Series): Northwestern Michigan and northwestern Wisconsin.

Original reference: C. R. Van Hise and C. K. Leith, 1911, U.S. Geol. Survey Mon. 52, p. 225, 227, chart opposite p. 598, 605.

N. K. Huber, 1959, Econ. Geology, v. 54, no. 1, p. 85 (table 1). Included in Animikie series. Underlies Bad River dolomite; unconformable above granite.

Named for two exposures east of Sunday Lake, one a short distance east of Little Presque Isle River and other near Newport mine, Penokee-Gogebic district, Mich.

**Sunday Mountain Volcanic Member** (of Orfordville Formation)

Sunday Mountain Volcanics

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. Member consists of schistose greenstones in low-grade metamorphic zone of formation, and chiefly fine- to medium-grained amphibolite with some fine-grained biotite gneiss and black graphitic quartzite in middle-grade zone. Occurs near top of Orfordville formation above Hardy Hill quartzite member (new). Middle Ordovician(?).

J. B. Hadley, 1942, Geol. Soc. America Bull., v. 53, no. 1, p. 119, 123. Maximum thickness 400 feet.

J. B. Hadley, 1950, Vermont Geol. Survey Bull. 1, p. 15–16. Metamorphic equivalent of rhyolite and dacite tuffs and possibly some flows. Geographically extended to Vermont. Ordovician.

R. J. Bean, 1953, Geol. Soc. America Bull., v. 64, no. 5, pl. 2. Mapped together with Post Pond volcanics as a unit overlying Orfordville formation. Map legend shows Upper(?) Ordovician age.

J. B. Lyons, 1955, Geol. Soc. America Bull., v. 66, no. 1, p. 114–116. Stratigraphic revision of Orfordville formation implies that the lithologically similar Post Pond and Sunday Mountain volcanic members are essentially equivalent, and the latter is not mapped separately.

Named for outcrops on and near Sunday Mountain, Orford Township, Grafton County.

**Sunderland Formation** (in Columbia Group)[1]

Pleistocene: Atlantic Coastal Plain from Delaware to Florida.

Original reference: G. B. Shattuck, 1901, Johns Hopkins Univ. Circ., v. 20, no. 152, p. 73–75.

C. W. Cooke, 1952, Maryland Dept. Geology, Mines and Mineral Resources Bull. 10, p. 45–47, 48. Described in Prince Georges County, Md., and District of Columbia. Consists almost entirely of valley fill; lies unconformably on deposits ranging in age from ancient crystalline rocks to the Pliocene. In northern end of Potomac estuary, lies much lower than Brandywine gravel, but at southern end of county lies nearly as high. The Wicomico formation is sunk below base of the Sunderland and is separated from it by a slope exposing older rocks. Thickness about 40 or 50 feet. As here interpreted, formation spans interval between first low-water stage of the Pleistocene and the beginning of the next; therefore, presumably accumulated in early Pleistocene during first (Nebraskan) glacial stage and first (Aftonian) interglacial stage. As defined in this region, appears to be equivalent to combined Sunderland and Coharie formations of North Carolina.

J. T. Hack, 1955, U.S. Geol. Survey Prof. Paper 267–A, p. 8, 29–31. Problem of separating upland deposits in Coastal Plain into formations is discussed. No basis is found for separating the Sunderland from the Brandywine; both formations at their type localities are underlain by a littoral deposit, North Keys sand (new) of Miocene(?) age. Part of the

Sunderland as mapped by earlier workers is here included in North Keys sand.

Name derived from hamlet of Sunderland, Calvert County, Md.

**Sunniland Limestone**

Lower Cretaceous: Southern Florida (subsurface).

P. L. Applin, 1960, U.S. Geol. Survey Prof. Paper 400–B, p. B209–B211. Term "Sunniland", as applied to rock unit, was published by Pressler (1947, Am. Assoc. Petroleum Geologists Bull., v. 31, no. 10) who referred to "Sunniland zone," "Sunniland limestone," and "the formation." Neither Pressler nor later writers defined the unit or described type section. Common usage has established name "Sunniland limestone" in geologic nomenclature of Florida. Name is here used to designate subsurface unit of middle Trinity (Comanche) age in southern Florida. Composed chiefly of limestone, dolomite, and shale. Overlies the so-called "thick anhydrite" or "lower anhydrite" unit, and underlies so-called "upper anhydrite" unit, both of Trinity age. Thickness 250 to 275 feet in wells in and near Sunniland field. Penetrated in about 60 deep test wells in central and southern Florida.

Sunniland oil field, Collier County.

**Sunnybrook 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. 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. The Sunnybrook, a sequence of undetermined thickness, consists dominantly of gray felsic rocks, including bedded feldspathic tuff and felsitic quartz-bearing tuff of rhyolite composition; within the felsitic rocks is a zone, approximately 400 feet thick, of dark-green chlorite-uralite schist, probably derived from pyroclastics. Thickness at least 1,500 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 Sunnybrook Crossing in eastern part of Newton mine area.

Sunnyside Member (of Blackhawk Formation)

Upper Cretaceous (Montana): Central eastern Utah.

R. G. Young, 1955, Geol. Soc. America Bull., v. 66, no. 2, p. 183, 185–186, figs. 2, 3, pl. 3. Composed of massive basal sandstone tongue and the overlying coal-bearing rocks which are replaced eastward by offshore bar sandstones. Basal sandstone is medium grained, buff, and massive; maximum thickness of about 50 feet at Pace Canyon, grading downward and eastward into tongue of Mancos shale which, in turn, rests disconformably on Kenilworth member (new) of Blackhawk formation. Coal-bearing rocks consist of about 25 feet of sandstone, shale, and coal which, at point about 4 miles northeast of Desert, are replaced by last of series of six offshore bar sandstones. Two important coal beds present in member, the Upper and Lower Sunnyside coals. Upper coal about 22 feet thick at Horse Canyon; Lower coal maximum thickness about 5 feet. Separated from Grassy member (new) above by tongue of Mancos shale.

Named for exposures near town of Sunnyside, Carbon County. In Book Cliffs.

Sunol Series

Upper Cretaceous: California.

O. P. Jenkins, 1938, Geologic map of California (1:500,000): California Div. Mines, sheet 4. Grouped under marine sediments on map legend.

**Sunrise Formation**[1]

Lower Jurassic: 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. Miller, and S. H. Cathcart, 1954, U.S. Geol. Survey Geol. Quad. Map GQ–45. Black, gray, and brown shale, locally altered to slate and hornfels, with interbedded argillaceous, cherty, and arenaceous limestone, locally grading into calcareous sandstone. One bed, 10 feet, of oolitic limestone in lower part. Overlies Gabbs formation; unconformably underlies Dunlap formation.

Type section: Upper part of New York Canyon, west of Sunrise Flat. Named for Sunrise Flat in Gabbs Valley Range.

†Sunrise Series[1] or Group[1]

Paleozoic and Mesozoic: Southern Alaska.

Original reference: W. C. Mendenhall, 1900, U.S. Geol. Survey 20th Ann. Rept., pt. 7, p. 305–307.

Crops out on western shores of Prince William Sound. Probably named for Sunrise City, which is in center of Turnagain Arm mining district.

Sunrise Springs Series[1]

Tertiary or Pleistocene: Northeastern Arizona.

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

In Cornfields-Sunrise Springs district.

Sun River Dolomite (in Madison Group)

Upper Mississippian: Northwestern Montana.

V. R. Chamberlain, 1955, Billings Geol. Soc. Guidebook 6th Ann Field Conf., p. 78, 79. Typically consists of very light yellowish white dolomitic limestone and limy dolomite with occasional bed of chert. Distinguished from Charles formation by its anhydrite free limestones and dolomites. Overlies Mission Canyon formation with apparent conformity.

Well exposed along Sun River west of Great Falls in Hannon Gulch.

Sunset Member (of Arnheim Formation)

Sunset division (in Arnheim Formation)[1]

Upper Ordovician: North-central Kentucky and southwestern Ohio.

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 lower member of Arnheim formation. Underlies Oregonia member; overlies Mount Auburn member of McMillan formation. Consists of calcareous shales and nodular limestones. Thickness about 60 feet. Richmond series.

Named for Sunset, Fleming County, Ky.

Sunset Point Formation

Cambrian: Southern and central Wisconsin.

G. O. Raasch, 1951, Illinois Acad. Sci. Trans., v. 44, p. 150. Dominantly sand with varied proportions of dolomite. Underlies Oneota formation; overlies Jordan member of Trempealeau formation. Name proposed to replace term Madison to alleviate much confusion, owing especially to widespread use of the same name, Madison, for a Mississippian limestone unit in Montana and Wyoming.

G. O. Raasch, 1952, Illinois Acad. Sci. Trans., v. 45, p. 85. In Stoddard quadrangle, underlies Hickory Ridge member (new) of Oneota formation.

Named after bluff of that name at Madison sandstone type locality, Madison, Wis.

**Sunshine Peak Rhyolite**[1] (in Potosi Volcanic Series)

Tertiary, middle and late: Southwestern Colorado.

Original reference: E. S. Larsen, 1935, U.S. Geol. Survey Bull. 843.

U.S. Geological Survey currently classifies the Sunshine Peak Rhyolite as part of Potosi Volcanic Series and designates the age as middle and late Tertiary on the basis of a study now in progress.

Named for exposures on Sunshine Peak, San Cristobal quadrangle.

**Sunshine Ranch Member** (of Saugus Formation)

Sunshine Ranch member (of Pico Formation)

Pliocene: Southern California.

G. B. Oakeshott, 1950, California Jour. Mines and Geology, v. 46, no. 1, p. 50 (table), 58 (fig. 3), 59–61, pls. 14, 16. Term Sunshine Ranch member of Pico formation applied to upper Pliocene continental beds lying below continental lower Pleistocene Saugus formation and above marine beds commonly called Pico. As described in unpublished report by J. C. Hazzard, Sunshine Ranch formation in its type area consists of a 20-foot basal portion of crossbedded to cobbly sandstone overlain by a coquina reef bed which averages 35 feet in thickness. This is followed by an interbedded series of gray coarse-grained to pebbly friable sandstone and gray to greenish-gray very fine grained sandstone, silty sandstone, and sandy siltstone. In Placerita oil field, thickness is approximately 1,300 feet; member has been folded into an asymmetrical syncline; here it disconformably underlies Saugus formation; overlies Mint Canyon formation with angular unconformity.

E. L. Winterer, 1955, *in* Pacific Petroleum Geologist Newsletter, v. 9, no. 6, p. 2. Reallocated to member of Saugus formation.

E. L. Winterer and D. L. Durham, 1958, U.S. Geol. Survey Oil and Gas Inv. Map OM–196. Term Sunshine Ranch was introduced by Hazzard (in Oakeshott, 1950) for interfingering marine, brackish-water, and nonmarine beds lying between Pico and Saugus formations in vicinity of San Fernando Reservoir in San Fernando Valley, a short distance south of the area of this report. Sunshine Ranch is here considered member of

Saugus formation and of Pliocene age. At Hazzard's type locality, Sunshine Ranch is about 3,000 feet thick.

G. B. Oakeshott, 1958, California Div. Mines Bull. 172, p. 22 (fig. 2), 23 (fig. 3), 78, 82–83, pl. 1. Member of Pico formation. Exposed both north and south of San Gabriel fault in San Fernando quadrangle where it unconformably underlies Saugus formation. Thickness 3,000 feet where exposed in steeply north-dipping section in Mission Hills near San Fernando Reservoir. North of fault, on Sierra Highway, approximately 1,300 feet thick. South of fault, unconformably overlies fossiliferous Lower Pico; north of fault, overlies lower Pliocene Repetto formation and also upper Miocene Mint Canyon formation with angular unconformity. Upper Pliocene. Sunshine Ranch member is roughly equivalent to "lower Saugus" of earlier workers.

Type area: In foothills area north of Sunshine Ranch between axial region of Reservoir anticline and Balboa Avenue, west of San Fernando Reservoir.

**Supai Formation** (in Aubrey Group)[1]

Pennsylvanian and Permian: Northern Arizona, eastern California, eastern Nevada, western New Mexico, and southern Utah.

Original reference: N. H. Darton, 1910, U.S. Geol. Survey Bull. 435, p. 21, 22, 25.

D. White, 1929, Carnegie Inst. Washington Pub. 405, p. 11. Includes Esplanade sandstone member.

A. A. Stoyanow, 1936, Geol. Soc. America Bull., v. 47, no. 4, p. 525, 533–534. In Fort Apache Reservation, about 979 feet thick and includes Fort Apache limestone and Kinishba beds (both new).

J. W. Huddle and E. Dobrovolny, 1945, U.S. Geol. Survey Oil and Gas Inv. Prelim. Chart 10. In central and northeastern Arizona, divided into three members which are in part contemporaneous and grade laterally into each other. Thickness ranges from 1,700 to 1,800 feet in outcrops along Mogollon Rim and thickens northward to nearly 2,500 feet in wells; thins northeastward toward Fort Defiance and Zuni uplifts; probably more than 2,500 feet thick beneath Black Mesa basin. Formation transgresses time lines and probably varies in age from Des Moines through Leonard. Overlies Naco formation; contact drawn above sequence of gray limestone and shale and below a sequence of red sandstone, shale, and limestone. Underlies Conconino sandstone; contact arbitrarily drawn at base of lowest massive sandstone with well-developed Coconino-type cross-bedding.

G. S. Campbell, 1951, Utah Geol. Soc. Guidebook 6, p. 63, 64 (fig. 15). Described in Confusion Range, Utah, where it consists of 3,000 feet of varicolored sandstones, the basal part of which is considered to be Wolfcampian in age. Overlies Bird Springs formation; underlies Kaibab limestone.

S. S. Winters, 1951, Plateau, v. 24, no. 1, p. 12–14. In Fort Apache Reservation, comprises four members: lowest consists of 330 feet of reddish-brown very fine-grained noncalcareous sandstone and siltstone; about 475 feet of slope-forming reddish-brown calcareous mudstone that alternates with ledge-forming gypsum beds, light-colored very calcareous claystones and gray limestones; Fort Apache limestone 95 to 118 feet thick; 370 feet of alternating slope-forming reddish-brown calcareous mudstones and siltstones, and ledge-forming beds of light-colored very calcareous claystones, gray limestones, and gypsum. Underlies Coconino sandstone; overlies Naco formation.

R. L. Jackson, 1951, Plateau, v. 24, no. 2, p. 90 (fig. 2). In Fort Apache area, Winters (unpub. thesis) subdivided Supai into (ascending) Amos Wash, Big "A", Apache, and Corduroy members. In Fossil Creek area [this report], the Supai comprises (ascending) Packard member (new), Oak Creek member (new), Big A sand facies, Apache member, and Corduroy member. Overlies and interfingers with Naco formation; underlies Coconino sandstone.

P. W. Hughes, 1952, Am. Assoc. Petroleum Geologists Bull., v. 36, no. 4, p. 635–657. Described in Chino Valley, Yavapai County, Ariz. Consists of two members: lower, 145 to 156 feet thick, is slope-forming unit of red sandstones and siltstones, capped by cliff-forming unit of cherty limestone; upper, about 938 feet thick, is alternating red sandstones and siltstones interbedded with a few strata of structureless claystone and some aphanitic limestone. Unconformably overlies Redwall limestone; underlies Coconino sandstone with contact gradational. Basal Supai is Lower Pennsylvanian.

D. F. Hewett, 1956, U.S. Geol. Survey Prof. Paper 275, p. 45, pl. 1. Mapped in San Bernardino County, Calif., where it overlies Bird Spring formation and underlies Kaibab limestone.

R. E. Lehner, 1958, U.S. Geol. Survey Bull. 1021–N, p. 533–540. Described in Clarkdale quadrangle, Arizona. Subdivided into three members: lower, 580 to 625 feet thick, is chiefly sandstone and siltstone with minor amounts of shaly mudstone; middle, 250 to 300 feet thick, present only north of Verde River, is principally siltstone intercalated with conglomerate, sandstone, and some limestone; and upper, 650 to 750 feet thick, present only north of Verde River, is sequence of sandstone and a few interbedded siltstone beds. Unconformably overlies Redwall limestone; intertongues with overlying Coconino. In Grand Canyon area, Hermit shale separates Supai from Coconino. Pennsylvanian and Permian.

R. K. Hose and C. A. Repenning, 1959, Am. Assoc. Petroleum Geologists Bull., v. 43, no. 9, p. 2174. Proposed that terms Supai(?) and Supai equivalents as used by Newell (1948, Geol. Soc. America Bull., v. 59, no. 10) and Supai sandstone as used by Campbell (1951) be abandoned in Confusion Range and term Arcturus be used.

In Defiance uplift area and near Toadlena, N. Mex., term Supai is used for bedded rocks that dominantly underlie and locally interfinger with the DeChelly.

Named from exposures at Supai Village, in Havasu (Cataract) Canyon, northern Arizona. Havasu Canyon drains northward into Grand Canyon of Colorado and joins it about 85 miles north of Black Mesa. Supai is contraction of word Havasupai.

Supaian series[1]

Carbonic: Northwestern Arizona.

C. R. Keyes, 1922, Pan-Am. Geologist, v. 38, no. 3, p. 251 (table). Includes (ascending) Pierce shales (new), Seligman limestones (new), Yampai shales (new), and Shiwits sandstones (new). Underlies Verdan series.

In Grand Canyon region.

Supan Tuff and Sand 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 is subdivided into five members. Supan tuff and sand is oldest in sequence. Underlies Bald Hill agglomerate member.

Occurs at Iron Canyon dam site near Red Bluff, Tehama County.

**Superior 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 Superior mine, Houghton County.

**Superior 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 Superior mine, Houghton County.

**Superior 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).

In Superior mine, Houghton County.

**Superior 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).

In Superior mine, Houghton County.

Suplee Formation (in Mowich Group)

Lower Jurassic: East-central Oregon.

R. L. Lupher, 1941, Geol. Soc. America Bull., v. 52, no. 2, p. 227 (table 1), 229, 239, 242. Consists of gradations of granular gray limestone and calcareous sandstone; poorly stratified or massive. Thickness ranges from 35 to 150 feet. Conformably underlies Nicely shale (new); overlies Robertson formation (new) in type area and Bear Valley area; where Robertson is absent, the Suplee lies discordantly upon Triassic beds.

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 Suplee post office, Crook County.

Sur Series[1]

Pre-Franciscan: Southern California.

Original reference: P. D. Trask, 1926, California Univ. Dept. Geol. Bull., v. 16, no. 6.

Parry Reiche, 1937, California Univ. Pubs., Dept. Geol. Sci. Bull., v. 24, no. 7, p. 116–132, geol. map. Name Sur series was applied by Trask (1926) to metamorphic rocks of Santa Lucia Range. Previous to that time, these rocks had been known variously as part of Santa Lucia formation and of Coast complex, although associated plutonic material had been distinguished by Lawson as Santa Lucia formation [Santa Lucia granite]. Present report uses Trask's term Sur series, but Trask's perpetuation of name Gabilan for the marbles, which occur at various horizons, spaced irregularly over several thousands of feet stratigraphically, seems ill advised. Series in Santa Lucia quadrangle comprises variety of generally phanerocrystalline metamorphic rocks including quartzose schists and gneisses, quartz biotite schists, marbles, and plagioclase amphibolites. Series crops out over much of northern Santa Lucia Range; similar rocks are exposed in northern part of Gavilan Range, and sporadic areas have been mapped in Santa Cruz Mountains. Thickness uncertain because of possibility of unrecognized structural complexities. Assuming homoclinal structure with average dip of 35°, there must be minimum of 7,000 feet near northwest corner of quadrangle. If Sur series east of Coast Ridge fault is not repetition of rocks of this northwest area, total thickness may be approximately 10,000 feet. Paleozoic(?).

C. E. Weaver, 1949, Geol. Soc. America Mem. 35, p. 18–19, pls. Term Sur series used to include pre-Franciscan schist and quartzite and pre-Franciscan limestone on Point Reyes, Peninsula. Two exposures of quartzite and schist, each less than 2 acres, occur associated with quartz diorite along an intrusive contact. One exposure is about 7,000 feet southwest of Inverness on northeastern slope of Point Reyes Mountain and is less than 50 feet thick. The other exposure, which is on western shore of Tomales Bay about 1¼ miles north of Inverness, consists of a narrow strip of banded quartz-mica schist about 500 feet long and 25 feet thick. It rests upon quartz diorite and dips at a low angle eastward beneath Tomales Bay and supposedly abuts San Andreas fault. A belt of crystalline limestone a little less than 1,000 feet wide lies about 1 mile west of Point Reyes Station. It is faulted into quartz diorite so that the eastern side abuts the quartz diorite and western side passes beneath Miocene sandstone. Southern tip of belt wedges into igneous rock.

N. L. Taliaferro, 1951, California Div. Mines Bull. 154, p. 118. Names Sur series, Gabilan limestone, and Santa Lucia granodiorite are essentially petrographic and not formational in usual sense since rocks of very different ages might be included under any one of the names.

O. E. Bowen, Jr., and C. H. Gray, Jr., 1958, (abs.) Geol. Soc. America Bull., v. 69, no. 12, pt. 2, p. 1676. An 8,200-foot section of strongly metamorphosed sediments of Sur series is exposed astride Fremont Peak 10 miles northeast of Salinas at north end of Gabilan Range. Homoclinal sequence strikes east and dips 70° N. Three units recognized: 1,400-foot upper schist; 3,300-foot middle carbonate schist; and 3,500-foot lower schist. Neither top nor bottom of sequence exposed; boundaries have been obliterated by quartz monzonite intrusions. Fremont Peak section is within 5,000- to 10,000-foot range of thickness suggested by Reiche and Trask for series in Lucia and Point Sur quadrangles of Santa Lucia Mountains. Indistinct forms in limestone suggestive of cup corals together with clastic debris possibly derived from round-section crinoids, observed one-half mile west of Fremont Peak on Rocky Ridge, yield only age-suggestive features of series. Part of sequence is possibly Paleozoic.

Named for exposures along Sur River.

Surgener Formation

Middle Ordovician (Mohawkian): Southwestern Virginia and northeastern Tennessee.

G. A. Cooper, 1956, Smithsonian Misc. Colln., v. 127, pt. 1, p. 93, chart 1 (facing p. 130). Name proposed for chalky weathering dark limestone, cherty dark limestone, gray to buff mudstone, and maroon mudstone. Underlies Dryden formation (new). At Hagan, Va., sequence includes Poteet, Rob Camp, and Martin Creek formations of Miller and Brosge (1950) ; also Dot formation [according to chart]. Name attributed to B. N. Cooper and G. A. Cooper.

Type section: Just east of Hagan Switchback on the L. and N. Railroad, 4½ miles due north of Surgener Cemetery, Rose Hill quadrangle, Lee County, Va. Named for cemetery which is one-half mile east of section along Yellow Creek.

Surprise Formation[1]

Surprise Member (of Kingston Peak Formation)

Precambrian: Southeastern California.

Original references: F. M. Murphy, 1930, Econ. Geology, v. 25, p. 309–311, 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. 360, 363, figs. 1, 3. Redefined as member of Kingston Peak formation. Characteristically a conglomeratic subgraywacke or conglomeratic mudstone, locally hornfelsed and phyllitic; in one area, a nonpebbly graywacke occurs within the conglomeratic rocks. Thickness 370 feet in Goler Wash; more than 1,600 feet near mouth of Woodland Canyon; base of formation not exposed north of Coyote Canyon so actual thickness of member is not known. Basal member of formation; overlies Archean gneiss; underlies Sour Dough member. Area of report Manly Peak quadrangle.

Named for exposures along Surprise Canyon, southern part of Panamint Range, Inyo County.

Susanville Gravels

Eocene: Northern California.

Howel Williams, 1932, California Univ. Pub. Bull., Dept. Geol. Sci., v. 21, no. 8, p. 215. Susanville gravels, lying southeast of Lassen and containing an admixture of rhyolitic tuff, may be correlated tentatively with Montgomery Creek formation( new). Name credited to R. D. Russell.

Town of Susanville is in Lassen County.

**Susitna Slate[1]**

Jurassic(?) and Cretaceous: Southern Alaska.

Original reference: G. H. Eldridge, 1900, U.S. Geol. Survey 20th Ann. Rept., pt. 7, p. 14–20, map.

Exposed up Sushitna [Susitna] River for 50 miles, from 15 miles above mouth of the Chulitna to considerable distance above mouth of Indian Creek, Cook Inlet region.

**Suslota Limestone[1]**

Pennsylvanian: Central eastern Alaska.

Original reference: W. C. Mendenhall and F. C. Schrader, 1903, U.S. Geol. Survey Prof. Paper 15, p. 46–47.

Occurs west of Suslota Pass, Mentasta Mountain region.

Suspension Bridge Dolomite Member (of Lockport Dolomite)

Silurian: Western New York, and Ontario, Canada.

E. R. Cumings, 1939, Geologie der Erde, North America, v. 1, p. 596 (fig. 7), 597. Finely saccharoidal medium-bedded dolomite; sparsely fossiliferous about 50 feet. Middle member of Lockport; overlies Gasport dolomite member; underlies Eramosa dolomite member.

B. F. Howell and J. T. Sanford, 1947, Wagner Free Inst. Sci. Bull., v. 22, no. 4, p. 34. Replaced by term Goat Island member; name Suspension Bridge preoccupied.

Exposed in Niagara Gorge.

**Susquehanna Group**

Susquehanna Series[1]

Upper Devonian: Pennsylvania.

Original reference: G. H. Ashley, 1923, Eng. Mining Jour.-Press, v. 115, p. 1106–1108.

H. H. Arndt and others, 1959, Geol. Soc. America Guidebook Pittsburgh Mtg., p. 3. Susquehanna group defined as all units between highest Catskill red beds at top and base of Tully limestone at bottom. Includes Catskill formation, transition beds (named locally), and Upper Devonian marine beds. North of confluence of Susquehanna and Juniata Rivers, Susquehanna group is of order of 7,000 feet thick, characterized by about 3,500 feet of red beds in upper part. Transition unit about 1,500 feet thick north of confluence of Susquehanna and Juniata Rivers. Lowermost unit (2,000 feet in Susquehanna River area) consists of marine medium-gray sandstones and siltstones with dark-gray shale near base. Base of this unit placed at base of Tully limestone member. This lower unit is synonymous with Fort Littleton and Rush formations where they are mapped, and possibly some "Chemung" may be included. Middle and Upper Devonian.

Carlyle Gray and others, 1960, Geologic map of Pennsylvania (1:250,000): Pennsylvania Geol. Survey, 4th ser. Map bracket shows group, in central and eastern Pennsylvania, includes (ascending) marine beds (contains "Chemung" beds and "Portage" beds including Burket, Brallier, Harrell, and Trimmers Rock; Tully limestone at base), Catskill formation, and Oswayo formation. Upper Devonian.

Named for occurrence in Susquehanna River area.

†Susquehanna Mica Schist[1]

Precambrian: Northern Maryland.

Original reference: W. B. Clark, E. B. Mathews, and E. W. Berry, 1918, Maryland Geol. Survey, v. 10, p. 69 (table).

**Sussex Sandstone Member** (of Cody Shale)

Sussex Sandstone Member (of Steele Shale)

Upper Cretaceous: Wyoming (subsurface and surface).

J. B. Wilson, 1951, Wyoming Geol. Survey Rept. Inv. 3, p. 3–11. Member of Cody shale known primarily in subsurface. Light-gray fine-grained glauconitic marine sandstone about 40 feet thick where best developed in Sussex and North Meadow Creek oil fields. Occurs above Shannon sandstone member and below Parkman sandstone member.

J D. Love, J. L. Weitz, and R. K. Hose, 1955, Geologic map of Wyoming (1:500,000): U.S. Geol. Survey. Mapped as member of Cody shale. Member is 2,500 feet above base of Cody.

G. H. Horn, 1955, U.S. Geol. Survey Oil and Gas Inv. Map OM-164. Shown on map legend as member of Steele shale.

Present in Powder River Basin. Exposed at surface near Salt Creek oil field.

Sutherland Falls Marble[1]

Sutherland Falls Marble Member (of Boardman Formation)

Sutherland Falls Marble Member (of Shelburne Formation)

Lower Ordovician: Western Vermont.

Original reference: Edward Hitchcock, 1861, Vermont Geol. Rept., v. 2, p. 767.

Phillip Fowler, 1950, Vermont Geol. Survey Bull. 2, p. 25, 26. Rank reduced to lowest member of Boardman formation (new). Thin-bedded green-streaked white and cream-colored marble with contorted chains of dolomite crystals standing out on weathered surfaces; contains a central siliceous band, the Hen Hawk layer. Thickness regularly 90 to 100 feet. Underlies Intermediate dolomite member of Boardman; overlies Clarendon Springs dolomite. Type locality designated.

J. B. Thompson, Jr., 1959, New England Intercollegiate Geol. Conf. Guidebook 51st Ann. Mtg., p. 75 (table 1). In Clarendon-Dorset area, basal member of Shelburne formation. Thickness 50 to 100 feet. Underlies Intermediate marble member. Overlies Clarendon Springs formation.

Type locality: Probably a quarry 2,000 feet west of Sutherland Falls in Proctor, Rutland County. Name apparently taken from Sutherland Falls on Otter Creek.

**Sutro Member** (of Alta Formation)

Sutro Tuffs

Oligocene(?): Western Nevada.

V. P. Gianella, 1934, Mining and Metallurgy, v. 15, no. 331, p. 299. Tuffs, about 400 feet thick, are water laid and interbedded with Forman volcanics; Miocene.

V. P. Gianella, 1936, Nevada Univ. Bull., v. 30, no. 9, p. 56–59, pl. 1. Tuff member of Alta andesite composed of fine volcanic dust and ash with particles as much as one-fourth inch, occasionally much coarser. Color usually creamy yellow to light buff. Occurs 500 feet stratigraphically above base of Alta andesites. Derivation of name given.

D. I. Axelrod, 1949, (abs.) Geol. Soc. America Bull., v. 60, no. 12, pt. 2, p. 1935. Oligocene age indicated on basis of flora.

G. A. Thompson, 1956, U.S. Geol. Survey Bull. 1042–C, p. 51–52, pl. 3. A member of Alta formation ranging in texture from shale to conglomerate, with grayish-green shale especially characteristic. Oligocene(?). Only of local extent.

Named for exposures in Sutro Tunnel. Present only in Comstock Lode district, Virginia City quadrangle.

**Sutter Formation**[1]

Tertiary, upper: Northern California.

Original reference: R. E. Dickerson, 1916, California Univ. Pub., Dept. Geol. Bull., v. 9, p. 404–406.

Ralph Stewart, 1949, U.S. Geol. Survey Oil and Gas Inv. Prelim. Chart 34, sheet 2. Expanded below to include about 150 feet of coarse gravels here termed the Butte gravel member. Upper Tertiary.

Named for occurrence in Sutter County, in what is now known as Marysville Buttes (formerly Sutter Buttes).

Sutter Mountain unit

Carboniferous(?): Northern Washington.

R. W. Jones, 1959, Dissert. Abs., v. 20, no. 3, p. 994. Consists of unmetamorphosed sedimentary and intermediate to basic volcanic rocks. These rocks are the lower plate of the Shuksan-Whitechuck overthrust which is east of map area. To the southwest, the Sutter Mountain unit is in high angle fault contact with Gold Mountain phyllite (new)

Report discusses geology of Finney Peak area, northern Cascades.

†Sutton Gneiss[1]

Precambrian: Central southern Massachusetts and northwestern Rhode Island.

Original reference: B. K. Emerson, 1898, U.S. Geol. Survey Mon. 29, p. 18.

Named for exposures east of Sutton, Worcester County, Mass.

Sutton 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. 218.

Exposed just east of B. & O. Railroad Station at Sutton, Braxton County.

Sutton Island Series[1]

Precambrian or Camrbian(?): Southeastern Maine.

Original reference: N. S. Shaler, 1889, U.S. Geol. Survey 8th Ann. Rept., pt. 2, p. 1037, 1041–1043, 1061, map.

G. H. Chadwick, 1942, (abs.) Geol. Soc. America Bull., v. 53, no. 12, pt. 2, p. 1797. Sutton Island abandoned; synonymous with Frenchmans Bay series (new) of Silurian age.

Named for development on Sutton Island, south of Mount Desert Island, Hancock County.

Suwanee Basalt Flow[1]

Pleistocene: New Mexico.

Original reference: R. L. Nichols, 1934, Geol. Soc. America Proc. 1933, p. 453.

Occurs in San Jose Valley, Valencia County.

**Suwannee Limestone**

Suwannee Limestone (in Vicksburg Group)[1]

Oligocene, upper: Eastern Florida and south-central Georgia.

Original reference: C. W. Cooke and W. C. Mansfield, 1936, Geol. Soc. America Proc. 1935, p. 71–72.

F. S. MacNeil, 1944, Am. Assoc. Petroleum Geologists Bull., v. 28, no. 9, p. 1314, 1315 (fig. 1). Vicksburg group restricted to exclude Suwannee limestone.

R. O. Vernon, 1951, Florida Geol. Survey Bull. 33, p. 173–178. As used in this report, Suwannee limestone includes all beds of Oligocene age in Citrus and Levy Counties. Upper part of formation is considered to be equivalent to lower Chickasawhay marl of eastern Mississippi, and lower part possibly equivalent of Byram formation and Marianna limestone of Florida. Thickness 59 to 120 feet. Unconformably overlies Ocala limestone (restricted) ; unconformably underlies Hawthorn formation; where Hawthorn is absent, Suwannee is covered by sediments of early Pleistocene or Alachua formation, terrestrial Miocene. Upper Oligocene.

W. E. Moore, 1955, Florida Geol. Survey Bull. 37, p. 51–58. As exposed in Jackson County, consists of tan- to buff-colored limestones, dolomitic limestones, and dolomitic to calcareous clays that underlie Tampa formation and overlie Marianna limestone. Thickness 5 to 12 feet in central area of county; maximum thickness about 210 feet (in water well at Sink Creek).

Typically exposed along Suwannee River in Florida, from Ellaville almost to White Springs.

Swakane Gneiss[1]

Pre-Ordovician: Central Washington.

Original reference: A. C. Waters, 1932, Jour. Geology, v. 40, no. 7, p. 603–633.

Well exposed along canyon of Swakane Creek, for which it is named.

Swan Creek Limestone[1]

Upper Ordovician: Western Tennessee.

Original reference: A. F. Foerste, 1903, Jour. Geology, v. 11, p. 43–44.

Named for Swan Creek, Hickman County.

Swan Creek phosphate[1]

Upper Devonian or Mississippian: Western Tennessee.

Original reference: J. M. Safford and J. B. Killebrew, 1900, Elements of geology of Tennessee, p. 104, 136, 137, 138, 142.

Named for Swan Creek, Lewis and Hickman Counties.

Swan Creek Sandstone[1]

Mississippian: Southwestern Illinois.

Original reference: E. O. Ulrich, 1923, Geol. Soc. America Bull., v. 33, p. 831.

Exposed along Swan Creek, 1½ to 2½ miles east of Anna, Union County.

**Swandyke Hornblende Gneiss**[1]

Precambrian (Gunnison River Series) : Central Colorado.

Original reference: T. S. Lovering, 1935, U.S. Geol. Survey Prof. Paper 178.

T. S. Lovering and E. N. Goddard, 1950, U.S. Geol. Survey Prof. Paper 223, p. 20, 73, pl. 1. In type locality, consists chiefly of hornblende schist and hornblende gneiss interlayered with thin beds of quartz latite; thickness approximately 6,000 feet. Lithologic character and structural relations indicate that dioritic intrusives and related extrusives and intercalated sediments were in part contemporaneous with and in part younger than upper part of Idaho Springs formation. At Coal Creek, overlain by series of quartzites and quartz pebble conglomerates at least 14,000 feet thick.

Type locality: At Swandyke, about 10 miles east of Breckenridge, Summit County.

Swan Lake Glaciation

Pleistocene (early Wisconsin): Central southern Alaska.

T. N. V. Karlstrom *in* T. L. Péwé and others, 1953, U.S. Geol. Survey Circ. 289, p. 4, 13 (table 1). At least four major Quaternary glaciations recognized in Upper Cook Inlet area. Succeeded Caribou Hills glaciation, preceded Naptowne glaciation (new). Represented by distinct moraine near Swan Lake and by discontinuous lateral moraines found along lower slopes of mountain fronts, generally 1,000 to 2,000 feet above sea level, and in major mountain valleys. Drift, in general, retains hummocky aspect, but kettle depressions partly or completely filled.

Represented near Swan Lake which is in northwest part of Kenai Mountains, Upper Cook Inlet area.

Swannanoa Formation

[Lower Cambrian]: Western Virginia.

W. A. Nelson, 1949, (abs.) Virginia Acad. Sci. Proc. 1948–1949, p. 139. Lower part of Unicoi up to top of a 300-foot acid lava flow is named Swannanoa formation and upper part of Unicoi is named East Waynesboro formation.

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° SE., and a thrust fault bordering it on its western edge.

**Swan Peak Formation**

Swan Peak Quartzite[1]

Middle Ordovician: Northeastern Utah and southeastern Idaho.

Original reference: G. B. Richardson, 1913, Am. Jour. Sci., 4th, v. 36, p. 407, 409.

J. S. Williams, 1948, Geol. Soc. America Bull., v. 59, no. 11, p. 1136–1137, pl. 1. In Logan quadrangle, Utah, formation consists of three persistent members: lower, black shale; middle brown quartzite; and upper buff quartzite. Thickness 399 feet. Conformable and intergrading with underlying Garden City; unconformable below Fish Haven dolomite. Ordovician (Champlainian).

R. J. Ross, Jr., 1949, Am. Jour. Sci., v. 247, no. 7, p. 479, 483, 484. Formation discussed in area of its type section where it overlies Garden City limestone and underlies Fish Haven dolomite. Thickness at type section 315 feet.

G. W. Webb, 1956, Utah Geol. and Mineralog. Survey Bull. 57, p. 11–12, 35, 37–38, 39–40, 42–43 (fig. 11), 44. In Millard County, Utah, includes Watson Ranch tongue (new). Thickness 129 to 711 feet. In Ibex area, underlies Crystal Peak dolomite (new); elsewhere underlies Eureka quartzite; overlies Lehman formation.

R. E. Cohenour, 1959, Utah Geol. and Mineralog. Survey Bull. 63, p. 12 (table 1), 75–78, pls. 1, 20. In Sheeprock Mountains, Utah, overlies Kanosh shale and underlies Fish Haven dolomite. Thickness 348 to 462 feet. Kanosh shale is approximate age equivalent of lower part of Swan Peak formation of Ross (1949) of northeastern Utah and of Orient shale member of Orient formation in West Tintic mining district. Proposed that names Orient formation and its subdivisions Orient shale and Orient quartzite be supplanted by Kanosh shale and Swan Peak quartzite.

Named for Swan Peak, Rich County, Utah.

†Swan Pond Granite[1]

Late Carboniferous or post-Carboniferous: Northeastern Massachusetts.

Original reference: J. H. Sears, 1905, Phys. geog., min., and pal. of Essex County, Massachusetts, p. 141.

Well developed on shore of Swan Pond.

**Swansea Quartz Monzonite**

Swansea Rhyolite[1]

Eocene, middle: Central northern Utah.

Original reference: G. W. Tower, Jr., and G. O. Smith, 1899, U.S. Geol. Survey 19th Ann. Rept., pt. 3, map.

H. T. Morris, 1957, Utah Geol. Soc. Guidebook 12, p. 34. Discussion of Swansea quartz monzonite stock in East Tintic district.

D. R. Cook, 1957, Utah Geol. Soc. Guidebook 12, p. 65 (fig. 6). As shown on correlation chart, Swansea quartz monzonite overlies Laguna latite series (new) and underlies Silver City monzonite (new). Middle or upper Eocene.

Exposed in Swansea and South Swansea mines, Tintic district.

†Swanton Conglomerate[1]

Lower Cambrian to Lower Ordovician: Northwestern Vermont.

Original reference: A. Keith, 1923, Am. Jour, Sci., 5th, v. 5, p. 118–126.

Charles Schuchert, 1937, Geol. Soc. America Bull., v. 48, no. 7, p. 1045. Beds called Swanton by Keith (1923) and later renamed Corliss breccia are herein renamed Rockledge limestone breccia.

Named for exposures in eastern part of Swanton Township, Franklin County.

†Swanton Slate[1]

Lower Cambrian: Northwestern Vermont.

Original reference: J. B. Perry, 1868, Boston Soc. Nat. History Proc., v. 11, p. 347.

Occurs at Highgate Springs, Franklin County.

Swanville Formation (in Hamilton Group)

Middle Devonian: Southeastern Indiana.

Guy Campbell, 1942, Geol. Soc. America Bull., v. 53, no. 7, p. 1057, 1063–1064, 1067. A gray crystalline limestone overlies Silver Creek formation and underlies New Albany shale throughout area of Hamilton outcrop. Heretofore, it has been regarded as a continuous bed of the Beechwood, but it represents two distinct formations—the Beechwood and the Swanville. The Swanville, a thick-bedded hard bluish to gray crystalline limestone, is difficult to distinguish from Beechwood on lithology alone but the two have not been found in the same section at any place. Maximum thickness 6 feet; at type section 5 feet.

J. B. Patton and T. A. Dawson *in* H. H. Murray, 1955, Indiana Geol. Survey Field Conf. Guidebook 8, p. 42, pl. 1. Swanville and Deputy "formations" appear to be only faunal facies of units previously recognized and named, or combinations of such units; they might better be called "zones" or "faunal facies" of Sellersburg (North Vernon) limestone.

Type section: Scott-Jefferson County line on Highway 256, about 1 mile west of Swanville. Occurs in continuous bed from near Commiskey, Jennings County, to southeast corner of Scott County.

**Swarbrick Formation**[1]

Cambrian: South-central Nevada.

Original reference: H. G. Ferguson, 1933, Nevada Univ. Bull. 27, no. 3, p. 13–25.

W. H. Easton, chm., 1953, Am. Assoc. Petroleum Geologists Bull., v. 37, no. 1, p. 148. Listed among names not used in revision of stratigraphic units in Great Basin.

Forms hanging wall of ore-bearing fissure in Swarbrick prospect, in eastern part of Tybo district.

**Swarthmore Granodiorite**

Late Paleozoic: Southeastern Pennsylvania.

A. W. Postel and H. W. Jaffe, 1957, Pennsylvania Acad. Sci. Proc., v. 31, p. 120–123. Introduced to replace preempted name Springfield granodiorite. Study indicates that lead-alpha ages of ziron of Wissahickon schist are older than those of Swarthmore granodiorite and related rocks and that all of the ages are younger than Precambrian.

Type locality not stated. Postel (1941) reported exposures of Springfield granodiorite in vicinity of Swarthmore, Delaware County.

Swartz Rhyolite

Tertiary: Southwestern New Mexico.

W. E. Elston, 1957, New Mexico Bur. Mines Mineral Resources Bull. 38, p. 17 (table 1), 36, pl. 1. Porphyritic rhyolite flows, tuffs, and flow breccias associated with one or more domelike porphyritic rhyolite intrusive bodies and small dikes. The rhyolite consists of alternating brown and gray bands, about 3 mm wide. Flow folds common. Angular unconformities separate it from Bear Springs basalt below and Santa Fe fanglomerates above.

Named after small abandoned settlement near junction of Tom Brown Canyon and Mimbres River. A local formation found only in secs. 26, 27, 34, and 36, T. 18 S., R. 10 W., Dwyer quadrangle.

**Swasey Formation**[1]

Middle Cambrian: western Utah and southeastern Nevada.

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. 1133–1134, 1141, 1145–1146. Because Walcott's section of Swasey was not part of a continuous section and original definition was not sufficiently precise, Swasey is herein redefined and type section assigned. As emended, formation consists of a lower unit 117 feet thick and an upper unit 278 feet thick. Lower unit consists of 38 feet of interbedded dull-gray fine-grained platy argillaceous limestone and clay shale with well-preserved cranidia and pygidia of *Ehmania;* 50 feet of dull- and dark-gray platy and a few arenaceous limestones with several beds of *Ehmania*-coquina at top; and 29-foot zone of green micaceous chunky and fissile shale and interbedded gray thin-bedded limestones which increase in amount upward. Upper 278 feet consist of dark- and black-gray medium-grained massive and irregular-bedded limestone which contains oolites in the lower, and small algae (*Girvinella?*) in upper part. Overlies Dome limestone (emended); underlies Wheeler shale (emended).

H. E. Wheeler, 1948, Nevada Univ. Bull., Geology and Mining Ser., no. 47, p. 39–40, fig. 5. Geographically extended into Nevada, where it is same as units F–G of Highland Peak limestone as described by Wheeler and Lemmon (1939). Overlies Dome limestone also extended into Nevada. Lower 117 feet of type Swasey as described by Deiss is herein named Condor member.

R. E. Cohenour, 1959, Utah Geol. and Mineralog. Survey Bull. 63, p. 12 (table 1), 35, 47, 139–140, 145–146, 150, pl. 1. In Sheeprock Mountains, stratigraphically restricted at base to exclude Condor member herein raised to formational status. Thickness 169 feet.

R. A. Robison, 1960, Intermountain Assoc. Petroleum Geologists Guidebook 11th Ann. Field Conf., p. 43–52. Name Swasey herein restricted to cliff-forming limestone unit that overlies Whirlwind formation (new) and that underlies Wheeler shale. Term Condor member of Swasey considered invalid.

Type section: Marjum Canyon, House Range, Millard County, Utah. Here formation forms part of the continuous emended Cambrian section.

†Swatara Iron Sandstone (in Clinton Formation)[1]

Silurian (Niagaran): Southeastern Pennsylvania.

Original reference: C. K. Swartz and F. M. Swartz, 1931, Geol. Soc. America Bull., v. 42, p. 637, 638.

Occurs on Swatara Creek, Swatara Gap, 11 miles northwest of Lebanon, Lebanon County.

**Swauger Quartzite**

Precambrian (Belt Series): Southern central Idaho.

C. P. Ross, 1947, Geol. Soc. America Bull., v. 58, no. 12, pt. 1, p. 1096, 1097–1099, pl. 1. Mostly rather pure quartzite that varies from purple through deep-brownish-lavender and pinkish shades to almost pure white. Near base and locally at higher horizons are beds of green relatively impure quartzite. Most quartzite is distinctly bedded and some is cross-bedded. A few lenses of conglomerate and rusty impure dolomite are included. Variegated argillite is present at several horizons but is most conspicuous in lower part of formation. Beds of different colors and lithologies interfinger with each other. Unit has not been satisfactorily measured, but in vicinity of Flatiron Mountain the exposed thickness appears to be at least 1 mile. Underlies Kinnikinic quartzite and overlies Lemhi quartzite (new) with gradational contact.

A. L. Anderson, 1959, Idaho Bur. Mines and Geology Pamp. 118, p. 18–21. Thickness about 10,000 feet in Lemhi quadrangle. Overlies Lemhi quartzite.

Occupies most of southern and eastern parts of the small part of Lemhi Range included in Borah Peak quadrangle. Named after Swauger Ranch whose grazing lands include much of area in which it crops out within quadrangle.

**Swauk Formation**[1]

Eocene: Central and central northern Washington.

Original reference: I. C. Russell, 1900, U.S. Geol. Survey 20th Ann. Rept., pt. 2, p. 100–137.

R. L. Lupher, 1944, Washington Div. Geology Rept. Inv. 11, p. 7, 12–15, pl. 2. Overlies Cle Elum formation (new).

H. A. Coombs, 1950, Am. Jour. Sci., v. 248, no. 6, p. 369–377. Discussion of granitization in the Swauk. Structurally formation rests unconformably on Swakane gneiss which has been considered pre-Ordovician. Presumably in late Eocene time, beds were folded into series of anticlines and synclines whose axes trend grenerally in northwest-southeast direction.

R. S. Yeats, 1958, Dissert, Abs., v. 19, no. 4, p. 775. In Skykomish area, Temple Mountain andesite (new) overlies Swauk with angular unconformity. Paleobotanical evidence suggests Paleocene age for Swauk, though part may be Upper Cretaceous.

R. J. Foster, 1960, Geol. Soc. America Bull., v. 71, no. 2, p. 101 (table 1), 103–105, pl. 1. Predominantly arkose with some shale and minor conglomerate; rock types distributed irregularly; beds range from a few inches to more than 100 feet thick and grain size changes abruptly both laterally and vertically; most of formation massive, but crossbedding not uncommon. Thickness at least 4,000 feet, may be more. Unconformably underlies Teanaway basalt in most of area; locally, between Kachess and Cle Elum Lakes, unconformably covers pre-Tertiary peridotite and Easton schist. Where Swauk unconformably overlies peridotite, lateritic iron ores have been formed. Most authors have considered these laterites basal Swauk, but Lupher (1944) proposed name Cle Elum for these deposits. Age of Swauk has been much debated. When Knowlton (*in* G. O. Smith, 1904, U.S. Geol. Survey Geol. Atlas, Folio 106) identified fossil leaves as Eocene, term Paleocene had not come into use. It seems clear from Knowlton's reference to what are now considered Cretaceous and Paleocene formations that he regarded the Swauk as being near Cretaceous-Teritary boundary, not Eocene as we use it today. Paleocene or Late Cretaceous age based on paleobotany is in accord with stratigraphic relationship. The Swauk unconformably overlies metamorphic basement of unknown age. Unconformably above Swauk is Teanaway basalt, and concordantly above Teanaway is Roslyn arkose that contains middle or upper Eocene fossils. Area of this report is northern part of Mount Stuart and Snoqualmie folios, central Cascade Mountains.

Named for Swauk Creek and Swauk mining district, about 15 miles north of Ellensburg, Kittitas County.

**Swearinger Slate**[1]

Upper Triassic: Northern California.

Original reference: J. S. Diller, 1892, Geol. Soc. America Bull., v. 3, p. 370–394.

C. W. Averill, 1937, California Jour. Mines and Geology, v. 33, no. 2, p. 85, 86. Composed chiefly of dark slaty shale, with thin beds of limestone and chert forming small proportion of whole mass. Thickness 200 to 400 feet. Overlies Hosselkus limestone; underlies Trail formation.

Named for fact it occurs near Swearinger's house, on north side of Genesee Valley, Plumas County.

Swede Pond Quartzite[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 Faxon limestone and below Catamount schist.

Type locality: Swede Pond, Hague Township, Warren County.

**Sweetland Creek Shale**[1]

Upper Devonian or Mississippian: Southeastern Iowa and western Illinois.

Original reference: J. A. Udden, 1899, Jour. Geology, v. 7, p. 65–78.

Walter Youngquist and A. K. Miller, 1948, Jour. Paleontology, v. 22, no. 4, p. 440–450. Recent conodont studies in vicinity of type section confirms evidence that Sweetland Creek is referable to Upper Devonian and is approximately contemporaneous with Grassy Creek shale of Missouri. Formation is only of local occurrence in Iowa.

L. E. Workman and Tracey [Tracy] Gillette, 1956, Illinois Geol. Survey Rept. Inv. 189, p. 39. Sweetland Creek beds at their type locality represent only a relatively small part of the almost 200 feet of similar beds called Grassy Creek in northwestern Illinois. Therefore name Sweetland Creek is discarded in Illinois.

Named for exposures on Sweetland Creek, about 4 miles from Muscatine, Muscatine County, Iowa.

Sweetwater Dolomite[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.

Named for outcrops in Sweetwater, Nolan County.

Sweetwater Group[1]

Oligocene: Central Wyoming.

Original reference: F. V. Hayden, 1871, U.S. Geol. Survey Terr., 4th Ann. Rept., p. 29.

Occurs along Sweetwater River and continues north to hills opposite Seminoe Pass in Sweetwater Valley.

Sweetwater Member[1] (of White River Group)

Oligocene: Western Wyoming.

Original reference: C. M. Bauer, 1934, Geol. Soc. America Bull., v. 45, p. 665–695.

Occurs along Sweetwater escarpment from Lander-Rawlins Road as far east as Alcova, Natrona County, a distance of 80 miles.

Sweitzer Formation

Pliocene or Pleistocene: Southern California.

L. G. Hertlein, 1929, Stanford Univ. Abs. Dissert., v. 4, p. 82. A conglomerate 1 to 3 meters thick. Usually unconformably overlies beds of known Pliocene age.

L. G. Hertlein and U.S. Grant, 4th, 1939, California Jour. Mines and Geology, v. 35, no. 1, p. 63 (fig. 4), 71. Described as brown and brownish-red conglomerate or pebbly sandstone 5 to 30 feet thick. Unconformably overlies San Diego formation and caps most of the tops of mesas in area. Columnar section shows Sweitzer formation underlying Bay Point formation (new).

Type locality: Sweitzer Canyon in Balboa Park, San Diego County.

Swenson Gypsum Member[1] (of Peacock Formation)

Permian: Central northern Texas.

Original reference: L. T. Patton, 1930, Texas Univ. Bull. 3027, p. 45.

L. T. Patton, 1938, Am. Assoc. Petroleum Geologists Bull., v. 22, no. 7, p. 927. Swenson gypsum is same as Wagon Yard gypsum. Name Swenson gypsum member was proposed by writer [Patton] when his manuscript was submitted in 1927. Name Wagon Yard was not proposed until 1929. The writer [Patton] retained the name originally proposed when his manuscript was revised in 1930.

Named for exposures near town of Swenson, Stonewall County. Forms prominent escarpment extending from southern border of county to near Swenson, where escarpment dies down and gypsum bed disappears.

Swett Tuff Member (of Quichapa Formation)

Oligocene: Eastern Nevada and southwestern Utah.

J. H. Mackin, 1960, Am. Jour. Sci., v. 258, no. 2, p. 90 (table 1), 92 (fig. 2), 94. At type locality, underlies Bauers tuff member and overlies Leach Canyon tuff member (both new); elsewhere lava flows or other volcanic rocks, local in extent and origin, present at contacts. Thickness 30 to 45 feet in Swett Hills. An ignimbrite similar to Bauers tuff. Zircon age of Leach Canyon tuff member is 28 million years; this suggests that Quichapa formation is Oligocene. Report is 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: West-facing scarp of Swett Hills, Desert Mound quadrangle, Iron Springs district, Utah.

**Swift Formation** (in Ellis Group)

Swift Formation (in Sundance Group)

Upper Jurassic: North-central Montana, western South Dakota, and eastern Wyoming.

W. A. Cobban, 1945, Am. Assoc. Petroleum Geologists Bull., v. 29, no. 9, p. 1264 (fig. 1), 1281–1286, 1288 (fig. 5), 1289 (fig. 6), strat. sections. At type locality, consists of two members; lower is dark-gray noncalcareous shale 54½ feet thick; upper member is flaggy ripple-marked sandstone 80 feet thick containing abundant black-gray fissile shale partings. Lithologic character of type locality persists along mountain front from south boundary of Glacier National Park southeast almost to Sun River. From Sun River southeast along mountain front, formation becomes increasingly sandy. On South arch, formation consists of fine-grained flaggy sandstone which is locally pebbly at base. In vicinity of Little Belt Mountains, formation is massive fine-grained sandstone containing prominent basal conglomerate. Thicknesses: 135 feet at type locality; 106 feet, Rierdon Gulch; 118 feet, Sun River section, Lewis and Clark County; 101 feet, southwest of Craig. At type section, underlies Morrison formation; overlies Rierdon formation (new); in areas where Rierdon is absent, unconformably overlies Sawtooth formation (new).

J. A. Peterson, 1954, Am. Assoc. Petroleum Geologists Bull., v. 38, no. 4, p. 466 (table 2), 480, 481, 482, 483, 491–504, 505. Swift-Rierdon nomenclature of Ellis group in Montana is applied in eastern Wyoming and western South Dakota to formational units of Sundance group. Indications are that the names are applicable to marine Upper Jurassic throughout most of Wyoming and western South Dakota, but term Sundance should be retained because of historical significance. Thicknesses in outcrop sections of Swift vary from 63 feet in Laramie County to 289 feet in Johnson County. Overlies Rierdon formation; underlies Morrison formation.

T. P. Storey, 1958, Alberta Soc. Petroleum Geologists Jour., v. 6, no. 4, p. 90–104. Discussion of Jurassic of Williston basin and adjacent areas. On basis of regional extent and significance of sub-Swift and sub-Rierdon unconformities, a different stratigraphic interpretation is presented. Swift is divided into Lower, Middle, and Upper units. Lower Swift is so designated because it is considered to be lithologically similar to and regionally conformable with the Middle and Upper Swift which correspond to type Swift formation of western Montana. Lower Swift of Williston basin and equivalent Stockade Beaver and Hulett members of Lower Sundance in Black Hills, are considered to lie unconformably on the Rierdon and therefore are younger than the Rierdon and older than the Swift as designated by Cobban. This correlation is offered in lieu of general belief that Lower Sundance and Rierdon are equivalent in age. Thus, Lak and Redwater members of Sundance are considered equivalent to type Swift formation.

Type locality: Vicinity of Swift Reservoir, T. 28 N., R. 10 W., Pondera County, Mont. Section measured on north shore in NE¼ sec. 27.

**Swift Run Formation**

Swift Run Tuff

Precambrian: Northern Virginia, and Maryland.

G. W. Stose and A. J. Stose, 1944, Am. Jour. Sci., v. 242, no. 8, p. 410. A series of tuffaceous and arkosic sediments that underlie Catoctin basalt and overlie injection complex on west limb of Catoctin Mountain-Blue Ridge anticlinorium.

A. J. Stose and G. W. Stose, 1946, Maryland Dept. Geology, Mines and Water Resources [Rept. 12] Carroll and Frederick Counties, p. 18–20. Geographically extended into Maryland where it underlies Catoctin metabasalt and lies directly on injection complex. Beds comprise blue and green blebby tuff, sericite schist, and a sericitic quartzite with glassy and blue quartz grains; also includes some marble just above the basal quartzose beds. Parts of unit here described as Swift Run had formerly been mapped as part of Loudoun formation by early workers. Derivation of name given.

G. W. Stose and A. J. Stose, 1949, Geol. Soc. America Bull., v. 60, no. 2, p. 311. In central Virginia, Oronoco formation (Bloomer and Bloomer, 1947) is equivalent to Swift Run tuff which had previously been mapped as far south as this part of Virginia.

P. B. King, 1950, U.S. Geol. Survey Prof. Paper 230, p. 9–12, pl. 1. In Elkton, Va., area, termed Swift Run formation because unit is varied in character and tuffaceous element is subordinate. Underlies Catoctin greenstone, probably conformable. Crops out in narrow belt around inliers of injection complex.

R. O. Bloomer and H. J. Werner, 1955, Geol. Soc. America Bull., v. 66, no. 5, p. 487–589, pl. 1. Formation in Blue Ridge area, central Virginia, consists mainly of graywackes, subgraywackes, and volcanics 0 to 400 feet thick. Beds are from a fraction of an inch to about 20 feet thick. Where formation overlies Pedlar migmatite, lower part is conglomerate graywacke with clasts composed of quartz, potash feldspar, and granite in an equigranular matrix that unconformably overlies basement complex and conformably underlies Catoctin greenstone; overlaps basement complex from east to west. Separated from unaltered basement rock by a saprolite 10 to 100 feet thick.

H. E. Vokes, 1957, Maryland Dept. Geology, Mines and Water Resources Bull. 19, p. 43, 72. Referred to as tuff member of Catoctin metavolcanics.

Named from exposures on U.S. Highway 33 just east of Swift Run Gap, Va., and on Skyline Drive just north of the gap.

**Swift Water Formation**[1]

Probably Cambrian: Northwestern New Hampshire.

Original reference: C. H. Hitchcock, 1874, Am. Jour. Sci., 3d, v. 7, p. 468–476.

In region from Swiftwater and Woodville on south to north of Littleton, Grafton County.

Swisshelm Formation

Upper Devonian: Southeastern Arizona.

R. C. Epis, C. M. Gilbert, and R. L. Langenheim, Jr., 1957, Am. Assoc. Petroleum Geologists Bull., v. 41, no. 10, p. 2243–2256. In general, upper third of formation is largely impure limestone, whereas quartz sandstone, siltstone, and marl predominate in lower two thirds. Mostly thin bedded and nonresistant. Wherever well exposed, sandy and marly strata are shades of brown and yellow. Thickness 400 to 600 feet. underlies Escabrosa limestone; overlies El Paso limestone.

In Swisshelm and Pedregosa Mountains, southeastern Cochise County.

Swissvale Gypsum Member (of Minturn Formation)

Pennsylvanian (Desmoinesian): South-central Colorado.

K. G. Brill, Jr., 1952, Geol. Soc. America Bull., v. 63, no. 8, p. 821, 833, pl. 1. A bed of gypsum which lies about 2,000 feet above base of formation in Arkansas River section west of Canyon City. Gypsum cannot be traced continuously through the area. It may rise in section toward southeast or may have been injected between different beds in different parts of area.

Named from exposures about a quarter mile northeast of Swissvale switch (Denver and Rio Grande Western Railroad), Fremont County. Crops out sporadically from vicinity of Meeker southward to Coaldale.

**Switchback Shale**

Switchback Limestone[1]

Middle and Upper Cambrian: Northwestern Montana.

Original reference: C. F. Deiss, 1933, Montana Bur. Mines and Geology Mem. 6, p. 5, 39.

Charles Deiss, 1938, Geol. Soc. America Bull., v. 49, no. 7, p. 1078, 1084, 1089, 1090 (fig. 2); 1939, Geol. Soc. America Spec. Paper 18, p. 6, 8–9, 16, 29, 32, 46, 54 (fig. 6). Referred to as Switchback shale; overlies Steamboat limestone (as used here replaces Gordon Mountain limestone of 1933 sequence); underlies Devils Glen dolomite. Thickness at type locality 253 feet; average thickness 111 feet. Middle Cambrian.

Charles Deiss, 1943, Geol. Soc. America Bull., v. 54, no. 8, p. 1131 (table 1), 1133. Described in Sawtooth Range where it is 125 to 175 feet thick; underlies Devils Glen dolomite; overlies Steamboat limestone. Middle and Upper Cambrian.

Type locality: On ridge east of Kid Mountain and west of cirque on southwest side of Gordon Mountain, in SW¼ sec. 9, T. 19 N., R. 13 W., northern Lewis and Clark Range. Named from Switchback Pass approximately 2 miles southeast of Pentagon Mountain.

**Swope Limestone[1] or Formation[1]** (in Kansas City Group)

Swope Limestone (in Bronson Group)

Pennsylvanian (Missouri Series): Northwestern Missouri, southwestern Iowa, eastern Kansas, and southeastern Nebraska.

Original reference: C. O. Dunbar and G. E. Condra, 1932, Nebraska Geol. Survey Bull. 5, 2d ser., p. 17, table C.

J. R. Clair, 1943, Missouri Geol. Survey and Water Resources, 2d ser., v. 27, pl. 1. Swope limestone included in Kansas City group (redefined). Underlies Galesburg shale; overlies Ladore shale.

R. C. Moore, J. C. Frye, and J. M. Jewett, 1944, Kansas Geol. Survey Bull. 52, pt. 4, p. 192–193. Swope limestone in Bronson group includes (ascending) Middle Creek limestone, Hushpuckney shale, and Bethany Falls limestone members. Average thickness 23 feet. Overlies Ladore shale; underlies Galesburg shale. Missouri series.

R. C. Moore, 1948, Am. Assoc. Petroleum Geologists Bull., v. 32, no. 11, p. 2028–2029, 2031 (fig. 4). Included in Kansas City group (redefined in Kansas and Nebraska). Comprises (ascending) Middle Creek limestone, Hushpuckney shale, and Bethany Falls limestone members. Overlies Ladore formation; underlies Galesburg formation. Bronson reduced to subgroup of Kansas City group (redefined). This is classification agreed upon by 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. Included in Kansas City group. Thickness about 27 feet. Comprises (ascending) Middle Creek limestone, Hushpuckney shale, and Bethany Falls limestone members. Overlies Ladore shale; underlies Galesburg shale.

Named for Swope Park, Kansas City, Mo.

Sybille Tongue (of Phosphoria Formation)[1]

Permian: Central southern Wyoming.

Original reference: H. D. Thomas, 1934, Am. Assoc. Petroleum Geologists Bull., v. 18, no. 12, p. 1664.

H. D. Thomas, 1940, Kansas Geol. Soc. Guidebook 14th Ann. Field Conf., p. 124. Suggests that name be abandoned in favor of Minnekahta.

Type locality: Around Sybille anticline near Sybille Springs in Laramie Basin.

Sycamore Conglomerate

Miocene and Pliocene: Southern California.

G. J. Bellemin, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 4, p. 652 (fig. 1), 656. Named as one of five conglomerates interbedded in Miocene and Pliocene shales of Puente Hills, Los Angeles County.

Named for its occurrence in Sycamore Canyon.

**Sycamore Limestone**[1]

Mississippian: Central southern Oklahoma.

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

J. D. Prestridge, 1959, *in* Petroleum Geology of southern Oklahoma, v. 2: Tulsa, Am. Assoc. Petroleum Geologists, p. 156–164. In Ardmore basin, formation occupies stratigraphic interval between Caney (Meramecian) and Woodford (upper part-Kinderhookian) formations. Divisible into two members, herein named Cornell Ranch (lower) and Worthey (upper). Comprises up to 350 feet of slate-blue tough silty to finely sandy limestone with calcareous shales ranging from very thin partings to lentils up to 30 feet thick. Lower part contains cherty limestones and calcareous shales, with a green shale at base. Near base is bed of limestone, typically glauconitic at base, becoming cherty in upper part.

M. K. Elias and C. C. Branson, 1959, Oklahoma Geol. Survey Circ. 52, p. 22, 23. Sycamore sandstone exposed below Caney type section is unlike Sycamore of its type area and may be facies grading into Ahloso member of Caney.

Named for Sycamore Creek, Johnston County, which crosses its outcrop in T. 3 S., R. 4 E.

Sycamore Member (of Travis Peak Formation)

Sycamore Sand

Sycamore Sand (in Travis Peak Formation)[1]

Lower Cretaceous (Comanche Series): Central Texas.

Original reference: R. T. Hill, 1901, U.S. Geol. Survey 21st Ann. Rept., pt. 7, p. 141, 142.

R. H. Cuyler, 1939, Am. Assoc. Petroleum Geologists Bull., v. 23, no. 5, p. 631–632. Member consists primarily of sands and conglomerates. Thickness 30 to 90 feet. Underlies Cow Creek member. Hill's Sycamore has priority over Taff's Sycamore limestone in Mississippian of Oklahoma.

V. E. Barnes, 1948, Texas Univ. Bur. Econ. Geology Rept. Inv. 2, p. 5, 6–7 (fig. 1), 8. Marble Falls limestone and Smithwick shale are truncated, and deposited across them is massive conglomerate of Cretaceous age belonging to Sycamore sand member of Travis Peak formation.

F. E. Lozo and F. L. Stricklin, Jr., 1956, Gulf Coast Assoc. Geol. Soc. Trans., v. 6, p. 69, figs. Referred to as Sycamore sand. Cartographic rock unit ordinarily mapped with the Sycamore but originally included in Hill's definition of Cow Creek beds is distinct unit between Sycamore sands below and Cow Creek limestone above. It is here named Hammet shale.

Named for exposures on Sycamore Creek, Burnet County.

**Sycamore Canyon Member** (of Puente Formation)

Sycamore Canyon Formation

Miocene, upper: Southern California.

M. L. Krueger, 1936, (abs.) Am. Assoc. Petroleum Geologists Bull., v. 20, no. 11, p. 1520. Name Sycamore Canyon formation applied to a 3,800-foot interval of alternating conglomerates, sands, silts, and shales in Whittier Hills. Underlies Repetto formation; unconformably overlies upper Puente member of Puente formation.

S. N. Daviess and A. O. Woodford, 1949, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 83. Described in Whittier area. Rank reduced to member of Puente formation. Lower beds of conglomerate lens out within map area and in places interfinger with beds of underlying siltstone.

C. J. Kundert, 1952, California Div. Mines Spec. Rept. 18, p. 6–7. In Whittier-La Habra area member subdivided into Central Fee sandstone below and Hoover conglomerate above.

J. E. Schoellhamer and others, 1954, U.S. Geol. Survey Oil and Gas Inv. Map OM–154. Use of name extended to include the massive- to well-bedded feldspathic sandstones, gray to brown siltstone, and local conglomerates that crop out in southeastern end of Puente Hills, between Chino and Santa Ana River, and on Burruel Ridge south of Santa Ana River. On Burruel Ridge, the Sycamore Canyon is unconformably overlain by Repetto(?) and gradationally overlies Yorba member (new) of Puente.

Whittier Hills area is in Los Angeles County.

Sycamore Creek Sandstone[1]

Upper Devonian: Northeastern and central Arizona.

Original reference: C. Lausen and E. D. Wilson, 1925, Arizona Univ. Bur. Mines Bull. 120, p. 7, 12–13.

C. R. Keyes, 1942, Pan-Am. Geologist, v. 77, no. 3, p. 228. Sycamore sandstone designated the middle part of the Jeromian series (new). Underlies East Verde limestone (new); overlies Vecol limestone (new). Thickness 75 feet.

Best exposed at Sycamore Creek, a tributary of East Verde River, Coconino and Yavapai Counties.

Sykes Mountain Formation

Lower Cretaceous: Northwestern Wyoming.

Ralph Moberly, Jr., 1960, Geol. Soc. America Bull., v. 71, no. 8, p. 1139 (fig. 1), 1143 (fig. 2), 1149–1150, 1151 (fig. 5), pl. 1. Composed of thinly interbedded siltstones, sandstones, and shales, commonly containing some thicker blanket-shaped sandstone, especially near base, and thin beds of ironstones, all of which show some marine and some nonmarine features and weather yellowish brown. Lies with sharp contact on Himes member (new) of Cloverly formation; grades upward and interfingers with marine black bentonitic clayshale of Thermopolis shale. Thickness ranges from 100 to about 300 feet; at type section 136 feet. At type section, formation displays its characteristic increase in proportion of black shale in its upper part; upper contact is placed above uppermost sandstones, siltstones, and ironstones. Formation includes the "rusty beds", Dakota silt, Dakota sandstones, and Greybull member of Cloverly formation, of various authors. Because no existing name is adequate, new name is proposed. Formations in this report—Morrison, Cloverly, and Sykes Mountain—are defined on lithogenitic basis.

Type section: Northwest of Sykes Mountain between Crooked Creek and Gypsum Creek about 1 mile south of Montana State line in NE¼ sec. 25 T. 58 N., R. 96 W., Big Horn County, Wyo.

**Sykesville Formation**

Sykesville Granite[1]

Paleozoic: Central northern Maryland.

Original reference: A. I. Jonas, 1928, Maryland Geol. Survey Carroll County map.

A. J. Stose and G. W. Stose, 1944, U.S. Geol. Survey Prof. Paper 204, p. 53–54. Intrudes Peters Creek quartzite and an amphibolite schist in a belt that parallels the Peach Bottom syncline from Hartford County, Md., to Potomac River. In part of the area, the Sykesville has a steep-axis structure and a series of prominent joints at right angles to the linear direction of the fold axis. The Sykesville was intruded before development of the steep-axis structure and has shared the regional deformation with the adjoining schists of the Glenarm series, which is tentatively assigned to Precambrian.

H. E. Vokes, 1957, Maryland Dept. Geology, Mines and Water Resources Bull. 19, p. 42 (table 7), 63. At least three periods of granite formation are recognized in the Maryland rocks. The oldest granites are the probable migmatites associated with the Baltimore gneiss. Those of second period cut the Glenarm series. Representatives of the third period are Woodstock, Ellicott City, and Sykesville. The Sykesville is not a homogeneous rock; parts of it are a product of migmatization of the country rock and other parts show little deformation. It may include rocks of both the second and third periods of the formation of granitic rocks, and the migmatized and gneissic areas may represent the older period. Age shown on table as Devonian.

U.S. Geological Survey currently designates the age of the Sykesville Formation as Paleozoic on the basis of a study now in progress.

First described in Carroll County. Probably named from occurrence near Sykesville.

**Sylacauga Marble Member** (of Talladega Slate)[1]

Precambrian or Paleozoic: Eastern Alabama.

Original reference: C. Butts, 1926, Alabama Geol. Survey Spec. Rept. 14, p. 51, map.

Named for exposures and quarries around Sylacauga, Talladega County.

**Sylamore Sandstone Member** (of Chattanooga Shale)[1]

Sylamore Formation (in Champ Clark Group)

Upper Devonian: Northern Arkansas, Illinois, southwestern Missouri, and eastern Oklahoma.

Original reference: R. A. F. Penrose, Jr., 1891, Arkansas Geol. Survey Ann. Rept. 1890, v. 1, p. 113, 114.

J. G. Grohskopf, E. L. Clark, and S. P. Ellison, 1943, Missouri Geol. Survey and Water Resources 62d Bienn. Rept., App. 4, p. 7–8. Sylamore formation as used in this report is applied to sandstone that underlies Chattanooga shale or Compton formation and rests on Cotter dolomite or Fortune formation (new). Mississippian (Kinderhook).

L. E. Workman and Tracey [Tracy] Gillette, 1956, Illinois Geol. Survey Rept. Inv. 185, p. 14. Sylamore formation included in Champ Clark group (new). Rarely more than 5 feet thick and commonly not more than a few inches thick. Underlies Grassy Creek formation. At base of Kinderhook series. Correlated with Sylamore sandstone of Arkansas, Misener sandstone of Oklahoma, and Hardin sandstone of Tennessee. Name Sylamore has been used for the sandstone in Missouri and western Illinois and is accepted for use throughout Illinois. It has priority over Hardin and Misener.

G. G. Huffman and others, 1958, Oklahoma Geol. Survey Bull. 77, p. 38–39. Member described on south and west flanks of Ozark uplift. White, phosphatic sandstone with salt and pepper appearance on fresh surface. Basal part consists of dark-gray sandy shale and bluish-gray phosphatic limy sandstone. Maximum thickness 18 feet; thins northward and is absent in most of area. Unconformably overlies St. Clair, Frisco, and Sallisaw formations in southern part of area; northward unconformably overlies Tyner formation near Murphy and the Burgen and Cotter along Spavinaw Creek. Succeeded conformably by black shale member of formation. Age debatable; final determination awaits precise dating of overlying black shale.

G. G. Huffman and J. M. Starke, 1960, Oklahoma Geology Notes, v. 20, no. 7, p. 159–160. Chattanooga shale divided into Sylamore sandstone member below and Noel shale member above. On basis of conodonts, Noel shale appears to be Late Devonian and Early Mississippian. Distribution noted.

M. G. Mehl, 1960, Denison Univ. Jour. Sci. Lab., v. 45, art. 5, p. 66–69. Discussion of use of term Sylamore. Examination of strata involved at or near type locality does not give satisfactory answer concerning either its [Sylamore] age or relationships. There is no way of determining to which of the several sands in the section either Branner or Penrose (1891) wished to apply name Sylamore. At present there is no uniformity in the interpretation of term Sylamore. One solution lies in redefinition of term, but it seems unlikely there would be general acceptance of such a definition. It is here recommended that Sylamore be omitted from stratigraphic names in Missouri.

Named for exposures on Sylamore Creek, Stone County, Ark.

**Sylvan Shale**[1]

Sylvan Shale (in Patterson Ranch Group)

Upper Ordovician: Southwestern, central southern, central eastern, and northeastern 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. 133. Unconformably underlies Hawkins limestone member (new) of Chimneyhill limestone

C. E. Decker, 1942, Oklahoma Acad. Sci. Proc., v. 22, p. 153, 154 (table 1). Uppermost formation in Patterson Ranch group (new).

H. D. Miser and others, 1954, Geologic map of Oklahoma (1:500,000): U.S. Geol. Survey. Mapped in southwestern, central southern, central eastern, and northeastern Oklahoma.

T. W. Amsden, 1957, Oklahoma Geol. Survey Circ. 44, p. 6 (fig. 3), fig. 4 (facing p. 8). Underlies Ideal Quarry member (new) of Chimneyhill formation.

G. G. Huffman and others, 1958, Oklahoma Geol. Survey Bull. 77, p. 27–29, measured sections, pls. Described on north and west flanks of Ozark uplift, northeastern Oklahoma. Ranges from dark green and fissile to brown silty shale with concretionary weathering. Locally, thin stringers of brown dolomitic sandstone present in lower parts. Thickness 12 to 36 feet. Conformably overlies Fernvale limestone. Near Qualls and on Blackgum Mountain, succeeded unconformably by St. Clair limestone of Silurian age; northward in Nigger Hollow and in Horseshoe Bend section, overlain unconformably by Chattanooga black shale of late Devonian and early Mississippian age. Upper Ordovician, Cincinnatian.

Named for exposures near former village of Sylvan, Johnston County.

**Sylvania Sandstone**[1] or **Formation**

**Sylvania Sandstone Member** (of Amherstburg Formation)

Sylvania Sandstone (in Detroit River Group)

Middle Devonian: Northwestern Ohio and southeastern Michigan, and Ontario, Canada.

Original reference: E. Orton, 1888, Ohio Geol. Survey, v. 6, p. 4, 18.

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

K. K. Landes, 1945, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 28. Sylvania formation crops out in Monroe County, Mich., and across Ohio line in vicinity of Sylvania. Underlies Detroit River formation; overlies Bois Blanc formation. Middle Devonian.

G. M. Ehlers, 1950, (abs.) Geol. Soc. America Bull., v. 61, no. 12, pt. 2, p. 1455–1456. Sylvania sandstone, oldest unit of Detroit River group, is succeeded by Amherstburg dolomite.

K. K. Landes, 1951, U.S. Geol. Survey Circ. 133, p. 1, 2 (fig. 2). In subsurface, Sylvania sandstone is considered member of Amherstburg formation. Thickness as much as 300 feet.

J. E. Carman, 1960, Fieldiana: Geology, v. 14, no. 1, p. 1–5. In northern Ohio, overlies Holland Quarry shale (new).

Named for Sylvania, Lucas County, Ohio.

†Symonds Formation

Lower Cretaceous(?): Southeastern Alaska.

Fred Barker, 1957, U.S. Geol. Survey Geol. Quad. Map GQ–100. Fine- to coarse-grained carbonaceous plagioclase-quartz-sericite-chlorite graywacke, much of which is laminated in layers one-quarter inch to several inches thick, forms bulk of formation. Very fine grained black graywacke and black slate next in abundance. Augite-bearing volcanic flow breccia conformably interlayered with the graywacke and slate on Horse and Douglas Islands. A 15-foot thick layer of brown marble forms basal unit of formation at contact with Barlow Cove formation (new) on Hump Island. Greenstone sills, dikes, and flows(?) lie in slate of formation in some areas and range in thickness from several inches to several feet. Formation largely concealed by water but believed to be at least 5,000 and possibly 10,000 feet thick. Strata as exposed on Shelter Island may grade by facies change into Shelter formation (new). Overlies Barlow Cove formation (new).

Type locality: Symonds Point, Juneau (B–3) quadrangle. Crops out along eastern shore of Admiralty Island from Symonds Point to southern boundary of quadrangle, on Horse, Colt, and Portland Islands, and on parts of Lincoln, Shelter, Hump, and Douglas Islands.

**Syracuse Salt** (in Salina Group)

Syracuse Formation (in Salina Group)

Syracuse Salt Member (of Camillus Formation)

Syracuse Salt Member (of Salina Formation)[1]

Upper Silurian: Western to east-central New York.

Original reference: J. M. Clarke, 1903, New York State Mus. Handb. 19, p. 18–19, chart.

C. K. Swartz and others, 1942, Geol. Soc. America Bull., v. 53, no. 4, chart 3. Correlation chart shows Syracuse salt in Saline group. Cayugan series.

R. E. Griswold, 1951, New York State Water and Power Control Comm. Bull. GW–29, p. 10. Salina formation consists of (ascending) Pittsford shale, Vernon shale, Syracuse salt, Camillus shale, and Bertie limestone members, of which only the Vernon and Camillus have been definitely recognized in Wayne County.

W. P. Leutze, 1956, Am. Assoc. Petroleum Geologists Bull., v. 40, no. 7, p. 1693–1697. Term Syracuse formation is modification of term Syracuse salt. Since salt is not present at outcrop, the change seems appropriate. At outcrop (Onondoga and Madison Counties), formation is predominantly brown dolomites and gray shales. Beds of structureless clay, containing brecciated shale and dolomite or a few blocks of bedded gypsum, mark former horizons of soluble evaporite beds. Top of formation is transition from brown thin-bedded dolomite into overlying olive-colored Camillus shale. Base of formation is marked by a conglomerate of shale and dolomite pebbles and sand grains in a dolomite matrix. Overlies Vernon shale. Subdivided into (ascending) transition member, 90 to 120 feet thick; lower clay member, 10 to 15 feet; middle dolomite member, 35 to 50 feet; upper clay member 10 to 20 feet; and upper dolomite member 8 to 24 feet. Includes three faunal zones. Prior to this study, all rocks between Vernon shale and Bertie waterlime were called Camillus shale at outcrop, and consequently most publications list fossils from the Syracuse as coming from Camillus shale.

W. L. Kreidler, 1957, New York State Mus. Bull. 361, p. 6. Referred to as member of Camillus formation.

First recognized in wells near Syracuse.

Syracuse Serpentine[1]

Age(?): New York.

Original reference: G. H. Williams, 1890, Geol. Soc. America Bull., v. 1, p. 533–534.

Occurs in James Street Hill, Syracuse, Onondaga County.

**Syrena Formation** (in Magdalena Group)[1]

Pennsylvanian: Southwestern New Mexico.

Original reference: A. C. Spencer and S. Paige, 1935, U.S. Geol. Survey Bull. 859.

M. L. Thompson, 1942, New Mexico Bur. Mines and Mineral Resources Bull. 17, p. 23. Studies indicate that Syrena and Oswald formations each include large parts of at least two series of the Pennsylvanian. They are not useful as regional stratigraphic units and will not be considered in this report on Pennsylvanian of New Mexico.

P. F. Kerr and others, 1950, Geol. Soc. America Bull., v. 61, no. 4, p. 283 (fig. 5), 284–285. Divided into Mountain Home shale, 110–130 feet thick below and Humboldt limestone (Don limestone) 250 feet thick. Where exposed in Santa Rita pit along margin of granodiorite stock, upper Syrena has been extensively metamorphosed. Entire formation has been highly silicified and chloritized. Overlies Oswald limestone; unconformably underlies Cretaceous Beartooth quartzite. In some areas, overlain by sandstone, shales, and limestone correlated with Permian Abo sandstone; where Abo is missing, Syrena is directly overlain by Cretaceous rocks. In some areas, beds considered Abo by various workers could not be distinguished from metamorphosed Syrena and for this report are considered part of Syrena.

Named for Syrena patented mining claim about 1 mile south of Hanover post office, Santa Rita mining district.

**Tabernacle Flow**

Pleistocene, upper: Central Utah.

G. B. Maxey, 1946, Am. Jour. Sci., v. 244, no. 5, p. 328. Overlies Pavant flow (new). Extruded in late Pleistocene, probably during later part of Bonneville stage or during Provo stage of Pleistocene Lake Bonneville.

P. E. Dennis, G. B. Maxey, and H. E. Thomas, 1946, Utah State Engineer Tech. Pub. 3, p. 27, pl. 1. Basalt tuff, lapilli, scoria, and lava in flows 30 feet or more thick. Maximum thickness 300 feet.

Covers small area approximately 7 miles west of Meadow, in Pavant Range, Millard County.

Table Creek Shale (in Wabaunsee Group)[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. 80.

G. E. Condra and E. C. Reed, 1943, Nebraska Geol. Survey Bull. 14, p. 42. Name Table Creek included beds between Dover limestone and what was supposed to be Tarkio limestone; later it was found that lower boundary of "Table Creek" at this place is top of Elmont limestone and that the Tarkio is represented higher in the section by a sandstone located about 15 feet below the Dover. This means that the so-called

"Table Creek shale" represents three formations: shale below the Dover (with Maple Hill limestone missing), plus sandstone equivalent of the Tarkio, plus the Willard shale. Consequently name Table Creek is discarded and name Langdon shale proposed for shale between base of Dover limestone and top of Maple Hill limestone.

H. G. Hershey and others, 1960, Iowa Highway Research Board Bull. 15, p. 12. Gray sandstone at top, reddish calcareous shale near center, sandy shale near base. Nyman coal near top of formation. At SW cor. SE¼SE¼ sec. 13, T. 67 N., R. 42 W., Fremont County, formation is 3¾ feet thick. Condra and Reed (1943) proposed "Langdon" for the interval. Underlies Dover limestone. The three formations immediately below the Table Creek are not generally recognized in area. In part of Fremont County, beds are exposed that are tentatively correlated with part of Table Creek-Willard interval; basal part of Pierson Point shale is at top of this section. Wabaunsee group.

Named for outcrops on Table Creek at Nebraska City, Otoe County, Nebr.

Table Mountain Andesite[1] or Basalt

Cenozoic: Northern California.

Original reference: Howel Williams, 1932, California Univ. Pub., Bull. Dept. Geol. Sci., v. 21, no. 8, p. 311 (diagram).

O. P. Jenkins, 1943, California Div. Mines Bull. 118, pt. 4, p. 685. Cenozoic.

J. A. S. Adams, 1955, Geochim. et Cosmochim. Acta., v. 8, p. 77 (table 2). Listed on table accompanying report on uranium geochemistry of Lassen volcanic rocks.

Composes Table Mountain, northwest of Lassen Peak.

Table Mountain Basalt Flows

Table Mountain Formation

Paleocene: North-central Colorado.

R. L. Ives, 1938, Geol. Soc. America Bull.. v. 49, no. 7, p. 1049. Interbedded sandstones, shales, and basalt flows. Thickness about 900 feet. Unconformably overlies Precambrian rocks. Interpreted as preglacial. Lovering classifies beds as Miocene, and lithologically similar beds in upper part of Middle Park formation classified as very late Upper Cretaceous or Paleocene.

S. O. Reichert, 1956, Geol. Soc. America Bull., v. 67, no. 1, pl. 1 (facing p. 107). Mapped as Table Mountain basalt flows of Paleocene age.

In Denver Basin.

Table Mountain Formation[1] or Gravels

Tertiary: Southern California.

Original reference: W. J. Miller, 1935, California Jour. Mines and Geology, v. 31, no. 2, p. 138, map.

Baylor Brooks and Ellis Roberts, 1954, California Div. Mines Bull. 170, map sheet 23. Mapped as Table Mountain gravels. Older than Jacumba pyroclastics and younger than La Posta quartz diorite. Tertiary.

Well exposed in Table Mountain, 4 miles northeast of Jacumba, San Diego County.

Table Mountain Flow, Latite, or Formation

Pliocene or Pleistocene: Central California.

F. L. Ransome, 1898, U.S. Geol. Survey Bull. 89, p. 14–27, 28–46. Discussion of lava flows on western slope of the Sierra Nevada in region drained by Stanislaus River. The latites belong to at least three distinct flows. The oldest, Table Mountain flow (or facies), consists of dark compact augite-latite of somewhat basaltic aspect, with conspicuous tabular crystals of labradorite and smaller phenocrysts of augite. Older than Dardanelle flow. Rests on a variety of rocks, in some places granite and in some places on limestone or quartzite of Calaveras formation. Miocene and Pliocene.

N. L. Taliaferro and A. J. Solari, 1946, California Div. Mines Bull. 145, pls. 1, 2 [text not pub.]. Consists of lava flows in former channel of Stanislaus River. Unconformable above Mehrten formation. Pliocene or Pleistocene.

Named for occurrence on Table Mountain, Tuolumne County. Longest flow of series. Traced from the West Dardanelle where its surface is at elevation of 8,600 feet, down to Knight's Ferry where it forms plateaus at elevation of about 500 feet.

†Table Mountain Sandstone[1]

Permian: Central southern Oklahoma.

Original reference: C. N. Gould, 1924, Am. Assoc. Petroleum Geologists Bull., v. 8, no. 3, p. 324–341.

C. C. Branson, 1957, Oklahoma Geology Notes, v. 17, no. 11, p. 103. Abandoned by Oklahoma Geological Survey. If used, would invalidate Table Mountain formation, Cenozoic of California.

Named for Table Mountain in Garvey County.

Table Rock Granite[1]

Carboniferous(?): Northwestern South Carolina.

Original reference: E. Sloan, 1907, Summary of mineral resources of South Carolina, p. 7, 8.

Named for development at Table Rock Mountain, Pickens County.

†Table Rock Sandstone[1]

Upper Devonian: Southwestern New York.

Original reference: G. H. Chadwick, 1933, Pan-Am. Geologist, v. 60, no. 2, p. 96–98.

J. F. Pepper and Wallace de Witt, Jr., 1950, U.S. Geol. Survey Oil and Gas Inv. Prelim. Chart. 37. Abandoned. Naming of some massive siltstones in the Gardeau shale, such as Table Rock sandstone, serves little purpose since they cannot be positively identified beyond their type occurrence.

Occurs at top of lower Portage Falls, Genesee River region.

Tabor Member (of Crockett Formation)

Eocene (Claiborne): Central Texas.

G. D. Harris, 1941, Texas Univ. Bur. Econ. Geology Mineral Resources Survey Circ. 33, p. 13, 14, 18, 19, 20. Crockett, as exposed in Lee County, is divided into (ascending) Stone City, Wheelock, Two Mile (new), and Tabor members. Tabor consists of sand, sandstone, and clay. Thickness as much as 47 feet. Member capped by Bryan sand. Name is from manuscript of H. B. Stenzel.

This may or may not be same unit as Mount Tabor Member (Stenzel, 1938).

Type locality and derivation of name not stated.

†Tachatna Series[1]

Middle Devonian: Southern Alaska.

Original reference: J. E. Spurr, 1900, U.S. Geol. Survey 20th Ann. Rept., pt. 7, p. 157–159, 179.

Extends from some distance below junction of Kuskokwim with East Fork down to junction of Tachatna [Takotna] River, and from the Tachatna to below Vinasale, Kuskokwim region.

Tackawasick Limestone[1]

Middle Ordovician: Eastern New York.

Original reference: R. Ruedemann, 1929, Geol. Soc. America Bull., v. 40, p. 410, 414.

P. H. Osberg, 1952, Vermont Geol. Survey Bull. 5, p. 116 (fig. 16). Correlation chart for Vermont shows Tackawasick limestone in Taconic sequence above Ryesdorph conglomerate. Taconic sequence occupies a range that extends southward from Brandon, Vt., into Massachusetts and Connecticut.

Type locality and derivation of name not given. Unit first described in Capital district, eastern New York.

Tacoma Series

Middle Silurian: Southwestern Maine.

L. W. Fisher, 1936, Am. Mineralogist, v. 21, no. 5, p. 323. Includes (ascending) Thorncrag limy gneiss, Stetson Brook limestone, Hill Ridge biotite schist, Minwah limy gneiss, and Sabattus garnet schist (all new). Older than post-Silurian pegmatites, aplites and granites; younger than Bates limestone (new). Cambro-Ordovician(?).

L. W. Fisher, 1937, (abs.) Geol. Soc. America Proc. 1936, p. 71. In Lewiston area are seven formations (ascending): Danville injection gneiss (new), Androscoggin gneiss, Bates crystalline limestone, Deer Rips lime-silicate gneiss (new), Thorncrag biotite-sillimanite gneiss, Tacoma lime-silicate series, and Sabbatus quartz-sillimanite-biotite schist. Middle Silurian.

Occurs in Lewiston area, Androscoggin County.

Taconic Limestone[1]

Cambrian and Ordovician: Maine and southwestern Vermont.

Original reference: E. Hitchcock, 1862, Geology Maine, Prelim. Rept., v. 2, p. 245–259.

†Taconic Slate[1]

Ordovician: New York.

Original reference: E. Emmons, 1842, Geology of New York, pt. 2, div. 4, geology of 2d dist., p. 135–164.

Occurs at western base of Taconic Range.

†Taconic System[1]

Precambrian, Cambrian, and Silurian: Eastern North America.

Original reference: E. Emmons, 1842, Geology of New York, pt. 2, div. 4, geology of 2d dist., p. 135–164, 429.

**Taft Granite**[1]

Cretaceous: Eastern California.

Original reference: F. C. Calkins, 1930, U.S. Geol. Survey Prof. Paper 160, p. 122, map.

Named for fact it composes Taft Point, Yosemite National Park.

**Taft Sandstone Member** (of Boggy Shale)[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.

C. W. Wilson, Jr., and N. D. Newell, 1937, Oklahoma Geol. Survey Bull. 57, p. 56–57. Taft sandstone forms prominent escarpment ranging up to 200 feet in height above Crekola-Inola plain. At type locality in T. 15 N., unit consists of about 20 feet of coarse-grained massive sandstone. Upper third of the division consists of silty to sandy shale. Farther south, in T. 14 N., a series of massive sandstones and interbedded shales, amounting in aggregate to some 80 feet of beds, surmounts the Taft escarpment. Probably outcrops around Taft are equivalent only to lower part of sandstone section in T. 14 N. More work needed to determine logical boundaries of Taft member. Separated from underlying Inola limestone member by unnamed shale member.

Named for exposures south of Taft, sec. 19, T. 15 N., R. 17 E., Muskogee County.

**Taft Hill Member** (of Blackleaf Formation)

Lower Cretaceous: Northwestern Montana.

W. A. Cobban and others, 1959, Am. Assoc. Petroleum Geologists Bull., v. 43, no. 12, p. 2790, 2792 (fig. 3) ; 1959, Billings Geol. Soc. [Guidebook] 10th Ann. Field Conf., p. 89 (fig. 1), 90. Approximate percentages of various lithologic types are: gray bentonitic siltstone, 48; sandstone, 32; nonbentonitic marine shale and siltstone, 20. A widespread 30-foot-thick massive bed of greenish-gray impure glauconitic sandstone has its top about 100 feet above base of member. A few 2-foot-thick glauconitic sandstone beds also present. Many of the sandstone beds are coarse grained. Type section has over-all thickness of about 240 feet. Underlies Vaughn bentonitic member (new) ; overlies Flood member (new).

Type section: A composite from measurements at four localities between east face of Taft Hill and a point 5 miles farther east. Named for exposures along east slope of Taft Hill, a dissected prominent bench 1½ to 6 miles south of Vaughn, Cascade County.

**Taggard Red Member** (of Greenbrier Limestone)

Taggard Limestone (in Greenbrier Limestone)[1]

Taggard Shales (in Greenbrier Limestone)[1]

Upper Mississippian: Southern West Virginia and southwestern Virginia.

Original reference: D. B. Reger, 1926, West Virginia Geol. Survey Rept. Mercer, Monroe, and Summers Counties, p. 450, 476–479.

R. H. Wilpolt and D. W. Marden, 1949, U.S. Geol. Survey Oil and Gas Inv. Prelim. Chart 38, sheet 1. Term Taggard was applied by Reger (1926) to three lithologic units, a lower and upper Taggard shale with an intervening Taggard limestone. In this report, these have been combined into one unit, Taggard red member of Greenbrier limestone. Member consists of maroon red and dense limestone and calcareous mudstone. Thickness 3 to 50 feet. Commonly present from 50 to 100 feet above Hillsdale member.

Dana Wells, 1950, Am. Assoc. Petroleum Geologists Bull., v. 34, no. 5, p. 902–918. Name Denmar formation proposed for sequence of gray slightly cherty calcarenite and calcilutite beds that are younger than top of Hillsdale in its type section and older than the Taggard [limestone and shale] in its type section.

Type locality (Reger, 1926): On Taggard Branch of Indian Creek, Monroe County, W. Va.

Taghanic (Taughannock) Stage

Taughannock Group

Middle Devonian (Erian): 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 the Taghanic (Taughannock) is sixth in sequence (ascending). [For complete sequence see Helderberg stage this reference.] Follows Tioughnioga stage (new) and is succeeded by Finger Lakes stage (new). Includes sediments of Tully and Geneseo with their correlates elsewhere on the continent.

A. T. Cross and J. H. Hoskins, 1951, Jour. Paleontology, v. 25, no. 6, p. 718 (fig. 3). Shown on composite stratigraphic column of western New York and northwestern Pennsylvania as Taughannock group. Includes Tully and Genesee formations. Overlies Tioughnioga group; underlies Finger Lakes group.

Type section: In Taghanic (Taughannock) Falls Park, northwest of Ithaca, west side of Cayuga Lake, N.Y.

**Tagpochau Limestone**

Miocene, lower: 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. 63–68]. The Tappocho is a coral limestone, pink, hard, fine-textured; conglomeratic or agglomeratic near base. Lower Miocene.

P. E. Cloud, Jr., R. G. Schmidt, and H. W. Burke, 1956, U.S. Geol. Survey Prof. Paper 280–A, p. 62–77, pl. 2, chart 2. Tagpochau limestone, as used here, has been revised to include both the Tappocho and Laulau limestones of Tayama. Six lithic facies and two members are mapped within Tagpochau limestone, as follows: Donni sandstone member; Machegit conglomerate member (new); transitional facies of calcareous tuff, marl, and calcareous andesitic conglomerate; tuffaceous facies of poorly indurated, very impure limestones; marly limestone facies; rubbly limestone facies; equigranular limestone facies; and dominant inequigranular limestone facies. In several areas south from Mount Tagpochau, it is not possible to differentiate these facies. Thickness ranges from featheredge to 820 feet at type section and 900 feet in northern Saipan. Type section designated.

Type section: Extends from base of Miocene succession to head of valley that runs westward from Nicholson Spring upward to summit of Mount

Tagpochau. Tayama gave locality as summit of Mount Tappocho which is Mount Tagpochau (Ogso Tagpochau). Spelling of formational name is revised to conform with Chamorro usage.

Tahana Member (of Purisima Formation)

Pliocene: Northern California.

R. M. Touring, 1959, Dissert. Abs., v. 20, no. 4, p. 1325. Consists of 2,150 feet of tuffaceous mudstone, siltstones, and lithic arenites believed to have been largely derived from Mehrten formation. Underlies Pomponio member (new); overlies Monterey formation.

Area of report is in Santa Cruz Mountains, 30 to 40 miles south of San Francisco.

**Tahkandit Limestone**[1]

Permian: Northeastern Alaska.

Original reference: J. B. Mertie, Jr., 1930, U.S. Geol. Survey Bull. 816, p. 121.

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: Along Yukon just above mouth of Nation River, where a belt of the rocks crosses the Yukon, trending northeast, Eagle-Circle district.

†Tahkandit Series[1]

Permian and Pennsylvanian(?): Eastern Alaska.

Original reference: J. E. Spurr, 1898, U.S. Geol. Survey 18th Ann. Rept., pt. 3, p. 169–174.

Yukon River region.

Tahlequah Member (of Moorefield Formation)

Mississippian (Chesterian): Northeastern Oklahoma.

G. G. Huffman and others, 1958, Oklahoma Geol. Survey Bull. 77, p. 49–51, pls. 1–5. Massive light to dark-gray medium-crystalline glauconitic limestone that in some areas contains crinoidal coquinite and nodules and stringers of whitish-tan chert; large scale crossbedding developed locally. Thickness as much as 30 feet. Conformably underlies Bayou Manard (new); at type locality, it is in fault contact with younger units of formation; unconformably overlies parts of "Boone" chert, Keokuk chert, Reed Springs chert, and Short Creek oolite.

Type locality: Along south side of a small creek south of city limits of Tahlequah, Cherokee County.

**Tahoe Glaciation**

**Tahoe Till**

Tahoe glacial stage[1]

Pleistocene: Eastern California.

Original reference: E. Blackwelder, 1931, Geol. Soc. America Bull., v. 42, p. 865–922.

W. C. Putnam, 1949, Geol. Soc. America Bull., v. 60, no. 8, p. 1290–1291. At least four ice advances occurred in Pleistocene: earliest, here named Aeolian Buttes, was followed by Sherwin, Tahoe, and Tioga, previously named by Blackwelder. Rhyolitic ash and pumice, now Bishop welded tuff, were erupted in interval between Aeolian Buttes and Sherwin glacial stages.

W. C. Putnam, 1960, California Univ. Pubs. in Geol. Sci., v. 34, no. 5, p. 235, 237–238, map 1. Sherwin till is pre- rather than post-Bishop tuff. Name Aeolian Buttes considered invalid as representing an earlier Pleistocene, pre-Sherwin glacial stage. Hence, glacial sequence is McGee, Sherwin, Tahoe, and Tioga.

Name amended to glaciation in compliance with 1961 Code of Stratigraphic Nomenclature.

Named for Lake Tahoe on eastern slope of the Sierra Nevada. Moraines of stage flank Rock Creek Canyon in Sierra Nevada west of Highway 395, Mono County.

Tahoka Clay

Pleistocene (Wisconsin) : Western Texas and eastern New Mexico.

G. L. Evans and G. E. Meade, 1945, Texas Univ. Bur. Econ. Geology Pub. 4401, p. 495–498. Mainly bluish-gray calcareous and gypsiferous clays and gray sands which grade marginally to coarser sands and gravels; thin discontinuous beds and small lentils of fresh-water limestone present locally in basinward facies of deposit. Thickness 21 to 35 feet. Unconformably overlies older strata—in some places Triassic shales or Cretaceous limestones; around margin of basins, overlaps older Quaternary or upper Tertiary strata which are resting upon Triassic or Cretaceous. Disconformably underlies local developments of dune and playa deposits. Late Pleistocene (Wisconsin) indicated for main body of deposit.

Named for town of Tahoka, Lynn County, Tex., which is near Tahoka Lake, Mound Lake, and other playas around which the deposit is typically developed and well exposed. Extends into eastern New Mexico.

Taholah Formation

Pleistocene, lower: Northwestern Washington.

S. L. Glover, 1940, Northwest Sci., v. 14, no. 3, p. 69–71. Name applied to early Pleistocene deposits on coastal area of Olympic Peninsula. Probably correlate with sediments of Admiralty age in Puget Sound region. Formation is generally horizontal and composed of sands, gravels, and clays. Total thickness may exceed 1,500 feet. Underlies Queets bed (new) ; overlies Quinault formation.

S. L. Glover, 1940, (abs.) Geol. Soc. America Bull., v. 51, no. 12, pt. 2, p. 2022–2023. Immediately overlies Browns Point formation (new).

Well exposed in Taholah-Moclips vicinity, Grays Harbor County.

Taihamu Limestone

*See* Taihanom (Taihanomu) Limestone.

Taihanom (Taihanomu) Limestone

Aquitanian: Mariana Island (Rota).

Risaburo Tayama, 1939, Correlation of the strata of the 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. 52, table 4 [English translation in library of U.S. Geol. Survey, p. 62]. Correlated with Kasutesho limestone on Tinian, and Laulau limestone on Saipan. Oligocene.

S. Hanzawa *in* Jacques Avias and others, 1956, Lexique Strat. Internat., v. 6, Océanie, fasc. 2, p. 59–60. Consists of marly limestone, calcareous sandstone, sandy limestone, and limestone-breccia (ascending order). Unconformably overlies Mariiru limestone. Aquitanian. Refers to S. Sugawara (1939, unpub. ms.) and K. Asano (1939, Jubil. Pub. Yabe's 60th birthday).

South coast of Rota Island.

**Takotna Formation**[1]

Middle Devonian: Southern Alaska.

Original reference: J. E. Spurr, 1900, U.S. Geol. Survey 20th Ann. Rept., pt. 7, p. 157–159, 179.

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.

Extends from some distance below junction of Kuskokwim with East Fork down to junction of Tachatna [Takotna] River, and from the Tachatna to below Vinasale; upper Kuskokwim region.

Talawag Member (of Mutual ? Formation)

Precambrian: Western Utah.

R. E. Cohenour, 1959, Utah Geol. and Mineralog. Survey Bull. 63, p. 26–27, 127, 128, pls. 1, 4, 8. Mutual(?) formation is divided into two units: a basal slate or argillite and an upper conglomeratic quartzite herein referred to as Talawag member. Thickness 706 feet on north slope of Talawag Peak.

Named for occurrences on Talawag Peak and in Talawag Canyon, Sheeprock Mountains.

**Talbot Formation** (in Columbia Group)[1]

Pleistocene: Atlantic Coastal Plain from Delaware to Florida.

Original reference: G. B. Shattuck, 1901, Johns Hopkins Univ. Circ., v. 20, no. 152, p. 73–75.

G. G. Parker and C. W. Cooke, 1944, Florida Geol. Survey Bull. 27, p. 75–77, pls. 2, 3. In southern Florida, the Talbot, Penholoway, and Wicomico formations comprise a conformable sequence of deposits whose differentiation is based mainly on location of their respective shore lines—42, 70, and 100 feet above present sea level. The Talbot merges downward into the Penholoway and Wicomico successively. Sequence unconformably overlies Caloosahatchee marl and is likewise separated by stratigraphic break from Pamlico formation, which fringes around it. Boundary between Talbot and Pamlico very inconspicuous.

Named for Talbot County, eastern shore of Maryland. Well exposed in Florida along Highway 18, the Childs-Okeechobee Road and west of Lake Okeechobee; also present on Immokalee Island.

**Talcott Basalt** (in Newark Group)

Talcott Diabase (in Newark Group)[1]

Talcott Lava Member (of Meriden Formation)

Upper Triassic: Central Connecticut.

Original reference: B. K. Emerson, 1898, U.S. Geol. Survey Geol. Atlas, Folio 50; 1898, U.S. Geol. Survey Mon. 29, p. 476.

John Rodgers and others, 1956, Preliminary geological map of Connecticut (1:253,440): Connecticut Geol. Nat. History Survey. Rank reduced to basal member of Meriden formation. Described as 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. Contains pillows. Underlies lower sedimentary member of Meridan formation.

E. P. Lehmann, 1959, Connecticut Geol. Nat. History Survey Quad. Rept. 8, p. 8 (table 1), 10–11, pl. 1. Term Meriden not used in this report [Middletown quadrangle]; Talcott basalt included in Newark group. Stratigraphically lowest lava flow in quadrangle. Crops out along low ridges trending east of north along west margin of map area. Estimated stratigraphic thickness about 150 feet. Contact with underlying New Haven arkose not exposed. Underlies Shuttle Meadow formation (new).

R. W. Schnabel, 1960, U.S. Geol. Survey Geol. Quad. Map GQ–134. Talcott basalt described in Avon quadrangle, Connecticut, where it ranges in thickness from about 120 feet at northern boundary to about 200 feet at southern boundary. Apparently conformable with enclosing sedimentary rocks, New Haven arkose below and Shuttle Meadow formation above.

Named for occurrence at Talcott.

Talcott Shale (in Bluefield Formation[1] or Group)

Mississippian: Southeastern West Virginia.

Original reference: D. B. Reger, 1926, West Virginia Geol. Survey Rept. Mercer, Monroe, and Summers Counties, p. 300, 418.

P. H. Price and E. T. Heck, 1939, West Virginia Geol. Survey [Rept.] Greenbrier County, p. 263. Incidental mention in report on Greenbrier County.

Type locality: On south side of Greenbrier River, 0.6 mile southeast of Talcott, Summers County.

†Talford Schist[1]

Lower Devonian: Central New Hampshire.

Original reference: M. P. Billings and C. R. Williams, 1935, Geology of Franconia quadrangle, p. 8, 13.

C. R. Williams and M. P. Billings, 1938, Geol. Soc. America Bull., v. 49, no. 7, p. 1015, 1019. Abandoned. Littleton formation is extended to those areas of the Franconia quadrangle where Talford schist was formerly recognized as distinct unit.

Named for Talford Brook in southern part of Franconia quadrangle.

†Talihina Chert[1]

Ordovician, Silurian, and Devonian: Southeastern Oklahoma.

Original reference: J. A. Taff, 1902, U.S. Geol. Survey Geol. Atlas, Folio 79.

C. C. Branson, 1957, Oklahoma Geology Notes, v. 17, no. 11, p. 103. Abandoned by Oklahoma Geological Survey. Sequence is now divided into formations.

Named for exposures in Potato Hills, southwest of Talihina, Le Flore County.

**Talisman Quartzite**[1]

Pennsylvanian(?): Southwestern Utah.

Original reference: B. S. Butler, 1913, U.S. Geol. Survey Prof. Paper 80.

R. C. Moore and others, 1944, Geol. Soc. America Bull., v. 55, no. 6, p. 703, pl. 1 (column 53a). Correlation chart shows quartzite to be of Morrow and Lampasas age; text states that no fossils have been recovered from the unit.

Type locality: Talisman mine, southeast of Frisco district.

**Talkeetna Formation**[1]

Lower Jurassic: Central southern Alaska.

Original reference: G. C. Martin, 1926, U.S. Geol. Survey Bull. 776, p. 218, 219.

R. A. Eckhart, 1953, U.S. Geol. Survey Bull. 989–C, p. 41–42, pl. 5. Largely of interbedded tuffs, lavas, and volcanic breccias in Sheep Mountain, adjacent to upper Matanuska Valley.

In Matanuska Valley and eastern part of Talkeetna Mountains, Cook Inlet region.

**Talladega Slate**[1] or **Formation**

Talladega Series

Precambrian(?) to Carboniferous (?): Eastern Alabama, Georgia, North Carolina, and Tennessee.

Original reference: E. A. Smith, 1888, Alabama Geol. Survey Rept. Prog. 1884–1888, geol. map of Alabama, no description.

G. W. Crickmay, 1936, Geol. Soc. America Bull., v. 47, no. 9, p. 1371–1392. Series has been traced from Alabama, where it is typically exposed, across northwest Georgia, into North Carolina and Tennessee. Occupies belt trending northeast, 300 miles in length and 1 to 25 miles in width. Believed to be Precambrian.

G. W. Stose and A. J. Stose, 1944, Am. Jour. Sci., v. 242, no. 8, p. 412–415. Term series is preferred to slate. Precambrian.

G. W. Crickmay, 1952, Georgia Geol. Survey Bull. 58, p. 27–30. Discussion of crystalline rocks of Georgia. Rocks are grouped into 11 belts, in part using names proposed by Adams (1933, Jour. Geology, v. 41, no. 2). Talladega belt in Georgia divided geographically into two parts: one extending west and southwest from Allatoona, Bartow County, and the other north and northeast of that village. West of Allatoona, the series resembles typical expression in Alabama with phyllites predominating. North of Allatoona, the series comprises more highly metamorphic rocks, which have been grouped into 10 formations (ascending) Pinelog quartzite, Hiawassee [Hiwassee] slate, Great Smoky formation, Nantahala schist, Tusquitee quartzite, Brasstown schist, Valleytown schist, Murphy marble, Andrews schist, and Nottely quartzite. Precambrian.

Named for exposures on Talladega Creek, Talladega County, Ala.

**Tallahassee Limestone**

Tallahassee Limestone (in Claiborne Group)

Eocene, middle: Western Florida (subsurface)

P. L. Applin and E. R. Applin, 1944, Am. Assoc. Petroleum Geologists Bull., v. 28, no. 12, p. 1680, 1688–1693, 1747 (fig. 32). Name applied to lower unit of late middle Eocene. Ordinarily underlies Avon Park limestone (new) but in some wells occurs below the Ocala; overlies early middle Eocene beds, either the clastic sediments of Cook Mountain age or Lake City limestone (new). Composed chiefly of cream-colored and tan crystalline limestone with some softer argillaceous limestone; also with minor amounts of chert and gypsum. Thickness ranges from more than 75 feet in wells near its western edge to 550 feet in Wakulla County and 650 feet in Jefferson County. Tentatively correlated with Yegua formation (Claiborne). Avon Park limestone, Tallahassee limestone, 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.

Unit is confined to a few wells in vicinity of Tallahassee.

**Tallahatta Formation** (in Claiborne Group)[1]

Eocene, middle: Southern Alabama, western Georgia, and Mississippi.

Original reference: W. H. Dall, 1898, U.S. Geol. Survey 18th Ann. Rept., pt. 2, p. 344, chart.

R. E. Grim, 1936, Mississippi Geol. Survey Bull. 30, p. 20, 121 (fig. 18), 122, 123–128. Tallahatta formation divided into (ascending) Meridian, Basic, and Winona members. Thickness as much as 205 feet. Basal formation in Claiborne series; overlies Lisbon formation.

E. P. Thomas, 1942, Mississippi Geol. Survey Bull. 42, p. 15–28, pls. Includes Basic claystone member below and Neshoba sand member (new) above. Overlies Meridian sand, herein excluded from Tallahatta; underlies Winona greensand, herein raised to formational rank.

G. F. Brown and R. W. Adams, 1943, Mississippi Geol. Survey Bull. 55, p. 14 (table), 43–56. Formation divided into Meridian sand member at base and Basic City shale member (new) at top. Underlies Winona sand member of Lisbon formation; overlies Holly Springs formation (Wilcox series). Thickness as much as 380 feet.

F. S. MacNeil, 1947, U.S. Geol. Survey Oil and Gas Inv. Prelim. Chart 29. Chart shows Tallahatta undifferentiated in Alabama and Georgia; underlies Lisbon formation; overlies Hatchetigbee formation. In northern Mississippi includes Holly Springs sand member; elsewhere includes (ascending) Meridian sand, Basic City, and Neshoba sand members; underlies Winona formation; overlies Wilcox formation.

L. D. Toulmin, P. E. LaMoreaux, and C. R. Lanphere, 1951, Alabama Geol. Survey Spec. Rept. 21, p. 93–100. Described in Choctaw County where it is 90 to 120 feet thick, overlies Hatchetigbee formation and underlies Lisbon formation.

T. W. Lusk, 1956, Mississippi Geol. Survey Bull. 80, p. 54–61. In Benton County, overlies Meridian formation and underlies Koskiusko formation, but the Winona and Zilpha are absent in area.

Named for development in Tallahatta Hills, Choctaw County, Ala.

**Tallant Formation** (in Ochelata Group)

Pennsylvanian (Missouri Series): North-central Oklahoma.

M. C. Oakes, 1951, Tulsa Geol. Soc. Digest, v. 19, p. 119–120, 121–122. Consists of sandstone and shale. Contains two principal sandstone members (ascending), Bigheart and Revard. In addition there are other sandstone units, some of which may be extensive enough to be mapped, eventually, as members. Unconformably overlies Barnsdall formation (new); unconformably underlies sandstone in the lower part of the Vamoosa formation. Thickness about 200 feet.

W. F. Tanner, 1956, Oklahoma Geol. Survey Circ. 40, p. 32–39, pl. 1. Includes four fairly persistent members: Bigheart sandstone at base, unnamed shale, Revard sandstone, and a second unnamed shale. In addition, several sandstone beds have been assigned, either correctly or incorrectly, to the Tallant; among them are Buck Point, Gap, Hay Hollow, Hulah, Mission, and Possum.

Named from Tallant, sec. 35, T. 25 N., R. 10 E., Osage County.

Tallery Limestone (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, 341.

Type locality: On Tallery Mountain Road, southeast of True, Summers County, W. Va.

Tallery 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, 340.

Type locality: On Tallery Mountain, Summers County, W. Va.

Tallery Shale (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, 342–343.

Type locality: On Tallery Mountain Road, southeast of True, Summers County, W. Va.

**Tallman Fanglomerate**

Permian: 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]. Consists of large angular to subangular blocks of quartzite and chert, small slate fragments; thin bed of chert pebbles at base. Thickness uncertain, may be 2,000 to 5,000 feet. Underlies Koipato formation; overlies Harmony formation with angular unconformity.

Local deposit, present only near Tallman Ranch at mouth of Thomas Canyon, Sonoma Range.

Tallulah Falls Quartzite[1]

Precambrian or Lower Cambrian: Northeastern Georgia.

Original reference: S. L. Galpin, 1915, Georgia Geol. Survey Bull. 30, p. 119.

C. E. Hunter, 1946, Tennessee Valley Authority Regional Products Research Div. Rept. C, p. 46. Incidental mention in report on minerals and structural materials of western North Carolina and northern Georgia.

Named for development in vicinity of Tallulah Falls, Rabun County.

Talofofo Peat-Bearing Beds or Formation

Pliocene or Pleistocene: Mariana Islands (Guam).

Risaburo Tayama, 1952, Coral reefs in the South Seas: Japan Hydrog. Office Bull., v. 11, p. 55–56, table 4 [English translation in library of U.S. Geol. Survey, p. 66]. Gravel, sandy clay, and gray clay with layer of peat. Abundant mollusca and dendritic reef-bearing corals in gray clay. Correlated with Sumay (Mariana) limestone.

S. Hanzawa *in* Jacques Avias and others, 1956, Lexique Strat. Internat., v. 6, Océanie, fasc. 2, p. 60. Pleistocene.

Type locality: Along upper course of Talofofo River, Guam.

Taloga Formation (in Cimarron Group)[1]

Taloga Formation (in Quartermaster Group)

Permian (Guadalupe Series): Southern Kansas.

Original reference: F. W. Cragin, 1897, Am. Geologist, v. 19, p. 362–363.

R. C. Moore and others, 1951, Kansas Geol. Survey Bull. 89, p. 36 (fig. 15), 37. As used in Kansas, the Taloga is included in the Quartermaster group and consists of silty shale, siltstone, and very fine feldspathic sandstone (called "Big Basin" in some reports). Lower 25 feet is chiefly silty shale. Maximum thickness about 45 feet. Strata are seemingly equivalent, all or in part, to the Quartermaster formation in Oklahoma. Occurs above Day Creek dolomite.

C. C. Branson, 1957, Oklahoma Geology Notes, v. 17, no. 11, p. 103. Abandoned by Oklahoma Geological Survey. Cragin applied the name to Cloud Chief and Quartermaster rocks.

Named for Taloga, Dewey County, Oklahoma. In Kansas, crops out in western Clark and eastern Meade Counties.

**Talpa Limestone Member** (of Clyde Formation)[1]

Talpa Formation (in Clyde Group)

Permian: Central Texas.

Original reference: N. F. Drake, 1893, Texas Geol. Survey 4th Ann. Rept., pt. 1, p. 421, 428.

M. G. Cheney, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 1, p. 66 (fig. 1). Rank raised to formation 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, constitutes upper two-fifths of formation. Consists of even, relatively thin beds of limestone and shale similar to underlying Grape Creek member but differs in the harder, more brittle nature of the beds and the commonly slightly darker color. Thickness about 180 feet. Underlies Lueders limestone. Division of the Clyde into members in this area is not as natural as in the area north of Abilene; in area mapped herein, units might appropriately be treated as formations. Type "Paint Rock" in Concho County has been traced into type exposure of the Talpa limestone; "Paint Rock" is a synonym for Talpa limestone and preference in nomenclature is given latter term.

P. T. Stafford, 1960, U.S. Geol. Survey Bull. 1081–G, p. 275–276. Member Geographically extended into Brazos River valley where it is 45 to 55 feet thick and consists of alternating gray limestone and shale beds with less siltstone. Separated from underlying Grape Creek limestone member by unnamed shale member and from overlying Lueders limestone by an unnamed shale interval.

Named for Talpa, Coleman County.

**Tamaha Sandstone Member** (of McAlester Formation)

Tamaha 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. 40. Reallocated to member status in McAlester formation. New type locality designated.

Type locality: Sec. 30, T. 11 N., R. 22 E., some 2 miles west of Tamaha, Haskell County. Base of member makes prominent escarpment in SW¼ of this section.

Tamarack Formation[1]

Pre-Cretaceous: Northern California.

Original reference: O. H. Hershey, 1901, Am. Geologist, v. 27, p. 226.

Klamath Mountain region.

**Tamiami Formation**

Tamiami Limestone

Miocene, upper: Florida.

W. C. Mansfield, 1939, Florida Geol. Survey Bull. 18, p. 8, 15. Proposed for a limestone penetrated in digging shallow ditches to form roadbed of Tamiami Trail over a distance of about 34 miles in Collier and Monroe Counties. Consists mainly of dirty-white to gray rather hard porous nonoolitic limestone with inclusions of clear quartz grains. Underlies Buckingham limestone (new). Tentatively placed at base of Pliocene below Caloosahatchee.

G. G. Parker and C. W. Cooke, 1944, Florida Geol. Survey Bull. 27, p. 62–65. Tamiami formation was first noted by Sanford (1909) who named it Lostmans River limestone. Cooke and Mossom (1929, Florida Geol. Survey 20th Ann. Rept.) rejected Lostmans River limestone as valid formation and divided its rocks between Miami oolite on south and Caloosahatchee marl on north. Mansfield's (1939) Tamiami limestone is same limestone that Cook and Mossom correlated with Caloosahatchee marl. Place name Tamiami is preferred to Lostmans River because exposures on Tamiami Trail are more accessible than those of Lostmans River area. Term limestone is not appropriate because formation generally contains too much sand. Formation is, in general, a wedge-shaped deposit that thickens toward southeast and east. Thickness about 15 feet on Tamiami Trail 40 miles west of Miami; about 100 feet near shore of Biscayne Bay at Silver Bluff.

G. G. Parker, 1951, Am. Water Works Assoc. Jour., v. 43, no. 10, p. 823. Tamiami formation is of upper Miocene age and, as here indicated, includes all deposits of that age in Florida. As thus defined, includes Tamiami limestone and Buckingham limestone of Mansfield and part of Hawthorn formation of Parker and Cooke (1944, Florida Geol. Survey Bull. 27).

J. R. DuBar, 1957, Illinois Acad. Sci. Trans., v. 50, p. 192 (table 1); 1958, Gulf Coast Assoc. Geol. Soc. Trans., v. 8, p. 132–133, 136–139. Formation underlies Fort Denaud member (new) of Caloosahatchee marl. Contact with Caloosahatchee unconformable.

C. W. Cooke, 1959, U.S. Geol. Survey Prof. Paper 321, p. 2 (table 1). Upper Miocene.

Named for exposures along Tamiami Trail, Collier and Monroe Counties.

Tamihy Series[1] or Group

Jurassic: Central northern Washington, and southwestern British Columbia, Canada.

Original reference: R. A. Daly, 1912, Canada Geol. Survey Dept. Mines Mem. 38, map 16.

Hans Frebold, 1953, Geol. Soc. America Bull., v. 64, no. 10, p. 1232, chart 8d. Shown on correlation chart as Tamihi group. Probably younger than Cultus formation. Jurassic.

Mapped along Tamihy Creek, Wash., and British Columbia.

†Tampa Group[1]

Miocene, lower and middle: Northern and southern Florida.

Original reference: W. H. Dall, 1892, U.S. Geol. Survey Bull. 84, p. 112–113, 157, 335.

Named for exposures on Tampa Bay.

**Tampa Limestone**[1]

Tampa Formation or Stage

Miocene, lower: Central and northern Florida and southern Georgia.

Original reference: L. C. Johnson, 1888, Am. Jour. Sci., 3d, v. 36, p. 235.

C. W. Cooke and W. C. Mansfield, 1936, Geol. Soc. America Proc. 1935, p. 71–72. Name Suwannee limestone proposed for yellowish limestone typically exposed along Suwannee River in Florida; unit has been considered part of Tampa limestone.

R. O. Vernon, 1942, Florida Geol. Survey Bull. 21, p. 67–73. As used in this report [Holmes and Washington Counties], term Tampa applies to all sediments lying above Suwannee limestone and below Alum Bluff group.

C. W. Cooke, 1945, Florida Geol. Survey Bull. 29, p. 111–136. In Hillsborough, Pasco, and Pinellas Counties, which include type area, Tampa is commonly a fairly hard dense light-colored to yellowish limestone; locally closely packed with impressions of mollusks. In Chattahoochee area, soft beds alternate with hard, and much of the rock has chalky appearance. Thickest natural exposure is in Gadsden County, where 117 feet are exposed above low water in Apalachicola River at Chattahoochee. Underlies Suwannee limestone; in some areas, merges upward into Hawthorn formation. Presumably unconformable on Flint River where that is underlying formation. Lower Miocene.

H. S. Puri, 1953, Florida Geol. Survey Bull. 36, p. 16 (table 1), 17–21. Stage includes all Miocene sediments lying between Oligocene series and Alum Bluff stage (new). Definition includes such sediments exposed in Florida panhandle and their equivalents in central and western Gulf States. Stage includes all sediments deposited between post-Vicksburg (*Nodosaria blanpiedi* zone of Chickasawhay limestone) and pre-Alum Bluff ages. In Florida panhandle, two lithofacies recognized: calcareous St. Marks facies downdip and silty Chattahoochee facies updip.

R. C. Heath and P. C. Smith, 1954, Florida Geol. Survey Rept. Inv. 12, p. 13. Referred to as formation. This is usage of Florida Geological Survey.

K. B. Ketner and L. J. McGreevy, 1959, U.S. Geol. Survey Bull. 1074–C, p. 54 (table 1), 59–65. As used in this report [area between Hernando and Hardee Counties], Tampa includes lower Miocene Tampa limestone as defined by Cooke (1945) and lower Miocene strata commonly included in Alachua formation of Sellards (1914, Florida Geol. Survey 6th Ann. Rept.). In northern part of area, consists of lower phosphorite unit about 10 feet thick and upper clay unit about 25 feet thick; in southern part of area, represented by limestone unit about 100 feet thick, phosphorite and clay units not present. Overlies Suwannee limestone; underlies Hawthorn formation.

Named for exposures at Tampa, Fla.

Tampico Shale Member (of Piper Formation)

Middle Jurassic: Montana (subsurface and surface) and western North Dakota (subsurface), and Saskatchewan, Canada (subsurface).

J. W. Nordquist, 1955, Billings Geol. Soc. Guidebook 6th Ann. Field Conf., p. 97, 101. Consists of 86 feet of gray-green calcareous shale which is slightly silty in middle of unit in type well. In some wells, unit contains large amount of interbedded red shale and occasionally thin beds of dense buff to brown limestone, gypsum, and white calcareous sandstone. Sandstones become well developed northward in Saskatchewan. Red shales become more dominant southward in central and southern Montana. Maintains fairly uniform thickness. Upper and lower boundaries more clearly defined in subsurface of northern Montana than in outcrops in central and southern Montana. Underlies Firemoon limestone member (new). In subsurface, overlies Nesson formation (new) with apparent conformity throughout most of area of distribution. Unconformably overlies Madison limestone west of Bowdoin dome and unconformably overlies beds ranging from Upper Mississippian through Triassic in central and south-central Montana.

Type section: From interval 3,858 to 3,944 feet in Gulf Oil Corp. No. 1 Cornwell, center SW¼NE¼ sec. 14, T. 30 N., R. 38 E., Valley County, Mont. Named for town of Tampico which is 5 miles southwest of type well. Easily recognized as far east as Nesson anticline, and correlated westward to west side of Bearpaw Mountains where it pinches out by nondeposition. Crops out in central and southern Montana.

Tamworth Granite

Upper Devonian(?): East-central New Hampshire.

A. P. Smith and others, 1938, Geologic map and structure sections of the Mt. Chocorua quadrangle, New Hampshire (1:62,500): New Hampshire State Highway Dept. Described as medium-grained pink granite. Belongs to New Hampshire magma series.

Crops out around village of South Tamworth in southeastern part of Mt. Chocorua quadrangle.

†Tanak Volcanics

Quaternary: Southwestern Alaska.

F. M. Byers, Jr., and others, 1947, U.S. Geol. Survey Alaskan Volcano Inv. Rept. 2, pt. 3, p. 28, 31, pl. 3. Thick beds of tuff-breccia, with many thin beds of agglomerate and a few interbedded lava flows. Tuff-breccia beds average about 150 feet in thickness but locally thicken to 350 feet; include small lenses of water-laid sediments locally. Tuff-breccia is neutral gray on fresh surfaces; weathers to light reddish yellow; contains fragments of all types of precaldera rocks and minor quantities of bombs and lava fragments. Accidental material ranges in size from small grains up to blocks a foot in diameter. Weathering develops conspicuous "hoodoos." Near rim of caldera, well-indurated gray agglomerate is interbedded with tuff-breccia; within a mile of the caldera, it grades laterally into black vesicular agglomerate. Lava flows decrease in abundance away from caldera. Individual flows 20 to 80 feet thick and composed of light- to medium-gray aphanitic basalt. Many tuff-breccias probably nuée ardente deposits.

F. M. Byers, Jr., 1959, U.S. Geol. Survey Bull. 1028–L, p. 314. Included in Okmok volcanics (redefined).

Crops out high on walls of caldera of Mount Okmok, and on outer slopes it covers lowlands and fills precaldera valleys to depth of several hundred feet. Named from exposures on Cape Tanak on Umnak Island in eastern part of Aleutian Islands.

†Tanana Schist[1]

Precambrian: Eastern Alaska.

Original reference: A. H. Brooks, 1900; U.S. Geol. Survey 20th Ann. Rept., pt. 7, p. 468–469, 478, 483.

Well exposed along Tanana River.

**Tanapag Limestone**

Pleistocene or Recent: Mariana Islands (Saipan).

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. 58, table 4 [English translation in library of U.S. Geol. Survey, p. 69]. Consists primarily of coral limestone and secondarily of Nullipore limestone. Correlated with Dankura limestone on Tinian, Mirikattan limestone of Rota, and Merizo limestone of Guam. Raised coral reef. Recent.

S. Hanzawa *in* Jacques Avias and others, 1956, Lexique Strat. Internat., v. 6, Océanie, fasc. 2, p. 60–61. Early Holocene.

P. E. Cloud, Jr., R. G. Schmidt, and H. W. Burke, 1956, U.S. Geol. Survey Prof. Paper 280–A, p. 86–88, pl. 1, chart 1. Mainly dirty-white to brownish coral-algal reef and bioclastic limestone; contains fossil corals and coralline algae, many of which occur in position of growth. Thickness at type site herein designated, about 10 feet; probable maximum thickness not more than 50 feet. Includes rocks which Tayama has called Chacha limestone as well as his typical Tanapag limestone. Pleistocene.

Type site: West coast of Saipan between Tanapag and Matansa.

**Taneum Andesite**[1]

Miocene: Central Washington.

Original reference: G. O. Smith, 1904, U.S. Geol. Survey Geol. Atlas, Folio 106.

W. C. Warren, 1941, Jour. Geology, v. 49, no. 8, p. 809. In Mount Stuart quadrangle, underlies Yakima basalt.

Well exposed on south branch of Taneum Creek, Mount Stuart quadrangle, Chelan County.

Taneytown facies[1]

Upper Triassic: Maryland.

Original reference: G. E. Dorsey, 1919, Geol. Soc. America Bull., v. 30, p. 155–156.

Probably named for occurrence at or near Taneytown, Carroll County.

Tank Volcanics[1]

Quaternary(?): Southern California.

Original reference: A. C. Lawson, 1906, California Univ. Pub., Dept. Geol. Bull., v. 4, p. 431–462.

Well exposed in vicinity of railway tank, 2 miles below Tehachapi Station, on Tehachapi Creek, Kern County.

**Tank Hill Limestone**[1]

Tank Hill Limestone (in Pogonip Group)

Lower Ordovician: Eastern Nevada.

Original reference: L. G. Westgate and A. Knopf, 1932, U.S. Geol. Survey Prof. Paper 171.

L. F. Hintze, 1952, Utah Geol. and Mineralog. Survey Bull. 48, p. 48–50, 51–52. In Ely Springs Range, Pogonip group includes Yellow Hill limestone and Tank Hill limestone (top of Ordovician sequence). Inasmuch as both upper and lower limits of the Yellow Hill are fault bounded, as is lower limit of the Tank Hill, it is not considered advisable to carry these formations as stratigraphic units into other areas.

W. H. Twenhofel and others, 1954, Geol. Soc. America Bull., v. 65, no. 3, chart 2 (column 63). Shown on correlation chart below Eureka quartzite and above Yellow Hill limestone. Chazyan.

G. A. Cooper, 1956, Smithsonian Misc. Colln., v. 127, pt. 1, p. 129. Consists of 450 feet of gray thin-bedded limestone, conglomeratic in lower part. Upper 50 feet is shaly limestone with abundant fossils.

Named for exposures on west face of Tank Hill, Ely Springs Range, Pioche region.

Tanner shale[1]

Lower Triassic: Northeastern Arizona.

Original reference: C. R. Keyes, 1922, Pan-Am. Geologist, v. 38, p. 250, 338.

Crops out at Tanner's Crossing of Little Colorado River.

Tanners Hill Quarry Rock (in Conewango Formation)[1]

Devonian or Carboniferous: Northwestern Pennsylvania.

Original reference: F. A. Randall, 1883, Pennsylvania 2d Geol. Survey Rept. $I_4$, p. 297, 304–308, well sections by J. F. Carll.

Occurs in Tanners Hill section, Warren County.

†Tanners Hill red (in Conewango Formation)[1]

Tanners Hill red zone (in Chadakoin Formation)

Upper Devonian: Northwestern Pennsylvania and southwestern New York.

Original reference: J. F. Carll, 1875, Pennsylvania 2d Geol. Survey Rept. I.

Bradford Willard *in* Bradford Willard, F. M. Swartz, and A. B. Cleaves, 1939, Pennsylvania Geol. Survey, ser. 4, Bull. G–19, p. 14, 243, 252. Discussed as a red zone and reallocated to top of Chadakoin formation.

Overlies Ellicott shale member; underlies Panama conglomerate member of Venango formation. Upper Devonian.

G. A. Cooper and others, 1942, Geol. Soc. America Bull., v. 53, no. 12, pt. 1, chart 4. Tanner Hill shown as occurring below Haymaker beds of Chadakoin formation in sections for Genesee Valley and Lake Erie areas, New York, and northwestern Pennsylvania.

Exposed on Tanner's Hill, Warren County, Pa.

**Tansill Anhydrite** or **Formation** (in Artesia Group)

**Tansill Formation** (in Whitehorse Group)

Tansill Anhydrite or Formation (in Carlsbad Group)

Permian (Guadalupe Series): Southeastern New Mexico and western Texas.

R. K. DeFord *in* Addison Young, Max David, and E. A. Wahlstrom, 1939, Am. Assoc. Petroleum Geologists Bull., v. 23, no. 10, p. 1551. Tansill formation in Whitehorse group, name to be proposed by DeFord, Riggs, and Wills.

R. K. DeFord and G. D. Riggs, 1941, Am. Assoc. Petroleum Geologists Bull., v. 25, no. 9, p. 1713–1728. Presentation of formal definition of Tansill formation and detailed measurement and description of section at type locality. Thickness 123½ feet at type locality; here formation is divided into 13 units (I–XIII, ascending); units VIII, IX, and X inclusive are termed Ocotillo member. Formation is pre-Salado. Formation is a body of limestone, silt, and anhydrite that forms widespread layer of earth's crust in southeastern New Mexico and West Texas. Limestone on south and west grades into anhydrite on north and east; limestone lies around rim of Delaware basin. Time horizon at top of Tansill limestone can be traced basinward where it becomes top of Capitan reef dipping steeply downward 1,500 feet into basin—where it becomes in turn top of Delaware Mountain group; this horizon can also be traced lagoonward where it becomes top of Tansill anhydrite and is in most places somewhat below horizon known as "base of the salt." The horizon that forms top of Tansill formation is boundary between Guadalupe and Ochoa series. In this region, the Tansill is top formation of Whitehorse group of Guadalupe series. Time horizon at base is top of the Yates. Lang's (1937) Three Twins member of Chalk Bluff formation seems to include both the Tansill formation and the Yates sand; but, if so, the two units are described as intergradational, and superposition of Tansill on Yates is not clearly recognized; Lang's Chalk Bluff formation is essentially the Whitehorse group of subsurface geologists.

P. B. King, 1948, U.S. Geol. Survey Prof. Paper 215, p. 68, 101 (fig. 12). Chart shows Tansill formation as uppermost unit in Whitehorse group in subsurface in Midland basin; overlies Yates formation. Formations of the Whitehorse group are delimited and traced in both the Chalk Bluff and Carlsbad facies of present usage.

N. D. Newell, 1953, The Permian reef complex of the Guadalupe Mountains region, Texas and New Mexico: San Francisco, W. H. Freeman and Co., p. 46–47. Uppermost formation of Carlsbad group. Formation is 123 feet thick at type locality but expands rapidly reefward as it changes to calcarenite facies. At south side of Walnut Canyon, at edge of shelf, it is 320 feet thick.

P. T. Hayes, 1957, U.S. Geol. Survey Geol. Quad. Map GQ-98. Formation described in Carlsbad Caverns East quadrangle, New Mexico, where it is uppermost unit of Carlsbad group. Top has been removed by erosion in this quadrangle and at type locality. In subsurface, underlies Salado formation.

J. P. Brand and R. K. DeFord, 1958, Am. Assoc. Petroleum Geologists Bull., v. 42, no. 2, p. 375. In Kent quadrangle, Texas, underlies Yearwood formation (new).

Term Carlsbad abandoned. Term Artesia Group (D. B. Tait and others, 1962, Am. Assoc. Petroleum Geologists Bull., v. 46, no. 4) applied in New Mexico.

Type locality: On Carlsbad-Artesia Highway (U.S. 285), 3.7 miles from Eddy County Courthouse in Carlsbad. In W½ sec. 26, T. 21 S., R. 26 E., of New Mexico Principal Meridian, Eddy County, N. Mex. Name derived from Tansill power dam. Locality is on east flank of elongate dome that forms prominent topographic feature northwest of Carlsbad.

**Tantalus 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. Davis in Jacques Avias and others, 1956, Lexique Strat. Internat., v. 6, Océanie, fasc. 2, p. 132. Lava flow of melilite-nepheline basalt, with thick mantle of clinker and lava balls, and thick underlying clinker, that cascaded from Tantalus cone into Pauoa Valley. Cinder and clinker in valley below source cone 100 to 300 feet thick; maximum thickness of massive phase of lava about 40 feet. Unconformably overlies Koolau volcanic series and older alluvium; locally rests on black ash formed by same eruption. Probably simultaneous with Sugar Loaf basalt.

Named for Tantalus, the cinder cone at its vent. Covers about 0.3 square miles in Pauoa Valley, on southside of Koolau Range, 11 miles west of Makapuu Head.

**Tanyard 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, 19–29. Basal formation of group. Underlies Gorman formation (new). A sequence of limestones and dolomites. Thickness 560 feet. Comprises (ascending) Threadgill and Staendebach (new) members. 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. 142–144, 151, 156–157, pls. 5, 6 [1945]. Proposed for rocks similar to and partially correlative with Lower Ordovician rocks exposed at type section at the Tanyard. Consists of fine- to coarse-grained, commonly vuggy to porous, light-yellowish to woodash-gray and pearl-gray, irregularly bedded dolomites and sublithographic, pearl- to woodash-gray and old-ivory, thickly to thinly bedded limestones, both essentially nonglauconite; locally formation is dolomite throughout. Thickness 518 to 658 feet; at type section about 550 feet. On basis of chert and grain-size differences in the dolomites, it is divided into Threadgill member below and Staendebach member above. Overlies Pedernales member or San Saba member of Wilberns formation.

P. E. Cloud, Jr., and V. E. Barnes, 1948, Texas Univ. Bur. Econ. Geology Pub. 4621, p. 35–38, 136–137, 157–158, 194–195, 244–250, 256, 291, 312, pl. 8 [1946]. Type section and local stratigraphy described in detail.

Type section: The Tanyard on east bank of Buchanan Lake (Colorado River) opposite mouth of John Jim Creek and Cedar Hollow and 2 to 3 miles north of mouth of Fall Creek, northwestern Burnet County. Tanyard is well known locality, having given its name to Tanyard Spring, Tanyard Camp and Tanyard Crossing.

**Tanyard Branch Member** (of Pride Mountain Formation)

Upper Mississippian: Northern Alabama.

S. W. Welch, 1958, U.S. Geol. Survey Oil and Gas Inv. Chart OC–58. Light-olive-gray to buff very fine to fine-grained thin to medium uneven bedded sandstone 15 feet thick (at base); olive-gray shale 5 feet thick; light-olive-gray to buff, very fine to fine-grained sandstone rubble 10 feet thick (at top). Maximum thickness about 35 feet near Alabama-Mississippi State line; thins eastward to an average of about 20 feet through most of Colbert County. Underlies Wagnon member (new); overlies Alsobrook member.

Named for its exposure on a small hill on east side of Tanyard Branch just south of U.S. Highway 72 in south-central SE½ sec. 2, T. 4 S., R. 13 W., Colbert County.

Taosan 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, 11.

Named for Taos County.

Tapaliza Formation or Group

Oligocene, upper, and Miocene, lower: Panamá.

Charles Schuchert, 1935, Historical geology of the Antellean-Caribbean region: New York, John Wiley and Sons, p. 563, 660. Dark foraminiferal shales.

A. A. Olsson, 1942, 8th Am. Sci. Cong. Proc., v. 4, Geol. Sci., p. 234 (chart), 241. Tapaliza [group] includes Arusa and Aguagua formations. Chart shows Tapaliza above Capeti limestones and below Gatún formation. Upper Oligocene and lower Miocene.

In Darien area. Tapaliza is name of village on tributary of Río Pucro.

**Tapeats Sandstone** (in Tonto Group)[1]

Lower and Middle Cambrian: Central and northern Arizona, southeastern California, and southern Nevada.

Original reference: L. F. Noble, 1914, U.S. Geol. Survey Bull. 549.

E. D. Wilson, 1939, Geol. Soc. America Bull., v. 50, no. 7, p. 1126. In central Arizona, the Tapeats overlies, with pronounced angular unconformity, rocks of Precambrian City Creek series (new).

E. T. Schenk and H. E. Wheeler, 1942, Jour. Geology, v. 50, no. 7, p. 885, 888. Since Prospect Mountain and Tapeats formations are lithogenetically the same, the former name is employed because of its priority of definition.

E. D. McKee, 1945, Carnegie Inst. Washington Pub. 563, p. 15–17, 38–39. Coarse-grained sandstone is by far the most extensive of the several lithologic facies represented in Tapeats sandstone. Fairly uniform in character throughout eastern Grand Canyon, although locally variable, and normally weathers into single sheer cliff of chocolate-brown color.

D. F. Hewett, 1956, U.S. Geol. Survey Prof. Paper 275, p. 32–34, fig. 4, pl. 1. Widely distributed throughout eastern half of Ivanpah quadrangle, California and Nevada. Thickness along eastern limits, in a general north-south direction, ranges from 130 to 600 feet. Underlies Bright Angel shale; overlies Precambrian granite. Age given as Lower Cambrian for exposures in this area.

T. F. Stipp and H. M. Beikman, 1959, U.S. Geol. Survey Oil and Gas Inv. Map OM–201. Age given as Lower and Middle Cambrian for occurrences in northwestern and central Arizona.

Named for Tapeats Creek, below mouth of which, just north of Shinumo quadrangle, the bed of Colorado River lies within this sandstone; Arizona.

Tapotchau Limestone

*See* **Tagpochau Limestone.**

Tappan Lava Flow

Quaternary: North-central Arizona.

H. S. Colton, 1937, Mus. Northern Arizona Bull. 10, p. 20 (fig.), 21–22. Longest flow that can be demonstrated in San Francisco Mountain volcanic field. Over most of its course, flow is very narrow, 1 to 300 feet. Age not stated but may be contemporary with basalt action of Pleistocene.

D. N. Hinckley, 1955, U.S. Atomic Energy Comm. [Pub.] RME–81 (rev.), p. 8. Quaternary.

At Tappan Springs about 3 miles southwest of Cameron. Traced from Lockett Tank to Cameron and down Little Colorado River to Hopi Trail Canyon, and to point 9 miles below Cameron, Coconino County.

Tappocho Limestone

*See* **Tagpochau Limestone.**

**Taputapu Volcanics**

Pliocene(?): Samoa Islands (Tutuila).

H. T. Stearns, 1944, Geol. Soc. America Bull., v. 55, no. 11, p. 1285 (table 1), 1305–1306, pl. 1. Comprise lava flows, dikes, cones, and tuff deposits making up volcanic dome 6 miles long, 3 miles wide, and 1,500 feet high, and here referred to as Taputapu Volcano. Most flows are olivine basalts 6 to 50 feet thick; they contain much clinker, have thin flow units, and are capped in places with thicker flows of porphyritic and nonporphyritic olivine-poor basalt and andesite. Beds of red vitric tuff a few inches to several feet thick and thick lenses of cinder are common between flows. Thickness about 1,639 feet. Pliocene and upper Pleistocene(?).

G. A. Macdonald *in* Jacques Avias and others, 1956, Lexique Strat. Internat., v. 6, Océanie, fasc. 2, p. 214–215. Appears to overlap Pago volcanic series. Pliocene(?).

Type locality: Cape Taputapu, west end of island. Exposed over western one-fourth of island.

Tarantula Formation

Cretaceous: Western Texas.

R. M. Huffington, 1947, Harvard Univ. Summ. of Theses, 1943–45, p. 196. Strata of Washita Taranutula formation, 680 feet thick, are probably Georgetown and Grayson in age. Overlies beds of Fredericksburg Finlay formation; underlies Lasca formation (new).

Area of report is northern Quitman Mountains, southern Hudspeth County.

Tarantula Gravel

Tertiary: Southwestern Texas.

R. K. DeFord and L. W. Bridges, 1959, Texas Jour. Sci., v. 11, no. 3, p. 286–295. Predominantly conglomerate; basalt flow interbedded in lower part. Pale yellowish brown where orthoquartzite fragments are plentiful and somewhat whiter where there are more tuff fragments; in places has reddish cast; basal strata cemented with calcite, and amount of cement decreases upward. Thickness at least 300 feet but may be more than 400 feet. At MS1 of type section, typical Tarantula overlies Capote Mountain tuff (new); within 6 miles north-northwestward, oversteps entire Vieja group and rests on Cox sandstone, Bluff limestone, and Yucca formation.

Type section: A composite of three measured sections (MS1, MS2, and MS3). MS1(30°36.1′N., 104°47.8′W.) extends S. 50° E. from its top at top of small hill to its base in a stream bed, adjacent to and south of main body of basalt in Rim Rock fault; MS2 (30°37.3′N., 104°50.4′W.) extends in northerly direction from its top at top of a small hill to base of a vertical exposure in stream bed, 100 feet SE of county road (Porvenir mail route); MS3 (30°35.8′N., 104°49.6′W.) extends in westerly direction from top of long gentle slope to base of steep hill in middle of Tarantula Hills. Named for Tarantula Hills, Jeff Davis County.

Target Limestone Member (of Springer Formation)

Lower Pennsylvanian: Southern Oklahoma.

A. P. Bennison, 1954, Am. Assoc. Petroleum Geologists Bull., v. 38, no. 5, p. 913–914. Gray argillaceous limestone grading laterally into impure sandy marl. Average thickness about 6 feet, and maximum thickness probably does not exceed 10 feet; this includes varying amount of interbedded clay shale. Stratigraphically about 60 feet below massive fine-grained sandstone member probably equivalent to Lake Ardmore sandstone.

Named for intermittent Target Creek flowing across limestone near target range of Ardmore Air Force Base, Carter County. Areal extent limited to secs. 2 and 3, T. 3 S., R. 2 E.

**Tarkio Limestone Member** (of Zeandale Limestone)

Tarkio Limestone (in Wabaunsee Group)

Tarkio Limestone Member (of Wabaunsee Formation)[1]

Pennsylvanian (Virgil Series): Southwestern Iowa, eastern Kansas, northwestern Missouri, and southeastern Nebraska.

Original reference: S. Calvin, 1901, Iowa Geol. Survey, v. 11, p. 420, 422, 430–437.

H. S. McQueen and F. C. Greene, 1938, Missouri Geol. Survey and Water Resources, 2d ser., v. 25, pl. 5. In Missouri, Tarkio limestone is basal formation in Wabaunsee group. Overlies Willard shale and underlies Pierson Point shale.

F. C. Greene and W. V. Searight, 1949, Missouri Geol. Survey and Water Resources Rept. Inv. 11, p. viii (fig. 4), 19, 20. Wabaunsee group is redefined for Missouri to accord with interstate agreement. Tarkio limestone overlies Willard shale and underlies Wamego shale.

G. E. Condra, 1949, Nebraska Geol. Survey Bull. 16, p. 16–17. In 1910 Condra, traced Swallow's (1866 [1867], Am. Assoc. Adv. Sci. Proc., v. 15) so-called "Chocolate" limestone through outcrops in Mill Creek and Kansas River valleys of Kansas, also in southeastern Nebraska and northwestern Missouri and into division 1 of Calvin's section near Coin, Iowa. After it was realized that all of Calvin's "Tarkio", except the thin to missing top division, had been named in Kansas, Condra and Bengston (1915, Nebraska Acad. Sci. Pub., v. 9, no. 2) applied name Tarkio to top subdivision of Nemaha "formation," now called a subgroup. After it was realized that Chocolate limestone is not a geographic name and that name Tarkio could be applied to the "Chocolate" limestone, Condra (1935) [compiler unable to locate this reference] designated a type locality for the revised Tarkio, where the formation is well exposed in section extending from the Maple Hill limestone down to below the Reading limestone. Moore (1936, Kansas Geol. Survey Bull. 22) selected a type locality in Kansas. The Tarkio is a distinctive unit from northwestern Missouri and southeastern Nebraska to south-central Kansas. Thickness ranges between 2 and 11 feet, being greatest in east-central Kansas. The Tarkio, as redefined by Condra, is distinctive unit in east-central Kansas, in Richardson and Pawnee Counties, Nebr., and in Missouri River bluffs north of Corning County, Mo., but grades into sandy shale at McKissick Grove, Iowa, and Nebraska City, Nebr. Elmont limestone, as exposed in the two northern locations cited above closely resembles the type Tarkio and has been erroneously correlated as Tarkio by some earlier workers. In Nebraska, underlies Pierson Point (Wamego) formation; overlies Willard shale.

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 limestone (new). Underlies Wamego shale member; overlies Willard shale.

H. G. Hershey and others, 1960, Iowa Highway Research Board Bull. 15, p. 12, fig. 5. Formation in Wabaunsee group. The three formations immediately below Table Creek shale are not generally recognized in area of this report. In N½SE¼SW¼ sec. 36, T. 70 N., R. 43 W., Fremont County, beds are exposed which are tentatively correlated with a part of Table Creek shale—Willard shale interval. At top of this section, 3½ feet of green and gray shale is identified as basal part of Pierson Point shale. Below this is Tarkio limestone, recognized as two limestone beds with an intervening fossiliferous gray shale. Overlies Willard shale. Tarkio described here is in accordance with Kansas usage and not Tarkio as described by Calvin.

Type locality (Condra): In Missouri River bluffs northeast of Corning, Holt County, Mo. This location is west of Tarkio Valley in Missouri.

Type locality (Moore): On Mill Creek southwest of Maple Hill, Wabaunsee County, Kans. This area noted by Swallow under designation of "Chocolate limestone." Calvin applied Tarkio to rocks on Tarkio Creek, north of Coin, Page County, Iowa.

†Tarrant Formation[1] (in Eagle Ford Group)

Tarrant Member (of Eagle Ford Formation)

Upper Cretaceous: Eastern Texas.

Original reference: W. S. Adkins, 1933, Texas Univ. Bull. 3232, p. 239, 270, 425.

W. L. Moreman, 1942, Jour. Paleontology, v. 16, no. 2, p. 192. Basal formation in Eagle Ford group. Underlies Britton formation.

R. T. Hazzard, B. W. Blanpied, and W. C. Spooner, [1947], Shreveport Geol. Soc. 1945 Ref. Rept., v. 2, p. 480. Shown on correlation chart as member of Eagle Ford formation, surface and subsurface in eastern Texas.

W. L. Turner, 1951, Field and Lab., v. 19, no. 2, p. 53–54. Adkin's classification not applicable to rocks exposed in Eagle Ford quadrangle; hence, term Tarrant not used in this report.

L. W. Stephenson, 1952, U.S. Geol. Survey Prof. Paper 242, p. 3. In this report the "Tarrant" unit is included in Lewisville member of Woodbine formation.

U.S. Geological Survey has abandoned the term Tarrant.

Type locality: One mile east of Tarrant Station, Tarrant County, at crossing of St. Louis, San Francisco & Texas Railway over tributary of Bear Creek.

Tarryall Formation[1]

Carboniferous and Triassic(?): Central Colorado.

Original reference: G. A. Muilenbrug, 1925, Colorado Geol. Survey Bull. 31, p. 12–25.

Exposed in and around Tarryall Creek, Park County.

**Tar Springs Sandstone**[1]

Tar Springs Sandstone (in Elvira Group)

Upper Mississippian (Chester Series): Western Kentucky, southern Illinois, southwestern Indiana, and southeastern Missouri.

Original references: D. D. Owen, 1856, Kentucky Geol. Survey, v. 1, p. 174, geol. section; 1857, Kentucky Geol. Survey, v. 2, p. 85–88.

J. M. Weller, 1939, Kansas Geol. Soc. Guidebook 13th Ann. Field Conf., p. 131, 137; J. M. Weller and A. H. Sutton, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 5, p. 766 (fig. 1), 835–836. Assigned to Elvira group (new). Sandstone is 50 to 75 feet thick in Union County, Ill., and southeastern Perry County, Mo. In standard Mississippian section, underlies Vienna limestone and overlies Glen Dean limestone.

D. J. McGregor, T. G. Perry, and W. J. Wayne, 1957, Indiana Geol. Survey Field Conf. Guidebook 9, p. 6. Unconformably underlies Pennsylvanian Mansfield formation in some areas of southwestern Indiana.

T. G. Perry and N. M. Smith, 1958, Indiana Geol. Survey Bull. 12, p. 27, pl. 1. In Indiana Tar Springs is commonly light-gray to light-brown rust-spotted thick-bedded to massive fine- and medium-grained sandstone which is locally crossbedded and laminated. Thickness 40 to 90 feet. Shown on stratigraphic column below Vienna limestone and above Glen Dean limestone. Term Elvira group not used in Indiana.

Named for Tar Springs, 3 miles south of Cloverport, Breckinridge County, Ky.

Tartar cyclothem

*See* Tarter cyclothem.

Tarter 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). Assigned to member status in Abbott formation (new). Occurs above Manley coal member (new) and below Pope Creek coal member. Name Tarter sandstone previously applied to sandstone below Tarter coal is discontinued in order to retain name for the coal. No name given to sandstone. Coal named by Wanless (1939, Geol. Soc. America Spec. Paper 17). Presentation of new rock-stratigraphic classification of Pennsylvanian in Illinois. Cyclical classification retained but is independent of rock-stratigraphic classification.

Type locality: SE¼ sec. 2, T. 5 N., R. 1 E.. Fulton County.

Tarter cyclothem (in Abbott Formation)

Tarter cyclothem (in Tradewater Group)

Pennsylvanian: Western Illinois.

J. M. Weller, L. G. Henbest, and C. O. Dunbar *in* C. O. Dunbar and L. G. Henbest, 1942, Illinois Geol. Survey Bull. 67, p. 14 (fig. 1). Shown on columnar section at top of Caseyville group. Overlies Babylon cyclothem; underlies Pope Creek cyclothem.

H. R. Wanless, 1957, Illinois Geol. Survey Bull. 82, p. 50 (fig. 22), 64, 66–67, 202. In outcrops, cyclothem is from 3 to 10 feet thick. Includes Tarter sandstone and coal. Separated from underlying and overlying cyclothems by minor unconformities; base of Tarter sandstone is from 2 to 15 feet above Babylon coal; in many places, upper Tarter strata are truncated by Pope Creek sandstone which in one place cuts out Tarter coal; locally, Bernadotte sandstone cuts out entire Pope Creek cyclothem and rests on Tarter strata. Type locality and derivation of name given.

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 53 (table 2), pl. 1. In Abbott formation (new). Above Babylon cyclothem and below Pope Creek cyclothem. Presentation of new rock-stratigraphic classification of Pennsylvanian strata in Illinois; cyclical classification is independent of rock-stratigraphic classification.

Type section: Ravine, one-fourth mile southwest of bridge, in SE¼ sec. 2, T. 5 N., R. 1 E., Vermont quadrangle, Fulton County. Named for Tarter Bridge over Spoon River.

**Tarter Member** (of Abbott Formation)

Tarter Member (of Tradewater Formation)

Tarter Sandstone (in Tradewater Group)

Lower Pennsylvanian: Western Illinois.

C. B. Read, 1947, Jour. Geology, v. 55, no. 3, pt. 2, p. 275. Incidental mention as member of Tradewater formation in discussion of Pennsylvanian floral zones and provinces.

H. R. Wanless, 1957, Illinois Geol. Survey Bull. 82, p. 50 (fig. 22), 66, 67, geol. sections 5, 7, 26, 33–35, 41. A sandstone in Tarter cyclothem. Light gray or bluish gray locally discolored by carbonaceous matter; commonly argillaceous; at several localities, consists of irregular nodular masses at base of underclay. Thickness a few inches to 3 feet; where more than 1 foot thick, sandstone appears to be rather massive. Base of sandstone varies from 2 to 15 feet above Babylon coal.

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 31. Name Tarter sandstone discontinued so that term Tarter may be applied to coal member of Abbott formation (new). Sandstone is only locally present and no replacement name is considered necessary.

Type locality (cyclothem): Ravine one-fourth mile southwest of bridge in SE¼ sec. 2, T. 5 N., R. 1 E., Fulton County. Named for Tarter Bridge over Spoon River.

Tascotal Formation (in Buck Hill Volcanic Series)

Oligocene and younger (?): Western Texas.

S. S. Goldich and C. L. Seward, 1948, West Texas Geol. Soc. [Guidebook] Fall Field Trip Oct. 29–31, p. 14 (table 1), 17 (fig. 3), 21–22. In Tascotal quadrangle, consists of two lithologic facies: (1) thin-bedded flaggy sandy light-colored tuff in lower part, and (2) coarse-grained crossbedded tuffaceous gray-buff sand in upper part; some conglomerate, breccia, and ash beds occur in both facies. Approximately 800 feet thick. Lies on eroded surface of Mitchell Mesa rhyolite; underlies flows of Rawls basalt. Tertiary.

R. L. Erickson, 1953, Geol. Soc. America Bull., v. 64, no. 12, pt. 1, p. 1358 (table 1), 1365–1368, pl. 1. At type locality, where it is 797 feet thick, it is divided into two members: (1) a lower member of tuff and sandy tuff beds, and (2) an upper member of sandstone, tuffaceous sandstone, and conglomerate. Overlies Mitchell Mesa tuff-flow; underlies Rawls basalt.

W. N. McAnulty, 1955, Geol. Soc. America Bull., v. 66, no. 5, p. 536 (table 1), 555, pl. 1. Described in Cathedral Mountain quadrangle where it has a maximum thickness of 462 feet; thins northward to 50 feet on butte west of McIntyre Peak where it is capped by Rawls basalt. Oligocene and younger (?).

Type locality: At Wire Gap, Presidio County. Named for high mesa in Tascotal Mesa quadrangle.

Tassia Wash Group

Tertiary (?) (pre-Pliocene): Northwestern Arizona.

C. R. Longwell, 1936, Geol. Soc. America Bull., v. 47, p. 1414–1415, pl. 1. Consists of (ascending): fine-grained compact limestone and sandstone with calcareous cement, in layers 3 to 10 feet thick, over 200 feet thick; limestone and sandstone interbedded with buff siltstone, thickness about 50 feet; buff siltstone, weathering to earthy incoherent silt, thickness about 50 feet; and coarse limestone breccia [this may or may not be unit referred to as Greggs breccia], firmly cemented, with reddish sandy matrix, thickness 60 feet. In structural conformity with underlying Kaibab.

In Tassai Wash east of gap where wash cuts through Tassai Ridge.

†Tassajara (lake?) Bed[1]

Pliocene (?): Western California.

Original reference: J. G. Cooper, 1894, California Acad. Sci. Proc., 2d ser., v. 4, p. 170.

Probably named for exposures on Tassajero (Tassajara) Creek, Alameda County.

**Tassajero Formation**[1]

Pliocene or Pleistocene: Western California.

Original reference: B. L. Clark, 1933, Geol. Soc. America Bull., v. 44, no. 1, p. 151.

B. L. Clark, 1940, (abs.) Geol. Soc. America Bull., v. 51, no. 12, pt. 2, p. 1957. Underlies Green Valley formation.

C. E. Weaver and others, 1944, Geol. Soc. America Bull., v. 55, no. 5, p. 585, chart 11. At type section, consists largely of lacustral deposits, mostly sandstones and shales with thin beds of fresh-water limestones. At base is 200 to 300 feet of volcanic ash referred to as "Moraga" tuff. Overlies Green Valley formation. Lower Pliocene.

Type section: On south and southeast side of Mount Diablo where it is crossed by Tassajero Creek, Contra Costa County.

†Tatalina Group[1]

Precambrian, Cambrian(?), and lower Ordovician: Northeastern Alaska.

Original reference: L. M. Prindle, 1913, U.S. Geol. Survey Bull. 525, p. 37–38.

Typically exposed in valley of Tatalina River, Yukon-Tanana region.

Tate Formation (in McMillan Group)

Tate Member (in McMillan Formation)[1]

Upper Ordovician: Central Kentucky and southwestern Ohio.

Original reference: A. F. Foerste, 1906, Kentucky Geol. Survey Bull. 7, p. 19, 212.

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. The Tate is a comparatively nonfossiliferous gray shale and fine-grained argillaceous limestone occupying interval between the Fairmount and the Gilbert. Northward on eastern flank of Cincinnati arch, the Bellevue wedges in at the base. Thickness 60 to 80 feet.

Traceable from Casey and Boyle Counties, Ky., to Adams County, Ohio. Derivation of name not stated.

**Tatina Group**[1]

Ordovician and Silurian(?): Central southern Alaska.

Original reference: A. H. Brooks, 1911, U.S. Geol. Survey Prof. Paper 70, p. 55, 69–73, map.

Type exposure: In upper basin of Tatina River, formerly called Rohn River, in Mount McKinley region.

**Tatman Formation**[1]

Eocene, lower: Northern Wyoming.

Original reference: W. J. Sinclair and W. Granger, 1912, Am. Mus. Nat. History Bull., v. 31, p. 60–62.

F. B. Van Houton, 1944, Geol. Soc. America Bull., v. 55, no. 2, p. 185 (table 2), 191–199. Conformably overlies Willwood formation (new). Consists of about 870 feet of alternating fine-grained sandstone and laminated brown carbonaceous shale, swamp and lake deposits.

R. L. Hay, 1956, Am. Assoc. Petroleum Geologists Bull., v. 40, no. 8, p. 1880, 1886. In Absaroka Range, overlies Willwood formation and underlies Pitchfork formation (new).

Named for Tatman Mountain. Bighorn Basin.

Tatman Mountain Gravels[1]

Oligocene(?) or Eocene: Northern Wyoming.

Original reference: W. J. Sinclair and W. Granger, 1911, Am. Mus. Nat. History Bull., v. 30, p. 88, 105–111.

H. E. Wood 2d and others, 1941, Geol. Soc. America Bull., v. 52, no. 1, p. 32. Age post-Wasatchian but otherwise uncertain.

Occur on Tatman Mountain, Bighorn Basin.

Tatow Limestone

Lower Cambrian: Central western Utah.

Charles Deiss, 1938, Geol. Soc. America Bull., v. 49, no. 7, p. 1138–1139, 1141 (fig. 5), 1143–1144. Walcott, in his House Range section (1908, Smithsonian Misc. Colln., v. 53, no. 1812), doubtfully correlated limestone above Pioche shale with the Langston of Blacksmith Fork and assigned it to Middle Cambrian. Rocks overlying Pioche form cliffs in House Range, weather to red-brown slopes similar to those formed of Langston limestone in Blacksmith Fork, and occupy relatively same position in section. However, these rocks in House Range are not dolomitic, contain more arenaceous shale, and also contain a *Poulsenia* fauna considered to be Lower Cambrian in age. These rocks cannot be correlated with Middle Cambrian Langston and are here named Tatow limestone. Lower 40 feet consist of gray fine-grained limestone which contains tan clay flakes and nodules, calcareous platy sandstone, and micaceous shale partings. Upper 125 feet composed of steel-, tan-, and blue-gray more or less oolitic and arenaceous limestone; interbedded with green-gray argillaceous calcareous thin-bedded sandstone; irregular zones or partings of fissile to chunky arenaceous and micaceous shale. Poorly preserved fossils in limestones 50 feet above base and 32 feet below top. Overlies Pioche shale; underlies Howell limestone (emended); boundary between Tatow and Howell placed arbitarily. Lower Cambrian (Waucobian).

H. E. Wheeler, 1948, Nevada Univ. Bull., Geology and Mining Ser., no. 47, p. 28–32. Unit termed Tatow limestone by Deiss is here assigned to Busby quartzite which is geographically extended into House Range. Pinches out in vicinity of Pioche, Nev.

Type section: Measured 1½ miles north of Marjum Pass, House Range, Millard County. Name derived from Tatow Knob 14 miles north of Marjum Pass.

Tau Trachyte

Pliocene and lower Pleistocene(?): Samoa Island (Tutuila).

H. T. Stearns, 1944, Geol. Soc. America Bull., v. 55, no. 11, p. 1285 (table 1). Named in list of eight trachytes, which 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. Tau plug associated with Pago volcanic series (new).

Taunton Clays[1]

Pleistocene: Massachusetts.

Original reference: J. B. Woodworth, 1896, U.S. Geol. Survey 17th Ann. Rept., pt. 1, p. 986.

Occurs near Taunton, Bristol County.

**Taylor Marl[1]**

Taylor Group

Upper Cretaceous (Gulf Series): Central and eastern Texas.

Original reference: R. T. Hill, 1892, Artesian Invest. Final Rept., pt. 3, p. 73, Cong., 1st Sess., S. Ex. Doc. 41, pt. 3.

L. W. Stephenson, 1918, U.S. Geol. Survey Prof. Paper 120–H, p. 154–157. Taylor marl overlies Austin chalk and underlies Navarro formation. Includes Pecan Gap chalk and Wolfe City sand members (both new).

L. W. Stephenson, 1937, U.S. Geol. Survey Prof. Paper 186–G, p. 133–146. Unconformity of regional extent separates Austin chalk and beds of Austin age from overlying Taylor marl and beds of Taylor age. Time value of unconformity varies greatly from place to place along strike, owing in part to unequal erosion at top of Austin and in part to differential warping in early Taylor time. Differential warping caused deposition of Taylor sediments to begin earlier in Waco area than elsewhere; there thickness of lower Taylor sediments below Pecan Gap chalk member is 900 feet; minimum thickness or complete absence of lower Taylor sediments beneath beds of Pecan Gap age is between New Braunfels and San Antonio. Field relations of traceable beds in Red River and Lamar Counties indicate that Annona chalk as a whole is time equivalent of lower part of Taylor marl, Wolfe City sand member, and the typical Pecan Gap chalk.

H. B. Stenzel, 1938, Texas Univ. Bur. Econ. Geology Pub. 3818, p. 37–45. Taylor group is oldest of formations exposed in Leon County [this report]. At the outcrops, the group consists of several formations which change considerably in thickness along strike. Some of the formations wedge out completely. On account of these lateral changes, the subsurface section of the Taylor is more readily comparable with surface section of the Taylor in counties along Red River. In counties along Red River, the group is divided into (ascending) Brownstown marl, Gober chalk, lower Taylor marl (partial equivalent of Ozan formation of Arkansas), Wolfe City sand, Pecan Gap chalk, upper Taylor marl (equivalent of Marlbook marl of Arkansas).

D. L. Frizzell, 1954, Texas Univ. Bur. Econ. Geology Rept. Inv. 22, p. 39–49. Group comprises (ascending) lower marl, Annona chalk, Wolfe City sand, Pecan Gap chalk, Anacacho limestone (upper part), upper marl, and Neylandville marl. Overlies Austin strata; underlies Navarro group restricted to exclude Neylandville marl. Foraminifera described.

Named for Taylor Prairie, central Texas. Typically developed in vicinity of Taylor, Williamson County, and in Travis County.

**Taylor Meta-Andesite[1]**

Mississippian: Northern California.

Original reference: J. S. Diller, 1908, U.S. Geol. Survey Bull. 353.

J. M. Weller and others, 1948, Geol. Soc. America Bull., v. 59, no. 2, chart 5 (column 14). Shown on correlation chart above Arlington formation and below Pennsylvanian (?) Shoofly formation.

Named for exposures around Taylor Rock, Taylorsville region.

Taylor Sandstone (in Greene Formation)[1]

Permian: Southwestern Pennsylvania and northern West Virginia.

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

R. L. Nace and P. P. Bieber, 1958, West Virginia Geol. Survey Bull. 14, p. 17 (table 2). Listed in summary of stratigraphic sections of Dunkard group in Harrison County. Thickness about 30 feet. Lies between middle and upper Rockport limestones.

Thomas Arkle, Jr., 1959, Geol. Soc. America Guidebook Pittsburgh Mtg., p. 118 (table). Listed in Greene series.

Named for Taylor Township, Greene County, Pa.

Taylor Branch Limestone[1]

Taylor Branch Limestone Member (of Burlingame Formation)

Pennsylvanian (Virgil Series): Southeastern Nebraska, southwestern Iowa, and northeastern Kansas.

Original reference: G. E. Condra, 1935, Nebraska Geol. Survey Paper 8, p. 5, 10.

E. H. Wenberg, 1942, Iowa Acad. Sci. Proc., v. 49, p. 343 (fig. 6). Listed as Taylor Branch limestone in insoluble residue correlations of Missouri and Virgil strata in Iowa.

G. E. Condra and E. C. Reed, 1943, Nebraska Geol. Survey Bull. 14, p. 45–46. In Nebraska, Burlingame limestone includes (ascending) Taylor Branch limestone, Winnebago shale, and South Fork limestone members.

Type locality: In clay pit south of Taylor Branch south of Table Rock, Pawnee County, Nebr.

Taylor Brook Formation or Injection Gneiss

Cambrian (?): Southwestern Maine.

L. W. Fisher, 1938, (abs.) Geol. Soc. America Proc. 1937, p. 81. Five mappable units established in area formerly mapped as Precambrian in southwestern Maine. Sequence (ascending) Danville-Pejepscot (new) series; Taylor Brook injection gneiss (new) including a sedimentary amphibolite; Androscoggin series; and Thorncrag-Sabbatus series. Middle Silurian.

L. W. Fisher, 1941, Geol. Soc. America Bull., v. 52, no. 1, p. 115–117, pl. 1, table 1 (facing p. 112). Coarse-grained quartz-feldspar-biotite gneiss with a few finely granulated quartzite lenses. Thickness 3,500 feet. Conformably underlies Androscoggin formation overlies Pejepscot formation. Cambrian (?). Type locality given.

Type locality: In Taylor Brook in western part of city of Auburn, Androscoggin County. Covers an area of about 10 square miles.

Taylors Falls Member (of Franconia Formation)

Upper Cambrian (St. Croixian): East-central Minnesota.

C. R. Stauffer, G. M. Schwartz, and G. M. Thiel, 1938, (abs.) Geol. Soc. America Bull., v. 49, no. 12, pt. 2, p. 1901–1902. Named in a list of

Minnesota Upper Cambrian formations. Underlies Minneiska member (new) or Hudson member; overlies Ironton 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. Typically a sandstone but may include much shaly sandstone, glauconitic sand, and even some dolomitic beds as traced away from type locality. Member is a northward continuation of type section of Franconia sandstone and, hence, of *Conapsis* zone. In Minnesota, name is preferred to term Goodenough member as used by Twenhofel, Raasch, and Thwaites (1935) for same faunal zone. Underlies Hudson member; overlies Ironton member. Derivation of name given.

R. R. Berg, 1954, Geol. Soc. America Bull., v. 65, no. 9, p. 867. Abandoned in preference to Mazomanie member.

Named from outcrop along Taylors Falls Highway near southwest corner of Interstate Park at the Dalles of St. Croix River, Chisago County.

**Taylorsville Formation**[1]

Silurian: Northern California.

Original reference: J. S. Diller, 1892, Geol. Soc. America Bull., v. 3, p. 370–394.

C. W. Merriam, 1940. Geol. Soc. America Spec. Paper 25, p. 48. Devonian age questioned because of lack of faunal evidence.

P. A. Lydon, T. E. Gay, Jr., and C. W. Jennings, 1960, Geologic map of California (1:250,000): Westwood sheet, California Div. Mines. Largely slate and graywacke, with lesser amounts of conglomerate, breccia and metamorphosed dikes and sills. Mapped with Silurian marine sedimentary and metasedimentary rocks.

Named for exposures on east face of spur above the limestone about 1 mile south of Taylorsville, Plumas County.

Taylortown Limestone (in Washington Formation)[1]

Permian: Southwestern Pennsylvania.

Original reference: E. V. d'Invilliers, 1895, Pennsylvania 2d Geol. Survey Summ. Final Rept., v. 3, pt. 2, p. 2577.

Probably named for Taylorstown or Taylorstown Station, Washington County.

**Tazewell Stade**

Tazewell Loess,[1] Drift, Till

Tazewell (Tazewellian) Substage[1] and Subage

Pleistocene (Wisconsin): Mississippi Valley.

Original reference: M. M. Leighton, 1933, Science, v. 77, p. 168.

J. C. Frye and A. B. Leonard, 1952, Kansas Geol. Survey Bull. 99, p. 24, 36, 37, 44, 50, 52, 123, 128. Bradyan subage (new) occurs between Tazewellian and Caryan subages. Report also mentions Tazewell substage, loess and till.

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 than 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. Deposition of Tazewell loess occurred in central Iowa during period 15,000 to 17,000 years before present. Minimum date of Tazewell-Cary interstadial is 15,000 years.

V. C. Shepps, 1959, Pennsylvania Geol. Survey, 4th ser., Bull. G-32, p. 22-30. Advance during Tazewell substage in northwestern Pennsylvania is named Mogadore. Till deposited is named Mogadore.

J. C. Frye and H. B. Willman, 1960, Illinois Geol. Survey Circ. 285, p. 7. Presentation of revised time-stratigraphic classification of Wisconsinan stage in Lake Michigan glacial lobe. From former classification, the Woodfordian substage (new) includes Iowan substage of Illinois usage (but not of the type), the Tazewell and Cary 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. Tazewell glacial substage is separated from older Iowan glacial substage by Gardena intraglacial substage and from younger Cary glacial substage by St. Charles intraglacial substage. Author [Leighton] disagrees with classification presented by Frye and Willman (1960) in which they included Iowan substage (of Illinois), Tazewell substage, and Cary substage in Woodfordian substage. Leighton believes that Frye and Willman overlooked fact that some of Tazewell and Cary drifts in eastern Illinois which they include in their "Woodfordian" are from Saginaw lobe, not Michigan lobe, Frye and Willman named Tazewell loess Richland; this name is superfluous.

Name amended to Tazewell Stade to comply with Stratigraphic Code adopted 1961.

Name derived from Tazewell, Tazewell County, Ill.

**Teanaway Basalt**[1]

Eocene: Central Washington.

Original reference: G. O. Smith and B. Willis, 1901, Am. Inst. Min. Engineers Trans., v. 30, p. 359.

C. E. Weaver, 1937, Washington [State] Univ. Pubs. in Geology, v. 4, p. 26 (table), 38-39. Basaltic lava flows and intercalated tuffs, possibly in part equivalent to Metchosin volcanics of western Washington. Thickness 100 to 4,000 feet. Lower to middle Eocene.

R. J. Foster, 1960, Geol. Soc. America Bull., v. 71, no. 2, p. 101 (table 1), 107-108, pl. 1. Area herein discussed [northern parts of Mount Stuart and Snoqualmie folios] contains main body of Teanaway which is composed of basaltic lava complexly interbedded with sedimentary and pyroclastic rocks. In type area, more than 5,000 feet thick and consists of basaltic lava, tuff, and lapilli-tuff; upper part of section primarily clastic with tuff and lapilli-tuff predominating; some columnar basalt. Lies unconformably above Swauk formation, and locally Silver Pass volcanic rocks (new). Overlain by Roslyn formation, Yakima basalt, and post-Roslyn rhyolite; the Roslyn, oldest of the three formations, concordantly overlies the Teanaway; the other two are unconformable. Unfossiliferous. Stratigraphic relationships suggest a tentative Eocene age.

Type area (Weaver, 1937): Basin of Teanaway River where lavas are exposed on south flank of Wenatchee Mountains and dip in southerly direction beneath later sedimentary and volcanic formations in Yakima

Valley. Type area (Foster, 1960): Along Middle Fork of Teanaway River. [This is interpreted by Foster to be area that Smith intended for type.] Crops out in an arcuate band, up to 4 miles wide, extending from east of Kachess Lake to Table Mountain. Exposures of Teanaway essentially represent a cross section through a volcanic field.

**Teapot Sandstone Member** (of Mesaverde Formation)[1]

Teapot Sandstone Member (of Parkman Sandstone)

Upper Cretaceous: Eastern Wyoming.

Original reference: V. H. Barnett, 1915, U.S. Geol. Survey Bull. 581, p. 113.

C. H. Wegemann, 1918, U.S. Geol. Survey Bull. 670, p. 22–23. Uppermost member of Mesaverde formation in Salt Creek oil field, Wyoming. Thickness about 50 feet. Separated from underlying Parkman sandstone member by about 325 feet of shale (unnamed). Underlies Lewis shale.

E. I. Rich, 1958, Am. Assoc. Petroleum Geologists Bull., v. 42, no. 10, p. 2435–2436. Forms top of Mesaverde formation in southwestern part of Powder River and southeastern part of Wind River basin. Overlies unnamed middle member. Underlies Lewis shale in some areas and in other areas Meeteetse formation. In southeastern part of Wind River basin, member is overlain by rocks containing marine faunal assemblage characteristic of Bearpaw shale of Montana and is underlain by rocks probably equivalent to upper Claggett shale or lower part of Judith River formation. Age limits are restricted and the Teapot member is, in area of this report, of late Judith River or early Bearpaw age. Not recognized in surface or subsurface in Big Horn basin.

J. M. Parker, Jr., 1958, Wyoming Geol. Assoc. Guidebook 13th Ann. Field Conf., p. 90, 98. Present subsurface and outcrop control makes it possible to show that type Teapot is part of original Parkman, as first described near Parkman and later defined on Crow Indian Reservation. Hence, Parkman should be treated as formation with Teapot sandstone as uppermost member.

Named for Teapot Rock, a topographic feature carved from this sandstone about one-half mile east of Casper-Salt Creek Road.

**Teapot 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).

Largest exposure of Teapot Mountain porphyry is on ridge south of Teapot Mountain and west of the metallized schist area, Ray district.

Teay Formation[1]

Pleistocene: Southwestern West Virginia.

Original reference: M. R. Campbell, 1900, U.S. Geol. Survey Geol. Atlas, Folio 69.

Forms floor of Teay Valley, Cabell County.

Tebo Formation (in Cabaniss Group)

Tebo Formation (in Cherokee Group)

Pennsylvanian (Des Moines Series): Missouri and Kansas.

H. S. McQueen, 1943, Missouri Geol. Survey and Water Resources, 2d ser., p. 78–83, 100, 101, 102, 103, measured sections, pl. 5. Name Tebo was originally given to coal seam, type locality of which is on Tebo Creek, Henry County. Associated with coal is an underclay and overlying black roof slate which appear to make a unit. Name Tebo formation is applied to this unit. Unconformably overlies Loutre formation; unconformably underlies Ardmore formation. Thickness as much as 9 feet.

W. V. Searight and others, 1953, Am. Assoc. Petroleum Geologists Bull., v. 37, no. 12, p. 2748 (fig. 1). Stratigraphic column shows Tebo formation above Weir formation and below Scammon formation. Cabaniss group.

C. C. Branson, 1954, Oklahoma Geol. Survey Guide Book 2, p. 5. Listed as coal cycle in Senora formation, Cabaniss group in Oklahoma.

W. V. Searight, 1955, Missouri Geol. Survey and Water Resources Rept. Inv. 20, p. 22 (fig. 11), 23 (fig. 12). Thickness about 17½ feet in Vernon County, Mo. Underlies Tiawah limestone in Scammon formation, Cabaniss group.

W. B. Howe, 1956, Kansas Geol. Survey Bull. 123, p. 22 (fig. 5), 48–52, measured sections. In southeastern Kansas, the following divisions recognized: dark- to light-gray silty to sandy shale at base, impure limestone, underclay, and Tebo coal. Thickness ranges from few inches to about 26 feet. Overlies Weir formation; underlies Scammon formation. Cabaniss subgroup of Cherokee group.

Type locality: Tebo Creek, Henry County, Mo.

Tecolote Member (of Santa Rosa Island Formation)

Pleistocene: Santa Rosa Island, California.

P. C. Orr, 1960, Geol. Soc. America Bull., v. 71, no. 7, p. 1113, 1115 (fig. 2), 1116–1118. Consists of buff-colored clays and clay sands, old soil profiles, and thin lenses of subangular gravel; many minor unconformities representing stream channelling and at least one major unconformity in which thick layer of coarse gravel was deposited about midway in member. In some areas, earth has been burned brick red; many of these fire areas contain charred bones of dwarf mammoth and are attributed to activities of early man. One fire area about midpoint in sequence radiocarbon dated at 29,700 ± 3,000 years B. P. Upper part of sequence dated 12,000 years B. P. Thickness about 60 feet. Uppermost member of formation. Overlies Fox member.

Tecopa Shale

Lower and Middle Cambrian: Southeastern California and southeastern Nevada.

H. E. Wheeler, 1948, Nevada Univ. Bull., Geology and Mining Ser., no. 47, p. 27–28, fig. 5. Name applied to shales that lie between Zabriskie quartzite below and Lyndon limestone above. Thickness 1,119 feet. Cadiz formation of Hazzard and Mason (1936) not considered valid lithologic unit, nor is it applicable to strata in question; neither is Bright Angel as used by Nolan (1929, Am. Jour. Sci., 5th, v. 17, no. 101) in Spring Mountain area, Nevada, applicable, hence new name proposed.

W. H. Easton and others, 1953, Am. Assoc. Petroleum Geologists Bull., v. 37, no. 1, p. 148. In suggested revision of stratigraphic units in Great Basin area, Tecopa shale is included in Wood Canyon formation.

Type section: About 6 miles northeast of Tecopa, Inyo County, Calif., near southern end of Resting Springs Range. This is Hazzard's (1938 [1937], California Jour. Mines and Geology, v. 33, no. 4) section extending from top of Zabriskie quartzite (unit 4H) to base of Lyndon limestone (unit 5E) in cross-section B–B'. Present at west base of Eagle Mountain, near Death Valley Junction, and on west side of mountains immediately west of Shoshone.

**Tecovas Formation** (in Dockum Group)[1]

Upper Triassic: Northwestern Texas.

Original reference: C. N. Gould, 1907, U.S. Geol. Survey Water-Supply Paper 191, p. 20–29.

G. Maxwell, 1954, *in* Panhandle Geol. Soc. [Guidebook] Field Trip May 1, p. 15. Underlies Trujillo formation; west-central Potter County where the Trujillo is absent, the Tecovas underlies Tertiary sediments.

Named for exposures on Tecovas Creek, Potter County.

Tecumseh 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, 28–29, pl. 2. Thin-bedded to massive and commonly lavender colored. A buff to yellow sandstone, prominently iron-stained and as much as 6 feet thick, occurs near middle of unit on Tecumseh Hill and along east face of White Reef near Thompson mine. Thickness on Tecumseh Hill in main mining area about 35 to 40 feet; to the north near Barbee mine about 30 feet or less, and on East Reef at Duffin mine about 50 feet. Thickness increases east of Leeds. Underlies Duffin sandstone and shale (new) with local unconformity; overlies Leeds sandstone (new) with local unconformity.

Named for exposures on Tecumseh Hill, Silver Reef (Harrisburg) Mining District, Washington County.

**Tecumseh Shale** (in Shawnee Group)[1]

Tecumseh Shale Member (of Shawnee Formation)[1]

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

Original reference: J. W. Beede, 1898, Kansas Acad. Sci. Trans., v. 15, p. 28.

G. E. Condra, 1949, Nebraska Geol. Survey Bull. 16, p. 23. As currently defined, underlies Ozawkie limestone member of Deer Creek formation and overlies Avoca limestone member of Lecompton formation. In Nebraska, divided into (ascending) Kenosha shale, Ost limestone, and Rakes Creek shale formation. Thickness in Nebraska about 36 feet; 65 feet at type locality; 12 feet at south line of Kansas.

H. G. Hershey and others, 1960, Iowa Highway Research Board Bull. 15, p. 18–19, fig. 5. Comprises (descending) Rakes Creek shale, Ost limestone, and Kenosha shale members. Not differentiated in some areas. Where the two lower members of Deer Creek cannot be differentiated they are often included in the Tecumseh. Thickness about 10 ft. Underlies Deer Creek formation; overlies Lecompton formation. Shawnee group.

Type locality: Tecumseh, Shawnee County, Kans.

Tecuya Beds[1] or Formation

Oligocene or Miocene: Southern California.

Original reference: C. Stock, 1920, California Univ. Pub., Dept. Geol. Bull., v. 12, no. 4.

J. G. Marks, 1941, (abs.) Geol. Soc. America Bull., v. 52, no. 12, pt. 2, p. 1922. Referred to as Tecuya formation consisting of continental deposits of Oligocene or Miocene age. Unconformably overlies Tejon formation at its type locality; in Reed and Grapevine Canyons, underlies Tertiary dacite agglomerate and a flow of andesite.

Exposed in vicinity of Tecuja [Tecuya] Canyon in lower part of San Joaquin Valley, Kern County.

**Teewinot Formation**

Pliocene, middle: Northwestern Wyoming.

J. D. Love, 1956, Am. Assoc. Petroleum Geologists Bull., v. 40, no. 8, p. 1899, 1907–1911, fig. 1. Succession of white limestone, tuff, pumicite, claystone, and conglomerate. Three facies developed in type area: a basal conglomerate, at least 1,400 feet thick; a middle limestone and pumicite, over 3,300 feet thick; and an upper claystone and pumicite, more than 400 feet thick. Unconformably overlain by Bivouac formation (new). Unconformably overlies rocks ranging in age from Cambrian to Miocene.

Type section: In and adjacent to Jackson Hole National Elk Refuge, Teton County, in T. 42 N., R. 115 W., and sec. 36, T. 42 N., R. 116 W. Name derived from Mount Teewinot, a sharp peak east-northeast of the Grand Teton, overlooking type area of formation in bottom of Jackson Hole at the east.

Tehachapi Formation[1]

Quaternary (?): Southern California.

Original reference: H. G. Hanks, 1886, California State Mining Bur. 6th Ann. Rept., pt. 1, p. 23.

Occurs one-half mile from town of Tehachapi, Kern County, on road to Caliente, also 9 miles west of Tehachapi, in Bright's Valley.

Tehachapi Marble[1]

Age not stated: Southern California.

Original reference: H. G. Hanks, 1886, California State Mining Bur. 6th Ann. Rept. State Mineralogist, pt. 1, p. 23.

Probably named for town of Tehachapi, Kern County.

**Tehama Formation**[1]

Pliocene: Northern California.

Original reference: R. D. Russell and V. L. Vander Hoof, 1931, California Univ. Pub., Dept. Geol. Sci. Bull., v. 20, no. 2, p. 11–21.

C. A. Anderson and R. D. Russell, 1939, California Jour. Mines and Geology, v. 35, no. 3, p. 232–235, pl. 3. Consists of silts, silty clays, sands, and gravels, predominantly pale and yellowish to greenish gray, weathering pale buff to yellow brown. Nomlaki tuff member at base. Thickness more than 2,000 feet in central part of Pliocene valley in which it accumulated, with Nomlaki tuff about 700 feet from base. Contemporaneous with Tuscan formation and interfingers with it in their zone of junction. Capped by Red Bluff gravels.

Named for Tehama County.

†Tehuacana Formation[1]

Eocene, lower: Eastern Texas.

Original reference: Julia Gardner, 1932, Geol. map of Texas, prelim. ed.

Tehuacana Bluff, the steep hill just west of town of Tehuacana, Limestone County.

**Tehuacana Member** (of Kincaid Formation)[1]

Paleocene: Eastern Texas.

Original reference: G. D. Harris, 1896, Bulls. Am. Paleontology, v. 1, no. 4, p. 129, 155.

Mackenzie Gordon, Jr., J. I. Tracey, Jr., and M. W. Ellis, 1958, U.S. Geol. Survey Prof. Paper 299, p. 13–14. Uppermost member of formation in Texas. Overlies Pisgah member. Consists of grayish-white fossiliferous limestone and greenish-gray calcareous sandstone.

G. R. Kellough, 1959, Gulf Coast Assoc. Geol. Soc. Trans., v. 9, p. 153, 159–160. In Tehuacana Creek section, Tehuacana member includes 35 feet of shaly sands and sandy limestones containing minor amounts of fine-grained glauconite. Overlies Pisgah member; underlies Mexia member of Wills Point.

Type locality: Abandoned quarry at Tehuacana, Limestone County

**Tejon Formation**[1]

Tejon Group

Tejon Stage

Eocene, upper: Western California.

Original reference: W. M. 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, p. 129.

B. L. Clark and H. E. Vokes, 1936, Geol. Soc. America Bull., v. 47, p. 853 (fig. 1), 864–868. Used as a stage name based on faunal assemblages. Occupies the interval between a transition stage above the Domengine stage and below the Gaviota stage.

J. G. Marks, 1941, (abs.) Geol. Soc. America Bull., v. 52, no. 12, pt. 2, p. 1922; 1943, California Div. Mines Bull. 118, pt. 3, p. 534–535. Formation subdivided into four members in type area (ascending): Uvas conglomerate, Liveoak, Metralla sandstone, and Reed Canyon silt. Type area designated; here Tejon marine sediments form a wedge of steeply dipping strata 410 feet thick at Pastoria Creek and 4,380 feet in Reed Canyon a quarter mile east of Tecuya Creek. Underlies Tecuya formation; overlies basement complex.

E. A. Watson, 1942, Am. Midland Naturalist, v. 28, no. 2, p. 451–456. Eocene section in Pacheco syncline is conformable sequence about 5,400 feet thick. Strata were mapped as two formations, Martinez and Tejon, by Merriam (1897, Jour. Geology, v. 5, no. 8), Dickerson (1914, California Univ. Dept., Geol. Sci. Bull. 8, no. 6), Lawson (1914, U.S. Geol. Survey Geol. Atlas, Folio 193), and Weaver (*in* Tolman, 1932, California Dept. Public Works Water Resources Bull. 28). Name Tejon was applied to upper 2,800 feet of beds on basis of supposed equivalence in age rather than on similarity in lithology to type Tejon in Kern County. Since exact contemporaneity is difficult to prove, and since these strata are far removed from type locality and cannot be traced into them, another formational name might be advisable or term Markley used instead. In present report, the strata in question are called "Tejon." Shales of lower 1,500 feet of formation carry foraminiferal faunules that probably fall in "Tejon and Transition stage" of Clark and Vokes (1936). Upper part of section thought to be equivalent in age to Kreyenhagen as mapped by Taff (1935, Geol. Soc. America Bull. v. 46, no. 7) on north side of Mount

Diablo. Overlies Martinez with contact gradational; underlies San Ramon formation.

W. C. Putnam, 1942, Geol. Soc. America Bull., v. 53, no. 5, p. 697 (fig. 3). Used as a group term in Ventura region; includes (ascending) Matilija, Cozy Dell, and Coldwater formations. Underlies Sespe formation; overlies undifferentiated Eocene.

C. E. Weaver and others, 1944, Geol. Soc. America Bull., v. 55, no. 5, p. 587–588, chart 11. Foraminifera of lower 250 feet of "Tejon" formation in Pacheco syncline suggest a correlation of this part of section with Canoas silt (basal) member of Kreyenhagen. Not certain whether basal part of Tejon of this syncline or upper part of Martinez formation should be correlated with type Domengine. On northeast flank of syncline, about 800 feet above base of "Tejon" are beds containing *Turritella uvasana aedificata*, which is also abundant in sandstone of "Domengine stage" on south side of Mount Diablo. Upper part of "Tejon" occupies same stratigraphic position and has same foraminiferal species at top as does Markley formation at its type locality.

J. C. Brice, 1953, California Div. Mines Bull. 166, p. 12 (fig. 2), 29–30, pls. 1, 2, 7. Described and mapped in Lower Lake quadrangle. Consists principally of a white conglomeratic sandstone about 1,000 feet thick. Unconformably underlies Cache formation; unconformably overlies Martinez formation.

C. E. Weaver, 1953, Washington [State] Univ. Pubs. in Geology 7, p. 5, 19 (correlation table). Eocene rocks south of Martinez in Concord quadrangle were mapped by Lawson (1914, U.S. Geol. Survey Geol. Atlas, Folio 193) as Martinez and Tejon formations. Contact as shown on maps of the San Francisco folio between the Martinez and Tejon on west limb of Pacheco syncline corresponds approximately to boundary between Escobar and Muir sandstones (both new) of present report. The Tejon of west limb of syncline is herein classified as Escobar sandstone and overlying Alhambra shale (new) with its three divisions. Tejon as mapped on east limb in San Francisco folio now includes the middle Eocene Muir sandstone, the upper Eocene Escobar sandstone, and Alhambra shale.

Type area: On north slope of Tehachapi Mountains at extreme south end of Joaquin Valley, between Pastoria Creek on the east and Tecuya Creek on the west. Named for occurrence in vicinity of Fort Tejon, Kern County.

Tejon Lookout Granite

Jurassic(?): Southern California.

J. C. Crowell, 1952, California Div. Mines Spec. Rept. 24, p. 10, pls. 1, 2. A light-buff medium- to coarse-grained biotite granite. Intrudes rocks similar to Lebec quartz monzonite (new); the Lebec and Tejon Lookout are probably related although now separated by Garlock fault.

Crops out in wedge-shaped area between San Andreas and Garlock faults and well exposed near Tejon Lookout, Lebec quadrangle.

Telegraph 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), 2181, 2183–2184. Thin- to thick-bedded mottled dolomite in alternating light- to dark-brown or dark-gray layers, and including a tongue (15 to 450 feet thick) of well-bedded gray limestone. At type section, represented by 2,000 feet of dolomite, uppermost beds cut out by faulting; 1,950 feet thick at Williams Canyon; 800 feet in northern Pinyon Range. Overlies Union Mountain member (new); underlies Devils Gate limestone.

Type locality: Telegraph Canyon, Sulphur Springs Range, Mineral Hill quadrangle.

**Telegraph Creek Formation** (in Montana Group)[1]

**Telegraph Creek Member** (of Cody Shale or Colorado Shale)

Upper Cretaceous: Central southern Montana.

Original reference: W. T. Thom, Jr., 1922, U.S. Geol. Survey Bull. 736–B, p. 38.

W. A. Cobban, 1950, Am. Assoc. Petroleum Geologists Bull., v. 34, no. 9, p. 1899–1900. Formation extended into Sweetgrass arch area, Montana. Unit has been included into Virgelle sandstone, mapped as separate formation and referred to as Transition zone, and termed Telegraph Creek(?). Fossil evidence definitely establishes Telegraph Creek age, and term can be used without query in this area.

P. W. Richards and C. P. Rogers, Jr., 1951, U.S. Geol. Survey Oil and Gas Inv. Map OM–111. Rank reduced to member status in Cody shale. Thickness 867 feet. Overlies Niobrara shale member; underlies shale member equivalent to Eagle sandstone. Report covers Hardin area, Big Horn, and Yellowstone Counties, Mont.

J. D. Love, J. L. Weitz, and R. K. Hose, 1955, Geologic map of Wyoming (1:65,000): U.S. Geol. Survey. Montana group as mapped in northwestern Wyoming includes Telegraph Creek, Eagle sandstone, Claggett shale, and Judith River formation.

W. A. Cobban and others, 1959, Am. Assoc. Petroleum Geologists Bull., v. 43, no. 12, p. 2792 (fig. 3), 2793. In Sweetgrass arch and East Glacier-Marias Pass areas, Montana, formation overlies Kevin shale member of Marias River shale (both new).

M. R. Mudge, 1959, Billings Geol. Soc. [Guidebook] 10th Ann. Field Conf., p. 19. Described in Sun River Canyon area, Montana, where it is 340 feet thick, underlies Virgelle sandstone and overlies Kevin shale member of Marias River formation. Divisible into three parts: lower fine-grained calcareous dark-gray sandstone with many 1- to 3-inch-thick beds of fine-grained calcareous dark-gray sandstone and sandy shale partings; middle, mostly beds of calcareous hard dense dark-gray sandstone, 0.4 to 1 foot thick, in places ripple marked and crossbedded; upper, beds (as much as 4 feet thick) of light-gray calcareous poorly indurated sandstone alternating with beds of equal thickness of gray calcareous sandy shale.

U.S. Geological Survey currently classifies the Telegraph Creek as a member of the Colorado Shale in the Bearpaw Mountains area, Montana, on the basis of a study now in progress.

Typically developed at head of Telegraph Creek, T. 2 S., Rs. 28 and 29 E., Crow Creek Indian Reservation, Mont.

†Telegraph Hill Sandstone (in Franciscan Group)[1]

Jurassic(?): Western California.

Original reference: R. Crandall, 1907, Am. Philos. Soc. Proc., v. 46, p. 3–58.

Named for exposures at Telegraph Hill, San Francisco.

Telescope Group[1]

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. Pub. Geol. Sci., v. 30, no. 5, p. 355, 378 (fig. 7). This study [Manly Peak quadrangle] has made possible correlation of formations defined by Murphy (1930, 1932 [1933]) in Telescope Peak quadrangle with formations now commonly used in Death Valley region. Relationships of Murphy's formations to standard Death Valley section have not been generally understood. Murphy tentatively assigned all units above the Panamint metamorphic complex to the Lower Paleozoic. Units of the Telescope group—Sour Dough limestone, Middle Park formation, Mountain Girl conglomerate, Wildrose formation, Sentinel dolomite, Redlands dolomitic limestone, and Hanaupah formation—are here correlated with Precambrian Kingston Peak, Noonday, and Johnnie formations.

Appears to be named for Telescope Peak, south part of Panamint Range, on and around which formations of group are mapped.

Television Sandstone (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). Black-weathering concretionary sandstone 100 feet thick. Overlies Marlife shale (new); underlies Uhalde sandstone and shale (new). Name credited to D. W. Sutton (unpub. thesis).

Type locality: Moreno Gulch, Fresno County. Name derived from Television Hill, NW cor. sec. 10, T. 14 S., R. 11 E.

Tellera or Tellara limestone[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, 11.

Exposed on east flank of Sandia Range in Sandia Mountains. Derivation of name not stated.

**Tellico Sandstone or Formation**

Tellico Sandstone (in Blount Group)[1]

Middle Ordovician: Southeastern Tennessee, northwestern Georgia, and western North Carolina.

Original reference: A. Keith, 1895, U.S. Geol. Survey Geol. Atlas, Folio 16, p. 4.

C. E. Prouty, 1946, Am. Assoc. Petroleum Geologists Bull., v. 30, no. 7, p. 1155, 1156. In Knoxville area, overlies Farragut limestone. Name proposed to replace "Holston" marble.

Charles Butts and Benjamin Gildersleeve, 1948, Georgia Geol. Survey Bull. 54, p. 29, geol. map. Formation in northwestern Georgia is predominantly a coarse-grained ferruginous sandstone with some shale and, in places, a conglomerate at base. Occurs as single narrow belt along extreme northeastern edge of Paleozoic area, extending southwestward a distance of about 8 miles from Tennessee-Georgia line to within 4 miles north of Eton, Murray County. Thickness about 500 feet. Blount group.

John Rodgers, 1952, Geology of the Athens quadrangle, Tennessee (1:24,000): U.S. Geol. Survey Geol. Quad. Map. The red quartzose limestone overlying the Athens has hitherto been called Tellico sandstone, but typical Tellico on Tellico River has quite different lithologic character and is probably of different age. Also, the red quartzose limestone that is usually called Tellico sandstone is associated with and grades laterally into red quartz-free limestone or "marble," and the two together form a mappable unit that seemingly is equivalent to typical Holston limestone.

John Rodgers, 1953, Tennessee Div. Geology Bull. 58, pt. 2, p. 69, 73, 75, 77, 78, 79, 80. In belt between Saltville fault and Knoxville and Rocky Valley faults, rocks that Keith and others have mapped as Tellico sandstone are included in Holston formation. On basis of this correlation, in belts southeast of Chestuee and Dumplin Valley faults and of Saltville fault northeast of Morristown, the typical Tellico sandstone of Keith occurs within the Athens shale and becomes the Tellico sandstone member of the Athens shale.

B. N. Cooper, 1953, Geol. Soc. America Mem. 55, p. 3 (fig. 1), 4. Discussion of trilobites of Appalachian Valley. Tellico sandstone is ferruginous clastic facies which is time equivalent of beds identified elsewhere as Athens, Sevier, or Ottosee.

R. B. Neuman, 1955, U.S. Geol. Survey Prof. Paper 274–F, p. 145 (table), 154–155, pl. 28. Term Tellico formation is applied in this report [Tellico-Sevier belt, eastern Tennessee] to a sequence of gray silty, sandy calcareous shale and calcareous sandstone 2,700 to 4,500 feet thick. Dominant rock is shale in which sandstone forms lenticular units. In general, sandstone units are concentrated near middle of formation, and it is to this part that Keith originally applied term Tellico sandstone. Formation as used in present report includes rocks above and below those originally included in term by Keith. As herein defined, it includes upper part of Athens formation, the Tellico formation, and that part of the Sevier formation beneath the "sandstone lentil" of the Knoxville and Loudon folios. Overlies Blockhouse shale (new) with contact gradational; conformably underlies Chota formation (new). Middle Ordovician. Classification used in this report differs from that used by Rodgers (1953).

G. A. Cooper, 1956, Smithsonian Misc. Colln., v. 127, pt. 1, p. 93–94. In its type belt, the Tellico overlies shales (Blockhouse) with graptolites that are partly equivalent to Athens formation and is overlain by shales and sandstones (Sevier) of uncertain correlation. In belts passing through Friendsville and Knoxville, the sands and calcarenites mistaken for Tellico overlie "Holston" marble (equivalent to Red Knobs) and are overlain by Sevier formation. In this belt, "Tellico" fossils are clearly related to those of Arline formation (new) and possibly fossils occurring as high as Benbolt. Probable that type Tellico is actually older than that of belts north of Athens. Entire interval of shales and sandstones from the Knox to base of Sevier formation is equivalent on basis of fossils to interval from top of Knox through the "Tellico"-Red Knobs of belts south of Knoxville.

Josiah Bridge, 1956, U.S. Geol. Survey Prof. Paper 277, p. 57. Term Blount group discarded.

J. M. Cattermole, 1955, U.S. Geol. Survey Geol. Quad. Map GQ–76. In Shooks Gap and Bearden quadrangles, Tennessee, strata previously mapped as Tellico are named Chapman Ridge sandstone.

Named for exposures in cut on Tellico River, Monroe County, Tenn.

Tellowa Formation (in Pottsville Group)[1]

Pennsylvanian: Southwestern Virginia and southern West Virginia.

Original reference: M. R. Campbell, 1897, U.S. Geol. Survey Geol. Atlas, Folio 44.

Type locality not stated.

**Telluride Conglomerate[1] or Formation**

Oligocene(?): Southwestern Colorado.

Original reference: W. Cross, 1901, U.S. Geol. Survey Bull. 182, p. 29–39.

E. S. Larsen, Jr., and Whitman Cross, 1956, U.S. Geol. Survey Prof. Paper 258, p. 14, 60, pl. 1. Predominantly coarse conglomerate containing pebbles and boulders of schist, granite, quartzite, limestone, and other rocks derived from Paleozoic sediments; local bodies of sandy limestone. As much as 1,000 feet thick. Unconformably overlies Cretaceous and older rocks and, locally, glacial till; underlies San Juan tuff. Contains no determinable fossils; age judged by relations to other formations. Believed to be nearly same age as Blanco Basin formation which is tentatively placed in Oligocene.

F. B. Van Houten, 1957, Geol. Soc. America Bull., v. 68, no. 3, p. 386, 387 (table 1), 388. There is no good evidence for assigning Telluride and apparently equivalent Blanco Basin formations an Oligocene(?) age. They are more probably arkosic border facies of upper Paleocene and lower Eocene San Jose (Wasatch formation).

Named for exposures about town of Telluride and throughout Telluride quadrangle.

**Temblor Formation[1] or Sandstone**

Temblor Group or Stage

Miocene, lower and middle: Southern California.

Original reference: F. M. Anderson, 1905, California Acad. Sci. Proc., 3d ser., v. 2, p. 168–187.

R. Anderson and R. W. Pack, 1915, U.S. Geol. Survey Bull. 603. Includes Big Blue serpentinous member (new).

J. E. Eaton, U. S. Grant, and H. B. Allen, 1941, Am. Assoc. Petroleum Geologists Bull., v. 25, no. 2, p. 196 (fig. 1), 204–205 (fig. 3), 212–213, 217 (fig. 4), 224–230. Discussion of Miocene of Caliente Range and environs. Marine Miocene is a transgressive series, essentially conformable basinward, but revealing, strandward, the occurrence of two oscillations which respectively inaugurate and divide its upper third. It comprises three nearly equal divisions, Vaqueros, Temblor, and Monterey stages, which approximate lower, middle, and upper Miocene. Each of these has more or less distinctive epeiorgenic history, fauna, and average physical aspect. 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.

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I. F. Wilson, 1943, California Jour. Mines and Geology, v. 39, no. 2, p. 213–215, 226 (fig. 5). Temblor group, in San Benito quadrangle, is represented by three mappable units: lower sandstone, 100 to 500 feet thick; shale in middle of section, 300 to 1,000 feet thick; and upper sandstone, 400 feet thick. They are exposed along axis of Butts Ranch syncline and are youngest rocks affected by the folding. Disconformably overlies Kreyenhagen shale. Middle Miocene.

A. M. Keen, 1943, San Diego Soc. Nat. History Trans., v. 10, no. 2, p. 25–60. Correlation chart of Kern River area shows Temblor comprises (ascending) Pyramid Hill sand, Freeman-Jewett silts, Olcese sand, and Round Mountain silt members. Principal cartographic unit in area is Round Mountain silt member; less widespread are Olcese sand and the Freeman-Jewett silt. Additional members of Temblor underlie the area but outcrop beyond borders of map.

M. D. Crittenden, Jr., 1951, California Div. Mines Bull. 157, p. 22 (fig. 4), 35–36, pl. 1. In San Jose-Mount Hamilton quadrangle, formation is 500 to 1,000 feet thick; continuous section not measured. Conformably overlies Franciscan and grades upward into Monterey shale; underlies Briones. Formation is limited on west by fault of the Calaveras system.

H. H. Heikkila and G. M. MacLeod, 1951, California Div. Mines Spec. Rept. 6, p. 4 (table 1), 5 (table 2), 7–11, pl. 1. Formation, in Bitterwater Creek area, Kern County, comprises (ascending) Agua sandstone, Santos undifferentiated, upper Santos shale, Carneros sandstone, and Media shale members, and unit termed "Button bed." Thickness as much as 5,350 feet. Overlies Point of Rocks formation; underlies Monterey shale. Lower and middle Miocene.

H. P. Smith, 1956, California Univ. Pubs. Geol. Sci., v. 32, no. 2, p. 68 (fig. 2), 71–72, geol. map. In Devils Den district, overlies Wagonwheel formation.

M. L. Hill, S. A. Carlson, and T. W. Dibblee, Jr., 1958, Am. Assoc. Petroleum Geologists Bull., v. 42, no. 12, p. 2986, 2989. Upper 900 feet of unit herein named Painted Rock sandstone member of Vaqueros formation was included by Eaton and others (1941) in their Temblor. Saltos shale member (new) of Monterey was mapped by Eaton and others as upper part of Temblor.

Named for exposures on Temblor Ranch, McKittrick district, Kern County.

Temecula Arkose

Pleistocene: Southern California.

J. F. Mann, Jr., 1955, California Div. Mines Spec. Rept. 43, p. 3, 9, 11–13, pl. 1. White to buff to greenish arkose, buff soil zone, brown silts, silicified algal marls, white tuff; about 600 feet thick. Underlies Pauba formation (new) with angular unconformity; overlies sediments tentatively considered as Paleocene.

Widely distributed in Elsinore fault zone in western Riverside and northern San Diego Counties. Named for exposures on Pechanga Indian Reservation, southeast of Temecula, Riverside County.

**Temescal Formation**[1]

Pleistocene: Western California.

Original reference: A. C. Lawson, 1914, U.S. Geol. Survey Geol. Atlas, Folio 193.

D. H. Radbruch, 1957, U.S. Geol. Survey Misc. Geol. Inv. Map I–239. Clayey gravel, silty sandy clay, and sand-clay-silt mixtures. Pale yellowish orange to dark yellowish orange. Thickness 5 to 60 feet. Grades laterally into Merritt sand; overlies Alameda formation. Pleistocene.

Named for development along Temescal Creek, Alameda County.

Temescal Porphyry[1]

Upper Jurassic(?): Southern California.

Original reference: P. H. Dudley, 1932, Geol. Soc. America Bull., v. 43, no. 1, p. 223.

A. O. Woodford, T. G. Moran, and J. S. Shelton, 1946, Am. Assoc. Petroleum Geologists Bull., v. 30, no. 4, p. 528. Name replaced by Temescal Wash dacite porphyry.

Occurs between towns of Riverside, San Jacinto, Corona, and Elsinore, Riverside County.

**Temescal Wash Quartz Latite Porphyry**

Temescal Wash Dacite Porphyry

Jurassic(?): Southern California.

A. O. Woodford, T. G. Moran, and J. S. Shelton, 1946, Am. Assoc. Petroleum Geologists Bull., v. 30, no. 4, p. 528. Referred to as Temescal Wash dacite porphyry. Dark-colored rock with plagioclase and quartz phenocrysts and inconspicuous biotite or hornblende. Replaces name Temescal dacite porphyry (Dudley, 1936).

E. S. Larsen, Jr., 1948, Geol. Soc. America Mem. 29, p. 36–38, pl. 1. Described as Temescal Wash quartz latite porphyry. Considered older than Woodson Mountain granodiorite. Relation to San Marcos gabbro not positively determined.

Exposed over wide area a few miles southeast of Puente Hills, southeast of Los Angeles.

Tempa Schist

Age not stated: Western North Carolina.

C. E. Hunter and P. W. Mattocks, 1936, Tennessee Valley Auth. Div. Geology Bull. 4, p. 13. Composed of muscovite, quartz, biotite, chlorite, and sometimes feldspar. Cut by hornblende intrusions which are very likely same age as gabbro from which Roan gneiss was derived.

Crops out on Tempa Mountain just east of Spruce Pine, Mitchell County. This mass has a width of a little over 1 mile and a length of 4 miles.

Temperance River Group[1]

Precambrian (Keweenawan): Northeastern Minnesota.

Original reference: R. D. Irving, 1883, U.S. Geol. Survey 3d Ann. Rept., p. 143–146, pl. 14.

Occurs along Temperance River.

Temperance River member[1]

Precambrian (Keweenawan): Northeastern Minnesota.

Original reference: A. H. Elftman, 1898, Am. Geologist, v. 21, p. 90–109, 175–188.

†Temple Bar Conglomerate[1]

Pleistocene, lower: 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. 1443. Term is confusing and should be abandoned because it was applied by Lee to deposits of widely different lithology and origin.

G. S. Lasky and B. N. Webber, 1949, U.S. Geol. Survey Bull. 961, p. 38. Name apparently applied to most of deformed valley deposits of northwestern Arizona which are now included in Sandtrap conglomerate (new), Chapin Wash formation (new), and Artillery formation (new).

Typically exposed near mouth of Virgin River at Temple Bar, northwest corner of Mohave County.

**Temple Butte Limestone**[1]

Upper(?) Devonian: Northern Arizona.

Original reference: C. D. Walcott, 1889, Geol. Soc. America Bull., v. 1, p. 50.

R. H. Denison, 1951, Fieldiana: Geology, v. 11, no. 5, p. 254. In Upper Devonian (Chemung stage).

T. F. Stipp and H. M. Beikman, 1959, U.S. Geol. Survey Oil and Gas Inv. Map OM–201. Included in stratigraphic section of rocks in northwestern and central Arizona. Upper(?) Devonian.

Named for Temple Butte, 3 miles south of junction of Little Colorado River with Colorado River.

**Temple Cap Member** (of Navajo Sandstone)

Jurassic: Southwestern Utah.

R. K. Grater, 1948, Am. Jour. Sci., v. 246, no. 5, p. 312, 313. Sandstone composed of crossbedded, red, tan, or yellowish deposits. Uppermost part of Navajo; overlies several hundred feet of white crossbedded sandstone.

H. E. Gregory, 1950, U.S. Geol. Survey Prof. Paper 220, p. 51 (table), 89, pl. 5. Upper part of member is cliff-forming sandstone, generally massive and strongly crossbedded but in places obscurely or definitely separated into layers 5 to 20 feet thick, most of them crossbedded. Lower part is miscellaneous assemblage of irregularly bedded shaly calcareous sandstones, siliceous limestones, and limestone conglomerates colored red, gray, or brown. Entire member not everywhere present and Carmel formation lies directly on central massive Navajo bed. Along Zion-Carmel highway, upper part, 70 to 180 feet thick, is intricately crossbedded mass divisible into thick beds, and lower part, 6 to 30 feet thick, a series of lenticular sandstones; east of Kanab Canyon upper division becomes thinner, less massive, and more varied in composition and lower part becomes thicker and more calcareous; from Hurricane Cliffs westward into Santa Clara Valley entire member is represented by yellow-gray sandy shale. Some fluvial and eolian beds here treated as Temple Cap have been assigned to Carmel formation by some workers. Jurassic(?). Derivation of name given.

U.S. Geological Survey currently designates the age of the Temple Cap Member as Jurassic on the basis of a study now in progress.

Unit forms an entablature for East Temple, West Temple, and similar lofty structures in Zion Park and vicinity.

**Temple Lake Stade, Till**

Temple Lake glacial stage

Recent: Rocky Mountain Region.

J. H. Moss, 1951, Early man in the Eden Valley: Philadelphia, Pa., Univ. Pennsylvania, Univ. Mus., p. 56–62. Name Temple Lake moraine is applied to moraine and associated outwash plain that dam Lower Temple Lake on north. The advance to the moraine is named Temple Lake readvance.

J. H. Moss, 1951, Am. Jour. Sci., v. 249, no. 12, p. 865–883. Discussion of late glacial advances in southern Wind River Mountains, Wyo. Temple Lake substage has an antiquity intermediate between late Pinedale and the present. If Pinedale is equivalent to Mankato (Wisconsin 3) relative weathering characteristics would indicate that Temple Lake advance occurred just before or soon after climatic optimum.

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

G. M. Richmond, 1957, Internat. Assoc. for Quaternary Research, 5th Cong., Madrid. Two stages of Recent glaciation recognized in Rocky Mountain region: early Recent stage, Temple Lake; and late Recent stage, Gannett Peak. The Temple Lake (radiocarbon age 2800 200 years B. P.) is represented by cirque moraines, locally by two, that support scrub spruce on tundra and have thin azonal soil.

Temple Mountain Andesite

[Eocene or younger]: Northwestern Washington.

R. S. Yeats, 1958, Dissert. Abs., v. 19, no. 4, p. 775. At least two separate feeders for the extrusive andesites are recognized within area. In feeders, porphyritic andesite predominates; in extrusive andesites, breccias and amygdaloids predominate, with lahars common near base. Propylitization of andesites is due to endomorphism, not regional hydrothermal metamorphism. Underlies large body of quartz latite breccia, which possibly is extrusive phase of Grotto batholith. These andesites in part overlie the Swauk with angular unconformity, and in part intrude Swauk and Tonga (new) formations.

In eastern part of Skykomish area in northwestern Cascade Mountains, 45 miles east of Seattle.

**Temple Mountain Member** (of Chinle Formation)

Upper Triassic: Southeastern Utah.

R. C. Robeck, 1956, Am. Assoc. Petroleum Geologists Bull., v. 40, no. 10, p. 2499–2506. Consists of siltstone, mudstone, and sandstone; siltstone commonly light gray to some shade of mottled or banded purple and white; locally, layers of mudstone or lenses of sandstone impart bedding effect to siltstone; mudstone is purplish red, or mottled purple and white; sandstones light gray with tendency to weather light brown. Composition of member varies within area and lithologic types interfinger. In southwest, consists mostly of purple and white mudstone with lenses and layers of jasper; toward central part, siltstone ledges and sandstone lenses more abundant; at the north end, consists of alternating beds of siltstone, mudstone, and numerous sandstone channels and lenses which may be present at any interval in member. Thickness at type section 33 feet; elsewhere ranges from 5 to 101 feet. Unconformably underlies Moss

Back member; unconformably overlies Moenkopi formation, contact difficult to determine in places.

J. H. Stewart, 1957, Am. Assoc. Petroleum Geologists Bull., v. 41, no. 3, p. 446–449; J. H. Stewart and others, 1959, U.S. Geol. Survey Bull. 1046–Q, p. 501–504. Some strata outside San Rafael Swell may be correlated with Temple Mountain member, but these correlations are questionable, and it seems best at present to restrict member to the Swell. Locally strata similar to Temple Mountain underlies Shinarump member, suggesting that Temple Mountain member may be oldest member of Chinle.

Type section: Northeast side of South Temple Mountain at lat 38°41'04", long 110°40'20", on southeast flank of San Rafael Swell, Emery County.

Temples Peak Flows (of Chico Phonolites)

Quaternary: Northeastern New Mexico.

R. F. Collins, 1949, Geol. Soc. America Bull., v. 60, no. 6, p. 1036. Bright- to gray-green porphyritic phonolite with white orthoclase phenocrysts and abundant aegirine. Topography of flows is gently rolling with sharp canyons; boundaries lobate in plan, and rise as abrupt rounded hill forms with many reentrants. Upper surface covered with thin soil and tetrahedral joint blocks.

West rim of J. T. Rincon sec. 11, T. 26 N., R. 26 E., Colfax County, and flow area 3 miles north and west.

Temples Peak Formation

[Triassic or older]: Northeastern New Mexico.

R. F. Collins, 1949, Geol. Soc. America Bull., v. 60, no. 6, p. 1035. Coarse white quartz-pebble conglomerate of an allover cream to buff color which weathers brown to dark brown. Strongly lithified and locally jointed into large blocks. Total exposed thickness of 19 feet, including 2 feet or less of an underlying gray-brown sandstone member whose base is covered. Underlies Dockum conglomerate horizontally.

Type locality: In bottom of the J. T. Rincon or bowl at east base of Temples Peak, Colfax County. The only other exposure of formation is in upturned sediments on east flank of Palo Blanco, Colfax County.

**Templeton Member** (of Woodbine Formation)

Upper Cretaceous: Northeastern Texas.

H. R. Bergquist, 1949, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 98. Defined to include fossiliferous sedimentary rocks that lie between beds of Lewisville member and flags which mark base of typical Eagle Ford shale. Consists largely of smooth gray shale with lenses of glauconitic gray and tan soft sand. Thickness 70 to 80 feet.

Type locality: In pasture and in series of bluffs along Templeton Branch on A. P. Templeton property a short distance north and east of Highway 69 underpass of Texas and Pacific Railroad at Bells, Grayson County.

**Tenderfoot Member** (of Moenkopi Formation)

Triassic(?): Southwestern Colorado and southeastern Utah.

E. M. Shoemaker and W. L. Newman, 1959, Am. Assoc. Petroleum Geologists Bull., v. 43, no. 8, p. 1814, 1843–1845. Dominantly muddy or silty poorly sorted sandstone. Commonly at base, generally directly overlying Cutler formation, is sequence of beds up to 20 feet thick composed of weathered coarse arkosic detritus which is locally overlain by gypsum as much as 7 feet thick; next is unit of brick-red or orange- to dark-brown poorly sorted sandy mudstone to silty sandstone, which at most places makes up more than 80 percent of member; at most localities, this unit is succeeded by sequence of distinctly bedded sandstone. Thickness ranges from featheredge to 290 feet. In vicinity of Gateway, Colo., thins toward Uncompahgre Plateau; thinning due to overlap of basal beds and to truncation of top of member by overlying Chinle formation; locally cut out over salt intrusions by angular unconformity at base of overlying Ali Baba member (new) in Sinbad and Paradox Valleys, Colo., and probably in Fisher Valley, Utah. Locally overlies Paradox member of Hermosa formation.

J. H. Stewart, 1959, Am. Assoc. Petroleum Geologists Bull., v. 43, no. 8, p. 1858. Correlated with Hoskinnini herein reallocated to member status in Moenkopi.

Type section: East side Sinbad Valley, sec. 15, T. 49 N., R. 19 W., Mesa County, Colo. Named for Tenderfoot Mesa, where it constitutes whole of formation on north side of mesa.

Tenley Formation[1]

Pliocene(?): District of Columbia.

Original reference: C. K. Wentworth, 1930, Virginia Geol. Survey Bull. 32, p. 37.

Named for exposures at Tenleytown.

**Tenmile Granite**[1]

Precambrian: Southwestern Colorado.

Original reference: W. Cross and E. Howe, 1905, U.S. Geol. Survey Geol. Atlas, Folio 131.

Named for Tenmile Creek, which enters Animas River, southeast of Snowdon Peak.

Tenmile Gravel

Pleistocene, lower: Southwestern Idaho.

C. N. Savage, 1958, Idaho Bur. Mines and Geology County Rept. 3, p. 20 (table 1), 26, 38–39, 48, figs. 3, 4. Characteristically, a torrential deposit of well-rounded to subangular crystalline rock. Silt, sand, gravel, and cobbles, nonconsolidated to poorly consolidated. Some caliche. Fluviatile, crossbedded, channeled, and stratified. Thickness about 500 feet. Underlies intermediate Snake River eruptives and overlies Idaho formation with unconformable contacts.

In Boise Valley, Ada and Canyon Counties.

Tenmile Limestone (in Greene Formation)[1]

Permian: Southwestern Pennsylvania.

Original reference: J. J. Stevenson, 1907, Geol. Soc. America Bull., v. 18, p. 97, 105.

In Washington and Greene Counties.

†Tenmile Sands[1]

Pleistocene: 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, 20.

Named for exposures at Ten Mile Hill, on Charleston-Lanes Railway (A. C. L. Railroad) and at Ten Mile Hill, on Charleston-Branchville Railway (S. C. Railroad), Charleston County.

Tenmile Creek Dolomite

Middle Devonian: Northwestern Ohio.

G. A. Stewart, 1938, Geol. Soc. America Spec. Paper 8, p. 6, 7, 13. Three distinct lithologic units recognized in interval between Columbus limestone and Ohio shale. Name Tenmile Creek dolomite proposed for upper division. Fossiliferous. Thickness about 40 feet. Overlies Silica shale. Lower part may be time equivalent of Prouty limestone in north-central Ohio. Name credited to J. E. Carman (unpub. ms.). Name Traverse has been applied to interval between Columbus limestone and Ohio shale.

K. V. Hoover, 1960, Ohio Geol. Inf. Circ. 27, p. 8–15. Stratigraphic position and correlation of Olentangy shale discussed. It is here suggested that Olentangy, Plum Brook shale, Prout limestone, Silica shale, and Ten Mile Creek dolomite are stratigraphically correlatable, with the reservation that the Olentangy is probably Upper Devonian. Ten Mile Creek, which overlies Silica formation in northwestern Ohio, shows faunal affinity with Prout limestone of northern Ohio. Field relationships between limestone beds of Silica formation and Ten Mile Creek dolomite are similar. Both are bluish gray, argillaceous to crystalline, and thin to massive bedded. Regional information regarding thickness of Plum Brook shale-Prout limestone or Silica formation-Ten Mile Creek dolomite has not been worked out. Combined thickness of Silica formation and Ten Mile Creek dolomite has been reported in Lucas County exposures.

Tenmile Creek (also Ten Mile Creek) is just south of Silica, Lucas County.

Tenmile Creek Formation (in Stanley Group)

Pennsylvanian: Southeastern Oklahoma.

B. H. Harlton, 1938, Am. Assoc. Petroleum Geologists Bull., v. 22, no. 7, p. 854 (fig. 1), 856, 864–870. Proposed for lowermost formation in group. Consists of alternating sandstones and shales; aggregate thickness 5,650 feet. Basal part overlapped to south by Cretaceous Trinity sandstone; underlies Moyers formation (new). Pushmataha series (new).

R. M. Becker, chm., 1954, Ardmore Geol. Soc. [Guidebook] Field Trip Oct. 1954, chart facing p. 1. Shown on chart as Mississippian (Meramecian); overlies Albion formation.

L. M. Cline, 1960, Oklahoma Geol. Survey Bull. 85, p. 25 (table 2), 29–36, pls. Includes Tuskahoma siliceous shale bed (member).

O. B. Shelburne, Jr., 1960, Oklahoma Geol. Survey Bull. 88, p. 16–19, pl. 1. In this report [Boktukola syncline], formation is mapped in two units: lower part of Tenmile Creek formation and upper part of Tenmile Creek formation. The units are separated by Battiest chert member (new). Thickness more than 7,600 feet. Underlies Moyers formation.

Type section: Three miles east of Miller, T. 3 S., R. 15 E., Pushmataha County. Name derived from Tenmile Creek at south end of Tuskahoma syncline.

Tenmile River Beds[1]

Pennsylvanian: Southeastern Massachusetts and eastern Rhode Island.

Original reference: J. B. Woodworth, 1899, U.S. Geol. Survey Mon. 33, p. 134, 164–173.

Occurs in Tenmile River, Mass.

†Tennessee Sandstone[1]

Pennsylvanian: Western Arkansas.

Original reference: A. J. Collier, 1907, U.S. Geol. Survey Bull. 326, p. 19.

Typically exposed in Tennessee Ridge, Sebastian County.

Tennesseean Series

†Tennesseean System[1]

Mississippian: Eastern United States.

Original reference: E. O. Ulrich, 1905, U.S. Geol. Survey Prof. Paper 36, p. 24 (table).

R. C. Moore, 1948, Jour. Geology, v. 56, no. 4, p. 1. Upper Mississippian formations, which are classed as belonging to Meramecian and Chesterian parts of the American succession, collectively named "Tennesseean series," are judged on paleontological grounds to represent Visean and Namurian deposits of European continent.

Tennessee River Gravels[1]

Pleistocene: Western Kentucky.

Original reference: R. H. Loughridge, 1888, Kentucky Geol. Survey Rept. Jackson's Purchase region.

Probably named for exposures along Tennessee River.

†Tennessee River Group[1]

*See* Harpeth and Tennessee River Group.

**Tenney Canyon Tongue** (of Kayenta Formation)

Upper Triassic(?): Northeastern Arizona and southeastern Utah.

Paul Averitt and others, 1955, Am. Assoc. Petroleum Geologists Bull., v. 39, no. 12, p. 2522. Name applied to rocks in Kanab area that were classified by Gregory (1950) as Kayenta formation. Consists of very thin bedded to laminated pale-reddish-brown siltstone, mudstone, and very fine grained sandstone considered to be of fluvial origin. Contacts of unit with overlying Navajo sandstone and underlying Lamb Point tongue (new) of Navajo are sharp and even, marked by pronounced change in color, lithologic character, and crossbedding. Thickness 120 feet in Kanab Canyon; thins eastward from Kanab and pinches out between units of Navajo west of Paria; southwest of Kanab, tongue thickens gradually to 172 feet at Moki Mountain and 220 feet near Moccasin, Ariz.; west of Sevier fault coalesces with main body of Kayenta. Name credited to R. F. Wilson (in press).

J. S. Detterman, 1956, U.S. Geol. Survey Misc. Geol. Inv. Map I–137. Mapped in Tenney Canyon, where it overlies Lamb Point tongue of Navajo sandstone.

U.S. Geological Survey currently designates the age of the Tenney Canyon Tongue as Upper Triassic(?). This designation made on the basis of recent studies of the Kayenta.

Name applied to rocks in Kanab area, Utah. Tenney Canyon, a side canyon to Kanab Canyon, is approximately 3 miles north of Kanab, Kane County, Utah.

Tennison Creek Shale[1]

Pennsylvanian: Eastern Kansas.

Original reference: R. C. Moore, 1932, Kansas Geol. Soc. Guidebook 6th Ann. Field Conf., p. 90, 97.

Named for Tennison Creek, in western part of Bourbon County.

**Ten Rod Granite Gneiss**

Mississippian(?) or older: Southern Rhode Island.

G. E. Moore, Jr., 1958, U.S. Geol. Survey Geol. Quad. Map GQ–105. Pinkish- to medium-gray, fine- to medium grained porphyritic granite gneiss, with strong lineation and moderate foliation in most places. Phenocrysts of salmon-colored potash feldspar average about 30 mm long and constitute as much as 15 percent of rock. Flattened rod-shaped aggregates of quartz and streaks of thin elongate lenses of biotite locally present. Cuts Scituate granite gneiss. Devonian(?) or older. Has been included in Sterling gneiss by early workers.

U.S. Geological Survey currently designates the age of the Ten Rod Granite Gneiss as Mississippian(?) or older on the basis of a study now in progress.

Typically exposed in roadcut on Ten Rod Road, 0.85 mile west of Millville, Hope Valley quadrangle. Exposed in discontinuous belt of varying width that extends northwesterly across quadrangle from vicinity of Richmond School on southern boundary of quadrangle and in small bodies elsewhere in quadrangle.

**Tensleep Sandstone[1]**

Tensleep Formation

Tensleep Sandstone (in Montchauve Group)

Pennsylvanian and Lower Permian: Wyoming and Montana.

Original reference: N. H. Darton, 1904, Geol. Soc. America Bull., v. 15, p. 394–401.

C. C. Branson, 1939, Geol. Soc. America Bull., v. 50, no. 8, p. 1199–1226. Tensleep sandstone of Darton is only locally recognizable as lithologic unit in central Wyoming and is not true stratigraphic unit. No boundary can be drawn to separate it from Amsden formation, and fauna of upper part of Amsden is indistinguishable from that of Tensleep sandstone. Name Tensleep is here retained as name of formation which includes entire Pennsylvanian sequence in central Wyoming; that is, Tensleep sandstone of Darton, the upper part of the Amsden, and some unnamed beds above Tensleep sandstone. Marine fossils indicate Des Moines age for entire formation. Measured sections show thickness varies from 180 to 535 feet. Underlies Phosphoria or Chugwater formation; overlies Sacajawea formation; in some areas, separated from the Sacajawea by unnamed limestone interval referred to as beds of Chester(?) age.

D. C. Skeels, 1939, Jour. Geology, v. 47, no. 8, p. 817 (table 1). Discussion of structural geology of Trail Creek-Canyon Mountain area, Montana. Table 1 lists Tensleep formation, 150 feet thick, above Amsden formation and below Ellis formation. Pennsylvanian.

G. E. Condra, E. C. Reed, and O. J. Scherer, 1940, Nebraska Geol. Survey Bull. 13, p. 2 (fig. 2), 3 [revised 1950]. Discussion of correlation of formations of Laramie Range, Hartville uplift, Black Hills, and western Nebraska. Tensleep (Darton, 1904) is herein recognized as sandstone facies of Cassa group (new), but some geologists use term at its type locality to include also sandy beds of Embar age or older.

E. B. Branson and C. C. Branson, 1941, Am. Assoc. Petroleum Geologists Bull., v. 25, no. 1, p. 126 (fig. 2), 131–132. Discussion of Wind River Mountain area. Tensleep formation, 398 to 535 feet thick, overlies Sacajawea formation and disconformably underlies the Phosphoria. Tensleep, as herein defined, includes upper part of Amsden formation of Darton and that name is dropped. On Bull Lake Creek, 60 feet of laminated limestone without fossils lies with irregular contact on the Sacajawea and is overlain disconformably by Tensleep formation. This sequence of laminated limestones may constitute another formation, possibly of Chester age.

Helen Foster, 1947, Am. Assoc. Petroleum Geologists Bull., v. 31, no. 9, p. 1539 (table), 1558–1559. Tensleep formation described in Teton County, Wyo., where it is about 300 feet thick; overlies Amsden formation and underlies Phosphoria formation. Name Wells formation has been applied to Tensleep rocks in this part of Wyoming, but Wells formation probably includes not only beds equivalent to Tensleep but also younger Pennsylvanian rocks.

H. D. Thomas, 1948, Wyoming Geol. Assoc. Guidebook 3d Ann. Field Conf., p. 87, 88–89. Branson described Sacajawea formation, classed it as Ste. Genevieve, and carried name Tensleep down to base of sandstone he described (1939) as resting with marked disconformity on thin limestone he thought might be of Chester age. Now seems clear that Branson's type Sacajawea lies below Darwin sandstone and that his basal "Tensleep" sandstone, which he described as resting disconformably on older beds, is actually Darwin sandstone. Distinctive Tensleep sandstone can be recognized everywhere around Wind River basin. Lithologically it is massive crossbedded tan sandstone which in places may be pinkish or white. Locally, thin limestones, dolomites, or cherty layers are intercalated. Thickness commonly 300 to 400 feet. In Casper Mountain-Alcova area, at southeastern end of Wind River basin, name Casper has been used for Pennsylvanian rocks. Here the Casper is 400 to 500 feet thick and is therefore comparable to combined thickness of Amsden and Tensleep to west. Many geologists have divided the section into Amsden and Tensleep. Upper part of Casper is thick tan crossbedded sandstone which resembles Tensleep of areas to west, and has been called Tensleep by some geologists. However, entire Casper of this area seems completely younger than any part of Tensleep. Puzzling factor is that Tensleep sandstone of Wind River area is continuous with, and lithologically similar to, the "Tensleep" sandstone of Casper area, as proved by surface and subsurface data. Tensleep sandstone seems to be major lithologic facies which persists as a unit but which crosses time lines and becomes progressively younger to eastward.

R. S. Agatston, 1954, Am. Assoc. Petroleum Geologists Bull., v. 38, no. 4, p. 521–528. Tensleep sandstone was named by Darton (1904) and described as series of crossbedded sandstones underlying Permian red shales and limestones. Recommended herein that Tensleep be given formation status, that Darton's upper limit be retained, but that base be defined as top of massive generally cherty carbonate rocks of Amsden formation. Formation is composed of white, tan, and pink, fine- to medium-grained crossbedded massive sandstone with dolomite, limestone, and some shale and anhydrite beds. Throughout a large part of the research area, Amsden and Tensleep contact is sharp, and the two formations are conformable. Minor unconformities present locally. North of Tensleep is a related condition of alternating sandstone, shale, dolomite, and anhydrite beds at base of Tensleep, indicating instability in that area at that time. Tensleep or equivalent beds distributed throughout Big Horn basin, Big Horn Mountains, Powder River basin, Wind River basin and Mountains, Hartville uplift, and Black Hills. Lower Desmoinesian.

L. W. Henbest, 1956, Wyoming Geol. Assoc. Guidebook 11th Ann. Field Conf., p. 58–63. Biostratigraphic range from latest part of "*Fusulinella*" zone (probably late Atoka age) through *Wedekindellina euthysepta*-zone (most of early half of Des Moines age) is indicated for beds in Tensleep formation in which collections were made. Information from unpublished dissertations as cited by Love (1954, Wyoming Geol. Assoc. Guidebook 9th Ann. Field Conf.) reports discovery of *Triticites* in upper part of Tensleep in Jackson area. Illustrations have not been published, and determinations have not been verified in print. Some of the collections described in present report were found in chert nodules. Age determinations were of necessity based entirely on content of the nodules. Problem of possible redeposition in rocks of later age should be considered in future collecting from Amsden and Tensleep formations.

C. A. Burk and H. D. Thomas, 1956, Wyoming Geol. Survey Rept. Inv. 6, p. 10. Goose Egg formation (new) rests unconformably on Pennsylvanian or early Permian strata of the Tensleep, Casper, Hartville, or Minnelusa formations throughout Wyoming.

W. J. Mapel, 1959, U.S. Geol. Survey Bull. 1078, p. 23–25. Sandstone described in Buffalo-Lake De Smet area, Wyoming, where it is 280 feet thick. Overlies Amsden formation; separated from overlying Chugwater formation by unnamed gypsum and red shale sequence 180 feet thick.

T. W. Todd, 1959, Dissert. Abs., v. 20, no. 6, p. 2230–2231. Lithologically defined Sacajawea, Amsden formation, and Tensleep sandstone are products of marine transgressive-regressive cycle that took place on Wyoming cratonic shelf during Pennsylvanian period as one phase in development of eastern Cordilleran geosyncline. Name Montchauve group is suggested in recognition of natural unit of these formations.

D. O. Peterson, 1960, Dissert. Abs., v. 20, no. 7, p. 2757. Discussion of regional stratigraphy of Pennsylvanian system in northeastern Utah, western Wyoming, northwestern Colorado, and southeastern Idaho. Suggested that Quadrant and Casper formational names be abandoned and Tensleep-Amsden-Sacajawea terminology be extended to include strata formerly referred to by these names.

Named for exposures in walls of lower canyon of Tensleep Creek, Washakie County, Wyo.

Tepee zone[1] (in Pierre Shale or Formation)

Cretaceous: Colorado.

[Original reference]: G. K. Gilbert, 1897, U.S. Geol. Survey Geol. Atlas, Folio 36.

M. O. Griffitts, 1949, Am. Assoc. Petroleum Geologists Bull., v. 33, no. 12, p. 2020. Pierre formation subdivided into four zones (ascending): Sharon

Springs shale zone, Rusty zone, Hygiene zone, and Transition zone. These zone terms are recognized and used as formal stratigraphic names in present paper. Many geologists have noted a Tepee zone in eastern Colorado. Tepee zone should be correlated with Rocky Ridge member of Hygiene zone of northern Colorado.

Tepee Creek Formation

Permian: Southwestern Oklahoma.

C. A. Merritt and W. E. Ham, 1941, Am. Assoc. Petroleum Geologists Bull., v. 25, no. 2, p. 287, 290–299. Name applied to formation composed principally of zeolites and opal with variable amounts of dolomite and calcite; appears to be stratified. Maximum thickness 47 feet. Rests with erosional unconformity on anorthosite. Intruded by several small granite dikes of Precambrian age.

G. W. Chase, 1954, Am. Assoc. Petroleum Geologists Bull., v. 38, no. 9, p. 2028, 2034. Name Tepee Creek dropped from formal nomenclature. Replaced by Post Oak conglomerate member of Wichita formation.

W. E. Ham, C. A. Merritt, and E. A. Frederickson, 1957, Panhandle Geol. Soc. [Guidebook] May 2, 3, 4, p. 26–28. As now used, term Tepee Creek is applied to zeolite-opal sediments that were deposited as anorthosite conglomerates and sandstones unconformably on basic igneous rocks in central part of Wichita Mountain region. Their age can no longer be accepted as Precambrian. Instead these sediments probably are coarse-clastic shoreward facies of shales in Wichita formation of lower Permian age. Type locality stated.

Type locality: SW¼SW¼ sec. 6, T. 4 N., R. 18 W., Kiowa County. Occurs as four scattered outcrops in interior part of Wichita Mountains. Named for exposures near junction of Tepee Creek and North Fork of Red River.

**Tepee Trail Formation**

Eocene, upper: Northwestern Wyoming.

J. D. Love, 1939, Geol. Soc. America Spec. Paper 20, p. 10, 11 (fig. 2), 73–79, pls. 13, 17. Proposed for upper Eocene sequence unconformably overlying Aycross formation (new) and all older rocks and, in turn, unconformably overlain by Oligocene(?) rocks. Chiefly green and olive-drab basic andesite volcanic conglomerates; tuffs, flows, and thin carbonaceous beds. Thickness 2,000 feet. In most localities, beds are gently folded. Unconformably underlies Wiggins formation (new).

H. A. Tourtelot, 1957, Smithsonian Misc. Colln., v. 134, pt. 1, no. 4, p. 5–19. Described in northeastern Wind River basin where it forms belt of outcrop along south side of Owl Creek and Big Horn Mountains. Southern boundary of belt is marked by normal fault along which Tepee Trail has been dropped down against Wind River formation. Consists of sequence of green, brown, and gray strata rich in volcanic material of andesitic composition. Sequence divided into a lower unit referred to green and brown member and upper unit named Hendry Ranch member. Maximum thickness not determinable because formation overlaps on topography of mountains and base is not exposed; thickness composite section about 700 feet. Top of formation is everywhere an erosional surface. Middle(?) and upper Eocene.

Type section: Slopes and cliffs on eastern side of East Fork River, directly opposite Castle Rock. Name derived from Tepee Trail which crosses East

Fork Creek divide midway between Castle Rock and Steamboat Rock, descends Boulder Creek, and joins East Fork Ranger Trail at junction of Boulder Creek with East Fork River. Type section is just east of junction of the two trails. Area is southern margin of Absaroka Range.

Tequepis Sandstone[1]

Miocene: Southern California.

Original reference: R. N. Nelson, 1924, Geol. Soc. America Bull., v. 35, p. 166–167.

Occurs on north side of Santa Ynez River, one-half mile east of Redrock Canyon. Named for exposures on Tequepis Rancho.

**Tererro Formation**

Mississippian: Northern New Mexico.

E. H. Baltz and C. B. Read, 1960, Am. Assoc. Petroleum Geologists Bull., v. 44, no. 11, p. 1754 (fig. 5), 1755 (figs. 6, 7), 1756 (fig. 8), 1759–1768, 1769–1773. Sequence of limestone breccia and conglomerate, crystalline limestone, and calcarenite. Thickness ranges from trace to 130 feet in southern part of Sangre de Cristo Mountains and from 6 to 48 feet farther south; thickness at type locality 118 feet. Comprises (ascending) Macho, Manuelitas, and Cowles members (all new). Overlies Espiritu Santo formation (new) with erosional unconformity; unconformably underlies Sandia formation. Sparse faunule found in Manuelitas member indicates Early Mississippian for that part of formation; Macho member is, in part, possibly as old as Devonian(?) and, in part, Early Mississippian; because of its unconformable relation to Manuelitas member, Cowles member may be of Late Mississippian age. Further studies must precede correlation, firm assignments of age, and adjustments in terminology of Tererro, Espiritu Santo, and Arroyo Penasco formations.

Type locality: On slope and slightly north of quarry designated as type locality for Espiritu Santo formation, west of Holy Ghost Creek at Tererro, San Miguel County.

**Terlingua Clay**[1]

Upper Cretaceous (Gulf Series): Western Texas.

Original reference: J. A. Udden, 1907, Texas Univ. Bull. 93, p. 17, 33–41.

R. G. Yates and G. A. Thompson, 1959, U.S. Geol. Survey Prof. Paper 312, p. 13–14, pl. 1. As mapped in Terlingua district, consists of about 1,000 feet of structureless clay and a few thin beds of impure limestone. Included are only the upper three-fourths of formation of Udden; lower three-fourths of formation is included in upper Boquillas as herein described. Likewise unit only includes upper half of what Adkins (1933, Texas Univ. Bull. 3232) called Terlingua formation (restricted) but includes in addition all of Adkins' Taylor formation. Overlies Boquillas flags; underlies Aguja formation.

Named for exposures along Terlingua Creek, Brewster County, in Terlingua quadrangle.

Terra Blanca Formation[1]

Quaternary: Texas.

Original reference: R. T. Hill, 1890, Am. Geologist, v. 5, p. 69.

In valley of Canadian River in Staked Plains. Terra Blanca is name used by Mexican inhabitants of valley.

**Terra Cotta Clay Member** (of Dakota Formation)

Terra Cotta Shale Member (of Ellsworth Formation)

Cretaceous: Central and southern 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 as lower member of Ellsworth formation. Underlies Rocktown sandstone. Overlies Mentor sandstone member of Belvidere formation.

Norman Plummer and J. F. Romary, 1942, Kansas Geol. Survey Bull. 41, pt. 9, p. 319, 329–336. Defined to include massive clay, silt, and sandstone comprising approximately lower two-thirds of Dakota formation; most conspicuous feature of member is widespread distribution of gray- and red-mottled massive clay. Thickness up to 170 feet. Underlies Janssen clay member, contact is not sharp but in most places can be drawn within 5-foot zone; in this report contact is arbitrarily placed at top of zone of concentrated concretionary siderite, limonite, or hematite, which is overlain by bed of gray massive clay containing varying amounts of siderite pellets and with yellow to yellow-orange coloring along oblique joints. Overlies Kiowa shale. Derivation of name given.

Entire section well exposed in school district of Terra Cotta, comprising part of T. 15 S., R. 6 W., in east-central part of Ellsworth County.

Terra Cotta Series[1]

Ordovician, Silurian, and Devonian(?): Southern Alaska.

Original reference: J. E. Spurr, 1900, U.S. Geol. Survey 20th Ann. Rept., pt. 7, p. 156–157, 180.

Named for Terra Cotta Mountains.

Terra Loma Member (of Moreno Formation)

*See* Tierra Loma Shale Member (of Moreno Formation).

Terry Limestone (in Hinton Formation)[1]

Mississippian: Southern West Virginia.

Original reference: C. E. Krebs and D. D. Teets, Jr., 1916, West Virginia Geol. Survey Rept. Raleigh and western Mercer and Summers Counties, p. 69.

Occurs at Terry, Raleigh County.

**Terry Sandstone Member** (of Pierre Shale)[1]

Upper Cretaceous: Central northern Colorado.

Original reference: M. W. Ball, 1924, Am. Assoc. Petroleum Geologists 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 massive fine-grained sandstone makes up member at type locality. Highly fossiliferous calcareous sandstone concretions 6 to 18 inches in diameter common. Thickness 10 to 20 feet. Separated from younger Rocky Ridge sandstone member by 511 to 604 feet of sandy and nonsandy shale; separated from older Hygiene sandstone member by as much as 387 feet of olive-gray sandy shale that locally includes Tepee-Butte limestone.

Named for exposures at Terry Lake 2 miles north of Fort Collins, Larimer County. Forms ridge between Terry Lake and Rocky Ridge Reservoir. North of Rocky Ridge extent of member not known.

Terry Shale (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. 295, 330.

Exposed in Mercer and Summers Counties, W. Va., and in Tazewell County, Va. Named for association with Terry limestone.

**Tesla Formation**

Eocene, middle: Central California.

A. S. Huey, 1937 (abs.) Geol. Soc. America Proc. 1936, p. 335. Incidental mention as formation of Eocene (Capay) age.

A. S. Huey, 1948, California Div. Mines Bull. 140, p. 16 (fig. 2), 33–38, pls. 1, 2, 3. Characterized by variety of sedimentary rocks including white quartz sand, buff sand, iron- and manganese-stained concretionary sand, dark carbonaceous shales, lignite seams, and white to light-blue clays. Maximum thickness about 2,000 feet near Tesla. East of Tesla, Corral Hollow fault cuts out about 700 feet of upper part of formation, and west of Tesla upper part of formation is progressively overlapped by Cierbo formation. Overlies Moreno Grande formation (new). Tesla, as mapped in this area, was called Tejon by Anderson and Pack (1915, U.S. Geol. Survey Bull. 603).

Typically and most completely exposed near former mining camp of Tesla, Tesla quadrangle, about 40 miles southeast of Berkeley.

**Tesnus 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. 45.

J. M. Weller and others, 1948, Geol. Soc. America Bull., v. 59, no. 2, chart 5 (column 53). Shown on correlation chart as Upper Mississippian and Lower Pennsylvanian.

W. B. N. Berry and H. M. Nielsen, 1958, Am. Assoc. Petroleum Geologists Bull., v. 42, no. 9, p. 2257–2258, 2259. Overlies Santiago formation (revived). At many places, the two units grade into each other without any apparent depositional break. Santiago formation of this report contains fauna interpreted to be Late Devonian.

Named for exposures around Tesnus, Brewster County.

**Tessey Limestone**[1]

Upper Permian (Ochoa Series): Western Texas.

Original reference: J. A. Udden, 1917, Texas Univ. Bull. 1753, p. 53.

P. B. King, 1942, Am. Assoc. Petroleum Geologists Bull., v. 26, no. 4, p. 662–663, pl. 2. Tessey limestone, at top of Permian sequence in Glass Mountains, is an obscurely bedded, nondescript, dolomitic limestone about 1,000 feet thick, whose facies resembles that of beds laid down in back-reef area in northern Guadalupe Mountains. It may be at least in part the calcareous equivalent of some of the evaporites of Ochoa series farther north. Unconformable below Bissett conglomerate.

Named for post office once located about 2 miles north of mouth of Gilliam Canyon, Brewster County.

**Tesuque Formation** (in Santa Fe Group)

Miocene, middle(?) to Pliocene, lower: Central New Mexico.

F. E. Kottlowski, 1953, New Mexico Geol. Soc. Guidebook 4th Field Conf., p. 148 (chart). On chart only. Contains Bishops Lodge member (new) near base. Age shown as Miocene and Pliocene.

Brewster Baldwin and F. E. Kottlowski, 1955, New Mexico Bur. Mines Mineral Resources Scenic Trips to the Geol. Past, no. 1, p. 20, 21, 24. Characterized by ledge-forming soft pinkish-tan sandstones. Thickness nearly 10,000 feet near Santa Fe. Underlies Ancha formation.

Brewster Baldwin, 1956, New Mexico Geol. Soc. Guidebook 7th Field Conf., p. 118–119. Included in Santa Fe group. Includes Bishops Lodge member at base. Puye gravel (Smith, 1938), Ancha formation, and Tuerto gravel all rest with angular unconformity on deformed beds of Tesuque formation.

Typical exposure in Sangre de Cristo Mountains, 10 miles north of Santa Fe.

**Tete des Morts Member** (of Edgewood Dolomite)

Lower Silurian: Northeastern Iowa.

C. E. Brown and J. W. Whitlow, 1960, U.S. Geol. Survey Bull. 1123–A, p. 39–40, pl. 3. Massive-bedded medium-grained finely porous grayish-orange to grayish-yellow glauconitic dolomite having fine white siliceous specks. Where member is thick, nodular bands of chert occur in 3-foot zone in middle. Thickness commonly 20 to 22 feet; thinner over areas of thick Maquoketa shale. Overlies Mosalem member (new); underlies Kankakee formation.

Named for many cliffs formed by these rocks along headwater drainage of Tete des Morts River in Jackson and Dubuque Counties.

**Tetelna Volcanics**[1]

Carboniferous: Southeastern Alaska.

Original reference: W. C. Mendenhall, 1905, U.S. Geol. Survey Prof. Paper 41, p. 36, map.

Derivation of name not stated, and map shows no geographic feature of that name, but formation is mapped along Indian Creek, the Indian name of which is Tetelna.

†Teton Formation[1]

Permian and Triassic: Northwestern Wyoming.

Original reference: W. H. Weed, 1896, U.S. Geol. Survey Geol. Atlas, Folio 30.

V. E. McKelvey and others, 1956, Am. Assoc. Petroleum Geologists Bull., v. 40, no. 12, p. 2835. Report is summary description of Phosphoria, Park City, and Shedhorn formations; new nomenclature proposed; term Teton formation abandoned.

Named for Teton Range southwest of Yellowstone Park.

**Tetro Limestone Member** (of Deseret Formation)

Tetro Limestone[1]

Mississippian: Central northern Utah.

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

W. H. Easton and others, 1953, Am. Assoc. Petroleum Geologists Bull., v. 37, no. 1, p. 147 (fig. 2). Shown on correlation chart of recommended revision of stratigraphic units of Great Basin. Occurs below Humbug limestone and above Gardner dolomite.

U.S. Geological Survey currently classifies the Tetro as a member of Deseret Formation on the basis of a study now in progress.

Probably named for Tetro mine, Tintic district.

**Teutonia Quartz Monzonite**

Upper Cretaceous or Tertiary, lower: California and Nevada.

D. F. Hewett, 1956, U.S. Geol. Survey Prof. Paper 275, p. 61–65, pl. 1. Proposed for several large bodies of intrusive rock that crop out in broad belt extending across [Ivanpah] quadrangle and exceeding 250 square miles in area.

Named for Teutonia Peak where it is typically exposed. South-central part Ivanpah quadrangle, San Bernardino County, Calif.

**Teutonic Limestone**[1]

Teutonic Limestone (in Hartmann Group)

Middle 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), 6. Described in East Tintic Mountains where it conformably overlies Ophir formation and conformably underlies Dagmar limestone. Thickness 375 to 425 feet. Type locality noted.

J. K. Rigby, 1958, Utah Geol. Soc. Guidebook 13, p. 13–16, 79. Described in Stansbury Mountains where it is 800 to 1,110 feet thick. Underlies Dagmar dolomite; overlies Condor formation of Ophir group.

J. K. Rigby, 1959, Utah Geol. Soc. Guidebook 14, p. 14 (table 1), 17–18. Assigned to Hartmann group in southern Oquirrh Mountains. Exposed in core of Ophir anticline above Ophir shale [Ophir group] on north side of Ophir Canyon. Underlies Herkimer limestone, contact gradational.

Type locality: At Teutonic Ridge, 1½ miles west of Eureka, Tintic district, Juab County.

†Texan System[1]

Precambrian (Llano Series): Central Texas.

Original reference: T. B. Comstock and E. T. Dumble, 1890, Texas Geol. Survey 1st Ann. Rept., p. lvii, 276–282, pl. 3.

Named for State of Texas.

**Texas Creek Granodiorite**[1]

Jurassic or Cretaceous: Southeastern Alaska.

Original reference: A. F. Buddington, 1929, U.S. Geol. Survey Bull. 807, p. 22–27, 58–60, maps.

F. M. Byers, Jr., and C. L. Sainsbury, 1956, U.S. Geol. Survey Bull. 1024–F, p. 126, pl. 13. Confined chiefly to central part of Hyder district.

Named for Texas Creek, Hyder district.

**Texas Gulch Formation** (in Alder Group)

Precambrian (Yavapai Series): Central Arizona.

C. A. Anderson and S. C. Creasey, 1958, U.S. Geol. Survey Prof. Paper 308, p. 28–30, pl. 1. Composed of alternating belts of rhyolitic tuff and purple slate. Rhyolitic tuff generally gray or white but also commonly cream or light green; ranges from fine- through coarse-grained tuff to pebble conglomerates or to cobble conglomerates in local zones south of road to Cherry. Bulk of tuff is medium grained. Formation has been deformed intensely. Thickness and stratigraphic relationship not known. Probably older than Indian Hills volcanics (new). Crops out in band about 2,500 feet wide along western slope of Black Hills.

Representative section exposed in Texas Gulch, Jerome area, Yavapai County. Formation extends from southern border of area northward for about 14 miles to a point north of Jerome Highway where it is covered by Paleozoic rocks.

Texhoman series[1]

Tertiary, upper: Kansas.

Original reference: C. R. Keyes, 1915, Iowa Acad. Sci. Proc., v. 22, p. 255.

**Thacher Member** (of Manlius Formation)

Lower Devonian: Eastern and central New York.

L. V. Rickard, 1955, New York State Geol. Assoc. Guidebook 27th Ann. Mtg., p. 7, 9 (strat. section). Basal member of Manlius formation. Underlies Olney member; overlies Rondout limestone. Thickness 0 to 50 feet. Only part of Manlius present in eastern New York.

L. V. Rickard, 1956, Dissert. Abs., v. 16, no. 1, p. 102. Evidence indicates that entire type Manlius formation near Syracuse, central New York, is equivalent in age to Lower Devonian Coeymans and Kalkberg formations of eastern New York. Its reference to Silurian can no longer be upheld. The so-called Manlius of eastern New York is entirely older; name Thacher limestone is proposed for this unit. It becomes thinner to west and is apparently replaced by underlying and thickening Rondout.

Type locality and derivation of name not given.

**Thane Volcanic Group**[1]

Lower or Middle Jurassic(?): Southeastern Alaska.

Original reference: G. C. Martin, 1926, U.S. Geol. Survey Bull. 776, p. 247, 251–252, chart opposite p. 270.

J. T. Dutro, Jr., and T. G. Payne, 1957, Geologic map of Alaska (1:2,500,000): U.S. Geol. Survey. Thane volcanic group (in part) mapped with Middle Jurassic rocks.

Settlement of Thane, on Gastineau Channel, lies in midst of these rocks; Juneau region.

**Thatcher Limestone Member** (of Graneros Shale)

Upper Cretaceous: Southeastern Colorado.

N. W. Bass, C. E. Straub, and H. O. Woodbury, 1947, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 68. Consists of two beds of dense dark-gray limestone separated by dark-gray fissile shale, about 5 feet thick. Limestone beds weather rusty brown; lower bed is 4 to 6 inches thick and less persistent than upper bed which is about 18 inches thick. Occurs about 30 feet above base of shale.

Well exposed under east fence of U.S. Highway 350 across road from Keith's store at Thatcher, Las Animas County, and from that point northeastward for several miles. Forms prominent bench throughout Model anticline and adjacent region.

†Thayer Shale (in Kansas City Formation)[1]

Pennsylvanian: Eastern Kansas and northwestern Missouri.

Original references: E. Haworth, 1895, Kansas Univ. Quart., v. 3, p. 276, pl. facing p. 290; 1895, Am. Jour. Sci., 3d, v. 50, p. 459, pl. facing p. 466.

Named for exposures at Thayer, Neosho County, Kans.

**Thaynes Limestone,[1] Formation,** or **Group**

Lower Triassic: Northeastern Utah, southeastern Idaho, southwestern Montana, and southwestern Wyoming.

Original reference: J. M. Boutwell, 1907, Jour. Geology, v. 15, p. 439–458.

W. R. Lowell and M. R. Klepper, 1953, Geol. Soc. America Bull., v. 64, no. 2, p. 240, 241. At McKnight Canyon section of Beaverhead formation (new), base of section is marked by high-angle normal faults which have dropped Beaverhead formation against Triassic Thaynes formation and Mississippian Madison limestone.

Bernard Kummel, 1954, U.S. Geol. Survey Prof. Paper 254–H, p. 171–179. In type region, Thaynes formation consists of 1,190 feet of limestone, calcareous sandstone, sandstone, shale, and, in middle, red shale member. At type area, overlies Woodside formation and underlies Ankareh formation. Extends over wide area in Utah, Idaho, Wyoming, and Montana. Along southern, eastern, and northern margins, formation intertongues with Ankareh formation or Chugwater formation. Areas of occurrence discussed in detail. In vicinity of Fort Hall Indian Reservation, Mansfield (1916, Washington Acad. Sci. Jour., v. 6), raised Thaynes to rank of group and subdivided it into (ascending) Ross Fork limestone, Fort Hall formation, and Portneuf limestone. Toward Salt River Range and toward Bear Lake Valley, Ross Fork and Fort Hall formations lose their identity, and Portneuf is much more distinctive unit and name is retained as member of Thaynes. In this area, Timothy sandstone is considered uppermost member of Thaynes. In Eastern Bear Lake-Sublette Ridge area, eight lithologic units are recognized in Thaynes including Lanes tongue (new) of Ankareh formation in Portneuf limestone member. In northeastern Utah, Thaynes underlies Mahogany member (new) of Ankareh formation. Variable sequence of beds, that are commonly red, lies between top of Thaynes and base of Nugget sandstone throughout western Wyoming, southeastern Idaho, and northern Utah. Boutwell (1907) named these beds Ankareh formation. Although they are still so defined in western Wyoming, they have since been subdivided and named differently in other areas. Consequently there has been confusion in nomenclature and correlation of these formations. [See Ankareh formation.] Overlies Dinwoody in some areas of Montana and southeastern Idaho.

R. K. Hose and C. A. Repenning, 1959, Am. Assoc. Petroleum Geologists Bull., v. 43, no. 9, p. 2185–2189, 2194. Term Thaynes formation extended into Confusion Range where it replaces term Woodside as used by Newell (1948, Geol. Soc. America Bull., v. 59, no. 10). On lithologic basis sequence could be referred either to Thaynes of northern Utah and Idaho, or Moenkopi as recognized in southern Utah. Use of Thaynes seems more appropriate because of greater lithologic similarity of Confusion Range Lower Triassic sequence to type Thaynes formation as defined by Boutwell (1907) and refined by Kummel (1954). Divided informally into seven gross lithologic zones. Aggregate thickness about 1,935 feet. Overlies

Gerster limestone; faunal evidence indicates considerable hiatus between the two formations.

Named after Thaynes Canyon, Park City district, Utah.

**Thebes Sandstone** (in Richmond Group)[1]

Upper Ordovician: Southwestern Illinois and southeastern Missouri.

Original reference: A. H. Worthen, 1866, Illinois Geol. Survey, v. 1, p. 139.

E. B. Branson, 1944, Missouri Univ. Studies, v. 19, no. 3, p. 94. In eastern Missouri, shales [Maquoketa] grade into a sandstone which seems to be same sandstone that was named Thebes by Worthen (1866); the Thebes seems merely to represent a facies change.

E. P. Du Bois, 1945, Illinois Geol. Survey Rept. Inv. 105, p. 7. Specific names, such as Fernvale limestone, Divine limestone, and Thebes sandstone have been applied locally to parts of Maquoketa formation, but it appears that none of these, except possibly Divine limestone, are consistent stratigraphic units.

W. H. Twenhofel and others, 1954, Geol. Soc. America Bull., v. 65, no. 3, chart 2 (column 52). Correlation chart shows Thebes sandstone underlying Orchard Creek shale and overlying Maquoketa shale in southeastern Missouri.

Named for Thebes, Alexander County, Ill.

Theodosia Formation (in Jefferson City Group)

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. 15, 25–32, pl. 2. Predominantly dolomite, principally of the "cotton rock" type; some massive crystalline dolomite beds are present in southern part of area; generally light gray to buff; thin irregular buff to brown dolomitic sandstone lentils common; light- to dark-gray, oolitic and nonoolitic chert abundant; chert conglomerate and breccia common near base. Comprises the Lutie below and the Blackjack Knob member (both new). As defined, includes beds previously called "upper Jefferson City" and "lower Cotter dolomite." Thickness as much as 360 feet. Underlies Cotter formation with contact probably unconformable; unconformably overlies Rich Fountain formation (new).

Type section: Composed of two sections exposing two separate members; lower part, between post offices of Theodosia and Lutie in western part of Ozark County, Mo.; upper part, north side of Blackjack Knob, eastern Taney County, Mo. Lutie member is more wide-spread on outcrop in Missouri; Blackjack Knob member more widely distributed along boundary between the two States and in Arkansas.

**Theresa Dolomite**[1]

Upper Cambrian: Central to eastern New York.

Original reference: H. P. Cushing, 1908, Geol. Soc. America Bull., v. 19, p. 159–160.

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 age and

Whitehall, Tribes Hill, and Beekmantown of Lower Ordovician age. Lower "typical" Theresa of Cambrian age 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. Each revised unit is tied in with Divisions A through E of original "Calciferous" formation (Brainard and Seely, 1890, Am. Mus. Nat. History Bull., v. 3).

R. H. Wheeler, 1942, Am. Jour. Sci., v. 240, no. 7, p. 523–524. Corrected Skene Mountain section shows Theresa formation, about 80 feet thick, overlying Potsdam formation and underlying Little Falls formation.

D. W. Fisher and G. F. Hanson, 1951, Am. Jour. Sci., v. 249, no. 11, p. 795–814. Evidence 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, and Canajoharie shale) is revised to read Potsdam sandstone, Galway formation, Hoyt limestone, Ritchie limestone (new), Mosherville sandstone (new), Gailor dolomite, Lowville limestone, Amsterdam limestone, Trenton limestone (Rockland?, Hull, Sherman Fall representatives), and Canajoharie shale. Term "Theresa" is not applicable in this area; name Galway is reintroduced for strata younger than Potsdam and older than Hoyt.

Named for exposures in Theresa Township.

Theresa Syenite[1]

Precambrian: Northeastern New York.

Original reference: H. P. Cushing and others, 1910, New York State Mus. Bull. 145, p. 38, map.

Small intrusive mass, less than 2 miles in length and less than one-half mile broad, lying south of Theresa, Jefferson County.

**Thermopolis Shale**

Thermopolis Shale (in Colorado Group)[1]

Lower Cretaceous: Central northern Wyoming and central southern Montana.

Original reference: C. T. Lupton, 1916, U.S. Geol. Survey Bull. 621, p. 168.

J. B. Reeside, Jr., 1944, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 10. Chart shows Thermopolis shale above Kootenai formation and below Mowry shale. Includes Muddy sandstone member at top. Not included in Colorado group.

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. Name Thermopolis has been used in different senses; these usages have evolved into two general and quite different classifications in central Wyoming. Classification preferred by authors of this report and used in subsurface studies restricts Thermopolis to Lower Cretaceous black shale below Muddy sandstone and above "Rusty beds" sandstone and shale member of Cloverly formation; Muddy sandstone is considered a formation directly overlain by Mowry shale. Classification used by U.S. Geological Survey divides Thermopolis into three units: lower black shale of Lower Cretaceous age, ranging in thickness from 100 to 200 feet, that overlies Cloverly formation; middle sandstone member, the Muddy, of Upper Cretaceous age [presently considered Lower Cretaceous]; and upper black shale which grades into Mowry shale.

P. W. Richards, 1955, U.S. Geol. Survey Bull. 1026, p. 45–47. Described in Hardin area, Montana-Wyoming, where it is 425 feet thick; overlies Cloverly formation and underlies Mowry shale. Restricted to exclude Birdbear sandstone which is reallocated to member status in Cloverly. Lower Cretaceous.

M. M. Knechtel, 1959, U.S. Geol. Survey Bull. 1072–N, p. 739–740, pl. 52. Described in Little Rocky Mountains, Montana, where it consists chiefly of dark-bluish-gray shale and includes numerous thin bentonite beds. Near the middle is a prominent sandy unit herein named Cyprian sandstone member. In earlier publications in area, unit herein called Cyprian was tentatively designated Muddy sand. Thickness about 600 feet. Overlies Kootenai formation; underlies Mowry shale.

Ralph Moberly, Jr., 1960, Geol. Soc. America Bull., v. 71, no. 8, p. 1149. Overlies Sykes Mountain formation (new).

Arthur Mirsky, 1960, Dissert. Abs., v. 21, no. 4, p. 850. Term Rusty Beds formally named as member of Thermopolis.

D. L. Eicher, 1960, Yale Univ., Peabody Mus. Nat. History Bull. 15, 126 p. As defined here, includes only that part of Lupton's (1916) Thermopolis shale which lies below Muddy sandstone (herein given formational rank) and is about 300 feet thick in Big Horn basin. Consists of black shale, basal member of which contains tan and rusty interbedded siltstones and sandstones about 120 feet thick, commonly called "rusty beds." Shale sequence above rusty beds is divided near middle into lower and upper parts by tan-weathering silty shale about 30 feet thick. Lower shale, below middle silty shale, contains a few thin ironstones, siltstones, and silty limestones throughout, and dahllite concretions in lower part. Upper shale, above middle silty shale, is generally darker and contains nearly no siltstone or limestone. Overlies Cloverly formation. Upper sequence of black shale and bentonites, overlying Muddy sandstone and formerly included in Thermopolis is herein named Shell Creek shale. Lupton named Thermopolis shale for exposures in area of town of Thermopolis but designated no type section; he presented supplementary lithologic description generalized from subsurface samples from near basin, 50 miles north. Detailed description of Thermopolis in its type area has never been published; entire sequence is not well exposed at any one place near Thermopolis. Lower Cretaceous. Type section designated for redefined Thermopolis. Regional relationships discussed. Detailed discussion of problems of nomenclature.

Type section (Eicher): On northeast and southwest flanks of Lucerne anticline, east of Big Horn River, in NW sec. 16, T. 43 N., R. 94 W., Hot Springs County, Wyo. Named for exposures near Thermopolis, Wyo.

The Rocks 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 Berry conglomerate and overlying Lucia shale (both new). Thickness about 1,500 feet.

R. R. Thorup, 1943, California Div. Mines Bull. 118, pt. 3, p. 465. Described as tan massive thick-bedded fine- to medium-grained well-sorted feldspathic sandstone. Disconformably underlies Berry conglomerate; conformably overlies Lucia shale. Formerly considered part of Vaqueros which is herein stratigraphically restricted in its type area.

V. S. Mallory, 1959, Lower Tertiary biostratigraphy of the California Coast Ranges: Tulsa, Okla., Am. Assoc. Petroleum Geologists, p. 55. Quite probable that some part of The Rocks formation is of Ulatisian age.

Type locality: Sec. 27, T. 20 S., R. 6 E., Junipero Serra quadrangle, Monterey County. Named because of its tendency to form rugged topography.

Therrill Formation

Therrill Member (of Weches Formation)

Eocene, middle: Eastern Texas.

H. B. Stenzel, 1938, Texas Univ. Bur. Econ. Geology Pub. 3818, p. 20 (table), 97, 106–108. Upper member of Weches formation. Composed of black to black-green clay with iron sulphide nodules, a small amount of glauconite, and few fossils where fresh, and of brown shales or yellow and red clays with some yellow calcareous clay-ironstone concretions where weathered. Thickness about 4 or 5 feet. Overlies Viesca member (new) with boundary transitional; underlies Sparta sand.

H. B. Stenzel, 1953, *in* Am. Assoc. Petroleum Geologists, Soc. Econ. Paleontologists and Mineralogists, and Soc. Econ. Geologists Guidebook, Joint Ann. Mtg., Houston, p. 47, 49. Shown on road log as formation. Thickness as much as 52 feet.

Type locality: Waterfalls near Magnolia Brown pump station and tank farm near center of Magnolia Petroleum Co. tract, J. B. and J. E. Therrill survey, Leon County.

The Straits Schist Member (of Hartland Formation)

Pre-Triassic: Western Connecticut.

John Rodgers and others, 1956, Preliminary geological map of Connecticut (1:253,440): Connecticut Geol. Nat. History Survey; John Rodgers, R. M. Gates, and J. L. Rosenfeld, 1959, Connecticut Geol. Nat. History Survey Bull. 84, p. 14. Described as coarse to very coarse muscovite schist. Commonly crumpled and cut by quartz veins and pegmatite. Locally quartz, with feldspar, and mica dominate alternate layers, and rock approaches gneiss. Includes lenticular bodies of gneiss.

M. H. Carr, 1960, Connecticut Geol. Nat. History Survey Quad. Rept. 9, p. 7–8, pl. 1. Described and mapped in Naugatuck quadrangle. At base of Hartland.

Named for The Straits, a defile on the Bethany-Naugatuck Road or Litchfield Turnpike near north edge of town of Bethany, New Haven County.

Thetis group[1]

Upper Cretaceous: Northwestern Alaska.

Original reference: A. J. Collier, 1905, U.S. Geol. Survey Bull. 259, p. 179.

Mined at Thetis mine, East of Cape Lisburne.

Thiensville Formation[1]

Middle Devonian: Southeastern Wisconsin.

Original reference: E. R. Pohl, 1929, Pub. Mus. City Milwaukee Bull., v. 11, p. 7–8.

F. C. Foley, W. C. Walton, and W. J. Drescher, 1953, U.S. Geol. Survey Water-Supply Paper 1229, p. 14–15. Middle Devonian.

Type locality: Cut on Highway 57, 2 miles north of Thiensville, near middle of E½ sec. 10, T. 9 N., R. 21 E., Ozaukee County.

Thirteen Mile Rock 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.

Thirtynine Mile Volcanic Series

Oligocene, lower(?): Central Colorado.

J. T. Stark and others, 1949, Geol. Soc. America Mem. 33, p. 101–103, pl. 1. Flows, both dense and very vesicular, flow breccias, and agglomerates. Some vesicular lavas have abundant amygdules of calcite or chalcedony or both. Flow structure not well developed. Porphyritic facies subordinate to aphanitic facies. Little bedding or evidence of succession of flows and agglomerates can be seen. Composition of series ranges from andesite to basalt. Attains thickness of 2,000 feet on south side of Thirtynine Mile Mountain and in Pikes Peak quadrangle. In most places, it overlies the Precambrian complex. Patches of Cretaceous rocks and of Denver formation preserved here and there and protrude from under volcanic cover. Mapped as Thirty-nine Mile andesite on plate 1.

Well exposed in Thirtynine Mile Mountain in southeastern corner of South Park, Park County. Total area underlain by series, both within and outside the Park, is about 300 square miles.

Thomas Clay (in Conemaugh Formation)[1]

Pennsylvanian: Western Maryland.

Original reference: C. K. Swartz, 1922, Maryland Geol. Survey, v. 11, pl. 7.

M. T. Sturgeon and others, 1958, Ohio Geol. Survey Bull. 57, p. 121. In northern Appalachian region, Anderson underclay, which takes its name from overlying Anderson coal in Ohio, is known as (Lower) Bakerstown or Thomas clay.

Georges Creek Basin.

Thomas Limestone (in Conemaugh Formation)[1]

Pennsylvanian: Western Maryland.

Original reference: C. K. Swartz, 1922, Maryland Geol. Survey, v. 11, p. 60, 119, pl. 6.

Named for its position beneath Thomas coal in Upper Potomac Basin.

Thomas Sandstone (in Conemaugh Formation)[1]

Pennsylvanian: Western Maryland and northeastern West Virginia.

Original reference: C. K. Swartz, 1922, Maryland Geol. Survey, v. 11, p. 60, 119, pl. 6.

Named for its position above Thomas coal in Upper Potomac Basin, Md.

Thomas Hill Shale[1]

Pennsylvanian: Northeastern Missouri.

Original reference: H. A. Wheeler, 1893, Missouri Geol. Survey Sheet Rept. 2, v. 9, p. 63.

Named for exposures at Thomas Hill, Randolph County.

**Thomaston Granite**

Thomaston Granite Gneiss[1]

Upper Ordovician: Western Connecticut and southeastern New York.

Original reference: H. E. Gregory, 1906, Connecticut Geol. Nat. History Survey Bull. 6, p. 109–110, map.

Robert Balk, 1936, Geol. Soc. America Bull., v. 47, no. 5, p. 755–756, pl. 1. Geographically extended into New York.

T. W. Fluhr, 1948, Rocks and Minerals Mag., v. 23, no. 8, p. 699. In vicinity of New York, underlies Amawalk granite (new).

E. N. Cameron and others, 1954, U.S. Geol. Survey Prof. Paper 255, p. 22. Upper Ordovician.

R. M. Gates, 1954, Connecticut Geol. Nat. History Survey Quad. Rept. 3, p. 6. Name Thomaston granite should not be applied to the granite in Woodbury quadrangle [this report]. The Thomaston includes such a variety of granites, pegmatites, granitic gneisses, and feldspathic metasediments that it has a different meaning in every area. Granite in area of this report is herein named Nonewaug granite.

D. M. Scotford, 1956, Geol. Soc. America Bull., v. 67, no. 9, p. 1177. In area of this report [northeastern Westchester County], granite that was called Thomaston by Balk (1936) is herein named Siscowit granite. Rock is not continuous with Thomaston type area and bears little resemblance to the Thomaston.

Type locality: Abandoned quarry at Reynold's Bridge south of city of Thomaston, Litchfield County, Conn.

Thomasville Glacial Substage

Pleistocene (Iowan): West-central Colorado.

R. L. Nelson, 1954, Jour. Geology, v. 62, no. 4, p. 328–329, fig. 2, table 4. Time of oldest Wisconsin glaciation in Frying Pan Valley. Older than Biglow glacial substage (new); younger than Lime Creek glacial substage (new). Marked by moraine and outwash deposits.

An end-moraine thought to be the terminal of the Thomasville advance lies 1 mile upstream from Thomasville. In Frying Pan River drainage just west of Continental Divide in Sawatch Range.

**Thompson Limestone[1]**

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, chart 8C (column 92). As shown on correlation chart, Thompson limestone occurs above Fant andesite and below Mormon sandstone. Middle Jurassic.

Named for exposures on Thompson's Ranch, on west slope of Mount Jura, east of Taylorsville, Plumas County.

Thompson Slate[1]

Precambrian: Minnesota.

Original reference: N. H. Winchell, 1899, Minnesota Geol. and Nat. History Survey Final Rept., v. 4, p. 551.

*See* Thomson Slate or Formation.

Thompson Red Shale[1]

Middle Jurassic: Northern California.

Original reference: C. H. Crickmay, 1933, Geol. Soc. America Bull., v. 44, no. 1, p. 81.

Mount Jura.

**Thompson Canyon Sandstone Member** or **Bed** (in Neslen Formation)

Thompson Canyon Sandstone Bed (in Price River Formation)[1]

Upper Cretaceous: Central eastern Utah.

Original reference: D. J. Fisher, 1935, 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 (column 39). Listed on correlation chart as member of Neslen formation.

D. J. Fisher, C. E. Erdman, and J. B. Reeside, Jr., 1960, U.S. Geol. Survey Prof. Paper 332, p. 17. Referred to as bed in Neslen formation.

Named for Thompson Canyon in Book Cliffs.

†Thompson Creek Beds[1]

Oligocene, lower: Western central Montana.

Original reference: E. Douglass, 1902, Am. Philos. Soc. Trans., v. 20, new ser., pt. 3, p. 237–245.

Probably named for exposures on Thompson Creek, 3 miles northwest of Three Forks, Broadwater County.

Thompson Valley Limestone

Middle Ordovician: Southwestern Virginia and northeastern Tennessee.

C. E. Prouty, 1946, Am. Assoc. Petroleum Geologists Bull., v. 30, no. 7, p. 1152–1156. Proposed for thick-bedded light-gray commonly variegated coarse-grained limestone referred to as zone 6 of Tazewell County classification by Cooper and Prouty. This zone was included by them in their Ward Cove limestone (1943) which is here restricted to *Nidulites* beds (zone 7). Thickness 75 feet at type section; about 250 to 300 feet in Fountain City, Tenn. Underlies Ward Cove limestone; overlies Lincolnshire formation. In Saltville belt, beds similar to Thompson Valley limestone and exposed in McNutt Quarry, 1½ miles southeast of Sharon Springs, Va., were referred to as Effna limestone (Cooper, 1944). The Effna is below the Whitesburg, Athens, and Peery limestone sequence southeast of Saltville thrust. The Effna is thought to be partly equivalent to Thompson Valley but because relationships are indefinite, use of the two names seems advisable. Partially equivalent to Farragut limestone (new).

Type locality: Thompson Valley, Tazewell County, Va.

Thomson Formation

Thomson Slate[1]

Precambrian: Northeastern Minnesota and northwestern Wisconsin.

Original reference: J. E. Spurr, 1894, Am. Jour. Sci., 3d, v. 48, p. 159–166.

G. M. Schwartz, 1942, Geol. Soc. America Bull., v. 53, no. 7, p. 1001–1020; 1949, Minnesota Geol. Survey Bull. 33, p. 18–36. Thomson formation has been referred to in literature as Thomson slate, St. Louis slates, Cloquet slates, and Carlton slate, but term Thomson slate has priority. Herein suggested that term Thomson formation replace Thomson slate, because more than 50 percent of exposed part of formation is graywacke. Thickness about 20,000 feet. Beds have been compressed into series of folds that strike east-west. Formation has been variously correlated but in recent years has usually been considered equivalent of Animikie-Virginia slate of Mesabi Range. Detailed work suggests that this correlation is untenable and that formation is pre-Algoman. Detailed evidence given, and progressive metamorphism of formation to south described. Revised correlation suggests the possibility of occurrence of upturned Biwabik iron formation in 50-mile covered interval between Cloquet and Mesabi Range. Data likewise throw doubt on correlations proposed for Cuyuna Range about due west of southern exposures of main Thomson area. The Thomson is separated from the Lower Keweenawan (Puckwunge formation) by pronounced angular unconformity. Possibility of Thomson formation and Knife Lake series being equivalent of formations classified as Archean in Canada is not excluded.

Named for exposures along St. Louis River not far from Duluth, near Thomson, Carlton, and Cloquet, Minn.

Thoreau Formation (in San Rafael Group)

Upper Jurassic: Northwestern New Mexico.

C. T. Smith, 1951, *in* New Mexico Geol. Soc. Guidebook 2d Field Conf., p. 13 (chart), 38. Underlies Chavez member (new) of Morrison formation; overlies Todilto limestone.

C. T. Smith, 1954, New Mexico Bur. Mines Mineral Resources Bull. 31, p. 14–15. Consists of lower even-bedded sandstone and siltstone member and upper cross-laminated sandstone member; distinction between units not clear cut although upper member is generally more massive and coarser grained than lower. At type locality (herein designated), a little more than 200 feet of beds are assigned to lower member and 184 feet to upper member. Thins eastward; about 275 feet at eastern edge of quadrangle; most of thinning is in lower member. Local limestone lenses and limy siltstone mark gradation between Thoreau and underlying Todilto limestone.

J. A. Momper and W. W. Tyrrell, Jr., 1957, Four Corners Geol. Soc. Guidebook 2d Field Conf., p. 23–24. Upper Jurassic.

Type section: On west edge of quadrangle south of Mount Powell in secs. 9 and 17, T. 14 N., R. 13 W. Named for exposures along cliffs north of Thoreau, McKinley County.

Thorn Group

Middle Silurian (Niagaran): Northern Illinois, northern Indiana, and southeastern Wisconsin.

H. A. Lowenstam, 1949, Illinois Geol. Survey Rept. Inv. 145, p. 9 (fig. 2), 18. Includes all Niagaran formations exposed in Chicago region, in southeastern Wisconsin, and Wabash Valley of northern Indiana. It is predominant group of the low-clastic sedimentation belt; thins southward, forming tapering wedge that overlies Bainbridge group; at least 450 feet thick in syncline immediately west of La Salle anticlinal belt. Interreef strata are distinguished by their gray to greenish-gray color and abundance of chert; they differ from Bainbridge group in being predominantly dolomite and in containing reef-divided carbonate clastics. Local formation names are used in Chicago area and in northern Indiana. [Report deals with Niagaran reefs and their relation to oil accumulation; much data relative to thickness and distribution of units are based on subsurface studies.]

Essentially all lithologic types in group are represented in quarry at Thornton in southern suburbs of Chicago in secs. 28 and 33, T. 36 N., R. 14 E., about one-half mile west of Thorn Creek.

Thorncrag Biotite-Sillimanite Gneiss

Thorncrag Limy Gneiss (in Tacoma Series)

Middle Silurian: Southwestern Maine.

L. W. Fisher, 1936, Am. Mineralogist, v. 21, no. 5, p. 323. Listed in table of formations. Basal unit of Tacoma series (new). Older than Stetson Brook limestone (new); younger than Bates limestone (new). Cambro-Ordovician(?).

L. W. Fisher, 1937, (abs.) Geol. Soc. America Proc. 1936, p. 71. In Lewiston area are seven formations (ascending): Danville injection gneiss (new), Androscoggin gneiss, Bates crystalline limestone, Deer Rips lime-silicate-gneiss (new), Thorncrag biotite-sillimanite gneiss, Tacoma lime-silicate series, and Sabbatus quartz-sillimanite biotite schist. Middle Silurian.

Occurs in Lewiston area, Androscoggin County.

Thorn Hill Formation[1]

Lower Ordovician: Northeastern Tennessee.

Original reference: G. M. Hall and H. C. Amick, 1934, Tennessee Acad. Sci. Jour., v. 9, no. 2, p. 158–161.

Josiah Bridge, 1956, U.S. Geol. Survey Prof. Paper 277, p. 23, 50, 54. Unit formerly termed Thorn Hill is now included in Kingsport limestone and Mascot dolomite.

Type exposure: On highway about one-half mile from Thorn Hill post office, Morristown quadrangle, Grainger County.

Thornton Fire Clay (in Conemaugh Formation)[1]

Thornton clay member

Pennsylvanian (Conemaugh Series): Northern West Virginia, western Maryland, and eastern Ohio.

Original reference: I. C. White, 1903, West Virginia Geol. Survey, v. 2, p. 322.

N. K. Flint, 1951, Ohio Geol. Survey, 4th ser., Bull. 48, p. 57, 60, table 1. Included in Mahoning cyclothem in Perry County.

D. L. Norling, 1958, Ohio Geol. Survey Bull. 56, p. 28–29, geol. map. In Morgan County, Thornton clay member (Conemaugh series) occurs between Mahoning limestone member and Mahoning coal; rests on Lower Mahoning sandstone and shale member in areas where the limestone is absent. Thickness about 2½ feet.

Named for Thornton, Taylor County, W. Va.

**Thorofare Andesite[1]**

Upper Silurian: Central southern Maine.

Original reference: G. O. Smith, 1896, Geology of the Fox Islands, Maine, p. 12, 30–45.

Named for development on shores of Fox Island Thorofare, between North Haven and Vinalhaven Islands, Penobscot Bay region.

**Thorold Sandstone** (in Albion Group)

Thorold Sandstone (in Clinton Group)

Thorold Sandstone Member (of Albion Sandstone)[1]

Lower Silurian: Ontario, Canada, and western New York.

Original reference: A. W. Grabau, 1913, Geol. Soc. America Bull., v. 24, p. 431, 460–463.

C. K. Swartz and others, 1942, Geol. Soc. America Bull., v. 53, no. 4, chart 3, p. 15. Correlation chart shows Thorold sandstone at top of Albion group below Maplewood shale of Clinton group. Thorold is considered base of Clinton by some workers.

Tracy Gillette, 1947, New York State Mus. Bull. 341, p. 13 (fig. 2), 15 (table 2), 24–29. Thorold can be traced from Niagara Gorge eastward through Lockport and Gasport outcrops to Genesee Gorge and eastward from the gorge to western Cayuga County. Overlies Grimsby sandstone; underlies (eastward) Neahga shale, Reynales limestone, Maplewood shale, and Bear Creek shale. Lower part of Clinton group.

D. W. Fisher, 1959, New York State Mus. Sci. Service Geol. Survey Map and Chart Ser. 1. Thorold sandstone occurs at base of Clinton group (Niagara Falls quadrangle); underlies Neahga shale; overlies Grimsby sandstone and shale of Medina group. Thorold of Gillette (1947) is not continuous with type Thorold; name Kodak sandstone (Chadwick, 1920 [?]) is revived for basal sandstone of Clinton group in New York.

Named for exposures on Welland Canal, at Thorold, Ontario.

Thoroughgood Formation

Devonian: Southern New Mexico.

R. H. Flower, 1958, Roswell Geol. Soc. Guidebook, 11th Field Conf., p. 74, 75. Yellow sands and silts with shaly interbeds. Thickness 12 feet. Only thinning edge of unit present in Rhodes Canyon where it underlies Rhodes Canyon formation (new) and overlies Contadero formation.

F. E. Kottlowski, 1959, Soc. Econ. Paleontologists and Mineralogists Permian Basin Sec., and Roswell Geol. Soc. Guidebook Joint Field Conf., Apr. 17–18, p. 265, 266. Thoroughgood and Rhodes Canyon formations are informal units not yet properly defined. "Thoroughgood" formation consists of tan blocky silty fine-grained sandstone and shaly calcareous siltstone; thins from 12 feet on Sheep Mountain to 24–6 inches in Rhodes Canyon.

In Rhodes Canyon [San Andres Mountains, Sierra County].

Thorp Springs Limestone[1]

Lower Cretaceous (Comanche Series): Central northern Texas.

Original reference: R. T. Hill, 1891, Geol. Soc. America Bull., v. 2, p. 509.

Crops out for several miles along bed of river at Granbury and Thorp Springs, Hood County, and also in bed of Paluxy at Glen Rose, Somervell County.

Thousand Creek Beds[1] or Formation

Pliocene (Hemphillian): Northwestern Nevada and southeastern Oregon.

Original reference: J. C. Merriam, 1910, California Univ. Dept. Geology Bull., v. 6, no. 2, p. 43–50.

H. E. Wood 2d and others, 1941, Geol. Soc. America Bull., v. 52, no. 1, p. 33, pl. 1; D. J. Jones, M. D. Picard, and J. C. Wyeth, 1954, Am. Assoc. Petroleum Geologists Bull., v. 38, no. 10, p. 2221 (table). Pliocene (Hemphillian).

D. O. Cochran, 1959, Oregon Dept. Geology and Mineral Industries Bull. 50, p. 10 (chart), 14. Thousand Creek formation listed with Cenozoic formations of Oregon. Light-colored stratified tuffs, containing rhyolite fragments and pumice. Thickness about 400 feet. Overlies Danforth(?) formation; underlies Mesa basalts.

Thousand Creek, Thousand Creek Ridge, Thousand Creek Canon (Canyon), and Thousand Creek Flats are in Humboldt County, Nev.

**Thousand Springs Basalt**[1] (in Snake River Group)

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. 30, 75–76, pl. 5. Thickness about 100 feet. Constitutes filling of ancient river channel carved in Hagerman lake beds. Younger than Malad basalt. Older than Burley lake beds and Sand Springs basalt.

U.S. Geological Survey currently classifies the Thousand Springs Basalt as a formation in the Snake River Group on the basis of a study now in progress.

Type locality: Thousand Springs, southwest of Wendell, in Gooding County, issue from this basalt.

†Thrall Limestone Member (of Foraker Limestone)[1]

Pennsylvanian: Southeastern Kansas.

Original reference: N. W. Bass, 1936, Kansas Geol. Survey Bull. 23.

Named for Thrall post office, Greenwood County.

**Threadgill Member** (of Tanyard Formation)

Threadgill Limestone

Lower Ordovician: Central Texas.

V. E. Barnes, 1942, Texas Univ. Bur. Econ. Geology Mineral Resources Survey Circ. 54, p. 1, 2. Ordovician Threadgill limestone grades downward into Cambrian Wilberns limestone. Name credited to Bridge and Barnes (unpub. ms.).

P. E. Cloud, Jr., V. E. Barnes, and Josiah Bridge, 1946, Texas Univ. Bur. Econ. Geology Pub. 4301, p. 143, 148, 151, 156, pl. 4 [1945]. Threadgill limestone revised to include equivalent dolomite as well and designated as Threadgill member of Tanyard formation. As a general rule, member is principally or wholly limestone in west, grading eastward to dolomitic facies and showing such abrupt lateral transitions from limestone to dolomite that it is difficult to determine whether a given contact is a lateral transition, a collapse contact, or a fault. At type section 280 feet from base to Cretaceous overlap; elsewhere thicknesses range from 91 feet in eastern part of Llano region to 313 feet in west. Underlies Staendebach member; overlies Pedernales dolomite member of Wilberns formation.

P. E. Cloud, Jr., and V. E. Barnes, 1948, Texas Univ. Bur. Econ. Geology Pub. 4621, p. 37, 190–191 pl. 6 [1946]. Type section and local stratigraphy described in detail.

V. E. Barnes and W. C. Bell, 1954, San Angelo Geol. Soc. Guidebook, Mar. 19–20, p. 35. Name Pedernales member of Wilberns formation dropped. Section shows Treadgill member of Tanyard above San Saba member of Wilberns.

Type section: On Threadgill and Mormon Creeks, south of Lange's mill, northwestern Gillespie County.

**Three Forks Shale,[1] Limestone,[1] or Formation**

Upper Devonian and Lower Mississippian: Montana, Idaho, North Dakota, South Dakota, and Wyoming.

Original reference: A. C. Peale, 1893, U.S. Geol. Survey Bull. 110.

G. W. Berry, 1943, Geol. Soc. America Bull., v. 54, no. 1, p. 14, 17 (fig. 4). Stratigraphically restricted at top to exclude about 60 feet of yellow sandstone herein named Sappington sandstone.

C. P. Ross, 1947, Geol. Soc. America Bull., v. 58, no. 12, pt. 1, p. 1095, 110–111, pl. 1 Three Forks limestone described in Borah Peak quadrangle, Idaho, where it is about 250 feet thick, overlies Grand View dolomite and underlies Milligen formation. Upper Devonian.

L. L. Sloss and W. M. Laird, 1947, Am. Assoc. Petroleum Geologists Bull., v. 31, no. 8, p. 1421. In this report, Sappington sandstone is considered local member of Three Forks formation. Thickness at Logan, Mont., 150 feet. Overlies Jefferson formation; underlies Lodgepole limestone of Madison group. Recommended that term Potlatch be used in subsurface in preference to Three Forks and Jefferson in Sweetgrass arch area.

C. A. Sandberg and C. R. Hammond, 1958, Am. Assoc. Petroleum Geologists Bull., v. 42, no. 10, p. 2321 (fig. 7), 2322–2326. Peale (1893) described five lithologic units in Three Forks from top to base: (1) yellow laminated sandstone, 25 feet; (2) dark-bluish-drab or black argillaceous limestone, 45 feet; (3) fossiliferous green, purple, and black calcareous shale, 70 feet; (4) grayish-brown limestone, 15 to 20 feet; and (5) reddish and brownish-yellow calcareous shale, 65 feet. Berry's (1943) Sappington sandstone is Peales uppermost unit (1). In present report, the Sappington is considered a member of the Three Forks but is assigned a Late Devonian and Early Mississippian age. Sloss and Laird (1947) excluded Peale's lowermost units 4 and 5 from the Three Forks. This was done on incorrect assumption that Peale had included these units (which Sloss and Laird described as "breccias and associated shales") with Jefferson formation. It is herein recommended that lower contact of Three Forks as originally defined by Peale be reestablished. The "breccias and associated shales" unit of Sloss and Laird is integral part of Three Forks and has been correlated northward from Logan area to Sweetgrass arch area where is is equivalent to upper part of Potlatch anhydrite formation as defined by Perry (1928). It is herein designated Potlatch member of Three Forks. In standard subsurface section, herein designated, Three Forks overlies Birdbear formation (new) and underlies Bakken formation.

Type section (Sloss and Laird): North side of Gallatin River at Logan, Mont. Named for exposures at junction of Three Forks of Missouri River, near Three Forks, Mont.

Standard subsurface section: In Williston basin and Montana east of 111° meridian in interval between depths of 10,076 and 10,310 feet in Mobil Producing Co. Birdbear Well 1, center SE¼NW¼ sec. 22, T. 149 N., R. 91 W., Dunn County, N. Dak.

**Threemile Limestone Member** (of Wreford Limestone)

Threemile Limestone (in Chase Group)[1]

Permian: Northeastern Kansas.

Original reference: R. C. Moore, 1936, Kansas Geol. Soc. 10th Ann. Field Conf., Guidebook, p. 12.

D. E. Hattin, 1957, Kansas Geol. Survey Bull. 124, p. 29–39. Basal member of Wreford limestone. Consists of basal thick-bedded cherty limestone unit which is separated from main body of limestone by persistent calcareous shale or shaly to thin-bedded argillaceous limestone; locally contains algal bed at top. Thickness ranges from 6½ feet in Marshall County to slightly less than 33 feet in Wabaunsee County where reeflike expansion in upper part augments normal development. Underlies Havensville shale member. Type exposure defined as exact type locality has not been stated. Wolfcamp series.

Type exposure: In quarry in NW¼SW¼ sec. 11, T. 11 S., R. 6 E., on Fort Riley Military Reservation, near Threemile Creek, Geary County, a few miles southwest of Ogden, Riley County.

Three Rivers Schist (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. Youngest of the four units included in series. Overlies Homer quartzite (new). Mica schists compose most abundant rock type with limestones next. Radiolarian type chert, acid and basic volcanic rocks, and argillaceous sediments present in lesser amounts. West of Sheep Creek, section is about 10,000 feet thick, top not present.

Occurs in southern Sierra Nevada, north-central Tulare County.

†Three Twins Member (of Chalk Bluff Formation)[1]

Permian: Southeastern New Mexico.

Original reference: W. B. Lang, 1937, Am. Assoc. Petroleum Geologists Bull., v. 21, no. 7.

G. E. Hendrickson and R. S. Jones, 1952, New Mexico Bur. Mines Mineral Resources Ground-Water Rept. 3, p. 16 (fig. 3), 20, 21. Described in Eddy County. Consists of evaporites, red beds, and dolomitic limestone. Overlies Seven Rivers gypsiferous member of Chalk Bluff and Azotea tongue of Carlsbad limestone. Grades southward into Carlsbad.

Term Three Twins abandoned as corollary action to abandonment of Chalk Bluff Formation.

Named for exposures in Spencer Draw in Three Twins Hills, northeast of Carlsbad, Eddy County. Exposed over small area in northern part of Azotea Mesa and large area east of Lake McMillan.

**Thrifty Formation** (in Cisco Group)[1]

Thrifty Group

Upper Pennsylvanian: Central and central northern Texas.

Original references: F. B. Plummer and R. C. Moore, 1921, Texas Univ. Bull. 2132, p. 152, 153; 1922, Jour. Geology, v. 30, p. 24.

Wallace Lee and others, 1938, Texas Univ. Bur. Econ Geology Pub. 3801, p, 54–61, 122–128. In Brazos River section, formation includes (ascending) Avis sandstone, Blach Ranch limestone, Ivan limestone, and Breckenridge limestone members. In Colorado River section, includes (ascending) Avis sandstone, *Bellerophon* limestone, Speck Mountain shale, Speck Mountain limestone, Lohn shale, Parks Mountain sandstone, and Chaffin limestone members. Overlies Graham formation; underlies Harpersville formation.

M. G. Cheney, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 1, p. 66 (fig. 1), 90–92. Rank raised to group and expanded upward to redefined Pennsylvanian-Permian boundary. Systemic boundary falls within Harpersville formation which term is abandoned. Includes (ascending) Avis sandstone, Ivan (Rocky Mounds; *Bellerophon*). Specks Mountain (Blach Ranch), Breckenridge, Chaffin, and Obregon (new) formations. Overlies Graham group; underlies redefined Permian Pueblo group.

John Kay, 1956, North Texas Geol. Soc. Field Guidebook May 25–26, fig. 4. Generalized columnar section shows base of Thrifty group at top of Breckenridge limestone. Includes Quinn clay, Crystal Falls limestone, and Saddle Creek limestone.

D. H. Eargle, 1958, San Angelo Geol. Soc. Guidebook Apr. 17–19, p. 50. Composite section of Brown and Coleman Counties shows formation includes (ascending) Speck Mountain limestone, Parks Mountain sandstone, and Chaffin limestone.

D. A. Myers, 1958, Jour. Paleontology, v. 32, no. 4, p. 678 (fig. 1). Columnar section shows formation includes (ascending) Speck Mountain, Breckenridge, and Chaffin members.

D. H. Eargle, 1960, U.S. Geol. Survey Prof. Paper 315–D, p. 58 (table 1), 71–74, pl. 27. Plummer and Moore described Thrifty formation as including sandstone, shale, and limestone overlying their Wayland shale and extending to top of their Breckenridge limestone (the limestone at top of Drake's Chaffin bed). As redefined herein, Thrifty formation consists of (ascending) Speck Mountain limestone, Breckenridge limestone, Parks Mountain sandstone, and Chaffin limestone members. Thickness about 55 feet in southern Coleman County; average thickness about 100 feet in northern Brown County. Overlies Graham formation; underlies Pueblo formation of Wichita group.

Named for Thrifty, Brown County, Colorado River region.

**Thumb Formation**

Cretaceous(?): Southeastern Nevada.

C. R. Longwell, 1952, Utah Geol. Soc. Guidebook 7, p. 34 (fig. 4), 35. Between 2,000 and 3,000 feet of gypseous redbeds, fresh-water limestone, and conglomeratic sandstones interspersed with many extensive lenses of megabreccia. Basal conglomerate bevels Aztec, Chinle, and Moenkopi formations. Unconformably underlies Horse Spring formation.

Well exposed east of Frenchman Mountains.

**Thunder Bay Limestone**[1] (in Traverse Group)

Middle and Upper(?) Devonian: Northeastern Michigan.

Original reference: C. C. Douglass, 1839?, Michigan Leg. H. Doc. 27, between p. 97 and 111.

A. S. Warthin, Jr., and G. A. Cooper, 1943, Am. Assoc. Petroleum Geologists Bull., v. 27, no. 5, p. 579 (fig. 3) 593–594. Although Thunder Bay was first formation named from Alpena region, most authors have overlooked its description. Grabau (1902) used term Thunder Bay for series comprising all Traverse rocks above Alpena limestone, leaving Douglass' original beds without a specific name. Warthin and Cooper (1935) proposed term Partridge Point for exact sequence described by Douglass, but this name, together with Grabau's Thunder Bay series, should be abandoned in favor of earlier usage of name. At Partridge Point, section consists of basal bluish argillaceous limestone, weathering to rusty brown, 1 foot to lake level; 3-foot covered interval; shale, gray, calcareous, with limestone lenses, becoming predominantly granular limestone at top, 7½ feet; and limestone, gray, irregularly bedded, weathering to buff, 2 feet; here underlies glacial lake deposits. Stratigraphically above Potter Farm formation and below Squaw Bay limestone. Upper Devonian. Data on type locality.

Type locality: Bluffs on shore of Partridge Point, extending from center into SE¼ sec. 11, T. 30 N., R. 8 E., Alpena County. In original description locality is given as "the south cape of Thunder Bay." This is not South Point, near Alpena-Alcona County line, but Partridge Point, about 3 miles south of Alpena, Alpena County.

Thunder Bay Series[1]

Middle Devonian: Northeastern Michigan.

Original reference: A. W. Grabau, 1902, Michigan Geol. Survey Rept. 1901, p. 192.

A. S. Warthin, Jr., and G. A. Cooper, 1943, Am. Assoc. Petroleum Geologists Bull., v. 27, no. 5, p. 539. Should be abandoned in favor of earlier use of name, Thunder Bay limestone.

Named for exposures on Thunder Bay, at and around Alpena.

**Thunderhead Sandstone** (in Great Smoky Group)

Thunderhead Conglomerate (in Chilhowee Group)[1]

Precambrian (Ocoee Series): Eastern Tennessee and western North Carolina.

Original reference: A. Keith, 1895, U.S. Geol. Survey Geol. Atlas, Folio 16, p. 2.

P. B. King and others, 1958, Geol. Soc. America Bull., v. 69, no. 8, p. 958–959. Redescribed as sandstone. Reallocated to Great Smoky group. Thickness about 8,000 feet near Thunderhead Mountain; 6,000 feet on Mount Le Conte, and more than 10,000 feet in northeastern part of mountains. These thicknesses are not of wholly contemporaneous beds because span of formation becomes progressively higher eastward; lower part in west is equivalent to Elkmont sandstone (new) farther east, and upper part in east is equivalent to Anakeesta formation (new) farther west. Type Clingman is probably equivalent to upper beds of Thunderhead sandstone.

Named for development on Thunder Head, Blount County, Tenn., and Swain County, N.C. Thunderhead Mountain is in remote part of region; formation is better exposed on Mount Le Conte farther east where full section is present.

Thurman Formation

Oligocene and and Miocene: Southwestern New Mexico.

V. C. Kelley and Caswell Silver, 1952, New Mexico Univ. Pubs. in Geology 4, p. 114 (fig. 14), 121–123. Basal part of formation in Thurman Arroyo is dense cream- to tan-colored resistant rhyolite tuff-breccia about 50 to 100 feet thick. Above this bed are alternating and intercalated thinner units of pinkish sandy clay and thicker units of rather evenly bedded tuff and tuffaceous sandstone. White fine- to medium-grained crystal tuff dominates section. Locally, as at type locality, thin flow of dark amygdaloidal basalt intercalated with tuffaceous sandstone. Characteristically white to light buff in outcrops. Thickness about 2,100 feet at type locality where it unconformably underlies Santa Fe formation and conformably overlies Palm Park formation (new).

Type locality: Along road to Palm Park barite mine in secs. 35 and 36, T. 18 S., R. 3 W., Donna Ana County. Named from Thurman Arroyo at south end of Caballo Mountains.

**Thurman Sandstone**[1] (in Cabaniss Group)

Pennsylvanian (Des Moines Series): Eastern and central Oklahoma.

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

M. C. Oakes, 1953, Am. Assoc. Petroleum Geologists Bull., v. 37, no. 6, p. 1524 (fig. 1), 1525. Basal formation of Cabaniss group (new).

J. V. A. Trumbull, 1957, U.S. Geol. Survey Bull. 1042–J, p. 335, pl. 1. In northwest Pittsburg County, Thurman is from 290 to 350 feet thick and consists of alternating beds of sandstone and shale, with basal bed of conglomerate or coarse sandstone in many places. Overlies Boggy formation; underlies Stuart shale.

Named for former village of Thurman, (about 6 miles west of Indianola) in northern part of Pittsburg County. Crops out in strip a few miles wide extending through northern Coal, western and northwestern Pittsburg, and western McIntosh Counties.

**Thurmond Formation** (in Pottsville Group)[1]

Middle Pennsylvanian: Southern West Virginia.

Original reference: M. R. Campbell, 1902, U.S. Geol. Survey Geol. Atlas, Folio 77.

Well exposed at town of Thurmond, Fayette County.

**Thursday Dolomite**

Middle Silurian: Northwestern Utah.

F. W. Osterwald, 1953, U.S. Geol. Survey Trace Elements Inv. Rept. TEI–330, p. 105; H. M. Staatz and F. H. Osterwald, 1959, U.S. Geol. Survey Bull. 1069, p. 19 (fig. 2), 28–29, pl. 1. Light-gray medium-grained friable rock; medium-grained gray dolomite bed about 15 feet thick with 1- to 4-inch bands of pink chert parallel to bedding present about 135 feet from base of formation in northern part of Spors Mountain; in northern part of district network of thin brown chert present in several beds about 340 feet above base of formation. Thickness about 329 feet. Overlies Lost Sheep dolomite (new); underlies Sevy dolomite. Complete sections rare; formation is either cut off by faults or covered by Lake Bonneville beds in most of district.

Type section: About 4,200 feet west-southwest of Thursday mine, Juab County. Well exposed in northern half of Spors Mountain where it caps a series of long northeast-trending ridges.

Tiawah Limestone Bed (in Scammon Formation)

Tiawah Limestone Member (of Cabaniss Formation or Senora Formation)

Tiawah Lime[1] (in Boggy Formation)

Pennsylvanian (Des Moines Series): Northeastern Oklahoma and southeastern Kansas.

Original reference: S. W. Lowman, 1932, Summaries and abstracts of technical papers presented before Tulsa Geol. Soc. 1932, unpaged, paper dated Dec. 19, 1932.

E. R. Ries, 1954, Oklahoma Geol. Survey Bull. 71, p. 26. In northeastern Oklahoma, included in Senora formation; stratigraphically below Chelsea sandstone member.

W. B. Howe, 1956, Kansas Geol. Survey Bull. 123, p. 54–55. Limestone bed in Scammon formation. In Crawford County, Kans., typically extremely dense, tough, and pyritic, forming a single resistant ledge. Thickness in Cherokee County, Kans., about 4 inches; in type area about 4 feet.

J. M. Jewett, 1959, Graphic column and classification of rocks in Kansas: Kansas Geol. Survey. Shown on chart as limestone member of Cabaniss formation. Below Chelsea sandstone.

Well developed in hills around Tiawah, Rogers County, Okla.

Tibbit Hill Schist[1]

Precambrian or 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. 137–138. Chloritic and epidotic schists varying from very dark green to dull yellowish green. Less metamorphosed parts invariably fine textured. Amygdules sparingly present; occur in bands in several places. Included in discussion of Oak Hill series. Underlies Call Mill slate. Lower Cambrian or Precambrian. Type locality cited.

V. H. Booth, 1950, Geol. Soc. America Bull., v. 61, no. 10, p. 1135, 1136, 1138–1141. Geographically extended into Vermont. Thickness unknown since base nowhere exposed.

R. A. Christman, 1959, Vermont Geol. Survey Bull. 12, p. 14–23, geol. map. In Mount Mansfield quadrangle, underlies Camels Hump group. Occurs in core of Fletcher anticline. Cambrian.

Named for Tibbit Hill west of Brome Lake in Sutton quadrangle, Quebec. Hill is composed largely of the schist.

Tibes Diorite

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. 112–113, geol. map. Intrudes lower Maestrichtian [Upper Cretaceous] rocks of Río Blanco formation. Does not intrude Eocene Jacaguas group.

Time of intrusion definitely post early Maestrichtian and probably pre-middle Eocene.

E. A. Pessagno, Jr., 1960, Caribbean Geol. Conf., 2d, Mayagüez, Puerto Rico, 1959, Trans., p. 85. Coarsely crystalline diorite made up of gray plagioclase feldspar and hornblende. Intrudes rocks of Río Chiquito formation. Footnote states name Río Chiquito no longer used; unit currently assigned to Río Blanco formation.

Occurs on western margin of Ponce quadrangle and extends several kilometers to west into Peñuelas quadrangle, south-central part of island.

**Tice Shale** (in Monterey Group)[1]

Miocene, upper: Western California.

Original reference: A. C. Lawson, 1914, U.S. Geol. Survey Geol. Atlas, Folio 193.

M. N. Bramlette, 1946, U.S. Geol. Survey Prof. Paper 212, pl. 2. Shown on stratigraphic section as occurring at base of Kleinpell's Mohnian stage, upper Miocene.

C. E. Weaver, 1949, Geol. Soc. America Mem. 35, p. 17 (table 3), 70–71, pls. Described in Coast Ranges immediately north of San Francisco Bay region. Thickness 300 to 350 feet. Underlies Hambre sandstone; overlies Oursan sandstone. Locally faulted against Pinole tuff.

C. A. Hall, Jr., 1958, California Univ. Pubs. Geol. Sci., v. 34, no. 1, p. 19, fig. 2, geol. map. Thickness 250 to 900 feet in Pleasanton area, Alameda and Contra Costa Counties. Overlies Oursan sandstone; underlies Hambre sandstone. Term Monterey group not considered appropriate in this area.

Named for exposures along Tice Creek, Concord quadrangle.

**Tichenor Limestone Member** (of Ludlowville Shale)[1]

Tichenor Formation

Middle Devonian: Western to central New York.

Original reference: J. M. Clarke, 1903, New York State Mus. Handb. 19, p. 22 and table.

A. J. Mozola, 1951, New York State Water Power and Control Comm. Bull. GW–26, p. 13. In Seneca County, Tichenor limestone member defines upper limit of Ludlowville. Composed of layers of dense light-colored limestone that are several inches thick overlain by hard calcareous shale about 5 feet thick. Underlies Moscow shale.

R. G. Sutton, 1951, Rochester Acad. Sci. Proc., v. 9, no. 5–6, p. 369–371, pl. 1. Member, in eastern part of Batavia quadrangle, is 9 feet thick; thins toward east and west. Overlies Ledyard-Wanakah member; underlies Deep Run member.

T. B. Coley, 1954, Jour. Paleontology, v. 28, no. 4, p. 453, 454, 455 (fig. 2). Referred to as Tichenor formation. Thickness 1 foot, at Jacox Run near Geneseo. Overlies Wanakah formation; underlies Deep Run formation.

Type locality: Tichenor Point, on Canandaigua Lake, in Ontario County.

Tick Canyon Formation

Miocene, lower to middle: Southern California.

R. H. Jahns, 1939, Am. Jour. Sci., v. 237, no. 11, p. 819–821. Detailed mapping of so-called Mint Canyon formation north and northeast of

Saugus and study of new vertebrate material from lowermost beds have led to revision in stratigraphy. Lower beds are termed Tick Canyon formation; Mint Canyon formation is retained for middle and upper beds, and Mint Canyon series is applied to strata as a whole. Tick Canyon consists mainly of red and reddish-brown clay (in part lacustrine), siltstone, and sandstone, with irregular zone of cobble to boulder conglomerate at base. Thickness varies; average approximately 350 feet. Disconformably underlies Mint Canyon formation; overlies Vasquez series; between Mint and Vasquez Canyons, the Tick Canyon lies in a steeply dipping depositional contact upon basement complex of pre-Cretaceous schists, quartzites, granodiorites, and migmatic rock types.

R. H. Jahns, 1940, Carnegie Inst. Washington Pub. 514, p. 147–194, pls. Tick Canyon formation (basal beds of Hershey's, 1902, California Univ. Pub., Dept. Geol. Bull., v. 3, Mellenia series and Kew's, 1924, U.S. Geol. Survey Bull. 753 Mint Canyon formation) are traceable in narrow irregular band extending from Tick Canyon area northwesterly to point between Vasquez and Texas Canyons, where lack of exposures prevents their demarcation from overlying Mint Canyon strata. Thickness 593 at type locality herein designated.

R. H. Jahns and W. R. Muehlberger, 1954, California Div. Mines Bull. 170, map sheet 6. Generalized stratigraphic column for Soledad basin shows Tick Canyon 0 to 900 feet thick.

G. B. Oakeshott, 1958, California Div. Mines Bull. 172, p. 23 (fig. 3), 63, pl. 1. In San Fernando quadrangle, exposed in narrow band 2 miles long between Texas and Mint Canyons, and in separate area extending approximately 1 mile both east and west of Tick Canyon. Maximum thickness 593 feet (Jahns, 1940). Thins westward and is apparently overlapped by Mint Canyon formation before reaching Texas Canyon. Lies unconformably on Upper Jurassic(?) or Lower Cretaceous(?) gneissoid granite across Vasquez Canyon and, west of that canyon, was deposited across Vasquez Canyon fault and on eroded surface of Vasquez formation. Southeastern one-half mile of this contact southeast of Vasquez Canyon may be near-vertical fault. Present north of San Gabriel fault.

Type section: Between Mint and Vasquez Canyons in Humphreys quadrangle, Los Angeles County. Named for exposures about one-half mile down canyon from abandoned borax mine at head of Tick Canyon, as well as in vicinity of Tick Canyon-Mint Canyon divide, Lang quadrangle.

Ticklenaked Formation

Age not stated: Northeastern Vermont.

J. G. Dennis, 1956, Vermont Geol. Survey Bull. 8, p. 20, 26, 27. Overlies Barton River formation. Refers to mapping by W. S. White and J. H. Eric, (unpub. theses).

Occurrence: Vermont part of Littleton quadrangle, Vermont-New Hampshire.

**Tickville Rhyolite**[1]

Eocene(?): Central northern Utah.

Original reference: J. Gilluly, 1932, U.S. Geol. Survey Prof. Paper 173, p. 60–61.

Occurs near Tickville.

Ticonderoga Formation

Cambrian (Trempealeauian) : New York and Vermont.

C. W. Welby, 1959, New England Intercollegiate Geol. Conf., p. 23, 33, pl. 1. Consists of dark-weathering medium- to dark-gray medium and finely crystalline dolostones with interbedded coarse- and medium-grained quartz sandstones. Maximum exposed thickness about 90 feet at Thompson Point; outcrop width south of Vergennes suggests thickness of as much as 350 to 400 feet. Overlies Potsdam sandstone; underlies Whitehall formation. Name credited to J. Rodgers.

Type section: On Mount Hope at Ticonderoga, N.Y.

Tidioute shale member[1]

Devonian or Carboniferous: Northwestern Pennsylvania.

Original reference: K. E. Caster, 1934, Bulls. Am. Paleontology, v. 21, no. 71, p. 116–119, table opposite p. 61.

Named for excellent exposure along Allegheny River at Tidioute, Warren County, and along State highway through Dennis Run, 1 mile southwest of Tidioute.

**Tie Gulch Dolomite Member** (of Manitou Formation)

Lower Ordovician: 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, 904 (fig. 9), 906–907. Proposed for regularly bedded thin-bedded medium-brown dolomite that forms upper part of formation. Thickness 47 to 66 feet. Overlies Dead Horse conglomerate member (new); underlies Parting member of Chaffee formation.

Type locality: Walls of Tie Gulch at east end of U.S. Highway 6 bridge over Tie Gulch, which enters Glenwood Canyon near center sec. 15, T. 5 S., R. 87 W., Garfield County.

Tierra Blanca 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, 13–14, 61, figs. 4, 29. Medium-bedded hard gray to brown coarse-grained criquina that carries considerable light-colored nodular chert. Most of the basal beds are interbedded with blue-gray marl so that line between Nunn and Tierra Blanca members is difficult to draw. Upper part invariably gray to brown criquina with up to 50 percent chert. Approximately 50 feet of section exposed at Lake Valley. Thickness ranges from 10 feet in parts of Sacramento Mountains to 125 feet in Percha Creek area. Rapid lateral changes in thickness common where biohermal structures are present. Cliff former and in most places makes vertical scarp along mountain front. Conformably underlies Arcente member.

F. E. Kottlowski, 1956, New Mexico Bur. Mines Mineral Resources Mem. 1, p. 34. Member is typical biostromal and biohermal limestone in San Andres Mountains and grades laterally and vertically into overlying and underlying shaly members. Overlies Alamogordo member in Ash Canyon; elsewhere in range overlies Nunn member.

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 Tierra Blanca Creek along which are excellent exposures in vicinity of Nunn Ranch.

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. 4), 9, 24, pls. 2, 3, 4, 5. Principally brown shale. Thickness about 1,200 feet. Includes 190-foot Mercy sandstone lentil (new) about 70 feet below top. Underlies Marca shale member (new); overlies Dosados sand and 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 Tierra Loma Schoolhouse on Tierra Loma quadrangle near E¼ cor. sec. 9, T. 14 S., R. 12 E.

**Tieton Andesite**[1]

Pleistocene: Central Washington.

Original reference: G. O. Smith, 1903, U.S. Geol. Survey Geol. Atlas, Folio 86.

W. C. Warren, 1941, Jour. Geology, v. 49, no. 8, p. 797 (fig. 2), 806–808. Further described in discussion of relationship of Yakima basalt to Keechelus andesitic series. Younger than Yakima basalt. Area of report is Mount Ait quadrangle.

Probably named for occurrence in Tieton Canyon, Ellensburg quadrangle.

Tiff Member (of Goddard Formation)

Mississippian: Southern Oklahoma.

C. W. Tomlinson and Allan Bennison, 1960, Oklahoma Geology Notes, v. 20, no. 5, p. 123–124. Proposed to replace preoccupied name Grindstone Creek member of Goddard formation of Tomlinson (1959). Consists of 10 to 40 feet of light- to dark-gray pelletal or gritty claystone. About 500 feet below Rod Club member of Springer formation. Fossiliferous.

Type section: NE¼SE¼SE¼SE¼ sec. 16, T. 3 S., R. 1 E., in gully at north end of large cutbank at east side of Grindstone Creek. Tiff was rural community 1 mile north and 2 miles east of type section and was on Caddo anticline in Carter County.

Tiffanian Age

Paleocene: North America.

H. E. Wood 2d and others, 1941, Geol. Soc. America Bull., v. 52, no. 1, p. 9, pl. 1. Provincial time term, based on Tiffany local fauna, often used in a more extended sense as a faunal level, northern rim of San Juan Basin, southwestern Colorado. Includes interval between Paleocene Torrejonian (older) and Clarkforkian ages. Report defines 18 provincial time terms, based on mammal-bearing units for North American continental Tertiary. [For sequence see under Puercan.]

Typical area: Mason pocket, sec. 20, T. 33 N., R. 6 W. [La Plata County, Colo.].

†Tiffany Beds (in Wasatch Formation)[1]

Paleocene: Southwestern Colorado and northwestern New Mexico.

Original reference: W. Granger, 1917, Am. Mus. Nat. History Bull. 37, p. 826–830.

H. E. Wood 2d, 1941, Geol. Soc. America Bull., v. 52, no. 1, p. 33. Tiffany could and should be defined as either a member or a formation; additional field work is desirable.

G. G. Simpson, 1948, Am. Jour. Sci., v. 246, no. 5, p. 275, 276 (fig. 2). Tiffany is faunal rather than stratigraphic term, but its rehabilitation in latter sense is probable outcome of still more detailed, combined paleontological and stratigraphic study. Tiffany local fauna is in lower part of San Jose formation as proposed in this report.

Type locality: Sec. 20, T. 33 N., R. 6 W., La Plata County, Colo. Named from Tiffany Station, on Denver & Rio Grande Railroad, 4 miles south of Mason Schoolhouse.

Tiflis Member (of Wahluke Formation)

Pleistocene, upper: Central Washington.

G. F. Beck, 1936, Mineralogist, v. 4, no. 11, p. 12. Name applied to upper part of formation. Member grades from water-laid materials at base to loess at top. Average thickness 15 feet.

Deposited in Tiflis downward north of Warden, Grant County.

**Tigaraha Schist**[1] (in Kigluaik Group)

Lower Paleozoic or older: Northwestern Alaska.

Original reference: F. H. Moffit, 1913, U.S. Geol. Survey Bull. 533, p. 20–33, maps.

Type locality: Includes sharp peak, near head of Buffalo Creek, named Tigaraha Mountain, Eskimo word for pointed.

**Tiger Formation**

Tertiary: Northeastern Washington.

C. F. Park, Jr., and R. S. Cannon, Jr., 1943, U.S. Geol. Survey Prof. Paper 202, p. 23, pl. 1. Name applied to semiconsolidated continental deposit consisting of conglomerates, sandstones, and clays; beds ill defined and materials poorly sorted. Maximum thickness about 1,000 feet. Overlies Metaline limestone.

M. C. Shroeder, 1952, Washington Div. Mines and Geology Bull. 40, p. 7 (chart), 20–21. Described in Bead Lake district where it unconformably overlies Pend Oreille andesite.

Extensively exposed in hills south of Tiger, Pend Oreille County.

†Tiger Creek Sandstone Member (of Bristow Formation)[1]

Pennsylvanian: Central Oklahoma.

Original reference: A. E. Fath, 1917, U.S. Geol. Survey Bull. 661B, p. 73–74, pl. 5.

C. C. Branson, 1957, Oklahoma Geology Notes, v. 17, no. 11, p. 103. Abandoned by Oklahoma Geological Survey. Appears to be Paola "limestone" member of Oread formation.

Named for exposures in south part of sec. 6, T. 17 N., R. 10 E., on south side of small tributary of Tiger Creek.

**Tightner Formation**[1]

Mississippian: Northern California.

Original reference: H. G. Ferguson, 1929, Am. Inst. Mining and Metall. Engineers Tech. Pub. 211, p. 4.

J. M. Weller and others, 1948, Geol. Soc. America Bull., v. 59, no. 2, chart 5 (column 15). Shown on correlation chart above Blue Canyon formation and below Kanaka formation.

Named for fact it forms principal wall rock of Tightner mine. Extends from North Yuba [Sierra County] to South Yuba.

**Tiglukpuk Formation**

Upper Jurassic: Northern Alaska.

R. W. Imlay, 1955, U.S. Geol. Survey Prof. Paper 274–D, p. 70–71, Coarsely clastic facies of Jurassic sedimentary rocks in northern Alaska. Characterized by conglomerate, graywacke, sandstone, chertlike material (possibly devitrified tuff), tuffs, sills, pillow lavas, and a few thin beds of limestone. Interbedded with dark siltstone and shale which constitute as much as 50 percent of some sections and as little as 10 percent of others. Coarser constituents of conglomerate range in size from granules to boulders; matrix is graywacke. Sills identified only west of Anaktuvuk River, and lavas only between Nuka and Utukok Rivers. Limestone occurs as thin coquinas composed of pelecyod *Aucella*. Thickness ranges from featheredge to about 2,000 feet; highly variable along strike and absent locally within belt of outcrop. Overlies Triassic and older rocks with angular discordance in area between Utukok and Ipnavik Rivers. Grades northward into shale-siltstone facies.

W. W. Patton, Jr., *in* George Gryc and others, 1956, Am. Assoc. Petroleum Geologists Bull., v. 40, no. 2, p. 213, 215, 218, 220, figs. 2, 5. Shale, siltstone, and graywacke are principal components. Graywacke typically greenish-gray, slightly calcareous, highly argillaceous, poorly sorted sandstone or conglomerate. No complete unfaulted section known. Thickest composite section, compiled from scattered outcrops along Lupine River, is approximately 1,800 feet. Type section, approximately 1,450 feet thick, believed to be most complete section exposed in continuous outcrop. Overlies Shublik formation with little or no angular discordance; underlies Okpikruak formation or younger Cretaceous rocks, in some places with angular discordance. Underlies Fortress Mountain formation (new) at type locality of Fortress Mountain. Type section designated.

Type section: Along series of cutbanks on east side of Tiglukpuk Creek between lat. 68°22′ N. and lat. 68°22′30″ N. Recognized and mapped in Arctic Foothills from Lupine River west to Nuka River.

Tigre Limestone[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. 347. Undefined name. Appeared in table showing that limestone overlies Watsi and Mona shales. Note on type region.

Type region: In Bocas del Toro area, in foothills about 15 kilometers southwest of mouth of Río Sixaola. Tigre is local name for small stream flowing into tributary of Río San San.

**Tihvipah Limestone**

Pennsylvanian: Southern California.

J. F. McAllister, 1952, California Div. Mines Spec. Rept. 25, p. 3, 14 (fig. 6), 26–27, pls. 1, 2, 3. Name applied to limestone and associated rocks above Rest Spring shale (new). Consists mostly of platy light-gray limestone, interbedded shaly limestone or calcareous shale, and some beds, 1 foot to 3 feet thick, fine-grained medium-gray limestone; shaly rocks range in color from very light gray to pale red or grayish pink. Some spherically concretionary dark-gray chert, unlike rounded chert pebbles which locally compose inconspicuous thin basal conglomerate. Thickness about 200 feet. In Quartz Spring area, top of Tihvipah limestone is eroded so its upper limit cannot be satisfactorily defined.

Type locality: On hill due east of Rest Spring, Inyo County. Named for exposure northwest of Tihvipah Spring, which is 2 miles N. 15 E. of Burro Spring. Name Tihvipah Spring does not appear on any previously published map, but in 1938 it was used by rangers of National Park Service in Death Valley.

Tijeras quartzite[1]

Precambrian: 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, 11.

Well exposed in great Tijeras arch of pre-Cambric rocks at southern end of Sandia Range.

Tilden Formation[1]

Cambrian: Southwestern Montana.

Original reference: P. J. Shenon, 1931, Montana Bur. Mines and Geology Bull. 6.

Well exposed northwest of Ermont mine, Argenta, Beaverhead County.

**Tilden Limestone Lentil** (of Bingham Quartzite)[1]

Pennsylvanian: Central northern Utah.

Original reference: A. Keith, 1905, U.S. Geol. Survey Prof. Paper 38, p. 44, map, sections.

Named for Tilden mining claim, Bingham district.

Tilford Lens (in Newcastle Formation)

Upper Cretaceous: Western South Dakota.

R. M. Grace, 1952, Wyoming Geol. Survey Bull. 44, p. 14, 16. Composed almost entirely of friable sandstone. In this report, seven lenses are named in Newcastle.

Present northeast of Tilford, Meade County.

**Tillamook Volcanic Series**

Eocene: Northwestern Oregon.

W. C. Warren, Hans Norbisrath, and R. M. Grivetti, 1945, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 42. Name applied to series of basaltic lavas and tuffs which form backbone of Coast Range in south-central part of area mapped. Along west and north sides of series, lava is predominant rock type; toward east and south, tuffs, and, next tuffaceous shales become increasingly abundant. Thickness 6,000 to 10,000 feet along Trask River from mouth of its canyon to its forks. Oldest rocks in region; unconformably overlain by sedimentary beds containing Cowlitz (upper Eocene) fauna.

P. D. Snavely, Jr., and E. M. Baldwin, 1948, Am. Assoc. Petroleum Geologists Bull., v. 32, no. 5, p. 806. Lower part of Tillamook volcanic series is equivalent to newly defined Siletz River volcanic series in Lincoln County.

Well exposed along most of large streams in eastern Tillamook County.

†Timber Belt beds[1]

Eocene: Eastern Texas.

Original reference: E. T. Dumble and R. A. F. Penrose, Jr., 1890, Texas Geol. Survey 1st Ann. Rept., p. xxxvi, 17, 22, pl. 3.

Named for great timber region.

Timber Canyon Fanglomerate[1]

Pleistocene, upper: Southern California.

Original reference: U. S. Grant 4th and H. R. Gale, 1931, San Diego Soc. Nat. History Mem., v. 1, p. 37, 38, 63.

Occurs on top of ridges beveling edges of upturned marine beds west of Timber Canyon, on north side of Santa Clara Valley, Ventura and Los Angeles Basins.

Timber Crater Basalt Flow, Lavas

Pleistocene to Recent: Southwestern Oregon.

J. S. Diller and H. B. Patton, 1902, U.S. Geol. Survey Prof. Paper 3, p. 23–31, 32–34. Discussion of geology and petrography of Crater Lake National Park. Mount Mazama is name given to prominent peak that once stood on what is now rim of Crater Lake. Lavas in Mount Mazama were of three types: andesites, dacites, and basalts. Immediate rim of Crater Lake is made up wholly of andesites and dacites, chiefly the former; basalts are limited to outer slope. None of the basalt flows came from central vent of Mount Mazama. Principal basalt flows are the Timber Crater, Red Cone, Desert Cone, Bald Crater, and Crater Peak.

Howel Williams, 1942, Carnegie Inst. Washington Pub. 540, p. 140–141, pl. 3. Mapped as Timber Crater lavas.

Timber Crater is 5 miles northeast of Crater Lake, Cascade Range. Slopes of Timber Crater cone are covered with pumice showing that its activity closed before that of Mount Mazama.

†Timber Creek Beds[1]

Upper Cretaceous: Eastern Texas.

Original reference: J. A. Taff, 1893, Texas Geol. Survey 4th Ann. Rept., pt. 1, p. 285.

†Timber Creek Beds[1]

Eocene: New Jersey.

Original reference: W. M. Gabb and G. H. Horn, 1862, Philadelphia Acad. Nat. Sci. Jour., 2d ser., v. 5, p. 111, 135.

Exposed on Timber Creek.

†Timber Creek Group[1]

Upper Cretaceous (Gulf Series): Eastern Texas.

Original references: R. T. Hill and C. A. White, 1887, Philadelphia Acad. Nat. Sci. Proc. 1887, p. 40, 44; 1887, Am. Jour. Sci., 3d, v. 33, p. 296, 298.

Crops out coextensive with region known as Lower Cross Timbers.

**Timbered Hills Group[1]**

Upper Cambrian: Southern Oklahoma.

Original reference: C. E. Decker, 1933, Tulsa Geol. Soc. Digest, p. 55–57.

C. E. Decker, 1939, Oklahoma Geol. Survey Circ. 22, p. 15–20. Includes (ascending) unnamed basal limestone 98 feet thick, Reagan sandstone, Cap Mountain formation, and Honey Creek formation. Derivation of name given.

H. D. Miser and others, 1954, Geologic map of Oklahoma (1:500,000): U.S. Geol. Survey. As mapped, includes Honey Creek formation and Reagan sandstone.

Named because Reagan and Honey Creek are well exposed adjacent to East and West Timbered Hills in Arbuckle Mountains.

**Timber Lake Member** (of Fox Hills Formation)

Upper Cretaceous: North-central South Dakota and southern North Dakota.

R. E. Morgan and B. C. Petsch, 1945, South Dakota Geol. Survey Rept. Inv. 49, p. 15–17, fig. 4, pl. 3. Lower part commonly soft or uncemented uniform sand; upper part contains calcareous lens-shaped concretionary masses, thin limonitic claystones, and soft mottled sandstone. Thickness about 90 feet. Overlies Trail City member (new); underlies unnamed sandstones and shales in upper part of formation.

S. P. Fisher, 1952, North Dakota Geol. Survey Bull. 26, p. 11–12, 37. Geographically extended into Emmons County, N. Dak., where it is about 60 feet thick and consists of uncemented fine- to medium-grained green-brown and gray sands. Thins eastward. Overlies Trail City member.

R. E. Stevenson, 1957, Areal geology of the McIntosh quadrangle (1:62,500): South Dakota Geol. Survey. Underlies Bullhead member (new).

Named for exposures in and near town of Timber Lake, Dewey County, S. Dak.

**Times 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. 45, map.

Exposed in Times Gulch, Oatman district.

**Timms Point Silt Member** (of San Pedro Formation)

Timms Point Formation[1]

Timms Point Silt

Pleistocene, lower: Southern California.

Original reference: U.S. Grant, IV, and H. R. Gale, Nov. 3, 1931, San Diego Soc. Nat. History Mem., v. 1, p. 37, 42–43.

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 Timms Point silt. In San Pedro where units are superimposed, the sequence is (ascending) Lomita marl, Timms Point silt, and San Pedro sand. Exposed thickness 30 to 80 feet; minimum computed thickness about 120 feet. Lower Pleistocene.

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 section : Timms Point, Los Angeles County.

**Timothy Sandstone**[1]

**Timothy Sandstone Member** (of Thaynes Formation)

Timothy Formation

Lower Triassic: Southeastern Idaho, central northern Utah, and central western Wyoming.

Original references: G. R. Mansfield, 1920, Am. Jour. Sci., 4th v. 50, p. 62; 1920, U.S. Geol. Survey Bull. 713, p. 29, 50.

W. F. Scott, 1950, (abs.) Geol. Soc. America Bull., v. 61, no. 12, pt. 2, p. 1530. Formation comprises 1,310 feet of red shales and siltstones, with interbedded reddish-purple and reddish-brown sandstones in central Wasatch Mountains, Utah.

G. R. Mansfield, 1952, U.S. Geol. Survey Prof. Paper 238, p. 17, 33–34, pl. 1. Sandstone has conformable contacts with Portneuf limestone below and Higham grit above where mapped in Ammon and Paradise Valley quadrangles, Idaho. Upper Triassic.

Bernhard Kummel, 1954, U.S. Geol. Survey Prof. Paper 254–H, p. 173, fig. 18. Upper member of Thaynes formation in southeastern Idaho where it overlies Portneuf limestone member. Correlation chart shows age to be both Lower and Upper Triassic.

W. F. Scott, 1954, Dissert. Abs., v. 14, no. 8, p. 1200. Included in Moenkopi group.

H. R. Wanless, R. L. Belknap, and Helen Foster, 1955, Geol. Soc. America Mem. 63, p. 45–46. Red shale, siltstone, and sandstone overlying Thaynes formation in northwestern Wyoming referred to Timothy sandstone. Thickness between 159 to 278 feet.

Named for Timothy Creek, in Lanes Creek and Freedom quadrangles, Idaho, which cuts formation.

Timpahutean series[1]

Timpahuten series[1]

Middle Silurian: Nevada.

Original references: C. R. Keyes, 1923, Pan-Am Geologist, v. 40, p. 53; 1924, Pan-Am. Geologist. v. 41, p. 78.

Name derived from Timpahute Peak, north of Las Vegas, Clark County.

Timpanogos (Tampanogos) shales[1]

Cambrian: Utah.

Original reference: C. R. Keyes, 1924, Pan-Am. Geologist, v. 41, p. 38.

Derivation of name not stated.

†Timpas Limestone (in Colorado Group)[1]

Timpas Limestone Member (of Niobrara Formation)

Upper Cretaceous: Eastern Colorado and northeastern New Mexico.

Original reference: G. K. Gilbert, 1896, U.S. Geol. Survey 17th Ann. Rept., pt. 2, p. 566.

W. A. Cobban and J. B. Reeside, Jr., 1952, Geol. Soc. America Bull., v. 63, no. 10, chart 10b (columns 48, 49, 52). Shown on correlation chart as member of Niobrara formation. Underlies Apishapa shale member.

K. M. Waagé, 1952, Colorado Sci. Soc. Proc., v. 15, no. 9, p. 375 (fig. 1). Shown on generalized stratigraphic section of rocks exposed in Denver-Golden area. Underlies Apishapa shale; overlies Benton shale. Thickness 30 feet.

M. A. Jenkins, Jr., 1957, Rocky Mountains Assoc. Geologists Guidebook to the geology of North and Middle Parks Basins, Colorado, p. 53. Believed that names Fort Hays and Smoky Hill have priority over terms Timpas and Apishapa and, is used, would help standardize Niobrara terminology in west-central Colorado.

Named for Timpas Creek, which enters Arkansas River below Rocky Ford, Otero County, Colo.

**Timpoweap Member** (of Moenkopi Formation)

Lower Triassic: Central southern Utah.

H. E. Gregory, 1948, Geol. Soc. America Bull., v. 59, no. 3, p. 226, 227; 1950, U.S. Geol. Survey Prof. Paper 220, p. 48 (fig. 24), 52 (table), 60–61. Consists of three unlike groups of strata: at base, conglomerates and breccia; higher up limestone; and at top variegated shales. Average thickness 170 feet. Conglomeratic beds unevenly distributed and variable in composition; shales, yellow, white, brown, and red, ferruginous, calcareous, arenaceous, and gypsiferous, includes calcareous sandstone in beds 1 to 3 feet thick. Basal member of formation; separated from overlying Virgin limestone member by 200-foot interval of sandstone termed lower red member; unconformably overlies Kaibab limestone.

Type locality: Near Virgin City, Washington County. Traced eastward from type locality to Paria River. [River map shows Virgin, Washington County, and Timpoweap Canyon of Virgin River, Washington County.]

Tina Limestone Member (of Altamont Limestone)

Pennsylvanian (Des Moines Series): Kansas and Missouri.

L. M. Cline, 1941, Am. Assoc. Petroleum Geologists Bull., v. 25, no. 1, p. 29, 40. Proposed for lower limestone member of Altamont. Light-gray limestone; weathers buff. Thickness in Livingston and Carroll Counties, Mo., about 4 feet.

J. M. Jewett, 1941, Kansas Geol. Survey Bull. 38, pt. 2, p. 329–330. Geographically extended into eastern Kansas. Thickness as much as 16 feet. Underlies Lake Neosho shale member (new); overlies Bandera shale. It is unlikely that all limestone included in the Tina in Kansas is precisely equivalent to type Tina.

F. C. Greene and W. V. Searight, 1949, Missouri Geol. Survey and Water Resources Rept. Inv. 11, p. 7. Term Tina abandoned. Rocks chosen for type Tina have proved not to be Altamont. Name Amoret replaces Tina.

Typical exposures: About 2 miles southeast of Tina, Carroll County, Mo., in ravines in west-central part of sec. 7, T. 54 N., R. 22 W.

**Tinaquaic Sandstone Member** (of Sisquoc Formation)

Pliocene, lower and middle: Southern California.

W. P. Woodring, M. N. Bramlette, and K. E. Lohman, 1943, Am. Assoc. Petroleum Geologists Bull., v. 27, no. 10, p. 1347–1352. Name applied to marginal facies of Sisquoc formation. Consists principally of sandstone; includes diatom-bearing siltstone and conglomerate. In type region, member is 1,400 feet thick and rests unconformably on Monterey.

W. P. Woodring and M. N. Bramlette, 1950, U.S. Geol. Survey Prof. Paper 222, p. 28, 29, pl. 1. Lower and middle Pliocene.

Type region: In Foxen Canyon-Sisquoc River area, Santa Maria district. Name derived from land grant in type region.

Tincanebits Member (of Lyndon Limestone)

Tincanebits 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. Rusty-brown dolomite tongue in Bright Angel shale of western Grand Canyon. Thickness ranges from 8½ to 30 feet. Separated from underlying red-brown cliff-forming unit of Bright Angel by 30 to 100 feet of micaceous green shale and thin-bedded brown siltstone. 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. Older than Meriwitica tongue (new).

H. E. Wheeler and V. S. Mallory, 1953, Am. Assoc. Petroleum Geologists Bull., v. 37, no. 10, p. 2413 (fig. 2). In generalized paper on the designation of stratigraphic units, Tincanebits shown on diagram as member of Lyndon limestone.

In western Grand Canyon. Traced along walls of canyon for many miles.

**Tincup Quartz Monzonite Porphyry**

Paleocene(?) to Oligocene(?): Central Colorado.

M. G. Dings and C. S. Robinson, 1957, U.S. Geol. Survey Prof, Paper 289, p. 20–21, pl. 1. Typical rock consists of very conspicuous phenocrysts of white feldspar, colorless to slightly smoky quartz, and less abundant dark hornblende in a light-greenish-gray to grayish-green aphanitic groundmass. Porphyry masses occur in several forms, such as a stock, sills, a large tongue or wedge-shaped body, and two small irregular bodies with exposed lengths of less than half a mile. Probably older than Mount Princeton quartz monzonite.

Type locality: In a stock west of Napoleon Pass in Tincup mining district, Garfield quadrangle.

**Tindir Group**[1]

Precambrian and Lower Cambrian(?): Northeastern Alaska.

Original reference: D. D. Cairnes, 1914, Geol. Soc. America Bull., v. 25, p. 185–187.

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.

Named for exposures along international boundary between Tindir, Cathedral, and Harrington Creeks. Yukon-Tanana region.

Tinian Beds

Oligocene (Aquitanian): Mariana Islands (Tinian).

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. 20–21 [English translation in library of U.S. Geol. Survey, p. 19–20]; 1952, Coral reefs in the South Seas: Japan Hydrog. Office Bull., v. 11, p. 53, table 4 [English translation in library of U.S. Geol. Survey, p. 63]. Andesitic tuff in lower part and tuffaceous and calcareous sandstone in upper part. Base is coarse-grained tuffaceous sandstone, overlain by sequence of white sandy tuff, light-pink sandy tuff, yellowish sandy tuff, and light-pink sandy tuff; several thin beds of light-yellow sandstone containing limestone blocks intercalated; contains many *Globigerina*. Thickness about 30 meters.

Typically exposed along cliff bounding northeastern margin of Carolinas plateau of Tinian Island.

Tinkers Creek 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), 51–53. One of seven lithologic subdivisions in the formation. Includes Meadville shale, Sharpsville sandstone, and Orangeville shale members. Lies to northeast of River Styx facies (new).

Occurs in Cuyahoga, Geauga, Trumbull, and Ashtabula Counties.

Tinkers Falls Member[1] (of Tully Formation)

Middle Devonian: Central New York.

Original reference: G. A. Cooper and J. S. Williams, 1935, Geol. Soc. America Bull., v. 46, p. 790–806.

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 and W. S. Skinner, 1949, Pennsylvania Acad. Sci. Proc., v. 23, p. 29–33. Tully type section consists of following members: Tinkers Falls, Apulia, and West Brook. In the clastic facies of the Tully, the Tinkers Falls is represented by New Lisbon member.

Type section: Just under main overhanging ledge in face of Tinkers Falls, Onondaga County.

Tinley Drift or Till

Pleistocene (Wisconsin): Northern Illinois.

J. H. Bretz, 1939, Illinois Geol. Survey Bull. 65, pt. 1, p. 55. Incidental mention.

Leland Horberg and P. E. Potter, 1955, Illinois Geol. Survey Rept. Inv. 185, p. 9 (fig. 2), 10. Clayey yellow-gray to gray calcareous till about 15 feet thick. Overlies Valparaiso till in some areas and in others Lemont till or drift.

Derivation of name not given; till is present in gravel pit at Worth, Cook County, not far from Tinley Park.

**Tin Mountain Limestone**

Lower Mississippian: Southern California.

J. F. McAllister, 1952, California Div. Mines Spec. Rept. 25, p. 3, 14 (fig. 6), 20–22, pls. 1, 2, 3. Lower part consists of dark-gray limestone in beds 2 to 6 inches thick, separated by much thinner beds of light-brownish-gray to pale-red shale; upper part is medium-gray limestone in beds that range in thickness from a few inches to 2 feet; both upper and lower parts contain some dark-gray chert, that weathers dusky brown or dark yellowish brown; fossiliferous. Thickness 475 feet at type locality. Underlies Perdido formation (new); overlies Devonian Lost Burro formation (new).

R. L. Langenheim, Jr., and Herbert Tischler, 1960, California Univ. Pub. Geol. Sci., v. 38, no. 2, p. 92–97, 132–134, 135–136. In Quartz Spring area, overlies Quartz Spring sandstone member (new) of Lost Burro formation. Thickness about 366 feet. Underlies Perdido formation. Lower Mississippian.

Type locality: Southern slope of hills about 2½ miles southeast of Quartz Spring, Inyo County, and about 3,000 feet north of road to Rest Spring, where entire sequence is exposed. Named for Tin Mountain, northernmost peak in Panamint Range, Inyo County.

†Tintic Andesite[1]

Tertiary: Central northern Utah.

Original reference: G. W. Tower, Jr., and G. O. Smith, 1899, U.S. Geol. Survey 19th Ann. Rept., pt. 3.

Tintic district.

**Tintic Quartzite**[1]

Lower and Middle Cambrian: Central and northern Utah.

Original reference: G. O. Smith, 1900, U.S. Geol. Survey Geol. Atlas, Folio 65.

A. J. Eardley and R. A. Hatch, 1940, Geol. Soc. America Bull., v. 51, no. 6, p. 809 (fig. 3), 815. Extended northward to Willard Canyon [between Ogden and Brigham City] where it underlies Ophir shale and overlies Farmington Canyon complex.

A. J. Eardley, 1944, Geol. Soc. America Bull., v. 55, no. 7, p. 826 (table 1), 827–828. In north-central Wasatch Mountains, dominantly pink and gray quartzite, with some beds of buff, red, and blood-purple varieties; intraformational conglomerate beds common. Basal conglomerate 100 feet thick occurs in Cottonwood Canyon where it is in sedimentary contact with Farmington Canyon complex; basal conglomerate not present in Ogden Canyon. Approximately 1,000 feet thick in Cottonwood-Durst Peak area; 500 to 700 feet in front range of Wasatch. Unconformably overlies crystalline complex. Underlies Ophir shale. Name Tintic is preferred to Brigham quartzite in this area. Lower (?) Cambrian.

A. A. Baker, J. W. Huddle, and D. M. Kinney, 1949, Am. Assoc. Petroleum Geologists Bull., v. 33, no. 7, p. 1165–1167. Extended into Uinta Basin. In Cottonwood-America Fork district about 800 feet thick; underlies Ophir formation; overlies Precambrian. Lower Cambrian.

A. E. Granger and others, 1952, Utah Geol. Soc. Guidebook 8, p. 7. In Wasatch Mountains, east of Salt Lake City, unconformably overlies Mutual formation (new). Underlies Ophir shale.

F. W. Christiansen, 1952, Geol. Soc. America Bull., v. 63, no. 7, p. 720 (table 1), 721–722. In Canyon Range 1,500 feet thick; underlies Ophir formation and overlies Precambrian.

N. C. Williams, 1953, Am. Assoc. Petroleum Geologists Bull., v. 37, no. 12, p. 2736 (fig. 1), 2737 (fig. 2), 2738–2739. In western Uinta Mountains, overlies Red Pine shale (new), which replaces Ophir of previous reports. As used here, Tintic quartzite replaces Pine Valley quartzite.

H. T. Morris, 1957, Utah Geol. Soc. Guidebook 12, p. 4, 5 (fig. 2). In East Tintic Mountains 2,300 to 3,200 feet thick; underlies Ophir formation and overlies Big Cottonwood (?) formation. Lower Cambrian.

J. K. Rigby, 1958, Utah Geol. Soc. Guidebook 13, p. 8–9, 14 (fig. 3). In Stansbury Mountains 4,200 feet thick with base not exposed; at least four subdivisions recognized. Underlies Pioche shale.

G. B. Maxey, 1958, Geol. Soc. America Bull., v. 69, no. 6, p. 667. Within area of this report [northern Utah and southeastern Idaho], rocks previously assigned to Tintic quartzite belong in Prospect Mountain formation.

R. E. Cohenour, 1959, Utah Geol. and Mineralog. Survey Bull. 63, p. 12 (table 1), 30–32, pl. 1. In Sheeprock Mountains 2,572 feet thick; underlies Ophir group, which includes Pioche shale at base, and unconformably overlies Talawag quartzite member (new) of Mutual (?) formation.

Named for exposures in Tintic Canyon and other places in Tintic district.

†Tintic Slate[1]

Lower and Middle Cambrian: Central northern Utah.

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

Tintic district.

**Tinton Sand Member** (of Red Bank Sand)[1]

Tinton Formation (in Monmouth Group)

Tinton Member (of Monmouth Formation)

Upper Cretaceous: New Jersey.

Original references: S. Weller, 1905, New Jersey Geol. Survey Ann. Rept. 1904, p. 147, 154–159; 1905, Jour. Geology, v. 13, p. 76, 81.

P. H. Jennings, 1936, Bulls. Am. Paleontology, v. 23, no. 78, p. 4, 5 (chart). Referred to as Tinton formation in Monmouth group.

W. B. Spangler and J. J. Peterson, 1950, Am. Assoc. Petroleum Geologists Bull., v. 34, no. 1, p. 8 (fig. 4), 40, 51–52. Reallocated to member status in the Monmouth herein reduced to formational rank. Conformably overlies Red Bank member; conformably underlies Hornerstown formation. Where best developed in Monmouth County, reaches maximum thickness of 25 feet; dips about 20 feet per mile southeast and cannot be recognized south of Red Valley in southern part of county.

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. The Tinton may be post-Navarro and pre-Midway. Stratigraphic evidence indicates an unconformity between Cretaceous and Tertiary formations. Hornerstown rests successively from northeast to southwest on the Tinton, Red Bank and Navesink.

R. K. Olsson, 1959, Dissert. Abs., v. 19, no. 8, p. 2063–2064. In area of this report, New Egypt formation (new) of outcrop area is lateral equivalent of Tinton formation and in subsurface represents both Tinton and Hornerstown.

R. K. Olsson, 1960, Jour. Paleontology, v. 34, no. 1, p. 2, 4 (fig. 2). Overlies Shrewsbury member of Red Bank formation. Foraminifera described.

Exposed at Tinton Falls, Monmouth County.

**Tioga Bentonite Bed** (in Seneca Member of Onondaga Limestone)

Middle Devonian: Pennsylvania (subsurface), Maryland, New York, Ohio, Virginia, and West Virginia.

J. R. Ebright, C. R. Fettke, and A. I. Ingham, 1949, Pennsylvania Geol. Survey, 4th ser., Bull. M–30, p. 10; C. R. Fettke, 1952, Am. Assoc. Petroleum Geologists Bull., v. 36, no. 10, p. 2038–2040. Thin but persistent seam of brown micaceous shale, commonly containing abundant pyrite; constitutes marker in Middle Devonian. Occurs at or near boundary between Hamilton group and Onondaga formation; shale seam appears to be bentonitic and will be referred to as Tioga bentonite.

W. A. Oliver, Jr., 1954, Geol. Soc. America Bull., v. 65, no. 7, p. 629, 631 (fig. 2), pl. 1. At base of Seneca member in central New York is a uniform bed of clay 6 inches thick; this is Tioga bentonite which has been recognized in subsurface throughout Pennsylvania and adjacent parts of West Virginia, Ohio, and southwestern New York. Surface exposures of bentonite are deeply weathered and clean samples are rare.

J. M. Dennison, 1960, Dissert. Abs., v. 21, no. 3, p. 593. Top of Tioga metabentonite proposed as top of Onesquethaw stage. The Tioga is present in subsurface between New York and central Appalachian sections and crops out in New York in addition to 45 known localities in West Virginia, Virginia, and Maryland.

So named because it was first recognized in drill cuttings from Tioga gas field, Tioga County, Pa.

**Tioga Glaciation, Till**

Tioga glacial stage[1]

Pleistocene: Eastern California.

Original reference: E. Blackwelder, 1931, Geol. Soc. America Bull., v. 42, p. 865–922.

W. C. Putnam, 1949, Geol. Soc. America Bull., v. 60, no. 8, p. 1281, 1291–1292. At least four ice advances occurred in Pleistocene: earliest, here named Aeolian Buttes, was followed by Sherwin, Tahoe, and Tioga, previously named by Blackwelder. Constructional forms have been destroyed on the two older tills but preserved on the later ones. Rhyolitic ash and pumice, now Bishop welded tuff, were erupted in interval between Aeolian Buttes and Sherwin glacial stages.

W. C. Putnam, 1960, California Univ. Pubs., Geol. Sci., v. 34, no. 5, p. 235, 238–239, map 1. Sherwin till is pre- rather than post-Bishop tuff. Name Aeolian Buttes considered invalid as representing an earlier Pleistocene, pre-Sherwin glacial stage. Hence glacial sequence is McGee, Sherwin, Tahoe, and Tioga.

Name amended to glaciation in compliance with 1961 Code of Stratigraphic Nomenclature.

Occurs in Tioga Pass area on eastern slope of Sierra Nevada.

Tioga magnafacies[1]

Upper Devonian: Central northern Pennsylvania.

Original reference: K. E. Caster, 1934, Bulls. Am. Paleontology, v. 21, no. 71, p. 23.

K. E. Caster, 1938, Jour. Paleontology, v. 12, no. 1, p. 52 (fig. 9). Upper Devonian.

Tioga-Elkland region.

Tionesta Clay (in Pottsville Formation)[1]

Tionesta clay member or underclay member

Pennsylvanian (Pottsville Series) : Eastern Ohio.

Original reference: E. Orton, 1884, Ohio Geol. Survey, v. 5.

N. K. Flint, 1951, Ohio Geol. Survey, 4th ser., Bull. 48, p. 39. Included in Tionesta cyclothem, Pottsville series.

R. E. Lamborn, 1956, Ohio Geol. Survey, 4th ser., Bull. 55, p. 44–49, geol. map. In Tuscarawas County, Tionesta clay member (Pottsville series) is dark gray, plastic, and 2 to 3 feet thick. Occurs below Tionesta coal and above Upper Mercer limestone member.

M. T. Sturgeon and others, 1958, Ohio Geol. Survey Bull. 57, p. 46, 49 (table 7). Underclay member of Tionesta cyclothem in report on Athens County. Average thickness 1⅓ feet. Pottsville series.

Name derived from Tionesta, Forest County, Pa.

Tionesta cyclothem

Pennsylvanian (Pottsville Series) : Southeastern Ohio.

N. K. Flint, 1951, Ohio Geol. Survey, 4th ser., Bull. 48, p. 39, table 1, geol. map. Includes (ascending) Tionesta shale and (or) sandstone, 5 feet; Tionesta clay, 6½ feet; Tionesta No. 3b coal. Occurs above Bedford cyclothem and below Brookville cyclothem of Allegheny series. In area of this report [Perry County], Pottsville series is described on a cyclothemic basis; 10 cyclothems are named. [For sequence see Anthony cyclothem.]

M. T. Sturgeon and others, 1958, Ohio Geol. Survey Bull. 57, p. 44–46, 49 (table 7). Rogers (1858) named Tionesta group from exposures along Allegheny River near village of Tionesta, Forest County, Pa. Orton (1884) recognized Tionesta members in Ohio. Tionesta cyclothem is incomplete and in Athens County [this report] has only three members: Tionesta shale and sandstone, Tionesta underclay, and Tionesta coal. Uppermost cyclothem of Pottsville series.

Name derived from Tionesta, Forest County, Pa.

†Tionesta Group (in Pottsville Formation)[1]

Pennsylvanian: Northwestern Pennsylvania.

Original reference: H. D. Rogers, 1858, Geology Pennsylvania, v. 2, pt. 1, p. 474–477.

Named for exposures along Allegheny River near village of Tionesta, Forest County.

Tionesta Iron Shales (in Pottsville Formation)[1]

Pennsylvanian: Northwestern Pennsylvania.

Original reference: I. C. White, 1879, Pennsylvania Geol. Survey Rept. $Q_2$.

†Tionesta Sandstone (in Pottsville Formation)[1]

Tionesta sandstone and shale member

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

Original reference: H. D. Rogers, 1858, Geology Pennsylvania, v. 2, pt. 1, p. 474–477, 489, 490.

M. T. Sturgeon and others, 1958, Ohio Geol. Survey Bull. 57, p. 46, 49 (table 7). Tionesta sandstone and shale member of Tionesta cyclothem in report on Athens County. Rogers (1858) applied name Tionesta to present

Homewood sandstone, but Tionesta, as now applied to clastic members is restricted to shale and sandstone below Tionesta underclay and overlying Upper Mercer cyclothem. Maximum thickness less than 12 feet. Full thickness not exposed in Athens County. Pottsville series.

Name derived from Tionesta, Forest County, Pa.

Tionesta Series[1]

Pennsylvanian: Western Pennsylvania.

Original reference: F. Platt, 1875, Pennsylvania 2d Geol. Survey Rept. H, p. 8–9.

Tioughnioga Group

Tioughnioga Stage

Middle Devonian (Erian): 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 the Tioughnioga is fifth in sequence (ascending). Follows Cazenovia and is followed by the Taghanic (or Taughannock). [For complete sequence see Helderberg stage this reference.] Interval embraced is from base of Centerfield to base of Tully limestone. Includes the Ludlowville and Moscow formations which are closely related faunally and are mainly restricted to eastern part of Devonian geosyncline. Except for the Centerfield and its equivalents, stage is not represented in Ohio and Mississippi Valleys.

A. T. Cross and J. H. Hoskins, 1951, Jour. Paleontology, v. 25, no. 6, p. 718 (fig. 3). Shown on composite stratigraphic column of western New York and northwestern Pennsylvania as Tioughnioga group. Includes Ludlowville and Moscow formations. Overlies Cazenovia group; underlies Taughannock group.

Name is taken from headwaters of Tioughnioga River in south half of Cazenovia quadrangle, New York.

**Tippah Sand Lentil** (in Porters Creek Clay)

Tippah Sandstone Member (of Porters Creek Clay)[1]

Paleocene: Northeastern Mississippi and southwestern Tennessee.

Original reference: E. N. Lowe, 1915, Mississippi Geol. Survey Bull. 12, p. 64.

F. S. MacNeil, 1946, U.S. Geol. Survey Strategic Minerals Inv. Prelim. Rept. 3–195, p. 10–11. Rank reduced to lentil in lower part of Porters Creek clay. Formerly believed to lie at top of Porters Creek and correlated with Naheola formation of Alabama, however, it is lower stratigraphically than type exposures of Porters Creek. Consists of loose white to yellow glaucontic *Halymenites*-bearing sand with some calcareous ledges, especially at top and bottom. Type locality suggested as none designated previously.

Type locality: Exposures on south side of valley of Hurricane Creek in SW¼SE½, T. 2 S., R. 3 E., Tippah County, Miss.

Tippecanoe sequence

Ordovician (Chazyan to Mohawkian): 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. An "operational unit" for use in interregional facies analysis. Named from Tippecanoe County, Indiana. Wells drilled in area start in lower Mississippian or upper Devonian and penetrate a full section of sequence from base of New Albany shale to base of St. Peter sandstone. Formational limits in Kansas are Hunton dolomite-Simpson formations; in Wyoming Bighorn dolomite.

**Tippipah Limestone**

Lower Pennsylvanian to Lower Permian (?) : Southern Nevada.

M. S. Johnson and D. E. Hibbard, 1957, U.S. Geol. Survey Bull. 1021–K, p. 360–363, pls. 32, 33. Subdivided into four units (ascending) A through D, all of which consist of limestone. Unit A, 295 feet thick, consists of four zones of alternating resistant and nonresistant limestone. Unit B, about 580 feet thick, consists of light-gray, buff, lavender, and light-purplish silty limestone. Unit C, about 2,035 feet thick, is alternating sequence of resistant and nonresistant light- to medium-gray and brown limestone. Unit D, 1,195 feet thick, consists of alternating resistant and nonresistant beds, but principal difference is that beds of D are thicker and definitely more massive than beds of C. Overlies Eleana formation (new) with conformable contact.

Named for exposures on Syncline Ridge, about a mile east of Tippipah Spring, Atomic Energy Commission Nevada proving grounds area, Nye County. Also exposed about one-half mile north of Syncline Ridge in single outcrop which is surrounded by alluvium, and in a few areas along north end of Mine Mountains.

Tipton sandstone[1]

Tiptonian series

Precambrian (Protozoic) : Northwestern Iowa.

Original references: C. R. Keyes, 1914, Iowa Acad. Sci. Proc., v. 21, p. 187; Science, new ser., v. 40, 144.

C. R. Keyes, 1937, Pan-Am. Geologist, v. 67, no. 4, p. 307–309. Referred to as Tiptonian series, Protozoic. Tiptonian series (sandstones) occur above Keeweenawan series. Beds do not crop out in Iowa but reach surface in Minnesota.

Derivation of name not stated.

**Tipton Shale Member or Tongue** (of Green River Formation)[1]

Eocene, lower: Southwestern Wyoming, northwestern Colorado, and northeastern Utah.

Original reference: A. R. Schultz, 1920, U.S. Geol. Survey Bull. 702.

G. N. Pipiringos, 1955, Wyoming Geol. Assoc. Guidebook 10th Ann. Field Conf., p. 101, 102. In its type area Tipton tongue separates Niland (new) and Cathedral Bluffs tongues of Wasatch formation. Thickness about 250 feet at type locality. Lower part of Tipton is probably early Eocene; age of upper part uncertain.

W. H. Bradley, 1959, Am. Assoc. Petroleum Geologists Bull., v. 43, no. 5, p. 1073–1074. Underlies Wilkins Peak member (new).

H. R. Ritzma, 1959, Utah Geol. and Mineralog. Survey Bull. 66, p. 40 (fig. 4), 41–42. Geographically extended into Daggett County, Utah. Here Green River formation is broken by unconformity. Beds below unconformity are here considered Tipton tongue, and beds above unconformity as main body of Green River equivalent to Cathedral Bluffs member of Wasatch and Laney shale of Green River as mapped farther east.

Named for exposures in vicinity of Tipton, a station on Union Pacific Railroad in Sweetwater County, Wyo.

Tip Top Sand[1]

Mississippian (Chester) : Western Kentucky.

Original reference: A. H. Sutton, 1931, Kentucky Geol. Survey, ser. 6, v. 37, p. 275, 285.

L. L. Ray, A. P. Butler, Jr., and C. S. Denny, 1947, Kentucky Dept. Mines Minerals Geol. Div. ser. 8, Bull. 9, p. 16. Deposit at Tip Top, the so-called Tip Top sand, has been shown to be Chester in age and to be extension of lowest sandstone of Chester group, correlated with the Mooretown. Name Tip Top sand as proposed by Sutton (1931) is unnecessary and should be abandoned.

Exposed along Dixie Highway about one-quarter to one-half mile northwest of Illinois Central station of Tip Top. Deposit lies partly in Hardin and partly in Meade County.

†Tisbury Beds[1] or Gravel[1]

Pleistocene: Southeastern Massachusetts.

Original reference: J. B. Woodworth, 1896, U.S. Geol. Survey 17th Ann. Rept., pt. 1, p. 975–988, chart.

Well exposed in Chilmark and West Tisbury [Marthas Vineyard], Dukes County.

**Tishomingo Granite**[1]

Precambrian: Central southern Oklahoma.

Original reference: R. T. Hill, 1891, Am. Jour. Sci., 3d, v. 42, p. 118.

C. W. Tomlinson, 1952, Am. Assoc. Petroleum Geologists Bull., v. 36, no. 9, p. 1831. Washita Valley fault zone borders south side of Tishomingo anticline, which contains largest area of Precambrian rocks now exposed in Arbuckle Mountains; here the Tishomingo granite, with a narrow discontinuous border of overturned Reagan sandstone (Cambrian), is thrust southwestward on this fault plane over younger rocks to and including Caney shale (Mississippian), with maximum stratigraphic displacement about 11,000 feet.

Named for Tishomingo, Johnston County.

Titus Canyon Formation[1]

Oligocene, lower: Southeastern California.

Original reference: C. Stock and F. D. Bode, 1935, Nat. Acad. Sci. Proc., v. 21, no. 1, p. 571–579.

H. E. Wood 2d and others, 1941, Geol. Soc. America Bull., v. 52, no. 1, p. 33, pl. 1. Early Chadronian (lower Oligocene).

Type locality: Titus Canyon, near Leadfield. Area now in Death Valley National Monument.

Ti Valley Series

Pennsylvanian: Oklahoma, Iowa, Kansas, Missouri, and Texas.

C. L. Cooper, 1946, Illinois Geol. Survey Bull. 70, p. 16 (fig. 2), 18–19; 1947, Jour. Geology, v. 55, no. 3, pt. 2, p. 268. Used to include all Pennsylvanian formations in the Midcontinent between base of Pennsylvanian system and base of Des Moines series. Name is suggested as a solution for the Morrow-Atoka-Lampasas-Marble Falls nomenclatural problem.

C. C. Branson, 1957, Oklahoma Geology Notes, v. 17, no. 11, p. 103. Abandoned by Oklahoma Geological Survey.

Formations exposed in Ti Valley, on borderline between Arbuckle and Ouachita Mountains, east-central [Pittsburg County] Oklahoma contain beds ranging in age from Morrow through Atoka.

Tiverton Arkose[1]

Carboniferous: Southeastern Rhode Island.

Original reference: A. F. Foerste, 1899, U.S. Geol. Survey Mon. 33, p. 378–379.

Extends along escarpmemt from Steep Brook to Tiverton Four Corners, eastern part of Newport County and exposed at several places in Tiverton.

**Tivola Tongue** (of Ocala Limestone)[1]

Tivola Member (of Ocala Limestone)

Eocene, upper: Central Georgia.

Original reference: C. W. Cooke and H. K. Shearer, 1918, U.S. Geol. Survey Prof. Paper 120–C, p. 51–56.

J. F. L. Connell, 1958, Southwestern Louisiana Jour., v. 2, no. 4, p. 331–333. In this report [Jackson group of Georgia], unit is termed Tivola member of Ocala limestone. Commonly a soft friable exceedingly fossiliferous limestone. North of Hawkinsville, Pulaski County, a massive bed of dense white argillaceous limestone, well stained with red iron oxide, is identified as the Tivola member on basis of a fossil assemblage of lower upper Ocala age. To west of main outcrop of the Tivola, a prominent thick outlier of the unit unconformably overlies eroded Tuscaloosa surface. Merges laterally into Twiggs clay member of Barnwell formation as far south as Dooling, Dooly County. Type locality stated.

Type locality: At village of Tivola, 1 mile north of Penn-Dixie cement quarry at Clinchfield, Houston County. Extends from Houston County northeastward in not too widely separated outcrops into Twiggs, Wilkinson, and Bleckley Counties. Northeasternmost exposure is south of Gordon, Wilkinson County.

Toa Vaca Formation

Upper Cretaceous (Santonian): 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. 44–47. Composed of 90 percent tuff breccia, 5 percent andesite flows, and 5 percent tuffaceous mudstones and sandstone. Lack of altitude makes it impossible to calculate thickness of formation. Overlies Ildefonso formation (new). Unconformably overlain by Eocene Jacaguas group (new). Includes Río Jueyes and Guayama series of Hodge (1920).

E. A. Pessagno, Jr., 1960, Caribbean Geol. Conf., 2d, Mayagüez, Puerto Rico, 1959, Trans., p. 83–84. Consists of about 11,000 feet of coarse pyroclastics; andesite flows comprise about 1 to 2 percent of unit. Overlies lower part of Santa Ana formation (new); interfingers with Santa Ana to east and with unnamed Cretaceous sediments to west. Footnote states that name Santa Ana is no longer used; unit is termed Idlefornso [Ildefonso].

Type area: Along bed of Río Toa Vaca north of Route 150 and south of Orocovis quadrangle. Toa Vaca River drains northwestern part of Río Descalabrado quadrangle.

**Tobin Formation**

Lower 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]. Coarse conglomerate, at base locally fanglomerate, followed by about 50 feet of massive sandy dolomite and several hundred feet of shales with occasional calcareous nodules and thin seams of shaly limestone. Andesite lava flow 100 feet thick near base at south end of Tobin Range. Thickness variable, generally about 500 feet. Maximum thickness of 1,000 feet in northwest part of Augusta Mountain. Underlies Dixie Valley formation (new); overlies Koipato formation with angular unconformity.

Type locality: South end of Tobin Range.

Toboso conglomerate facies[1] (of Cuyahoga Formation)

Mississippian (Kinderhook): Central Ohio.

Original reference: J. E. Hyde, 1915, Jour. Geology, v. 23, p. 657, 667–669.

F. T. Holden, 1942, Jour. Geology, v. 50, no. 1, p. 44. Includes (descending) Berne, Black Hand conglomerate, and Pleasant Valley (new) members. Occurs between Killbuck shale facies (new) to northeast, and Granville shale facies to the southwest.

Probably named for occurrence at Toboso, Licking County.

†Tobucksy Sandstone[1]

Tobucksy Sandstone (in Hartshorne Formation)

Pennsylvanian (Des Moines Series): Southeastern Oklahoma.

Original reference: H. M. Chance, 1890, Am. Inst. Min. Engrs. Trans., v. 18, p. 658, 659.

C. C. Branson *in* E. W. Reed, S. L. Schoff, and C. C. Branson, 1955, Oklahoma Geol. Survey Bull. 72, p. 64. Hartshorne formation, at its type locality, consists of Upper Hartshorne coal, "Hartshorne sandstone", Lower Hartshorne coal and underclay, and shale tongues locally developed between these members; the specific sandstone called Hartshorne is given its older but seldom used name, Tobucksy sandstone, conferred upon it by Chance (1890).

Type locality of Hartshorne formation is in Pittsburg County.

Toccoa Quartzite[1]

Precambrian or Lower Cambrian: Northeastern Georgia.

Original reference: S. L. Galpin, 1915, Georgia Geol. Survey Bull. 30, p. 120.

G. W. Crickmay, 1952, Georgia Geol. Survey Bull. 58, p. 42, Toccoa quartzite of Galpin (1915) is fine-grained phase of Lithonia granite.

Crops out for 2 miles east of Ayersville to within about 1½ miles of Toccoa. Named from exposures in ballast quarry north of Southern Railway and about 2 miles west of Toccoa, Stephens County.

†Tocito Sandstone Lentil (of Mancos Shale)[1]

Upper Cretaceous: Northwestern New Mexico.

Original reference: J. B. Reeside, Jr., 1924, U.S. Geol. Survey Prof. Paper 134.

W. S. Pike, Jr., 1947, Geol. Soc. America Mem. 24, p. 28–29. Unit sometimes called Tocito sandstone lentil of Mancos in area adjacent to San Juan River is correlative of Gallup sandstone member and part of Dilco coal member of Mesaverde of southern San Juan basin region. Suggested that name Tocito be dropped.

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 Mesaverde group in San Juan basin, New Mexico, name Gallup sandstone replaces Tocito sandstone lentil of Mancos shale.

Named for outcrops near Tocito trading post, San Juan County.

**Todd Valley Formation**[1] **or Sand**

Pleistocene: Eastern Nebraska.

Original reference: A. L. Lugn, 1934, Nebraska State Mus., v. 1, Bull. 41, p. 324, 349–350.

G. C. Lueninghoener, 1947, Nebraska Univ. Studies, new ser. no. 2, p. 17. Formation as defined by Lugn included all fluviatile sands and gravels in Todd Valley. Term is herein redefined to apply only to uppermost part of fill consisting of gray-white fine sands in Todd Valley and their equivalents in other valleys. Thickness of redefined formation ranges from 0 to 50 or more feet.

G. E. Condra, E. C. Reed, and E. D. Gordon, 1950, Nebraska Geol. Survey Bull. 15–A, p. 30–31. Sand rests unevenly on eroded Loveland loess, Crete sands and gravels, and older beds. Sand of this age and condition of occurrence are found at places in Platte Valley westward to near North Platte and generally in Elkhorn, Logan, Salt Creek, and other valleys. Upper surface of formation in Todd Valley was extensively wind modified after deposition resulting in loess-mantled dunelike topography. Age of Todd Valley deposition proper is Iowan, and only upper part of Lugn's Todd Valley formation at type locality is of this age.

Named for occurrence in Todd Valley, an old filled valley of Platte River, Saunders County.

**Todilto Limestone** (in San Rafael Group)

Todilto Limestone Member (of Morrison Formation)[1]

Todilto Limestone Member (of Wanakah Formation)

Upper Jurassic: Northwestern New Mexico, northeastern Arizona, and southwestern Colorado.

Original references: H. E. Gregory, 1916, U.S. Geol. Survey Water-Supply Paper 380; 1917, U.S. Geol. Survey Prof. Paper 93.

A. A. Baker, C. H. Dane, and J. B. Reeside, Jr., 1936, U.S. Geol. Survey Prof. Paper 183, p. 9, 55, pls. Member of Morrison formation.

W. L. Stokes, 1944, Geol. Soc. America Bull., v. 55, no. 8, p. 958–959. Todilto limestone can be correlated with San Rafael group and dated as Upper Jurassic by marine beds in group.

A. A. Baker, C. H. Dane, and J. B. Reeside, Jr., 1947, Am. Assoc. Petroleum Geologists Bull., v. 31, no. 9, p. 1668. Todilto is transitional downward into Entrada sandstone and at many localities is overlain on erosional unconformity by clastic beds of Morrison formation. Evidence seems to indicate that Todilto should be regarded as representative of the Curtis or perhaps the Summerville. Area of outcrop above the Entrada extends northward into area beneath which thinning edge of Kayenta formation dies out between merging sandstone of Navajo and Wingate. Todilto is removed from Morrison formation, and term Wanakah formation is extended into New Mexico and northeastern Arizona. Todilto and overlying gypsum beds, where present, are members of the Wanakah.

C. T. Smith, 1951, *in* New Mexico Geol. Soc. Guidebook 2d Field Conf., p. 13 (chart), 38; C. T. Smith, 1954, New Mexico Bur. Mines Mineral Resources Bull. 31, p. 14–15, pl. 1. Underlies Thoreau formation (new).

J. W. Harshbarger, C. A. Repenning, and J. H. Irwin, 1957, U.S. Geol. Survey Prof. Paper 291, p. 38–39, 40 (fig. 26). Described in Navajo country where it is considered of formational rank and included in San Rafael group. At type locality, consists of (ascending) 16 feet of mudstone, 4 feet of limestone, and 5 feet of mudstone. In this area, lower and upper contacts are sharp and irregular. Underlies Summerville formation; overlies Entrada. Near Ysidro, N. Mex., (outside area of this report) formation includes section of gypsum 111 feet thick. Extends into southwestern Colorado.

Named for Todilto Park, McKinley County, N. Mex.

**Todos Santos Claystone Member** (of Sisquoc Formation)

Miocene and Pliocene: Southern California.

W. P. Woodring, M. N. Bramlette, and K. E. Lohman, 1943, Am. Assoc. Petroleum Geologists Bull., v. 27, no. 10, p. 1340 (table 1). A somewhat procelaneous claystone forming about lower half of basin facies of Sisquoc formation in Casmalia Hills Thickness about 1,500 feet. Overlies Monterey shale, the boundary being drawn at base of lowest thick claystone unit. Underlies diatomaceous strata of Sisquoc.

W. P. Woodring and M. N. Bramlette, 1950, U.S. Geol. Survey Prof. Paper 222, p. 26–31, pl. 2. Miocene and Pliocene.

Type region: In Casmalia Hills northwest of Casmalia, Santa Barbara County.

Togiak Gravels[1]

Pleistocene: Southwestern Alaska.

Original reference: J. E. Spurr, 1900, U.S. Geol. Survey 20th Ann. Rept., pt. 7, p. 177.

Occur along banks of Togiak River and Togiak Lake.

**Togo Formation** (in Deer Trail 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 oldest of five formations in group. Underlies Edna dolomite (new).

Report discusses magnesite belt of Stevens County.

**Tohachi Formation** (in Mesaverde Group)

Tohachi Shale[1]

Upper Cretaceous: Northwestern New Mexico and northeastern Arizona.

Original reference: H. E. Gregory, 1916, U.S. Geol. Survey Water-Supply Paper 380.

J. E. Allen, 1953, Am. Assoc. Petroleum Geologists Bull., v. 37, no. 11, p. 2569–2571. Referred to as Tohatchi formation. Recent mapping has shown that type localities described by Gregory (1917, U.S. Geol. Survey Prof. Paper 93) for Tohatchi shale consist of Upper Cretaceous rocks which conformably overlie Menefee formation of Mesaverde group and unconformably underlie Chuska sandstone of Pliocene(?) age. Consists of lower carbonaceous member 850 feet thick and upper bentonitic member more than 500 feet thick. Included in Mesaverde group.

Caswell Silver, 1954, Am. Assoc. Petroleum Geologists Bull., v. 38, no. 4, p. 660–661. Discussion of article by Allen (1953). Allen quoted Gregory incompletely, and this gave the impression that Gregory misplaced an angular unconformity and misassigned the strata to the Tertiary. A complete reference to Gregory would note that the table (1917, p. 15) and graphic section (1917, pl. 3) made known existence of strata which were left undescribed and unnamed except for label "post-Mesaverde" (Upper Cretaceous) and which were excluded from Tohatchi shale. These beds which underlie the angular unconformity appear to be those labeled "Tohatchi formation" by Allen. Gregory did not describe the unit. It is likely Gregory misjudged the thickness, and in his reconnaissance he obviously mapped extent of Tohatchi shale incorrectly at south end of Chuska Mountains. Gregory's description of the Tohatchi appears to have been confused with upper part of post-Mesaverde strata. Thus, it would seem that the Tohatchi of Gregory should henceforth carry query—Tohatchi shale(?). Therefore, Allen should not have written that: "the Tohatchi shale lies conformably above the Menefee formation (the foregoing original description probably included the upper 500 feet of the Menefee) and may be divided lithologically into two units." At the very least, such a statement should read the redefined Tohatchi shale or the "Tohatchi formation." Tohatchi shale has been used and accepted for 36 years; the Tohatchi shale (or formation) of Allen is not the Tohatchi shale(?). Gregory's Tohatchi shale lies on "post-Mesaverde rocks." Strata in Tohatchi quadrangle called "post-Mesaverde rocks" by Gregory but apparently mapped in part by him as Tohatchi shale have a complex and confusing relationship. They appear to be angularly discordant to strata both above and below. Some local angular unconformities may even occur between individual beds. Existence of strata equivalent to Gregory's Tohatchi shale would be difficult to define unless restricted to relatively thin shaly lower part of Allen's Chuska sandstone.

J. E. Allen, 1954, Am. Assoc. Petroleum Geologists Bull., v. 38, no. 4, p. 661. Reply to Silver's article. Important fact is that rocks [Gregory] described at his two type localities are of Cretaceous age and lie below an unconformity marked by persistent conglomerate. Silty and ashy beds not over 250 feet thick crop out in a few places in Tohatchi quadrangle between conglomerate and overlying Chuska sandstone; they are dissimilar to any rocks described by Gregory, we [Gregory and Allen] both mapped them with the Chuska. Below the unconformably the "post-Mesaverde rocks" of Gregory are apparently similar to upper member of my [Allen] Tohatchi formation. They do not have "a complex and confusing relationship" and they are not "angularly discordant to the strata . . . below." Lithological type described by Gregory (p. 80) as "Tohatchi shale" occurs below and not above type of lithology which Gregory designates as "post-Mesaverde".

J. E. Allen and Robert Balk, 1954, New Mexico Bur. Mines Mineral Resources Bull. 36, p. 96–97. Because of diverse lithology and revised spelling adopted by Board on Geographic Names, name of unit is herein changed from "Tohachi shale" to Tohatchi formation. Tohatchi shale of Gregory's two type localities lies conformably above shales and sandstones of Menefee formation (original description included at least upper 200 feet of Menefee) and may be divided into two units. Base of lower cliff-making unit of redefined Tohatchi formation has been arbitrarily placed at top of highest massive channel sandstone of the Menefee. Above this point, 400 to 850 feet of sandstones of lower member of Tohatchi are thin to medium bedded with about 50 percent shale interbeds. Upper member consists of at least 500 feet of generally uniform light-olive- to yellow-gray indistinctly thin-bedded highly bentonitic shales which are carboniferous near base. These are probably not the "post-Mesaverde" beds, which, although not discarded by Gregory (1917, p. 75) in his text, are shown in table (1917, p. 15) and graphic section (1917, pl. 3). Lower member tentatively correlated with combined tongues Cliff House and Pictured Cliff sandstones; upper bentonitic unit may be equivalent of Fruitland formation and possibly part of Kirtland formation.

H. E. Wright, Jr., 1954, Am. Assoc. Petroleum Geologists Bull., v. 38, no. 8, p. 1827–1834. Tohatchi shale was named by Gregory for many colored shales and some sandstones at southern end of Chuska Mountains. He stated that it unconformably overlies Cretaceous rocks and is overlain in turn by Chuska sandstone. Both the Tohatchi and Chuska were placed in Tertiary, and an unconformity between them was mentioned at one locality. Independent field work done in area by Allen and the writer [Wright] revealed only one unconformity. This lies between tilted Cretaceous rocks and flat-lying Tertiary rocks. Shales beneath this unconformity resemble those described by Gregory as Tohatchi shale, and Allen has assigned Tohatchi formation to Mesaverde group. The Tohatchi, as thus defined, has maximum thickness of 1,350 feet and rests conformably on the Menefee. Above the unconformity, the sands, minor shale, and basal conglomerate cannot be Gregory's Tertiary Tohatchi shale because there is no room anywhere in area for more than 250 feet of the stated 200 to 1,000 feet of Tohatchi shale between the unconformity and typical Chuska sandstone caprock. The 250 feet of sands, minor shale, and basal conglomerate must therefore have been included by Gregory as part of Chuska sandstone. They are herein described as Deza formation which grades upward into crossbedded eolian Chuska sandstone.

E. C. Beaumont, C. H. Dane, and J. D. Sears, 1956, Am. Assoc. Petroleum Geologists Bull., v. 40, no. 9, p. 2160–2161. Nomenclature of Mesaverde group, in San Juan basin, revised. Tohatchi formation as redefined by Allen and Balk accepted for uppermost unit in group, but Gregory's original spelling retained.

Named for exposures near Tohachi Indian School, McKinley County, N. Mex.

Tohatchi Formation

*See* **Tohachi Formation.**

Tok Sandstone

Tertiary(?): Eastern Alaska.

Original reference: A. H. Brooks, 1900, U.S. Geol. Survey 20th Ann. Rept., pt. 7, p. 473, 483.

Exposed a few miles below Tok River.

**Tokio Formation**[1]

Upper Cretaceous (Gulf Series): Southwestern Arkansas and southeastern Oklahoma.

Original reference: H. D. Miser and A. H. Purdue, 1918, U.S. Geol. Survey Bull. 690, p. 19, 24.

L. V. Davis, 1960, Oklahoma Geol. Survey Bull. 86, p. 42–46. Formation, in McCurtain County, includes strata formerly assigned to upper part of Bingen formation and was originally described as Tokio sand member of that formation. Name Bingen has been dropped. Tokio as defined has gravel at base and is separated from underlying Woodbine formation by unconformity. Formation thickens southeastward from featheredge in outcrop to more than 595 feet in subsurface in southern part of county. Underlies Ozan and Brownstown formations undifferentiated.

First described in vicinity of Tokio, Hempstead County, Ark.

Tokopah Porphyritic Granodiorite

Jurassic-Cretaceous: Central California.

D. C. Ross, 1958, California Div. Mines Spec. Rept. 53, p. 11–12, pl. 1. Notably porphyritic with stubby to equant subhedral to euhedral pink to gray microcline phenocrysts as large as 25 mm across, set in medium-grained groundmass averaging 3 to 5 mm; some of the plagioclase also present as phenocrysts as large as 15 mm in length. Relation to other named plutonic rocks in area not determined.

Named from exposures in upper Tokopah Valley in eastern part of area, Sequoia National Park.

**Tokun Formation**[1]

Eocene and Oligocene: Southeastern Alaska.

Original reference: G. C. Martin, 1908, U.S. Geol. Survey Bull. 335, p. 24, 35.

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 Eocene rocks.

Crops out on both shores of Lake Tokun, Controller Bay region.

Tolay Volcanics[1]

Pliocene, middle(?): Central western California (surface and subsurface).

Original reference: R. R. Morse and T. L. Bailey, 1935, Geol. Soc. America Bull., v. 46, no. 10, p. 1437–1455.

C. E. Weaver, 1949, Geol. Soc. America Mem. 35, p. 118. Patches of lava exposed west of Tolay Creek near Lakeville School and regarded as outcrops of Tolay volcanics are herein mapped as part of Sonoma volcanics.

G. T. Cardwell, 1958, U.S. Geol. Survey Water-Supply Paper 1427, p. 27 (table 6), 32. This report [Santa Rosa and Petaluma Valleys] follows Weaver (1949) and maps the Tolay volcanics of Morse and Bailey as part of Sonoma volcanics. Morse and Bailey considered Tolay volcanics to be of early Pliocene age. Inasmuch as uppermost strata of the Tolay are interbedded with lowermost beds of Petaluma, now believed to be of middle or late Pliocene age, the Tolay volcanics are probably of middle Pliocene age. Thickness in wells is more than 4,000 feet.

Exposed at surface in small area west of Tolay Creek, near Lakeville School, Petaluma quadrangle.

Tolchaco Gravels

Quaternary: Central northern Arizona.

Parry Reiche, 1937, Am. Jour. Sci., 5th ser., v. 34, no. 200, p. 130–134, pl. 1. Alluvial terrace deposits. Include two members related to previous channels of Little Colorado River and one or more members related to its present position. Upper member lies at elevations about 220 feet above the river grade and rests on Shinarump sandstones at three localities near Tappan Wash. Consists of loose massive to vaguely bedded sandy pebble and cobble gravel. Medium member, Cameron beds (new), lies at elevations about 170 feet above river profile. Lowest members, exposed at and across river from Cameron, consist of terraces formed at earlier stages of Little Colorado River, after it had attained its present location—these members have not been studied.

In Little Colorado River valley above Cameron. Named from the Navajo term for the Little Colorado River.

Tolchico shale[1]

Lower Triassic: Northeastern Arizona.

Original reference: C. R. Keyes, 1922, Pan-Am. Geologist, v. 38, p. 250, 338.

Well developed around mouth of Canyon Diablo. Probably named for Tolchico Settlement, The Crossing, Little Colorado River, Coconino County.

**Toledo Formation**[1]

Eocene, upper, to Oligocene, middle: Northwestern Oregon.

Original reference: Harrison and Eaton (Consulting Petroleum Geologists), 1920, Mineral Resources of Oregon: Oregon Bur. Mines and Geology, v. 3, no. 1, p. 3–40.

H. E. Vokes, Hans Norbisrath, and P. D. Snavely, Jr., 1949, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 88. Consists of two members: Moody shale at base and unnamed upper member. Thickness 2,500 to 3,000 feet. Underlies Yaquina sandstone; overlies Burpee formation. Present study establishes upper Eocene age for Moody member and middle Oligocene age for greater part of upper member; future work may raise Moody member to rank of formation and permit restricting of name Toledo to strata of upper member.

Type locality: Along banks of Yaquina River, 3 miles south of Toledo, Lincoln County.

Tolenas Marble[1]

Tertiary, upper (?), or Quaternary: Western California.

Original reference: W. L. Watts, 1890, California State Mining Bur. 10th Ann. Rept., p. 668–669.

Quarried at Tolenas Springs, Solano County.

Toll Pit Beds[1]

Silurian: Southeastern Michigan.

Original reference: W. H. Sherzer and A. W. Grabau, 1910, Michigan Geol. Survey Pub. 2, geol. ser. 1, p. 47.

Occurs at Toll Pit quarry, near Scofield, Monroe County.

Tolman Formation

Eocene: Northern California.

C. A. Hall, 1956, Dissert. Abs., v. 16, no. 12, p. 2426. Incidental mention as containing fossil algae; overlies Del Valle formation (new).

C. A. Hall, Jr., 1958, California Univ. Pubs. Geol. Sci., v. 34, no. 1, p. 14–15, fig. 2, geol. map. At type section, consists of bioclastic deposits; grades laterally from fine- to coarse-grained sandstone, and near Niles passes into a conglomerate; bioclastic deposits consist largely of fragments of calcareous algae and other organic material in finer grained quartz sand matrix. Rocks are dirty gray or brown and weather to lighter brown. Total thickness may be 900 feet or more; minimum thickness of 470 feet measured at type locality; beds are overturned and faulted. Overlies Sobrante sandstone; overlies (but not in direct superposition) Del Valle formation.

Type locality: Tolman Peak, north of town of Niles, Alameda County. Tolman Peak is herein named; it is located at intersection of lat 37°38′8″ N. and long 121°53′49″ W. Formation has general trend of N. 42° W., and is well exposed 1 mile north of Niles Canyon-Highway 9 intersection, and also approximately 2.7 miles N. 25° W. from intersection.

**Tolovana Limestone**[1]

Silurian: Northeastern Alaska.

Original reference: J. B. Mertie, Jr., 1936, U.S. Geol. Survey Bull. 872.

J. T. Dutro, Jr., and T. G. Payne, 1957, Geologic map of Alaska (1:2,500,000): U.S. Geol. Survey. Mapped in Yukon-Tanana region.

In Preacher, Tolovana, and Hot Springs districts.

Toltec Andesite 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. Chiefly black perlitic vitric porphyritic andesite. Lowermost member; fills valleys cut into underlying Conejos quartz latite. Thickness 0 to 50 feet. Underlies Lagunitas clastic member (new). Name credited to E. L. Trice, (unpub. thesis).

Northeastern part Brazos Peak quadrangle.

**Toluca Quartz Monzonite**

Ordovician: Western North Carolina and western South Carolina.

W. R. Griffitts and W. C. Overstreet, 1952, Am. Jour. Sci., v. 250, no. 11, p. 779–783, 787, 788 (table 1). Monazite-bearing granitic rock, typically medium gray, moderately to strongly gneissic. Unit was included in Whiteside granite as mapped by Keith and Sterrett (1931, U.S. Geol. Survey Bull. 660–D, p. 130–132); hence, Whiteside granite is herein restricted to area of its type locality. Considered older than Cherryville quartz monzonite (new). May be Carboniferous(?) or pre-Carboniferous(?).

W. C. Overstreet and W. R. Griffitts, 1955, Geol. Soc. America Guidebook for 1955 Ann. Mtg. Age determinations on zircon and monazite from granitic rocks, from associated bodies of pegmatites and quartz veins, and from enclosing schists and gneisses gave consistent early Ordovician (about 400 million years) for zircon and monazite from Toluca quartz monzonite and enclosing metamorphosed sediments.

J. L. Stuckey, 1958, Geologic map of North Carolina (1:500,000): North Carolina Div. Mineral Resources. Mapped as Paleozoic.

Named for exposures near Toluca, Lincoln County, N.C.

Tomah Member (of Franconia Formation)

Upper Cambrian: Southwestern Wisconsin.

R. R. Berg, 1951, Minnesota Geologist, v. 8, no. 4, p. 2; 1953, Jour. Paleontology, v. 27, no. 4, p. 554–555 (fig. 2); 1954, Geol. Soc. America Bull., v. 65, no. 9, p. 858 (fig. 1), 863–864, measured sections. Consists of thinly interbedded sandstone and shale; sandstone is yellow to gray, fine grained to silty, and laminated; shale consists of equal amounts of silt and illite clay; locally contains thin beds of wormstone. Thickness at type locality is 28 feet. Underlies Reno sandstone member (new); overlies Birkmose sandstone member (new).

Type locality: Roadcuts on U.S. Highway 16, 6 miles west of Tomah, NW¼ sec. 22, T. 17 N., R. 2 W., Monroe County.

**Tomahawk 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).

Keweenaw Point.

Tomales Formation[1]

Pleistocene, upper: Western California.

Original reference: R. E. Dickerson, 1922, California Acad. Sci. Proc., 4th ser., v. 11, no. 19, maps.

Named for occurrence on northeast side of Tomales Bay, Marin and Sonoma Counties.

Tomales Bay deposits[1]

Pleistocene: Western California.

Original reference: V. C. Osmont, 1904, California Univ. Pub., Dept. Geol. Bull., v. 4, p. 76.

Form series of low broad hills, extending along middle of valley near Olema, and occurring at intervals on both shores of Tomales Bay, Marin County. West of main ridge, occur in occasional patches around flanks of hills at head of Drake's Estero and north of Abbott's Lagoon.

†Tombigbee[1]

Eocene: Alabama.

Original reference: E. A. Smith, 1888, Alabama Geol. Survey Rept. Prog, 1884–1888, geog. map of Alabama.

†Tombigbee Chalk[1]

Upper Cretaceous: Southwestern Alabama and northeastern Mississippi.

Original references: W. J. McGee, 1890, Am. Jour. Sci., 3d, v. 40, p. 25, 30, 31; 1891, U.S. Geol. Survey 12th Ann. Rept., pt. 1, p. 419, 475.

Probably named for development on both sides of Tombigbee River in Greene, Hale, Sumter, and Marengo Counties, Ala., and near Tombigbee River, in northeast Mississippi.

**Tombigbee Sand Member** (of Eutaw Formation)[1]

Upper Cretaceous: Northeastern Mississippi, southern Alabama, western Georgia, and western Tennessee.

Original reference: E. W. Hilgard, 1860, Mississippi Geol. and Agric. Rept., p. 3, 61, 68–75.

W. H. Monroe and D. H. Eargle, 1946, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 50. In Aubrey, Aliceville, Mantua, and Eutaw quadrangles, Alabama, member underlies Mooreville chalk of Selma group. Thickness about 25 feet.

W. S. Parks, 1960, Mississippi Geol. Survey Bull. 87, p. 22 (table 2), 26, 36–40, pl. 1. In this report, Tombigbee sand refers to strata between lower typical Eutaw beds and Coffee formation above. In Prentiss County, member consists of 70 to 85 feet of massive, very glauconitic, in part agrillaceous, somewhat calcareous, and fossiliferous sand.

Named for exposures on Tombigbee River near Aberdeen, Monroe County, and at Plymouth Bluff, Lowndes County, Miss.

Tombstone Sandstone[1]

Upper Cretaceous: Central southern Montana.

Original reference: W. H. Weed, 1893, U.S. Geol. Survey Bull. 105, p. 16, 18.

Occurs at Cokedale, 10 miles west of Livingston, Park County.

Tombstonian series

Paleozoic [Upper Devonian]: Arizona.

C. R. Keyes, 1942, Pan-Am. Geologist, v. 77, no. 3, p. 228 (table). Includes (ascending) Patagonia limestone (new)—thickness 250 feet and Espinal limestone (new)—150 feet. Older than Jeromian series (new); younger than Rockfordian series.

Southeastern Arizona.

Tomera Formation (in Ely Group)

Middle Pennsylvanian (Atokan-Desmoinesian): Northeastern Nevada.

R. H. Dott, Jr., 1955, Am. Assoc. Petroleum Geologists Bull., v. 39, no. 11, p. 2243–2248, figs. 2, 5. Chert-pebble conglomerates and interbedded limestones, with numerous brachiopod coquinites. Individual brown-weathering conglomerate units rarely more than 30 to 50 feet thick. Interbedded limestone comprises about half of formation. Quartz arenite and siltstone associated with conglomerate as matrix and interbeds. Conglomerate units generally very thin to thick bedded, with flaggy to blocky split. Thicker conglomerate units commonly rather massive. Subangular to subround, poorly to moderately sorted granules and pebbles of dense chert with varying hues of gray, green, red, and brown; average size about 10 to 20 mm. Finer detrital beds weather grayish yellow or grayish orange, and light and moderate brown. Associated limestones consist principally of crinoidal and fossil hash calcarenite and calcirudite, and brachiopod coquinites. Complete section is composite of parts of several fault blocks. Lower 1,400 feet present in Tomera Ridge; at least 300 feet of higher strata present at lower South Fork Canyon making total thickness of 1,700 to 2,000 feet. Unconformably underlies Strathearn formation (new), overlapped by Humboldt formation; overlies Moleen formation (new). Moleen and Tomera formations 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 Moleen and Tomera.

Type section: At north end of lower parallel ridge east of Grindstone Mountain, here called Tomera Ridge (east-central sec. 34 and west-central sec. 35, T. 33 N., R. 54 E.), and at west side of head of lower canyon of South Fork of Humboldt River (SW¼ sec. 19, T. 33 N., R. 55 E.). Also exposed north of Highway 40 from east end of Carlin Canyon northeast toward Tomera Ranch and Moleen, and in low ridge southeast of canyon. Named for Tomera Ranch, northwest of Grindstone Mountain on south side of Humboldt River, just east of Carlin Canyon along Western Pacific Railroad (NE¼NW¼ sec. 25, T. 33 N., R. 33 E.).

†Tomichi Limestone[1]

Lower, Middle, and Upper Ordovician: Central Colorado.

Original reference: R. D. Crawford, 1913, Colorado Geol. Survey Bull. 4, p. 56.

J. H. Johnson, 1944, Geol. Soc. America Bull., v. 55, no. 3, p. 322. Fremont limestone as differentiated in this report includes beds previously called by many names. It forms upper part of Tomichi limestone of Crawford (1913) in Monarch and Tomichi districts.

Named for Tomichi, Gunnison County.

Tomil Agglomerate

Tomil Volcanics

Oligocene or Miocene: Caroline Islands (Yap and Map)

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. 29–30 [English translation in library of U.S. Geol. Survey, p. 26–27]; 1952, Coral reefs in the South Seas: Japan Hydrog. Office Bull., v. 11, p. 62–63 [English translation in library of U.S. Geol. Survey, p. 73–74]. Consists of augite-andesite, agglomerate, and tuff; andesite commonly amygdaloidal. Contains deposits of bauxite. Unconformably overlies Map beds. Believed to be overlapped by Garim limestone, but contact not observed. Oligocene.

S. Hanzawa *in* Jacques Avias and others, 1956, Lexique Strat. Internat., v. 6, Océanie, fasc. 2, p. 62–63. Miocene.

W. S. Cole, Ruth Todd, and C. G. Johnson, 1960, Bulls. Am. Paleontology, v. 41, no. 186, p. 78. Referred to as Tomil volcanics. Unconformably overlies both Map and Yap formations.

Typically exposed on Tomil Plateau, Tomil Island, Yap group.

Tomlinson Shale[1]

Pennsylvanian: Western Arkansas and central eastern Oklahoma.

Original reference: A. Winslow, 1896, New York Acad. Sci. Trans., v. 15, p. 51.

Named for Tomlinson, Scott County, Ark.

†Tomlinson Stage[1]

Pennsylvanian: Western Arkansas and central eastern Oklahoma.

Original reference: H. M. Chance, 1896, New York Acad. Sci. Trans., v. 15, p. 52.

Occur along Choctaw, Oklahoma & Gulf Railway, Okla. Probably named for Tomlinson, Scott County, Ark.

Tom Sauk Limestone Member (of Bonneterre Formation)

Cambrian: Southeastern Missouri.

G. F. Brightman, 1937, (abs.) Missouri Acad. Sci. Proc., v. 3, no. 4, p. 120. Pure fine-grained sublithographic limestone which occurs in Bonneterre formation only in St. Francois Mountains.

G. F. Brightman, 1938, Jour. Geology, v. 46, no. 3, pt. 1, p. 248–267. Limestone is irregular in distribution, thickness, and stratigraphic position.

Maximum thickness at outcrop 30 feet; in drill holes as much as 225 feet. Underlies bulk of Bonneterre formation. Type locality designated.

Type locality: Outcrop on south side of Little Tom Sauk Creek, on boundary between Iron and Reynolds Counties.

**Tomstown Dolomite**[1]

Tomstown Formation

Lower Cambrian: Central southern Pennsylvania, western Maryland, and northern Virginia.

Original reference: G. W. Stose, 1906, Jour. Geology, v. 14, p. 208.

B. L. Miller, D. M. Fraser, and R. D. Miller, 1939, Pennsylvania Geol. Survey, 4th ser., Bull. C–48, p. 223–229. Formation, in Northampton County, overlies Hardyston formation and underlies Allentown formation. Contact with Hardyston not observed. Replaces name Leithsville in this area.

G. W. Stose and A. I. Jonas, 1939, Pennsylvania Geol. Survey, 4th ser., Bull. C–67, p. 70–72. Tomstown dolomite directly overlies Antietam quartzite and makes curving band, about 1 mile wide, around outcrop of the quartzite on plunging end of main South Mountain anticline in Cumberland County. Makes lowland between foot of steep slope of South Mountain and line of low hills composed of overlying Waynesboro formation to northeast. Offset 1½ miles southward by Reading Banks fault and makes wide lowland west of this fault. Dolomite is cut off 1 mile north of Dillsburg by eastern part of Dogwood Run fault and is here offset southwestward. Thickness estimated between 1,000 and 1,500 feet.

Charles Butts, 1940, Virginia Geol. Survey Bull. 52, pt. 1, p. 40. Name Shady used in this report [Appalachian Valley] in preference to Tomstown.

B. L. Miller and others, 1941, Pennsylvania Geol. Survey Bull. C–39, p. 180–186. Described in Lehigh County where it is about 1,000 feet thick. Overlies Hardyston quartzite; underlies Allentown formation. Replaces term Leithsville in this area.

A. J. Stose and G. W. Stose, 1946, Maryland Dept. Geology, Mines and Mineral Resources [Rept. 12] Carroll and Frederick Counties, p. 42–43. Narrow belt of Tomstown dolomite extends along east foot of Catoctin Mountain west and southwest of Frederick. Lies between ridge of Antietam quartzite and Triassic border fault. Thickness about 200 feet.

H. P. Woodward, 1949, West Virginia Geol. Survey, v. 20, p. 124–139. Crops out only in Jefferson County. Outcrop is extended belt slightly more than 1 mile in width that enters county in vicinity of Antietam, Washington County, Md., and strikes southwestward along meander belt of Shenandoah River into Clark County. Estimated thickness between 1,200 and 1,500 feet. Overlies Antietam quartzite; underlies Waynesboro formation.

P. B. King, 1950, U.S. Geol. Survey Prov. Paper 230, p. 24–30, pl. 1. Described in Elkton area, Virginia, where it is about 1,000 feet thick. Overlies Antietam quartzite of Chilhowee group; underlies Waynesboro formation. Closely resembles in character and stratigraphic position Shady dolomite, whose type locality is in northeastern Tennessee. Name Tomstown is now used in Virginia as far south as Roanoke, beyond which name Shady dolomite is used for same unit. At some future time, name Tomstown may well be dropped as synonym, and Shady substituted for it.

Bradford Willard and others, 1959. Pennsylvania Geol. Survey, 4th ser., Bull. C–9, p. 10, 28–31, pl. 2. Mapped as Tomstown dolomite (Leithsville limestone) in Bucks County. Crops out in two narrow east-west strips. Overlies Hardyston quartzite. Difficult to distinguish from Triassic limestone conglomerate. Also difficult to distinguish from overlying Conococheague (Limeport) limestone.

Named for exposures at Tomstown, Franklin County, Pa.

**Tom Thumb Tuff Member** (of Klondike Mountain Formation)

Oligocene: Northern Washington.

Hunting Geophysical Services Inc., 1960, Washington Div. Mines and Geology Rept. Inv. 20, p. 6. At base of formation. Umpleby (1910, Washington Geol. Survey Bull. 1) referred to unit as Lake beds. Contains flora considered to be Oligocene in age. Not present in Curlew quadrangle. Republic quadrangle and part of Aeneas quadrangle mapped by Siegfried Muessig and J. J. Quinlan (1959, U.S. Geol. Survey Open-File Map).

Report discusses parts of Okanogan and Ferry Counties.

Tonawandan 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). Tonawanda stage includes upper Clinton strata. Thickness at type section 90 feet; 115 feet in Genesee Gorge; 210 feet in central New York; 180 feet near Oneida Lake; 105 feet at Clinton (Rome quadrangle).

Type section: Niagara Gorge. Named from good exposures in Tonawanda quadrangle, New York.

Tonga Formation (in Easton Group)

Paleocene or older: Northwestern Washington.

R. S. Yeats, 1958, Dissert. Abs., v. 19, no. 4, p. 775. Relict graded bedding, poor sorting, flat-pebble conglomerates, and load casts suggest turbidity current origin. Intruded by Beckler quartz diorite (new).

Between central and eastern part of Skykomish area in northwestern Cascade Mountains, 45 miles east of Seattle.

**Tonganoxie Sandstone[1] Member** (of Stranger Formation)

Pennsylvanian (Virgil Series) : Eastern Kansas and northwestern Missouri.

Original references: R. C. Moore, M. K. Ellias, 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]; J. M. Jewett and C. C. Williams, May 1, 1935, Kansas Acad. Sci. Trans., v. 38, p. 191–198.

F. C. Greene and W. V. Searight, 1949, Missouri Geol. Survey and Water Resources Rept. Inv. 11, p. 15. In Missouri underlies Vinland shale member.

T. W. Lins, 1950, Kansas Geol. Survey Bull. 86, pt. 5, p. 108–140. Basal member of Stranger formation. Represents filling of large southwest-trending valley, major feature of regional disconformity which separates Pedee group or older beds (Missourian) from overlying Douglas group

(Virgilian). Tonganoxie contains four lithologic units (ascending): conglomerate, sandstone, shale, and coal. Thickness 4 to 100 feet, no complete sections exposed and thickness determined from composite sections. Underlies Westphalia limestone member.

Type locality: Area east of Tonganoxie, Leavenworth County, Kans. Well exposed along U.S. Highway 40 in secs. 26 and 35, T. 11 S., R. 21 E., about 7 miles east of Tonganoxie and on Stranger Creek and its tributaries north of Linwood, Kans.

**Tongue River Member** (of Fort Union Formation)[1]

Tongue River Formation (in Fort Union Group)

Paleocene: Northeastern Wyoming, eastern Montana, southwestern North Dakota, and South Dakota.

Original reference: J. A. Taff, 1909, U.S. Geol. Survey Bull. 341, p. 129–130.

W. M. Laird and R. H. Mitchell, 1942, North Dakota Geol. Survey Bull. 14, p. 21–23. Described in southern Morton County where it is considered formation in Fort Union group. Thickness 180 feet. Overlies Cannonball formation. Paleocene.

R. V. Hennen, 1943, Am. Assoc. Petroleum Geologists Bull., v. 27, no. 12, p. 1573 (fig. 1), 1580. In Morton County, N. Dak., Almont sandstone (new) lies approximately 35 feet above base of Tongue River member of Fort Union.

W. E. Benson, 1949, (abs.) Geol. Soc. America Bull., v. 60, no. 12, pt. 2, p. 1873. Tongue River member of Fort Union formation conformably underlies Golden Valley formation.

S. P. Fisher, 1953, North Dakota Geol. Survey Rept. Inv. 11. Formation, as now recognized, includes all strata above Ludlow-Cannonball formation below Golden Valley beds. Includes Sentinel Butte shale facies in upper part. Thickness within map area [McKenzie County] 745 to 1,010 feet; average 800 feet.

P. R. May, 1954, U.S. Geol. Survey Bull. 995–G, p. 268. Tongue River member, which is exposed over nearly all Wibaux area [Montana and North Dakota], is composed of light-yellow, tan, and gray sandstones and shales; thin lenses of limestone; and numerous beds of lignite, the thicker margins of which are commonly marked by fringes of clinker. Thickness about 1,200 feet in Sidney lignite area; about 600 feet in Marmarth field. Overlies Ludlow member; underlies Sentinel Butte member. In older reports, term Fort Union formation is restricted to yellow strata herein referred to as Tongue River member. Paleocene.

B. M. Hanson, 1955, North Dakota Geol. Survey Rept. Inv. 18. Upper 350 feet of Tongue River formation well exposed in bluffs bordering Little Missouri River along its entire course through Elkhorn ranch area. Lower 750 feet of formation exposed between mapped area and Marmarth, 36 miles to south. At latter locality, the Tongue River conformably overlies Ludlow formation. Total thickness of Tongue River, including Sentinel Butte member, about 1,600 feet.

B. C. Petsch, 1956, Areal geology of the Ladner quadrangle (1:62,500) South Dakota Geol. Survey. Formation geographically extended into Ladner quadrangle, South Dakota, where it is dominantly massive sandstone that forms prominent cliffs. Thickness 35 to 200 feet. On North Cave Hills, composed of upper and lower sandstone separated by gray clay-shale, peat clay, and lignite seam ("E" bed of U.S. Geological Survey and Atomic Energy Commission), and Lodgepole facies which is commonly radioactive. Top of section; overlies Ludlow formation.

W. J. Mapel, 1958, Wyoming Geol. Assoc. Guidebook 13th Ann. Field Conf., p. 220 (fig. 2), 221. Tongue River member is at least 2,000 feet thick in southern Rosebud County, Mont., 800 feet near Sheridan; and about 600 feet near Gillette, Wyo. Overlies Lebo shale member; underlies Wasatch formation.

Named for exposures along Tongue River, northeastern Wyoming and southeastern Montana.

Tonica cyclothem (in Spoon-Carbondale Formations)

Pennsylvanian: Northern Illinois.

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 42, 53 (table 2), pl. 1. Proposed for strata previously referred to Liverpool cyclothem. Occurs above Abingdon cyclothem and below Lowell cyclothem. Presentation of new rock-stratigraphic classification of Pennsylvanian strata in Illinois; cyclical classification is independent of rock-stratigraphic classification.

Type locality: Along Vermilion River one-half mile west of Lowell, LaSalle County. Name derived from Tonica, 3 miles southeast of type section.

Tonka Formation

Mississippian and Pennsylvanian (Meramecian-Springeran): Northeastern Nevada.

R. H. Dott, Jr., 1955, Am. Assoc. Petroleum Geologists Bull., v. 39, no. 11, p. 2222–2233, figs. 2, 5. Brown weathering chert-pebble conglomerate with quartzite and fossiliferous calcareous interbeds. Coarse conglomerates and quartzites crop out as series of bold dark-brown or reddish-brown cliffs and ledges with intervening poorly exposed limestones and siltstones. Pebbles of conglomerate of varying hues of gray, brown, black, and especially grayish green. Sandstone and siltstone comprise less than one-third of formation. Calcareous interbeds are light gray, pinkish, grayish yellow, or light brown. Thickness at least 2,000 feet in type section; at least 3,000 feet in Carlin Canyon. Conformably overlies and grades eastward into White Pine? shale; conformably underlies Moleen formation (new).

Standard [type] section: Begins in ridge directly southeast of Tonka and extends three-quarters mile eastward. Two supplementary sections are: lower west side of Grindstone Mountain, 5 miles east, and Spring Canyon Mountain, 5 miles south of Tonka. Named for Tonka Siding on Western Pacific Railroad at east end of railroad tunnel in central Carlin Canyon (NE¼SE¼ sec. 28, T. 33 N., R. 53 E.).

**Tonnie Siltstone Member** (of Chinitna Formation)

Tonnie Sandstone Member (of Tuxedni Formation)

Tonnie Siltstone Member (of Tuxedni Formation)

Upper Jurassic: Central southern Alaska.

L. B. Kellum, 1945, New York Acad. Sci. Trans., ser. 2, v. 7, no. 8, p. 203 (table 1). Series of alternating sandstones, shales, and coarse conglomerates with numerous fossil-bearing horizons. Thickness 1,200 feet. Uppermost member of Tuxedni formation; underlies Shelikof formation.

C. E. Kirschner and D. L. Minard, 1948, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 95 [1949]. Youngest member of Tuxedni formation on Iniskin Peninsula. Consists of 900 feet of siltstone capped by approximately 200 feet of sandstone on Tonnie Peak. Siltstone is dark gray and weathers light brown; thick bedded and calcareous in part. Beds at top of member range from 1 to 10 feet thick and are composed of fine- to medium-grained sandstone. Overlies Bowser member (new); underlies Chinitna siltstone. Geographic distribution given.

R. W. Imlay, 1952, Geol. Soc. America Bull., v. 63, no. 9, p. 979; 1953, U.S. Geol. Survey Prof. Paper 249–B, p. 49, 51. Massive sandstone capping Tonnie Peak disappears to south, and in most places the siltstones assigned to the Tonnie cannot be separated from the overlying siltstones of Chinitna formation. Therefore, Tonnie member placed in Chinitna, forming roughly lower third of formation.

Crops out in trough of Tonnie syncline and in long, narrow belt that extends from Chinitna Bay to Iniskin Bay along west face of coastal ridge on Iniskin Peninsula. Best exposures in vicinity of Tonnie Peak.

**Tonoloway Limestone** (in Cayuga Group)[1]

Upper Silurian: West Virginia, Maryland, Pennsylvania, and Virginia.

Original reference: E. O. Ulrich, 1911, Geol. Soc. America Bull., v. 22, pl. 28.

F. M. Swartz, 1939, Pennsylvania Geol. Survey, 4th ser., Bull. G–19, p. 75–76, 79, 84. In Pennsylvania, underlies Keyser limestone. Some beds formerly included in Tonoloway are placed in Keyser of this report.

H. P. Woodward, 1941, West Virginia Geol. Survey, v. 14, p. 8, 207–257, measured sections. Described in West Virginia where it is 100 to 600 feet thick. Overlies Wills Creek formation; underlies Keyser limestone. This is "Bossardville limestone" of earlier reports. States type locality. Cayugan series, Upper Silurian.

Ernst Cloos, 1951, Maryland Dept. Geology, Mines and Water Resources [Rept. 14] Washington County, p. 79–80. In Maryland, overlies Wills Creek formation and underlies Keyser limestone member of Helderberg. Thickness about 600 feet. Includes Indian Spring sandstone and Indian Spring red beds.

H. H. Arndt and others, 1959, Geol. Soc. America Guidebook Pittsburgh Mtg., p. 5, 20. Thickness of formation 400 to 600 feet in central Pennsylvania. Overlies Wills Creek formation; underlies Keyser formation. Silurian.

Type locality: East flank of Tonoloway Ridge, along Cacapon near Rock Ford, Morgan County, W. Va.

**Tonopah Formation**[1]

Tertiary: Central Nevada.

Original reference: J. E. Spurr, 1905, U.S. Geol. Survey Prof. Paper 42, p. 41, map.

Well exposed in westerly workings of Tonopah Extension mine. Tonopah district.

Tonosí Limestone

Oligocene, middle: Panamá.

Karl Sapper, 1937, Mittelamerika, Handbuch der regionalen Geologie: Heidelberg, v. 8, pt. 4a, no. 29, p. 134 (chart). Named on correlation chart. Occurs above Bucaro formation and below unnamed upper Oligocene unit.

A. A. Olsson, 1942, 8th Am. Sci. Cong. Proc., v. 4, p. 234 (chart). Name Tonosí limestone appears on correlation chart. Occurs below upper Oligocene Santiago formation and above unnamed lower Oligocene unit.

W. P. Woodring *in* R. Hoffstetter and others, 1960, Lexique Strat. Internat., v. 5, Amérique Latine, fasc. 2a, p. 347. An undefined name for strata of Oligocene age in Tonsí area.

Los Santos Province.

**Tonto Group**[1]

Lower and Middle Cambrian: Central and northwestern Arizona.

Original references: G. K. Gilbert, 1864, Phil. Soc. Washington Bull., v. 1, p. 109; 1875, U.S Geog. and Geol. Survey W. 100th Mer., v. 3, p. 60, 171–186, fig. 82.

Charles Keyes, 1940, Pan-Am. Geologist, v. 74, no. 3, p. 237–239. Location of original outcrop of Tonto formation was Tonto Creek, from which title of formation was derived in vicinity of Fort Apache nearly 200 miles southeast from Grand Canyon station and not in Grand Canyon section which has come to be regarded by many geologists as type locality. Tonto group holds precedence over name Apache group of Precambrian age and has surprisingly limited areal expanse—not to include Grand Canyon section with which it was erroneously correlated.

Alexander Stoyanow, 1942, Geol. Soc. America Bull., v. 53, no. 9, p. 1270–1271. Since Gilbert originally referred to "Tonto group" as being located in headwaters of Verde and Tonto Creeks and because western tributaries in headwaters of Tonto Creek cut through Diamond Mesa and other mesas in which Tapeats sandstone (basal member of Tonto group) is well exposed, presence of this basal sandstone member of Tonto group in the true Tonto basin (Gilbert's type locality, 1875, p. 60) of western Gila County is beyond question. Type locality not in vicinity of Fort Apache as indicated by Keyes. Tonto confused with Apache beds.

T. F. Stipp and H. M. Beikman, 1959, U.S. Geol. Survey Oil and Gas Inv. Map OM–201. Includes rocks of Lower and Middle Cambrian age in northwestern and central Arizona where it underlies Temple Butte limestone.

Type locality: Tonto basin, western Gila County. Group floors the valleys that contain headwaters of Big Williams Fork of Colorado River and of Verde and Tonto Creeks, tributaries of Salt River.

†Tonto Sandstone[1]

Middle Cambrian: Arizona.

Original reference: G. K. Gilbert, 1875, U.S. Geog. and Geol. Survey W. 100th Mer., v. 3, p. 60, 171–186, fig. 82.

†Tonto Shale[1]

Middle Cambrian: Arizona.

Original reference: G. K. Gilbert, 1875, U.S. Geog. and Geol. Survey W. 100th Mer., v. 3, p. 60, 171–186, fig. 82.

**Tonzona Group**[1]

Silurian, Devonian, and Carboniferous: Central southern Alaska.

Original reference: A. H. Brooks, 1911, U.S. Geol. Survey Prof. Paper 70, p. 55, 66, 73, map.

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 both Silurian and Devonian rocks.

Named for Tonzona River, in whose basin these rocks typically occur, Tonzona district, Kuskokwim region.

**Topache Limestone**[1]

Devonian(?) and Mississippian: Southwestern Utah.

Original reference: B. S. Butler, 1913, U.S. Geol. Survey Prof. Paper 80.

J. M. Weller and others, 1948, Geol. Soc. America Bull., v. 59, no. 2, p. 135, pl. 2 (column 29). Name appears on Mississippian correlation chart. Parts of fauna typically of Madison limestone; others may be slightly younger.

Grant Steele, 1960, Dissert Abs., v. 20, no. 12, p. 4635. Three facies of lower part of Pennsylvanian system (Springeran to Des Moinesian) in eastern Great Basin are clearly defined by their proximity to tectonically active lands formed by Antler orogeny in late Mississippian to earliest Pennsylvanian time. Sediments characterizing eastern and southern facies (Ely, Oquirrh, Bird Spring, Callville, and Topache formations) being less affected by the Antler positives, were deposited in a limestone, dolomite, and silt province.

Type locality: Topache Peak, southeast of Frisco district.

**Topagoruk Formation**

Topagoruk Member (of Umiat Formation)

Lower Cretaceous: Northern Alaska (subsurface and surface).

George Gryc, W. W. Patton, Jr., and T. G. Payne, 1951, Washington Acad. Sci. Jour., v. 41, no. 5, p. 162–163, fig. 2. Top 1,000 feet of member include nonmarine units of Niakogon tongue (new) of Chandler formation (new) and consists of coal, shale, sandstone, and minor amounts of ironstone. Bottom 2,100 feet entirely marine clay shale, silt shale, silt, and sandstone. Thickens southward and intertongues with Hatbox and Niakogon tongues (new) of Chandler formation. Overlies Tuktu member (new); underlies Seabee member (new) of Schrader Bluff formation (new). Lower(?) Cretaceous.

F. M. Robinson, F. P. Rucker, and H. R. Berquist, 1956, Am. Assoc. Petroleum Geologists Bull., v. 40, no. 2, p. 229–232. Most exact type locality data given. Redescribed in subsurface as formation to include major part of previously described member. Original member extended from 50 feet to 3,100 feet in test well, whereas formation as now defined extends from 1,350 feet to 3,900 feet in same well. Formation primarily of medium- to medium-dark-gray clay shale, with thin beds and laminae of medium-gray siltstone, although upper 800 feet also contain some thin beds of very argillaceous, very fine-grained sandstone. Dominantly of fine marine clastics in contrast to overlying sandstone of Grandstand formation. Unconformably overlies Oumalik formation (new) in type well; formations have gradational contact in Oumalik type area.

F. M. Robinson, 1959, U.S. Geol. Survey Prof. Paper 305–J, p. 527–528, fig. 46. Age of formation given as Early Cretaceous.

Named from section from 50 to about 3,100 feet in Topagoruk test well No. 1, a dry hole located on coastal plain of northern Alaska, at lat 70°37′30″ N., long 155°33′36″ W., approximately 72 miles S. 14° E. of

Point Barrow. Type section [as redescribed] in this well between 1,350 and 3,900 feet.

**Topango Formation**[1]

Miocene, middle: Southern California.

Original reference: W. S. W. Kew, 1923, Am. Assoc. Petroleum Geologists Bull., v. 7, p. 411–420.

A. O. Woodford, T. G. Moran, and J. S. Shelton, 1946, Am. Assoc. Petroleum Geologists, v. 30, no. 4, p. 515–520. In Puente and San Jose Hills area. subdivided to include Buzzard Peak conglomerate member (new) near top. Here underlies Puente formation and overlies [Glendora volcanics]. Thickness 3,000 feet.

Takeo Susuki, 1952, (abs.) Geol. Soc. America Bull., v. 63, no. 12, pt. 2, p. 1345. At type locality, consists of more than 8,000 feet of conglomerates, sandstones, and shales with intercalated basalts; disconformably overlies Oligocene Sespe and underlies Upper Miocene Modelo shales with marked angular unconformity.

G. J. Neuerburg, 1953, California Div. Mines Spec. Rept. 33, p. 6 (table 1), 20–23. In Griffith Park area, Los Angeles County, composed of three unnamed members each separated by unconformities; aggregate thickness 4,900 feet. Underlies Hollycrest formation (new); unconformably overlies Cahuenga beds (new).

J. E. Schoellhamer and others, 1954, U.S. Geol. Survey Oil and Gas Inv. Map OM–154. Mentioned in Santa Ana Mountains area where it underlies La Vida member (new) of Puente formation.

J. G. Vedder, R. F. Yerkes, and J. E. Schoellhamer, 1957, U.S. Geol. Survey Oil and Gas Inv. Map OM–193. In Orange County, subdivided into three members (ascending): Bommer, Los Trancos, and Paularino.

Type locality: Topanga Canyon, 10 miles northwest of Santa Monica, Los Angeles County.

†Topatopa Formation[1]

Eocene: Southern California.

Original reference: G. H. Eldridge, 1907, U.S. Geol. Survey Bull. 309.

Crops out in mountains north of Santa Clara Valley, Ventura County.

**Topeka Limestone** (in Shawnee Group)[1]

Topeka Limestone Member (of Shawnee Formation)[1]

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

Original references: E. Haworth, 1895, Kansas Univ. Quart., v. 3, pl. opposite p. 290; 1895, Am. Jour. Sci., 3d, v. 50, pl. opposite p. 466.

R. C. Moore, 1949, Kansas Geol. Survey Bull. 83, p. 160–165. Uppermost formation in Shawnee group. Thickness in Kansas 33 to 55 feet. Comprises (ascending) Hartford limestone, Iowa Point shale, Curzon limestone, Jones Point shale, Sheldon limestone, Turner Creek shale, DuBois limestone, Holt shale, and Coal Creek limestone members. Overlies Calhoun shale; underlies Severy shale of Wabaunsee group.

G. E. Condra, 1949, Nebraska Geol. Survey Bull. 16, p. 20–21. Thickness of formation in Nebraska about 36 feet. Includes nine members [see above annotation]. Condra and Reed (1937), being uncertain regarding relation of the Hartford of southern Kansas to lower member of Topeka in northeastern Kansas, southeastern Nebraska, northwestern Missouri, and southwestern Iowa, proposed name Wolf River for basal member of Topeka in this area. Nebraska Survey will drop name Wolf River if it proves correlative with the Hartford. Underlies Severy shale; overlies Calhoun formation. Shawnee group.

F. C. Greene and W. V. Searight, 1949, Missouri Geol. Survey and Water Resources Rept. Inv. 11, p. vii (fig. 3), 16, 18. As defined in Missouri, it is uppermost formation in Shawnee group. Jones Point shale, Sheldon limestone, and Iowa Point shale formerly included in underlying Calhoun shale are here classed as members of the Topeka. Hence the Topeka consists of nine members [see annotation Moore, 1949, above]. Overlies Calhoun shale; underlies Severy shale.

H. G. Hershey and others, 1960, Iowa Highway Research Board Bull. 15, p. 15–17, fig. 5. In Iowa, thickness is variable largely as result of thinning and thickening of shale members. Thickness 13 feet in north at Macedonia; 35 feet northeast of Greenfield. Comprises nine members [see annotation Moore 1949, above]. Overlies Calhoun shale; underlies Severy shale of Wabaunsee group.

Type locality at Topeka, Shawnee County, Kans.

Tophet 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. 297, 356.

Type locality: On hill road toward Lick Creek, 0.2 mile north of Tophet, Summers County.

Tophet 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, 357.

Type locality: On hill road toward Lick Creek, 0.2 mile north of Tophet, Summers County.

Tophet 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, 356–358.

Type locality: In vicinity of Tophet, Summers County.

Top Hill Sandstone[1]

Pennsylvanian: Western central Kentucky.

Original reference: D. D. Owen, 1856, Kentucky Geol. Survey, v. 1, pl.

Hancock, Breckinridge, and Meade Counties.

**Toqua Sandstone Member** (of Blockhouse Shale)

Middle Ordovician: Eastern Tennessee.

R. B. Neuman, 1955, U.S. Geol. Survey Prof. Paper 274–F, p. 150–151, pl. 28. Light-gray fine- to coarse-grained calcareous sandstone. Finer grained sandstone well laminated, crossbedded, and in beds 4 to 12 inches thick separated by thinner beds of dark-gray shale. Coarser grained rock poorly laminated and in beds 10 to 20 inches thick set apart by poorly defined bedding plane partings. Weathers greenish brown or olive; its saprolite is yellow brown to ochrous. Thickness at type section about 400 feet. Overlies Whitesburg limestone member; underlies dark shale member.

Type section: Measured 1.15 miles southeast of Toqua Church, Vonore quadrangle, Monroe County, near southeast bank of Tellico River, along and near a wagon road. Name taken from Toqua Church.

**Toquima Formation**[1]

Lower, Middle, and Upper(?) Ordovician: Central Nevada.

Original reference: H. G. Ferguson, 1924, U.S. Geol. Survey Bull. 723.

C. E. Decker, 1952, Am. Assoc. Petroleum Geologists Bull., v. 36, no. 1, p. 107. Mentioned in discussion of significance of graptolites of Athens shale.

Present over considerable part of Toquima Range.

Tor Formation

Devonian: 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 Antelope Valley formation.

Toquima Range, Nye County.

**Torcer Formation**[1]

Lower Cretaceous(?): Western Texas.

Original reference: W. S. Adkins, 1933, Texas Univ. Bull. 3232, p. 254–257, 286.

C. C. Albritton, Jr., 1937, Jour. Paleontology, v. 11, no. 1, p. 19; 1937, Field and Laboratory, v. 5, no. 2, p. 50. Redefined to include only the Lower Cretaceous fraction of original Malone. Embraces minimum thickness of 400 feet of limestone, sandstone, and shale, with persistent basal chert-pebble conglomerate and quartzitic sandstone resting conformably on the Malone. Basal member contains diagnostic *Neocomites cf. indicus* Waagen along with foraminifers *Guembelina paucistriata* Albritton and *Anomalina torcerensis* Albritton; *Ammobaculites subcretaceous* Cushman and Alexander occurs higher in section. Top not exposed in Malone Mountains.

C. C. Albritton, Jr., 1938, Geol. Soc. America Bull., v. 49, p. 1754 (fig. 2), 1764–1767, strat. sections. Section used for defining formation shows duplication of beds. Pelecypods thought to be characteristic of formation actually occur in Malone and, hence, are Jurassic rather than Cretaceous. On basis of paleontological evidence, it can be shown that approximately the upper 400 feet of sedimentary column in Malone Mountains is Lower Cretaceous. For these strata, name Torcer is retained.

R. M. Huffington, 1943, Geol. Soc. America Bull., v. 54, no. 7, p. 992 (fig. 2), 996–997, 998 (fig. 3). Formation, which crops out only in northwestern part of northern Quitman Mountains area, is composed of two distinct lithologic units: a quartz- and chert-pebble conglomerate at the base that grades upward into a quartzitic sandstone. Torcer proper is predominantly impure black limestone and sandstone with abundant thin shale layers. Basal quartzite member thins to south and is only about 10 feet thick in Third Hill. Thickness of upper member about 300 feet. Conformably overlies Malone formation; contact is a narrow gradational zone.

Contact with overlying Yucca formation not exposed. Believed to be lowermost Cretaceous.

Type locality: In Malone Mountain. Named from exposures at and near Torcer (formerly Malone) Station, on Southern Pacific Railway, west of Sierra Blanca, Hudspeth County.

**Torch Lake 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).

Keweenaw Point.

**Torch Lake Flow**[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).

Keweenaw Point.

**Torchlight Sandstone Member** (of Frontier Formation)[1]

Upper Cretaceous: Northern Wyoming and southern Montana.

Original reference: F. F. Hintze, Jr., 1915, Wyoming Geol. Survey Bull. 10, p. 23.

J. H. Heathman, 1939, Wyoming Geol. Survey Bull. 28, p. 7 (table 2), 13. On south and east sides of Bighorn basin consists of massive sandstone about 75 feet thick at top of Frontier formation. Underlies Niobrara.

Exposed in Torchlight dome, Basin oil field, Wyoming.

Torcido member (of Serpiente Sandstone)

*See* Serpiente Sandstone.

Tordilla sandstone bed (in Dubose Member of Whitsett Formation)

Eocene, upper: South-central Texas.

D. H. Eargle, 1959, Am. Assoc. Petroleum Geologists Bull., v. 43, no. 11, p. 2633. Local name applied to a 30-foot silicified fine-grained sandstone bed in Dubose member of the Whitsett.

Exposed in Tordilla Hill, western tip of Karnes County.

**Tordrillo Formation**[1]

Middle Jurassic: Central southern Alaska.

Original reference: J. E. Spurr, 1900, U.S. Geol. Survey Ann. Rept., pt. 7, p. 153–155.

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.

On Tordrillo Mountains, Cook Inlet region.

Toreo Limestone

Eocene(?) : Panamá.

Original reference: O. H. Hershey, 1901, California Univ. Dept. Geol. Bull., v. 2, p. 239.

A. A. Olsson, 1942, 8th Am. Sci. Cong. Proc., v. 4; p. 242. Upper Eocene Torio limestone is unconformable below Montijo formation.

W. P. Woodring *in* R. Hoffstetter and others, 1960, Lexique Strat. Internat., v. 5, Amérique Latine, fasc. 2a, p. 348. Poorly defined name. Eocene(?). Correct spelling Toreo.

On west side of Azuero Peninsula. Along Río Toreo, Veraguas Province.

**Toreva Formation** (in Mesaverde Group)

Upper Cretaceous: Northeastern Arizona.

G. A. Kiersch, 1955, Mineral Resources Navajo-Hopi Indian Reservations, Arizona-Utah, v. 2: Tucson, Ariz., Univ. Arizona Press, p. 4 (fig. 1), 7. Comprises lower sandstone member, medial carbonaceous member, and upper sandstone member. Underlies Wepo formation (new); overlies Mancos shale. Name credited to Repenning and Page.

C. A. Repenning and H. G. Page, 1956, Am. Assoc. Petroleum Geologists Bull., v. 40, no. 2, p. 271–277. Lower member is light-brown to pale-yellowish-gray fine- to medium-grained quartz sandstone, forms vertical blocky cliffs 128 feet high. Middle member, in gradational contact with lower member, has extremely varied lithologic character from place to place; in general consists of alternation of flat and thinly bedded carbonaceous mudstone, varicolored siltstone units with coal, and thick lenses of yellowish-gray fine- to coarse-grained poorly sorted quartz sandstone; thickness 106 feet. Upper member is yellowish-gray to grayish-orange-pink sandstone; upper part commonly conglomeratic in southern part of Black Mesa; thickness 79 feet both upper and lower contacts of formation gradational.

Type locality: In Cliffs of Black Mesa 1.3 miles northwest of small settlement of Toreva, from which unit is named, in Hopi Indian Reservation, Navajo County. Traceable by nearly continuous outcrops about entire margin of Black Mesa.

Torio Limestone[1]

*See* Toreo Limestone, correct spelling.

†Tornado Limestone[1]

Lower Mississippian and Lower Pennsylvanian: Central Arizona.

Original reference: F. L. Ransome, 1915, Washington Acad. Sci. Jour., v. 5, p. 380–385.

N. P. Peterson, C. M. Gilbert, and G. L. Quick, 1951, U.S. Geol. Survey Bull. 971, p. 20, 21. Rocks previously included in Tornado limestone in Castle Dome area mapped as Escabrosa limestone (Mississippian) and Naco limestone (Pennsylvanian).

E. D. Wilson, 1950, Arizona Bur. Mines Bull. 156, Geol. Ser. 18, p. 52, 53. In general, the Mississippian beds are crystalline and relatively pure, whereas Pennsylvanian tend to be dense, impure, and cherty.

Named for Tornado Peak, Dripping Spring Range, Ray quadrangle.

**Tornillo Clay**[1]

Upper Cretaceous (Gulf Series): Western Texas.

Original reference: J. A. Udden, 1907, Texas Univ. Bull. 93, p. 17, 54–60.

J. A. Wilson and others, 1952, Texas Univ. Bur. Econ. Geology Rept. Inv. 14, p. 7. On basis of vertebrate faunas, it is believed that part of strata formerly included in Tornillo are Paleocene and lower Eocene.

R. G. Yates and G. A. Thompson, 1959, U.S. Geol. Survey Prof. Paper 312, p. 16, pl. 1. Described in Terlingua district where it is exposed only in extreme southeastern part of area. Thickness 600 to 1,000 feet. Overlies Aguja formation; underlies Chisos volcanics.

Named for exposures along Tornillo Creek, Brewster County, in Chisos Mountains quadrangle.

†Toro Formation[1]

Lower Cretaceous: Western California.

Original reference: H. W. Fairbanks, 1904, U.S. Geol. Survey Geol. Atlas, Folio 101.

N. L. Taliaferro, 1944, Am. Assoc. Petroleum Geologists Bull., v. 28, no. 4, p. 459. Original Toro included both the restricted Knoxville (Upper Jurassic) and Paskenta stage of Lower Cretaceous; the two are separated by an unconformity. Knoxville part of Toro contains pillow basalts and intruded by basic and ultrabasic igneous rocks; Lower Cretaceous part contains no igneous material except as debris in conglomerates. Name Marmolejo formation proposed for Lower Cretaceous of Santa Lucia Range.

Named for exposures along Toro Creek, San Luis Obispo County.

**Toro Limestone Member** (of Chagres Sandstone)

Toro Limestone[1]

Pliocene, lower: Panamá and Costa Rica.

Original reference: D. F. MacDonald, 1915, U.S. Bur. Mines Bull. 86, p. 26.

[T. F. Thompson], 1943, Panama Canal, Spec. Eng. Div., 3d Locks Proj., pt. 2, chap. 3, p. 21–22, fig. 3–2. Names Toro limestone and Caribbean limestone have been used to describe deposits of shell breccia or cemented coquina that overlie Gatún sandstone in region between Lemon Bay and Chagres River. The formation [Toro] has been assigned to upper Miocene.

W. P. Woodring and T. F. Thompson, 1949, Am. Assoc. Petroleum Geologists Bull., v. 33, no. 2, p. 244, 246 (fig. 2). Rank reduced to member status in Chagres sandstone. Chiefly a lime-cemented coquina made up of barnacle and shell fragments; lenses of medium- to coarse-grained sandstone interbedded with the calcareous beds. Variable thickness; maximum 125 feet. Overlies Gatún formation. Late Miocene.

W. P. Woodring, 1955, U.S. Geol. Survey Misc. Geol. Inv. Map I–1; 1957, U.S. Geol. Survey Prof. Paper 306–A, p. 47–50, 51 (fig. 4), pl. 1. Lower Pliocene

Type locality: Toro Point, C.Z.

**Torok 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. 160, 161, fig. 2. Comprises 2,000 feet of dark silt and clay shale with limestone concretions in lower part and about 8,500 feet of dark shale and marine conglomerate and sandstone of graywacke type in upper part at Castle Mountain. Consists of 4,500 feet of dark clay and silt shale in upper part which includes 500 feet of sandstone and some conglomerate, and 1,500 feet of dark silt and clay shale in lower part in vicinity of Tuktu Bluff about 11 miles north of Castle Mountain. Total thickness at Tuktu Bluff 6,000 feet; at Castle Mountain 10,500 feet.

Unconformably overlies Okpikruak formation (new) at most places. Underlies Nanushuk group.

W. W. Patton, Jr., 1956, *in* George Gryc and others, Am. Assoc. Petroleum Geologists Bull., v. 40, no. 2, p. 219, 222–223, fig. 5. Redefined to exclude sandstone, conglomerate, and intercalated shale sequence that overlies Okpikruak formation and crops out along east-trending belt near southern margin of Arctic Foothills province. These beds now included in Fortress Mountain formation (new). Restricted to northern predominantly shale facies. Type section only about 50 percent exposed. Bulk of formation, as redefined, composed of gray silt and clay shale interbedded with subordinate amounts of green to gray siltstone. Specific type section given. Type section approximately 6,000 feet thick.

E. G. Sable, 1956, Am. Assoc. Petroleum Geologists Bull., v. 40, no. 11, p. 2637, fig. 3. Underlies and intertongues with Kukpowruk formation (new) as traced southwestward.

R. M. Chapman and E. G. Sable, 1960, U.S. Geol. Survey Prof. Paper 303–C, p. 73–83, pls. Thickness about 6,458 feet in Utukok-Corwin region. Overlies Fortress Mountain formation and may be in part equivalent to it; underlies Kukpowruk formation with contact gradational and intertonguing.

Type locality: Torok Creek, a tributary to Chandler River in vicinity of Castle Mountain, and on Chandler River between mouth of Torok Creek and mouth of Kiruktagiak River. Type section along Chandler River and Torok Creek between lat 68°40′ N. and lat 68°43′45″ N.

**Toronto Limestone[1] Member** (of Oread Limestone)

Pennsylvanian (Virgil Series): Southeastern Kansas, southwestern Iowa, and western Missouri.

Original reference: E. Haworth and W. H. H. Piatt, 1894, Kansas Univ. Quart., v. 2, p. 117.

R. C. Moore, 1948, Am. Assoc. Petroleum Geologists Bull., v. 32, no. 11, p. 2035 (fig. 5). Basal member of Oread formation; underlies Snyderville shale member; overlies Lawrence formation. 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. 26. Persistent in central and southern Kansas and correlated by Kansas Survey with Weeping Water limestone of Nebraska; if this correlation is correct, the occurrence is in Iowa, Nebraska, Missouri, and through Kansas into Oklahoma. Name Toronto has priority over Weeping Water limestone of Nebraska, although Nebraska uses term Weeping Water.

H. G. O'Connor, 1960, Kansas Geol. Survey Bull. 148, p. 38, pl. 1. Member, in Douglas County, is typically light yellow brown or light gray when fresh; weathers deep yellow brown. Average thickness about 10 feet.

H. G. Hershey and others, 1960, Iowa Highway Research Board Bull. 15, p. 23, fig. 5. Nodular sandy limestone occurring about 8 feet beneath Leavenworth limestone in Adair County is tentatively identified as Toronto. A similar limestone is known from well records in Cass and Montgomery Counties. Data are not available to preclude possibility that this bed represents the Amazonia, Haskell, or Iatan limestones of the Lawrence-Stranger formations.

Type locality: Toronto, Woodson County, Kans.

**Toroweap Formation** (in Aubrey Group)

Permian: Northwestern Arizona, southeastern Nevada, and southwestern Utah.

E. D. McKee, 1937, Carnegie Inst. Washington Year Book 36, p. 341–343. Unconformity occurs at top of middle red-bed member of Kaibab. Proposed to restrict Kaibab to units above unconformity and to apply name Toroweap to units below unconformity.

E. D. McKee, 1938, Carnegie Inst. Washington Pub. 492, p. 12–28, geol. sections. In type locality, consists of two red-bed series separated by massive limestone unit. Complete lithological change occurs within distance of few miles laterally between distinctive western and eastern types (referred to as phases); western phase is larger in geographical extent and includes type locality. Western phase divided into three members, $\alpha$, $\beta$, and $\gamma$, representing, respectively, the upper red member or time of receding sea, the limestone member or time of extended sea, and lower red member or time of advancing sea. Thickness at type locality about 325 feet. Conformably overlies Coconino sandstone; underlies Kaibab formation (name used in restricted sense).

R. E. Lehner, 1958, U.S. Geol. Survey Bull. 1021–N, p. 543–545. Described in Clarkdale quadrangle, Arizona, where it is 150 to 165 feet thick, conformably overlies Coconino sandstone and underlies Kaibab limestone. Lithology indicates that in this area it is part of transitional phase where members of western phase are partly formed and intertongue with sandstone of eastern phase. Can be subdivided into three main units (ascending): red to buff sandstone; calcareous sandstone and arenaceous limestone; and alternating red and buff sandstone, siltstone, and some shale including a few white fine-grained pure sandstone beds intercalated. These units may be the easternmost, recognizable equivalents of McKee's three units. In area of present report, the middle unit is most prominent unit of formation.

T. F. Stipp and H. M. Beikman, 1959, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map OM–201. Included in Aubrey group.

Type section: Eastern wall of Toroweap Valley in Grand Canyon National Monument, Ariz. Section is about 8 miles north of Colorado River.

**Torpedo Sandstone Member** (of Wann Formation)

Torpedo Sandstone (in Ochelata Group)

Torpedo Sandstone Member (of Ochelata Formation)[1]

Pennsylvanian (Missouri Series): Central northern Oklahoma.

Original reference: O. B. Hopkins, 1918, U.S. Geol. Survey Bull. 686–H, p. 76–77, pl. 12.

M. C. Oakes, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 4, p. 720 (table 1), 727–728; 1940, Oklahoma Geol. Survey Bull. 62, p. 81–86. Included in Ochelata group. Overlies Wann formation (revived, restricted, and redefined); underlies unnamed shale below Birch Creek limestone, locally in contact with Birch Creek. At northern and southern extremities, cut off by unconformity at base of Birch Creek. Thickness as much as 60 feet. Type locality stated.

M. C. Oakes, 1959, Oklahoma Geol. Survey Bull. 81, p. 34, 37. Oakes (1940) revived, restricted, and redefined term Wann formation to apply to all strata between top of Iola formation below and base of Torpedo sandstone above or base of Birch Creek limestone where Torpedo sandstone is absent. Oakes (1951, Tulsa Geol. Soc. Digest, v. 19) included Birch Creek limestone in Barnsdall formation as basal member in northern Oklahoma. Torpedo sandstone and the shale above the Torpedo and beneath Birch Creek limestone crop out only in Washington County and eastern Osage County. This situation led Miser (1954, Geologic map of Oklahoma) to place top of Wann formation at base of Barnsdall formation throughout, and to include Torpedo sandstone and the shale above it in Wann formation. This amounts to minor change in definition of the Wann, but it is significant for northern Oklahoma only. This report follows Miser's interpretation of the Wann. Thickness of Torpedo 2 feet at Kansas-Oklahoma line; 30 feet 3 miles farther south. Unit does not appear to extend into Kansas.

Type locality: In hills, 1 mile northwest of Torpedo, on north side of Creek. Torpedo switch is on Atchison, Topeka, and Santa Fe Railroad, in SW¼ sec. 17, T. 26 N., R. 12 E., Osage County.

Torrance shale[1]

Permian (?): 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, 11.

In Manzano Mountains. Derivation of name not given.

**Torrejon Formation** (in Nacimiento Group)[1]

Paleocene: Northwestern New Mexico.

Original reference: J. L. Wortman, 1897, as reported by G. N. Calkins, secy. of Biology section, A. A. A. S., in Sci., new ser., v. 6, p. 852.

H. E. Wood 2d and others, 1941, Geol. Soc. America Bull., v. 52, no. 1, p. 33, pl. 1. Underlies Canyon Largo group (resurrected); overlies Puerco formation. Paleocene (Torrejonian).

G. G. Simpson, 1948, Am. Jour. Sci., v. 246, no. 5, p. 272–273. On east side of San Juan Basin, Puerco and Torrejon are not recognizable lithologic units. Seems practical to consider this part of stratigraphic sequence as single formation, the Nacimiento, containing Puerco and Torrejon faunas.

Extends from Arroyo Torrejon in Sandoval County across southern and western parts of San Juan Basin almost to Colorado-New Mexico boundary.

Torrejonian Age

Paleocene: North America.

H. E. Wood 2d and others, 1941, Geol. Soc. America Bull., v. 52, no. 1, p. 9, pl. 1. Provincial time term, based on Torrejon formation of San Juan Basin, New Mexico, type locality, the heads of Arroyo Torrejon. Covers interval between Paleocene Dragonian (older) and Tiffanian ages. Report defines 18 provincial time terms, based on mammal-bearing units, for North American continental Tertiary. [For sequence see under Puercan.]

Typical area: From [Arroyo Torrejon] northwest to Ojo Alamo, with additional poorer localities scattered to the north almost to Colorado line.

**Torres Member** (of Yeso Formation)

Permian (Leonard) : Central New Mexico.

R. H. Wilpolt and others, 1946, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 61. Comprises bulk of Yeso formation. Alternating beds of orange-red and buff sandstone and siltstone, gray limestone, and gypsum. Thickness ranges from 350 to 600 feet. Underlies Canas gypsum member; overlies Meseta Blanca sandstone member. Type section shown on graphic section 4.

Type locality: Outcrops in tributary of Agua Torres Canyon, after which it is named, on Sevilleta Grant, 7 miles due south of Black Butte, Socorro County.

Torrey Sand[1]

Torrey Sand Member (of La Jolla Formation)

Eocene, middle: Southern California.

Original reference: M. A. Hanna, 1926, California Univ. Pub., Dept. Geol. Sci. Bull., v. 16, no. 7, p. 187–246.

L. G. Hertlein and U.S. Grant 4th, 1939, California Jour. Mines and Geology, v. 35, no. 1, p. 66. Sand member of La Jolla. Maximum exposed thickness about 200 feet. Underlies Rose Canyon shale member; overlies Delmar sand member with gradational contact; in eastern part of La Jolla quadrangle, unconformably overlies Black Mountain volcanics.

A. M. Keen and Herdis Bentson, 1944, Geol. Soc. America Spec. Paper 56, p. 21 (fig. 4). Shown on chart as sand member of La Jolla. Middle Eocene.

G. B. Oakeshott, 1951, Am. Assoc. Petroleum Geologists Bull., v. 35, no. 2, p. 254 (table). Table lists Torrey sand (formation). Underlies Rose Canyon shale; overlies Delmar sand.

Typically exposed on Torrey Pines grade, where highway climbs from Soledad Valley, San Deigo County.

Torrington Member (of Lance Formation)[1]

Upper Cretaceous: Southeastern Wyoming.

Original reference: E. M. Schlaikjer, 1935, Harvard Coll. Mus. Comp. Zoology Bull., v. 76, no. 2, p. 31–54, 65.

Named for proximity to town of Torrington, on North Platte River, north of typical exposures on Horse Creek, Goshen County.

**Tortugas Andesite**

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), 13–15, pl. 2. Nonpersistent horizon of flow rock, breccia, and in places conglomerate—all of a characteristic augite-andesite composition—lying between Guaynabo formation (redefined) and Frailes formation (new). Varies in thickness rapidly, as for example at El Laberinto where probably over 1,300 feet of volcanic rocks of the Tortugas disappear almost abruptly along strike and suggests a local vent accumulation at this place. Unit was not recognized by Meyerhoff and Smith (1931). Its outcrop in vicinity of La Muda and Trujillo Alto is included in their Guaynabo, Luquillo, and Fajardo formations.

Named for exposures at Barrio Tortugas, north and east of La Muda, San Juan district.

**Tosi Chert Member** or **Tongue** (of Phosphoria Formation)

Permian: Western Wyoming, eastern Idaho, southwestern Montana, and eastern Utah.

R. P. Sheldon *in* V. E. McKelvey and others, 1956, Am. Assoc. Petroleum Geologists Bull., v. 40, no. 12, p. 2830 (fig. 2), 2832 (fig. 3), 2836 (fig. 4), 2851–2852; 1959, U.S. Geol. Survey Prof. Paper 313–A, p. 30–31, pls. 2, 3. Thin dark- to light-colored chert beds that lie above Retort phosphatic shale member (new) of the Phosphoria in Wyoming, Montana, and in limited areas in Idaho and Utah, are here designated Tosi chert member of Phosphoria formation. At type locality, composed of lower brownish-gray-black chert unit, 25 feet thick, that contains abundant columns of chert several inches in diameter and 1 to 2 feet long, oriented obliquely to bedding, and an upper light-gray sandy chert unit, 8 feet thick. Contact with underlying Retort gradational through zone consisting of interbedded fissile mudstone and thin-bedded chert. Tosi is prominent member of Phosphoria in southeastern Montana and northwestern Wyoming, where in recent reports it has been included in E unit or member; most extensive tongue of Phosphoria into Park City formation in central Wyoming and into Shedhorn sandstone (new) in Wyoming and Montana. North of type locality, thickens to about 40 feet in Yellowstone Park and 145 feet in Beaverhead County, Mont.; 70 feet in Wind River Mountains; 15 feet in Owl Creek Mountains, Wyo., about 40 feet at Brazer Canyon, Rich County, Utah. Lower part of Tosi grades from Retort member; contact progressively falls to lower horizons north and east of Tosi Creek, and in vicinity of Yellowstone Park the Tosi is separated from lower member of Shedhorn sandstone by a phosphorite 0.5 foot thick. Overlain by Dinwoody formation in Wyoming Range and in western Beaverhead County; in Brazer Canyon, underlies thin tongue of the Franson; east and north of these areas, Tosi is overlain by units of Shedhorn and Park City formations; in Owl Creek and Wind River Ranges and Conant Creek anticline, Tosi is overlain by Ervay member of Park City.

Type locality: Tosi Creek in SE¼ sec. 17, T. 39 N., R. 110 W., Sublette County, Wyo., 8½ miles ENE of Tosi Peak on east nose of small anticline.

†Toston Beds[1]

Oligocene, upper: Western central Montana.

Original reference: E. Douglass, 1902, Am. Phil. Soc. Trans., v. 20, new ser., pt. 3, p. 237–245.

M. R. Thorpe, 1937, Am. Jour. Sci., v. 33, 5th ser., no. 198, p. 427. Upper Oligocene.

Northeast of Toston near Cottonwood Creek, in Helena-Big Belt region, Broadwater County.

**Totatlanika Schist**[1]

Mississippian(?): Central Alaska.

Original reference: S. R. Capps, 1912, U.S. Geol. Survey Bull. 501, p. 22, map.

Clyde Wahrhaftig, 1958, U.S. Geol. Survey Prof. Paper 293–A, p. 12, pls. 1, 2, 5. Assigned Mississippian(?) age based on fossils recovered in Nenana River valley region. Probably underlies Nenana gravel from Slate Creek to northern edge of gravel.

Named for exposures in canyon of Totatlanika River, 15 miles east of Nenana River, Bonnifield region. Forms belt 5 to 20 miles wide that extends along north edge of Alaska, to Little Delta River, 60 miles east of Nenana River.

†Totsen Series[1] or Group[1]

Early Paleozoic(?) : Northern Alaska.

Original reference: F. C. Schrader, 1902, Geol. Soc. America Bull., v. 13, p. 239.

Named for Totsenbetna, a name formerly applied by the natives to Wild Creek.

Touchet Beds

Pleistocene: Eastern Washington.

R. L. Flint, 1938, Geol. Soc. America Bull., v. 49, no. 3, p. 493–495. Name applied to deposit of buff- to cream-colored silt and fine sand containing erratic stones. Younger than Palouse soil; grades stratigraphically and topographically into scabland fill. Thickness ranges from thin veneer up to more than 100 feet in single exposures.

Occurs in Pasco basin and in Columbia basin downstream as far as gorge through Cascade Mountains. Well exposed in vicinity of Touchet, Walla Walla County.

†Toughkenamon rock[1]

Precambrian: Southeastern Pennsylvania.

Original reference: F. Frazer, 1883, Pennsylvania 2d Geol. Survey Rept. $C_4$, p. 307–308, 319, 321.

Named for development near Toughkenamon Station, Chester County.

Tough Mountain Quartzite

*See* Tough Nut Quartzite.

Tough Nut Quartzite

Lower Cambrian: Southern California.

J. C. Hazzard, 1938, (abs.) Geol. Soc. America Proc. 1937, p. 241. Listed as underlying Kelso shale and unconformably overlying Archean gneiss. Thickness 1,085 feet.

J. C. Hazzard, 1954, California Div. Mines Bull. 170, chap. 4, p. 32 (table 1). Name preoccupied. Unit termed Prospect Mountain quartzite. Underlies Latham shale (new) which replaces preoccupied term Kelso.

Area is in Providence Mountains, San Bernardino County.

Toughnut Series[1]

Lower Cretaceous(?) : Southeastern Arizona.

Original reference: W. P. Blake, 1902, Tombstone and its mines.

In Tombstone district.

**Toutle Formation**

Eocene, upper, and Oligocene, lower: 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. Younger than Hatchet Mountain formation (new). Name credited to A. E. Roberts (in press).

A. E. Roberts, 1958, U.S. Geol. Survey Bull. 1062, p. 12 (chart), 24–31, pl. 1. Consists of about 570 feet of basaltic conglomerate, sandstone, siltstone, clay, and associated beds of lignite; locally interbedded basalt flows. In type area, unconformably overlies Hatchet Mountain formation; overlies Cowlitz formation in northern half of sec. 26, T. 11 N., R. 2 W. Unconformably underlies middle(?) Miocene volcanic sequence.

Type area: Along banks of Toutle River, from its tributary, Cline Creek, east to Coalbank Rapids, and north along Cedar Creek to Windom, Toledo-Castle Rock district.

Toutle River Mud Flow

Recent: Western Washington.

Don Mullineaux, 1960, Geol. Soc. Oregon Country Newsletter, v. 26, no. 5, p. 40. Flow came down North Fork of Toutle River, traversed length of main stream valley, and debouched into Cowlitz River valley; total length exceeds 40 miles. Flow almost completely filled Toutle River valley and created Silver Lake.

Flow issued from Mount St. Helens.

**Towanda Limestone Member** (of Doyle Shale)[1]

Permian: Eastern Kansas and southeastern Nebraska.

Original reference: R. C. Moore, 1920, Kansas Geol. Survey Bull. 6, pt. 2, p. 61.

R. C. Moore and others, 1951, Kansas Geol. Survey Bull. 89, p. 44. Consists of limestone, light bluish gray to yellow slabby and platy in middle and lower parts; brecciated in upper; fossils rare. Thickness commonly 5 to 10 feet; in Geary County, Kans., about 15 feet. Underlies Gage shale member; overlies Holmesville shale member.

Named from exposures near Towanda, Butler County, Kans.

†Towanda Sandstone (in Chemung Formation)[1]

Upper Devonian: Northeastern Pennsylvania.

Original reference: A. Sherwood, 1878, Pennsylvania 2d Geol. Survey Rept. G., p. 38–39.

Crops out in Wysox Township, opposite and a little above Towanda, Bradford County.

**Tow Creek Sandstone Member** (of Iles Formation)

Tow Creek Sandstone (in Mesaverde Formation)[1]

Upper Cretaceous: Northwestern Colorado.

Original reference: K. M. Willson, 1920, Colorado Geol. Survey Bull. 23, p. 30–39.

N. W. Bass, J. B. Eby, and M. R. Campbell, 1955, U.S. Geol. Survey Bull. 1027–D, p. 155–156. Reallocated to member status in Iles formation. Thickness 35 to 125 feet. Not everywhere a single massive bed; in some areas, consists of two or more beds separated by units of shale and sandy shale. Becomes shaly and loses identity in vicinity of Oak Creek. Underlies unnamed units of formation; overlies Mancos shale.

R. E. Kucera, 1959, Rocky Mountain Assoc. Geologists 11th Field Conf., Symposium, p. 41, 43, fig. 3. Basal member of Iles formation. Consists of

33 feet of light-brown to light-gray medium-grained crossbedded and massive sandstone in Yampa district. Overlies Mancos shale.

Forms top of ridges on both sides of Tow Creek, Routt County.

†Tower Group[1]

Precambrian: Northeastern Minnesota.

Original reference: A. Winchell, 1888, Minnesota Geol. Nat. History Survey 16th Ann. Rept., p. 330–367.

Mapped at Tower, St. Louis County.

†Tower Sandstone Lentil (of Green River Formation)[1]

†Tower Sandstone Lentil (in Laney Shale Member of Green River Formation)

Eocene: Southwestern Wyoming.

Original reference: J. W. Powell, 1876, Geology of eastern portion of Unita Mountains, p. 40, 45.

W. H. Bradley, 1959, Am. Assoc. Petroleum Geologists Bull., v. 43, no. 5, p. 1074. Redefined as lentil in lower part of Laney shale member of Green River; only in few places does it coincide with base of member. A crystal tuff, not fluviatile deposit, made up of clastic sand grains; uniformly fine grained—not coarse grained as it has been described many times.

Forms top of weathered rocks known as The Towers, in vicinity of Green River, Sweetwater County.

**Tower Creek Conglomerate**[1]

Pliocene: Yellowstone National Park.

Original reference: A. Hague and others, 1904, U.S. Geol. Survey Yellowstone Nat. Park Atlas, geol. maps to accompany U.S. Geol. Survey Mon. 32.

Well exposed in northwest corner of Gallatin quadrangle. Named for exposure on Yellowstone River, opposite mouth of Tower Creek, Canyon quadrangle.

Tower Peak Porphyritic Syenite

Age not stated: Central Montana.

R. N. Miller, 1959, Montana Bur. Mines and Geology Mem. 37, p. 21–23. Name applied to porphyritic syenite which characterizes Tower Peak. Rocks of this type are light orange to brown or dark brown on weathered surface. Freshly broken surface shows dense, glassy-appearing, moderate-grayish-brown matrix with abundant phenocrysts of dark-greenish-black ferromagnesian mineral, and two kinds of feldspar, one grayish pink and the other light gray.

Named for occurrence on Tower Peak in South Moccasin Mountains, Fergus County.

**Towle Shale**[1] **Member** (of Onaga Shale)

Towle Shale (in Admire Group)

Permian: Southeastern Nebraska and eastern Kansas.

Original reference: R. C. Moore and G. E. Condra, Oct. 1932, Revised classification chart of Pennsylvanian rocks of Kansas and Nebraska.

R. C. Moore, J. C. Frye, and J. M. Jewett, 1944, Kansas Geol. Survey Bull. 52, p. 170. Includes Indian Cave sandstone member which is present only locally and fills channels as deep as 120 feet. 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 member status in Onaga shale. Locally contains Indian Cave channel sandstone bed. Underlies Aspinwall limestone member; overlies Brownville limestone member of Wood Siding formation.

Type locality: Towle Farm, 2 miles south and 3 miles west of Falls City, SW¼ sec. 20, T. 1 N., R. 16 E., Richardson County, Nebr.

Towner Greenstone[1] (in Snowy Range Series)

Precambrian: Southeastern Wyoming.

Original reference: E. Blackwelder, 1926, Geol. Soc. America Bull., v. 37, p. 615, 622.

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 along road between Brooklyn Lodge and Towner Lake, Medicine Bow Mountains.

Townline Lake Granodiorite

Precambrian (Laurentian): Northeastern Minnesota.

J. T. Stark and V. G. Sleight, 1939, Geol. Soc. America Bull., v. 50, no. 7, p. 1032 (table 2), 1033. Name applied to granodiorite cutting Ely greenstone. May be offshoot of Saganaga granite.

Occurs as small mass on Townline Lake portage NW¼ sec. 18, T. 65 N., R. 5 W., in Vermilion district.

Town Mountain Granite[1]

Precambrian: Central Texas.

Original reference: H. B. Stenzel, 1932, Geol. Soc. America Bull., v. 43, no. 1, p. 144.

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 the already deformed metasediments [Valley Spring gneiss and Packsaddle schist] and was followed by Oatman Creek granite, Sixmile granite, and Llanite, the latter being the youngest.

Occurs on Llano uplift in Llano, Mason, Burnet, and Gillespie Counties.

Townsend Shale

Oligocene, lower: Northwestern Washington.

J. W. Durham, 1942, Jour. Paleontology, v. 16, no. 1, p. 86. Name proposed for a gray-black shale, 60 to 65 feet thick, that overlies the Lyre conglomerates, contact irregular, and unconformably underlies Quimper sandstone (new). Shale is well bedded and includes occasional nodular calcareous beds 6 to 12 inches thick.

C. E. Weaver and others, 1944, Geol. Soc. America Bull., v. 55, no. 5, p. 596, chart 11. Overlies Lyre conglomerate; unconformably underlies Quimper sandstone.

Type locality: North of Woodmans Wharf (now called Romana Beach), 8 miles southeast of Port Townsend, Jefferson County.

**Towow Formation**[1]

Pennsylvanian(?): Southwestern Maine.

Original reference: F. J. Katz, 1917, Washington Acad. Sci. Jour., v. 7, p. 199.

Occurs only in Lebanon Township. Name derived from original name of first settlement in town of Lebanon, York County.

**Towsley Formation**

Miocene, upper, and Pliocene, lower: Southern California.

E. L. Winterer and D. L. Durham, 1954, California Div. Mines Bull. 170, map sheet 5; 1958, U.S. Geol. Survey Oil and Gas Inv. Map OM-196. Sequence of lenticular units of light-colored conglomerate and sandstone interbedded with units of brown-weathering mudstone. Thickness as much as 4,000 feet; attains its maximum thickness along north slope of Santa Susana Mountains where it overlies and interfingers with Modelo formation; thins eastward to about 1,500 feet and near Newhall is overlapped by Pico formation.

Area of report is part of eastern Ventura Basin, Los Angeles County.

**Toyabe Quartz Latite**

Pliocene(?): South-central Nevada.

H. G. Ferguson and S. H. Cathcart, 1954, U.S. Geol. Survey Geol. Quad. Map GQ-40. Thick sequence of flows of very uniform composition. Flow breccias in places. Locally thin tuff layers between flows. Total thickness may exceed 1,500 feet, with individual flows averaging between 50 and 100 feet in thickness. Unconformable contacts with Gilbert andesite below and Pleistocene(?) basalt above.

Type locality: Crest and west flank of Toyabe [Toiyabe] Range.

**Trabuco Formation**[1]

Cretaceous: Southern California.

Original reference: E. L. Packard, 1916, California Univ. Pub., Dept. Geol. Bull., v. 9, p. 140-141.

W. P. Popenoe, 1942, Am. Assoc. Petroleum Geologists Bull., v. 26, no. 2, p. 166-170. Described in Santa Ana Mountains, Orange County, as soft red friable deeply weathered boulder conglomerate with some interbedded thin lenses of red crossbedded sandstone; unfossiliferous; thickness more than 300 feet. Forms base of unmetamorphosed sedimentary section. Unconformably overlies basement complex; underlies Baker Canyon member of Ladd formation. Cretaceous(?).

Named for Trabuco Canyon, Santa Ana Mountains.

Tracian Stage

Late Cretaceous: California.

P. P. Goudkoff, 1945, Am. Assoc. Petroleum Geologists Bull., v. 29, no. 7, p. 960 (table 1), 987-989, 1005-1006. 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). Includes interval between Ingramian stage (new) above and Weldonian stage (new).

Occurs in Great Valley in both surface and subsurface. Named from Amerada Petroleum Corp. F. D. L. Well 1, sec. 15, T. 2 S., R. 5 E., near town of Tracy, San Joaquin County.

†Tracy City measures[1]

Pennsylvanian: Southeastern Tennessee.

Original reference: J. M. Safford and J. B. Killebrew, 1900, Elements of geology of Tennessee, p. 104, 148–153, 167, 169.

Named for Tracy City, Grundy County.

**Tracy Creek Quartz Latite**

Tracy Creek Andesite[1]

Miocene(?): Southwestern Colorado.

Original reference: Whitman Cross and E. S. Larsen, 1935, U.S. Geol. Survey Bull. 843, p. 64–65, pl. 1.

E. S. Larsen, Jr., and Whitman Cross, 1956, U.S. Geol. Survey Prof. Paper 258, p. 86–87, pl. 1. Redescribed as quartz latite. Irregularly overlies Beidell quartz latite; underlies dark quartz latites of Conejos age.

Makes up much of drainage of Tracy Creek, for which it is named, Saguache quadrangle, Saguache County. Occurs chiefly in extreme southern part of Saguache quadrangle and extends into Del Norte quadrangle.

**Traders Iron-Bearing Member** (of Vulcan Iron-Formation)[1]

Precambrian (Animikie Series): Northern Michigan.

Original reference: C. R. Van Hise and W. S. Bayley, 1900, U.S. Geol. Survey Geol. Atlas, Folio 62.

H. L. James, 1958, U.S. Geol. Survey Prof. Paper 314–C, p. 30 (table 1), 35. Basal member of Vulcan iron-formation. Underlies Brier slate member; overlies Felch formation.

Named for Traders mine, north of Lake Antoine, Menominee district, [Dickinson County].

**Tradewater Formation**

Tradewater Formation (in Pottsville Group)[1]

Tradewater Group

Middle Pennsylvanian: Western Kentucky.

Original reference: L. C. Glenn, 1912, Kentucky Geol. Survey Rept. Prog. 1910 and 1911, p. 27.

R. M. Kosanke, 1950, Illinois Geol. Survey Bull. 74, p. 63–70. Tradewater group, formerly called upper Pottsville, is known from outcrops in southern, western, and northern Illinois. Top of group in southern and western Illinois is placed at base of Palzo and Isabel sandstones. Base in southern Illinois is at base of Grindstaff sandstone. Beds from the Tarter to base of Carbondale have been placed in Tradewater group. Maximum thickness 445 feet, southern Illinois; 100 feet, western Illinois; possibly as much as 600 feet in central Illinois. Group includes a number of sandstones, shales, coal beds, and two marine limestones, the Stonefort and Curlew, in southern Illinois, and Seville and Seahorne limestones in western Illinois. Overlies Caseyville group; underlies Carbondale group.

H. R. Wanless, 1957, Illinois Geol. Survey Bull. 82, p. 64–82, geol. sections. Tradewater group in Beardstown, Glasford, Havana, and Vermont quadrangles, is divided into pre-Babylon strata (at base) and the Babylon, Tarter, Pope Creek, Lower DeLong, Middle DeLong, Upper Delong, Seahorne, Wiley, and Greenbush cyclothems. Underlies Carbondale group. Pre-Babylon strata conform in position to knobs or other projections of the Mississippian surface and locally may fill solution cavities.

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 8 (fig. 1). Name discontinued in Illinois. Lower part of Tradewater included in McCormick group (new) and upper part in Kewanee group (new).

U.S. Geological Survey uses the term Tradewater Formation in Kentucky, but has discontinued use of the term Pottsville Group in Kentucky.

Named for exposures along Tradewater River east of Battery Rock.

Trafalgar 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 Jessup formation and below Lagro formation (both new). Name credited to W. J. Wayne (in preparation).

Type locality and derivation of name not given.

**Trail Formation**[1]

Upper Triassic: 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 I–175, table 2. Shown on paleotectonic map as Lower Jurassic; underlies Hardgrave sandstone.

K. B. Ketner, 1959, *in* E. D. McKee and others, U.S. Geol. Survey Misc. Geol. Inv. Map I–300, p. 17. Diller (1892) listed as Upper Triassic (ascending) the Swearinger slate, Hosselkus limestone, Trail formation, and Foreman formation, but he expressed doubt as to stratigraphic position of Trail formation. Diller (1908, U.S. Geol. Survey Bull. 353) assigned the Foreman and Trail to the Jurassic, and stratigraphic positions of Hosselkus and Swearinger slate were reversed. Order of Hosselkus and Swearinger was again reversed in interpretation by Silberling (*in* Reeside and others, 1957, Geol. Soc. America Bull., v. 66, no. 11) based on data of McMath, and Trail formation was returned to the Triassic stratigraphically below the Hosselkus and Swearinger. Sequence, as interpreted by Silberling and accepted for this folio, is (ascending) Trail formation, Swearinger slate, and Hosselkus. Footnote states that McMath (1958, unpub. thesis) now doubts validity of data given to Silberling.

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 Upper Jurassic marine sedimentary and metasedimentary rocks.

Named for exposures along Hosselkus Creek on the trail, Plumas County.

**Trail City Member** (of Fox Hills Formation)

Upper Cretaceous: North-central South Dakota and southern North Dakota.

R. E. Morgan and B. C. Petsch, 1945, South Dakota Geol. Survey Rept. Inv. 49, p. 13–14, fig. 4. Commonly brown or buff sandy shale, becoming more sandy toward top; contains three to five locally persistent zones of fossiliferous concretions, Thickness 50 to 90 feet. Underlies Timber Lake member (new); overlies Pierre formation.

S. P. Fisher, 1952, North Dakota Geol. Survey Bull. 26, p. 10–11, 37. Geographically extended into Emmons County, N. Dak., where it is 50 to 75 feet thick and consists of brown to gray sandy shales which pass upward into brown and green-gray sands. Thins eastward. Underlies Timber Lake member.

Named for exposures in area around Trail City, Corson County, S. Dak. Recognized at least 12 miles north of Trail City along edge of breaks of Grand River and also about 50 miles southwest from city along edge of breaks of Moreau River.

**Trail Creek Formation**[1]

Silurian: Central Idaho.

Original reference: L. G. Westgate and C. P. Ross, 1930, U.S. Geol. Survey Bull. 814, p. 10, 23.

C. P. Ross and J. D. Forrester, 1958, Idaho Bur. Mines and Geology Bull. 15, p. 8. Silurian rocks are relatively scarce in Idaho. Sequence includes Laketown dolomite which locally attains thickness of 2,000 feet, and shale and sandstone of Trail Creek formation.

Exposures confined to west side of Trail Creek, in its upper part, Hailey quadrangle.

**Trail Crossing Basalt**[1]

Eocene(?): Central northern Oregon.

Original reference: H. T. Stearns, 1931, U.S. Geol. Survey Water-Supply Paper 637, p. 134.

Exposed on both banks of Crooked River at Trail Crossing and extend northeast across Haystack Butte country in belt about 1 mile wide, in Deschutes Basin.

Trail Hill Sandstone (in Chinle Formation)

Upper Triassic: Southwestern Utah.

P. D. Proctor, 1953, Utah Geol. and Mineralog. Survey Bull. 44, p. 22–23, pl. 2. Brownish- to brick-red shales and interbedded fine- to medium-grained sandstones. Lenses of pebble conglomerates as much as 1 foot thick, crossbedding, and minor ripple marks characterize parts of unit. Sandstones, friable and brick-red, locally with white mottling or white banding. White to grayish-white siliceous limestone from 6 inches to 1½ feet in thickness at top of ledge sandstone. Red medium-grained friable sandstone with minor interbedded brick-red shales above siliceous limestone. Green to gray shales, locally bluish green, above pink to red sandstones; thickness 25 feet. Bed of jasper 2 to 6 inches thick occurs 8 feet below upper contact of shale. Overlies Fire Clay Hill bentonitic shale (new); underlies Leeds sandstone (new) with local unconformity.

In Silver Reef (Harrisburg) Mining District, Washington County.

**Training School 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. 132–133. Cone of bedded cinders and associated lava flow of melilite-nepheline basalt. Flow at least 50 feet thick. Flow rests unconformably on sandstone and conglomerate terrace graded to the plus 95 foot (Kaena) stand of the sea and was cliffed by the sea during the plus 25 foot (Waimanalo) stand.

Named for Maunawili Training School for Girls, near which it occurs. Flow is 1½ miles long and three-fourths mile wide, on northeast side of Koolau Range about 8½ miles northwest of Makapuu Head.

†Trampan Formation[1]

Miocene, upper: Western California.

Original reference: A. C. Lawson and C. Palache, 1902, California Univ. Pub., Dept. Geol. Bull., v. 2, p. 447–448.

Named for exposures along Las Trampas Creek, Contra Costa County.

Tranquilla Shale

Eocene, upper: Panamá.

H. N. Coryell and J. R. Embich, 1937, Jour. Paleontology, v. 11, no. 4, p. 289–291. Name proposed for basal Tertiary beds that have been included in Bohío formation. Bohio is restricted to include only Oligocene sediments which overlie Tranquilla. Greenish-gray shale that contains well-preserved foraminiferal fauna. On basis of fauna, regarded as Jackson (late Eocene).

W. P. Woodring and T. F. Thompson, 1949, Am. Assoc. Petroleum Geologists Bull., v. 33, no. 2, p. 227; W. P. Woodring, 1957, U.S. Geol. Survey Prof. Paper 306–A, p. 13. Name Tranquilla has priority over Gatuncillo formation, but name Tranquilla was defined inadequately. Type locality is now flooded by Madden Lake.

Type locality: Near town of Tranquilla, 79°13′ [33′] W., 10°15′ N., in upper Chagres River valley.

Tranquillon Volcanics

Miocene, lower (Saucesian): Southern California.

T. W. Dibblee, Jr., 1950, California Div. Mines Bull. 150, p. 33–34, pls. 1, 2. Defined as local phase of Obispo tuff of San Luis Obispo County; composed of as much as 1,200 feet of rhyolite, agglomerate, and ash. Where exposed on Tranquillon Mountain ridge, the volcanic series lies conformably below Monterey shale and unconformably above Rincon and older formations.

Type locality: Ridge west of Canada del Rodeo, Santa Barbara County.

Traveller Rhyolite[1]

Devonian: North-central Maine.

Original reference: F. W. Toppan, 1932, Geology of Maine, Dept. Geology Union College, Schenectady, N.Y., p. 69–70.

D. W. Rankin, 1958, (abs.) Geol. Soc. America Bull., v. 69, no. 12, pt. 2, p. 1632. At least 8,500 feet of felsitic flows, tuffs, and welded tuffs. Overlies marine subgraywacke of Oriskany age.

Forms mass of Traveller Mountains, a group of peaks north of Katahdin, Piscataquis County.

**Traverse Group**

Traverse Formation[1]

Middle and Upper Devonian: Southern Michigan.

Original reference: A. Winchell, 1871, Michigan Geol. Survey Rept. Prog., p. 26–33.

G. M. Ehlers and R. E. Radabaugh, 1937, Michigan Acad. Sci., Arts, and Letters Sec. Geology and Mineralogy [Guidebook] 7th Ann. Field Excursion, [p. 8–9]; 1938, Michigan Acad. Sci., Arts, and Letters, Papers, v.

23, p. 441–445. Belle shale formation of Traverse group overlies Rogers City formation (new).

B. F. Hake and J. B. Maebius, 1938, Michigan Acad. Sci., Arts, and Letters, Papers, v. 23, p. 447–461. Term group is used to designate the series of beds which underlie all gray and black shales near base of Antrim formation and which overlie massive buff to brown relatively unfossiliferous limestones and dolomites belonging to Dundee and older formations. Group, in central Michigan, comprises (ascending) Bell shale, Rockport limestone, middle shale and limestone unit, middle massive limestone unit, upper shale unit, and Squaw Bay limestone.

G. A. Stewart, 1938, Geol. Soc. America Spec. Paper 8, p. 6–7. Stauffer (1909, Ohio Geol. Survey, 4th ser., Bull. 10) applied Michigan term Traverse to upper Middle Devonian rocks in northwestern Ohio, on assumption that they were continuation of formation of that name in Michigan. However, faunal correlation was only approximate, and some have questioned whether term should be used for northwestern Ohio, especially as limits of unit have never been definitely fixed in Michigan, and it has not been possible to correlate it with formations elsewhere. Seems best to discontinue use of term Traverse for upper Middle Devonian units of northwestern Ohio between Columbus limestone and Ohio shale. Terms Blue limestone, Silica shale, and Tenmile Creek dolomite are herein used for units of this interval.

L. L. Sloss, 1939, Jour. Paleontology, v. 13, no. 1, p. 52–73. Three-fold division of Middle Devonian Traverse beds of Lower Peninsula of Michigan is suggested. Pohl (1930) divided Traverse into Gravel Point stage at base, Charlevoix stage in middle, and Petoskey formation at top. Present writer [Sloss] was unable to locate prominent angular unconformity at top of Charlevoix stage mentioned by Pohl and believes that Pohl was confused by unusually high initial dips prevailing in area due to proximity of large bioherms. Term formation not applicable to beds involved; for purposes of this paper, all three divisions are considered as faunal zones. Rugose corals indicate Traverse beds are contemporaneous with Hamilton group of New York and Cedar Valley formation of Iowa.

A. S. Warthin, Jr., and G. A. Cooper, 1943, Am. Assoc. Petroleum Geologists Bull., v. 27, no. 5, p. 571–595. First locality name for rocks now termed Traverse group was that given by Douglass in 1841 (Fourth Ann. Rept. of the State Geologist for 1840, Michigan Legis. Doc., v. 1, no. 11, p. 550). This name was "Little Traverse Bay limestones," changed to "Little Traverse Bay group" by Winchell (1871). [Winchell used Little Traverse Group.] Lane (1893, Michigan Geol. Survey Rept. State Board 1891–1892) introduced present usage by referring to Traverse group. Subdivisions of Traverse group in Thunder Bay region [this report] have been assigned to stage, series, or formation rank by different authors. Thunder Bay series, Alpena limestone, Lower Traverse series with Long Lake limestone and shale, and Bell shale (Grabau, 1902, Michigan Geol. Survey Rept. State Board, 1901); Thunder Bay series, Alpena limestone series, and Presque Isle series (Grabau and Shimer, 1910, North American Index Fossils, v. 2); Thunder Bay series, Alpena limestone, Long Lake series (Ver Wiebe, 1927, Michigan Acad. Sci., Arts, and Letters, Papers, v. 7); Thunder Bay stage, Alpena stage, Presque Isle stage with Long Lake member, Grand Lake member, and Bell shale member (Pohl, 1930, U.S. Natl. Mus. Proc., v. 76, art. 14). In present report, group is subdivided into formations based on combination of lithological and paleontological criteria. In this classification, term Thunder Bay is used in conformity with original definition of Douglass (1839?). Limits of Alpena limestone are redefined. Term Presque Isle series or stage, with its synonym, Long Lake series, are abandoned. Name Rockport Quarry limestone replaces preoccupied term Rockport limestone. Group, in Thunder Bay region, comprises (ascending) Bell shale, Rockport Quarry limestone, Newton Creek limestone, Alpena limestone, Four Mile Dam formation, Norway Point formation, Potter Farm formation, Thunder Bay limestone, and Squaw Bay limestone. Overlies Rogers City limestone, erosional unconformity. Top of group is usually recognized as top of highest Devonian limestone in Michigan. This would exclude from group "overlying transition zone" of shale referred to by some authors. Middle and Upper Devonian.

W. A. Kelly and G. W. Smith, 1947, Am. Assoc. Petroleum Geologists Bull., v. 31, no. 3, p. 447–469. Group described in Afton-Onaway area, Michigan. Comprises (ascending) Belle shale (recognized in wells), Rockport Quarry limestone, Ferron Point shale, Genshaw formation, Koehler limestone (new), Gravel Point formation, and Beebe School formation (new). Beebe School formation underlies Antrim shale.

Name derived from Little Traverse Bay and Grand Traverse Bay, Southern Peninsula.

Traverse Volcanics (in Salt Lake Group)

Oligocene and Miocene, lower: North-central Utah.

L. W. Slentz, 1955, Utah Geol. Soc. Guidebook 10, p. 23, 24 (fig. 6). Salt Lake group, in Lower Jordan Valley, is divided into (ascending) Traverse volcanics, Jordan Narrows unit, Camp Williams unit, Harkers fanglomerate, and Travertine unit. Figure 6 shows Traverse volcanics interfingering with Jordan Narrows unit. Thickness 1,000 to 3,000 feet.

Lower Jordan Valley is defined as that part of Jordan Valley northward from Traverse Mountains to Great Salt Lake.

Travertine unit (in Salt Lake Group)

*See* Camp Williams unit, Jordan Narrows unit, and Harkers Fanglomerate.

Travesser Formation (in Dockum Group)

Triassic: Northeastern New Mexico.

Brewster Baldwin and W. R. Muehlberger, 1959, New Mexico Bur. Mines Mineral Resources Bull. 63, p. 35 (table 2), 38, pls. 1–a, 2. Consists largely of clayey silt and fine-grained sandstone. Sandstone beds, as much as 20 feet thick, in measured section, range from massive to thin bedded and from parallel bedded to cross laminated. Conglomeratic lenses common; some fissile clay present. Commonly medium red brown; some orange sandstone and some dark-red-brown beds. Thickness 245 feet at type section; thickens eastward to as much as 550 feet in northeast Union County. Overlies Baldy Hill formation (new), possible angular unconformity; underlies Sloan Canyon formation.

Type section: Two miles south of Baldy Hill in sec. 12, T. 31 N., R. 32 Union County. Named for exposures near Travesser Creek, Underlies slope wash and alluvium from Tollgate eastward to Oklahoma State line.

Travester shale[1]

Middle Jurassic: 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. 3, 12.

Well exposed in Travester Canyon.

**Travis Peak Formation** (in Trinity Group)[1]

Lower Cretaceous (Comanche Series): Southern and eastern Texas.

Original reference: R. T. Hill, 1890, Texas Geol. Survey 1st Ann. Rept., p. 118–119, 133.

R. W. Imlay, 1940, Arkansas Geol. Survey Inf. Circ. 12, p. 28. Subsurface Hosston formation (new) replaces name Travis Peak, as applied to beds older than real Travis Peak of Texas. Stratigraphic equivalents of Travis Peak formation of Texas are present in Pine Island field of northwestern Louisiana in lower part of Pine Island formation which lies about 250 feet above Hosston formation. This correlation is based on occurrence of ammonites, *Dufrenoya* and *Prochelonicera*s which mark Travis Peak formation of Texas and upper Aptian stage of European section.

R. W. Imlay, 1945, Am. Assoc. Petroleum Geologists Bull., v. 29, no. 10, p. 1416–1469. Discussion of subsurface Lower Cretaceous formations of south Texas. Evidence presented to show that Travis Peak formation of outcrop area is represented in subsurface by shaly sequence, herein named Pearsall formation which includes basally Pine Island shale member, medially Cow Creek limestone member, and at top Hensell shale member. Recommended that term Travis Peak formation be used hereafter only for outcrops.

P. E. Cloud, Jr., and V. E. Barnes, 1948, Texas Univ. Bur. Econ. Geology Pub. 4621, p. 318–319 [1946]. Rocks of Lower Cretaceous age outcropping in Johnson City area are given conventionally as follows: Travis Peak formation with Sycamore sand, Cow Creek limestone, and Hensell sand member; and Glen Rose limestone. Mapping in Johnson City area and to west shows that the so-called Hensell sand member of Travis Peak is more really a shoreward facies of Glen Rose limestone, but present report uses conventional terminology.

V. E. Barnes, 1948, Texas Univ. Bur. Econ. Geology Rept. Inv. 2, p. 5–8. Proposed to remove Hensell sand from Travis Peak formation and place it in Shingle Hills formation (new). As restricted, Travis Peak contains two members: Sycamore sand and Cow Creek limestone. Underlies Shingle Hills formation.

F. E. Lozo and F. L. Stricklin, Jr., 1956, Gulf Coast Assoc., Geol. Soc. Trans., v. 6, p. 67–68. Type "Travis Peak formation" restudied. Data indicate that recognition of Travis Peak "formation," as originally defined and long accepted, should be deleted from modern stratigraphic terminology. Intra-Travis Peak disconformities at boundaries of original members (top of Cow Creek and top of Sycamore) effectively eliminate any implication of unity within "formation." At same time, with recognition of proposed new unit (Hammett shale, previously unrecognized in Cow Creek "beds" or included with the Sycamore), the remaining terminology of the historical cartographic lithic units can be retained in original or long used sense. Four other reasons given for discontinuing use of name "Travis Peak formation." Phrase "Travis Peak sand" is common synonym of "basal Trinity sand" and is applied to any sand locally at base of the Trinity, thus it spans entire Trinity division. Statements of "Travis Peak equivalence" mean only Trinity when based on member name-correlations. Faunal reports of "Travis Peak age" are based on comparison with middle member only; no diagnostic fauna is known from the Sycamore or Hensel [herein considered correct spelling]. Fossiliferous Cow Creek is known to be Aptian and entire "Travis Peak" is commonly identified as Aptian.

Named for Travis Peak post office, Burnet County.

Travis Peak Limestone (in Travis Peak Formation)[1]

Lower Cretaceous (Comanche Series) : Northeastern Texas.

Original reference: W. M. Winton, 1925, Texas Univ. Bull. 2544.

In Denton County.

**Treadwell Slate**[1] or **Formation**

Jurassic(?) to Lower Cretaceous(?) : Southeastern Alaska.

Original reference: G. C. Martin, 1926, U.S. Geol. Survey Bull. 776, p. 255–256, 270, chart opp. p. 247.

Fred Barker, 1957, U.S. Geol. Survey Geol. Quad. Map GQ–100. Black graphitic slate and interlayered gray to green fine-grained poorly schistose to massive plagioclase-quartz-sericite-chlorite graywacke form bulk of formation in Juneau (B–3) quadrangle. Thickness probably at least several thousand feet. On northeast limb of Shelter syncline. Jurassic(?) to Early Cretaceous(?).

On Treadwall Island, Juneau region.

**Treasure Mountain Rhyolite** (in Potosi Volcanic Group)

Treasure Mountain Quartz Latite (in Potosi Volcanic Series)[1]

Treasure Mountain Welded Tuff

Tertiary, middle or upper: Southern Colorado and northern New Mexico.

Original reference: H. B. Patton, Colorado Geol. Survey Bull. 13, p. 20, 33–35.

E. S. Larsen, Jr., and Whitman Cross, 1956, U.S. Geol. Survey Prof. Paper 258, p. 13, 93 (table 18), 117–124. Described in San Juan region as Treasure Mountain rhyolite. Made up in most places of a series of alternating flows, welded tuffs, and tuff beds of rhyolite and rhyolitic quartz latite. Generally, flows and welded tuffs are 100 feet or less in thickness, but some are as much as 200 or 300 feet, and tuff layers are locally somewhat thicker. Present in three domes; thickness in central part of domes are: Conejos quadrangle, 1,500 feet; San Cristobal quadrangle, 1,200 feet; and Saguache quadrangle, 300 feet. Underlies Sheep Mountain quartz latite; overlies Conejos quartz latite; locally underlies Alboroto rhyolite or later formations of Potosi series; where directly overlain by Hinsdale formation, the two are separated by interval long enough to develop San Juan peneplain.

Fred Barker, 1958, New Mexico Bur. Mines Mineral Resources Bull. 45, p. 38–42, pl. 1. A. P. Butler (1946, unpub. thesis) extended Treasure Mountain formation southward from Colorado to area of Tusas Valley. Only mappable unit of this formation in Las Tablas quadrangle is the bipartite layer of welded tuff; hence in this report it is termed Treasure Mountain welded tuff. Thickness 3 to 15 feet. Butler reported 100 feet.

W. R. Muehlberger and others, 1960, New Mexico Geol. Soc. Guidebook 11th Ann. Field Conf., p. 100–101. Trice (1957, unpub. thesis) subdivided Treasure Mountain rhyolite in Brazos Peak quadrangle into (ascending)

Toltec andesite, Lagunitas clastic member, and Osier Mountain welded tuff. Upper two members crop out in Chamo quadrangle [this report].

U.S. Geological Survey currently designates the age of the Treasure Mountain Rhyolite as middle or late Tertiary on the basis of an age change of Potosi Volcanic Group.

Named for exposures on Treasure Mountain in northwestern part of Summitville quadrangle, Colorado.

Treat Limestone[1]

Upper Ordovician (Richmond) : Northeastern Illinois.

Original reference: J. R. C. Evans, 1926, Chicago Univ., Abs. Theses, Sci. ser., v. 2, p. 199–200.

Type locality not stated.

†Trego zone (in Niobrara Formation)[1]

Upper Cretaceous: Northwestern Kansas.

Original reference: F. W. Cragin, 1896, Colorado Coll. Studies, v. 6, p. 51.

Named for Trego County.

Tremaines Bridge Beds[1]

Upper Ordovician: Northern New York.

Original reference: R. Ruedemann, 1925, New York State Mus. Bull. 258, p. 137, 141, 149, 154.

Observed only at head of "gulf" just above bridge leading to Tremaines and below Pulaski.

**Trempealeau Formation**[1]

Upper Cambrian: Southern Wisconsin, northern Illinois, northeastern Iowa, and southeastern Minnesota.

Original reference: F. T. Thwaites, 1923, Jour. Geology, v. 31, no. 7, p. 547.

W. H. Twenhofel, G. O. Raasch, and F. T. Thwaites, 1935, Geol. Soc. America Bull., v. 46, no. 11, p. 1705–1714, geol. sections. Formation subdivided into five members (ascending) basal conglomerate and greensand, St. Lawrence dolomite, Lodi "shale" (siltstone), Jordan sandstone, and Madison sandstone. Overlies Franconia formation.

Josiah Bridge, 1937, U.S. Geol. Survey Prof. Paper 186–L, p. 234 (table 1) Table shows Trempealeau formation comprises (ascending) St. Lawrence dolomite, Lodi shale and siltstone, Jordan sandstone, and Madison sandstone members. This is Kansas Geological Society Conference classification (1935).

C. R. Stauffer, G. M. Swartz, and G. A. Thiel, 1939, Geol. Soc. America Bull., v. 50, no. 8, p. 1237–1238. In proposed St. Croixian classification for Minnesota, term Trempealeau of the "Conference classification" is replaced by terms St. Lawrence and Jordan formations.

G. O. Raasch, 1939, Geol. Soc. America Spec. Paper 19, p. 97–113, 114 (fig. 14). Trempealeau formation restricted at top to exclude Madison which is restored to formation rank.

G. O. Raasch, 1951, Illinois Acad. Sci. Trans., v. 44, p. 147–150. Formation includes (ascending) Arcadia (new), St. Lawrence, Lodi, and Jordan members. Overlies Bad Axe member of Franconia; underlies Sunset Point formation (new name to replace term Madison).

C. A. Nelson, 1956, Geol. Soc. America Bull., v. 67, no. 2, p. 170–171. Discussion of upper Croixan stratigraphy of upper Mississippi Valley.

Recommended that term Trempealeau, previously used as a formation name to include St. Lawrence and Jordan formations and also as a stage name, be restricted to Trempealeauan stage.

Well exposed in Trempealeau Bluff on Mississippi River at Trempealeau, Trempealeau County, Wis.

Trempealeauan Stage

Upper Cambrian: North America.

B. F. Howell and others, 1944, Geol. Soc. America Bull., v. 55, no. 8, chart 1. Upper Cambrian comprises three stages (ascending): Dresbachian, Franconian, and Trempealeauan. The Trempealeauan includes four faunal zones: *Platycolpus-Scaevogyra*, upper *Dikelocephalus*, *Saukiella-Calvinella*, and *Plethopeltis*.

C. A. Nelson, 1956, Geol. Soc. America Bull., v. 67, no. 2, p. 170–171. Discussion of upper Croixan stratigraphy of upper Mississippi Valley. Recommended that term Trempealeau, previously used as a formation name to include St. Lawrence and Jordan formations and also as a stage name, be restricted to Trempealeauan stage.

W. C. Bell, R. R. Berg, and C. A. Nelson, 1956, Internat. Geol. Cong., 20th, Mexico, Cambrian Symposium, pt. 2, p. 441. Authors [Bell, Berg, and Nelson] of present report concur with Nelson's (1956) recommendation that name Trempealeau be reserved only as a stage name. Consensus among Cambrian workers at present time is that Trempealeauan stage be equated to Saukia zone of Raasch (1951, Illinois Acad. Sci. Trans., v. 44), which means in terms of Cambrian correlation chart (Howell and others, 1944), it would encompass zones of *Dikelocephalus postrectus* through *Plethopeltis*, inclusive. Further investigations in other parts of North America may demonstrate useful faunal subdivisions of significant geographic extent, but at present the interval correlations with type Trempealeauan are far from precise.

**Trent Marl**[1]

Miocene, lower: Southern North Carolina.

Original reference: B. L. Miller, 1910, Geol. Soc. America Bull., v. 20, p. 674–675.

H. E. LeGrand and P. M. Brown, 1955, Carolina Geol. Soc. Guidebook of Excursion in Coastal Plain of North Carolina, Oct. 8–9, p. 30. Kellum (1926, U.S. Geol. Survey Prof. Paper 143) concluded that the Trent was of early Miocene age, separated from underlying Castle Hayne limestone of Jackson age by erosional unconformity. Most of Kellum's Trent species came from vicinity of Silverdale, a locality not mentioned by Miller and which is about 17 miles from type locality along Trent River. Recent work has shown that Kellum's Trent (lower Miocene) is nonexistent and that units designated by Kellum as lower Miocene are in part of Castle Hayne age and in part of Yorktown age. Original Trent of Miller is here moved from middle Eocene to upper Eocene and included within the Castle Hayne although considered a distinctive facies of it.

Named for exposures along Trent River from vicinity of Trenton, Jones County, to near Junction of Trent and Neuse Rivers.

Trenton Clays[1]

Upper Cretaceous: Western New Jersey.

Original reference: H. B. Kummel and G. N. Knapp, 1904, New Jersey Geol. Survey, v. 6, p. 197.

Occur in a number of pits along Pond Run, 2 miles east of Trenton, Mercer County.

†Trenton Gravel[1]

Pleistocene: Western New Jersey and southeastern Pennsylvania.

Original reference: H. C. Lewis, 1881, Philadelphia Acad. Nat. Sci. Proc. 1880, v. 32, p. 296–309.

Covers flat ground of Camden, N.J., and lower part of Philadelphia, and forms islands in river. Part of city of Trenton, Mercer County, N.J., is built on terrace covered with this gravel.

**Trenton Limestone[1] or Group[1]**

Trenton Member (of Martinsburg Formation)

Middle Ordovician: New York, Georgia, Michigan, northern Ohio, Pennsylvania, Vermont, and western Virginia.

Original reference: L. Vanuxem, 1838, New York Geol. Survey 2d Rept., p. 257, 276, 283.

R. L. Bates, 1936, Virginia Geol. Survey Bull. 46–M, p. 184–185. Member of Martinsburg formation in Big A Mountain area. Trenton member is Upper Mohawkian in age, and remainder of formation is Cincinnatian. In some regions, Trenton is removed from Martinsburg and given formational status; as such, it is known from Pennsylvania to Alabama. With Trenton removed, the remaining shales are known as Reedsville formation which extends from Pennsylvania to Tennessee.

G. M. Kay, 1937, Geol. Soc. America Proc. 1936, p. 82. Stratigraphy of Trenton group in New York and Ontario reveals influence of regional structural development of distribution, lithology, and fauna of sediments. In early Trenton, Rockland and Hull stages, limestone-depositing seas advanced on lands retaining characteristics inherited from earlier Ordovician; boreal faunas invaded in Rockland. In middle Trenton Sherman Fall stage, Vermontian disturbance produced geanticline that became important source of detrital sediments east of region; also some synchronous elevation of Adirondack arch. In later Trenton Cobourg stage, the arch continued to rise, and trough on east was restricted by incursion of sediments on its eastern side; boreal faunas invaded northern part of region. In latest Trenton Collingwood and Gloucester stages, shale-forming fine-grained clastics spread far eastward.

G. M. Kay, 1937, Geol. Soc. America Bull., v. 48, no. 2, p. 233–302. Discussion of stratigraphy of Trenton group (Mohawkian series). Standard section of group comprises (ascending) Rockland limestone with Selby and Napanee members (both new); Hull formation, Sherman Fall formation with Shoreham and Denmark (new) members; Cobourg formation with Hallowell and Hillier members (both new), Collingwood shale; and Gloucester shale. Overlies Black River group. Formations of Rockland age include Rockland limestone, Coboconk limestone (Ontario), Cloche Island limestone (Ontario), Amsterdam limestone and Isle La Motte limestone. Formations of Hull age include Hull limestone and Larrabee member of Glens Falls formation (upper Glens Falls is of Sherman Fall age). Formations of Sherman Fall age include Sherman Fall limestone, Canajoharie shale, Snake Hill formation, Schenectady formation, Cumberland Head formation, Stony Point formation, Lacolle conglomerate (Quebec), and Rysedorph conglomerate. Formations of Cobourg age include Cobourg limestone, Liskeard formation (Ontario), and Utica shale.

Late Trenton shale formations include Collingwood shale (Ontario), Blue Mountain shale (Ontario), Atwater Creek shale, and Holland Patent formation. Within some part of its distribution, each formation and member is believed to be lithologically distinct; traced laterally, the differences may become obscure and faunal evidence may be useful basis of recognition. Lateral changes alter rank of certain synchronous units from one part of region to another; units have been given rank that seems most useful within each area of outcrop. 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. Cincinnatian sediments lie with essential conformity on youngest Trenton shales in each area except lower Mohawk Valley, where Indian Ladder shale of Eden age lies disconformably on Schenectady formation of middle Trenton (Sherman Fall) age. Report discusses Trenton history and refers to Rockland, Hull, Sherman Fall, Cobourg, Collingwood, and Gloucester stages.

John Rodgers, 1937, Geol. Soc. America Bull., v. 48, no. 11, p. 1579–1580. Discussion of Whitehall quadrangle, New York-Vermont. For mapping purposes, Trenton formation was divided into limestone part and shale part. Limestone part was mapped with Black River limestone. These are merely facies and as such can be compared with (not correlated with) rocks of similar facies in lower Mohawk Valley. Limestone part averages 100 feet and consists of thin-bedded shaly limestone, carrying characteristic Trenton fossils. At Crown Point, Amsterdam (Rockland), Larrabee (Hull), and Shoreham (lowermost Sherman Fall) formations have been recognized by Kay. Overlying limestone is at least 500 feet of shale. It is everywhere involved in minor thrust faults, being repeated by the slicing. Toward Taconic thrust on east, it is metamorphosed into low-grade slate and underlies large areas as near Benson. In some places in slate areas are outcrops of quartzitic slate, derived from sandy shale. Presumably they lie at top of section and represent an upper sandy facies of the Trenton. They would thus correspond in facies to Schenectady beds of lower Mohawk Valley. This facies has not hitherto been recognized in Champlain Valley.

Charles Butts, 1940, Virginia Geol. Survey Bull. 52, pt. 1, p. 213–216. In type region, the Trenton rests either upon Lowville or upper Black River limestone. In Lee County, Va., along northwest base of Wallen Ridge, the Trenton lies upon the Eggleston or upper Black River limestone. In type region, the Trenton is succeeded by Utica shale and the Utica by Lorraine shale. The Trenton in Lee County and adjacent areas is succeeded by Reedsville shale which corresponds approximately to the Lorraine. Trenton as distinct lithologic unit occurs only in Wise and Lee Counties; in other areas, not differentiated from Martinsburg shale.

G. M. Kay, 1941, (abs.) Geol. Soc. America Bull., v. 52, no. 12, pt. 2, p. 1969. Group, west of Adirondack axis, central Pennsylvania, includes basal Reedsville black shale (upper Utica); Coburn limestone, 175 feet at Salona (Whitcomb) (Cobourg); Salona limestone, 339 feet at Salona (Whitcomb) (Denmark and Shoreham); and Nealmont limestone, 65 to 135 feet, including type Rodman, Lemont, Center [Centre] Hall (Hull and Rockland). Overlies Black River group. Mohawkian series.

G. M. Kay, 1944, Jour. Geology, v. 52, no. 1, p. 1–23; no. 2, p. 97–116. Group in central Pennsylvania includes (ascending) Nealmont, Salona, Coburn, and Antes (new) formations. Overlies Curtin limestone of Black River group; underlies Cincinnatian Reedsville formation.

W. M. Cady, 1945, Geol. Soc. America Bull., v. 56, no. 5, p. 555–561. Group in west-central Vermont includes Orwell limestone (new), Glens Falls limestone, and Hortonville slate.

C. W. Wilson, Jr., 1948, Tennessee Div. Geology Bull. 53, p. 11. Safford's Nashville group redéfined to include strata of Hermitage, Bigby, Cannon, and Catheys formations and to exclude strata of the Leipers, Arnheim, and Fernvale formations which were included in Safford's original definition. Thus, name Nashville group will replace name Trenton group of New York, which has been in general use for these formations. Believed best to drop all New York names that have been used for the Ordovician of Tennessee.

Charles Butts and Benjamin Gildersleeve, 1948, Georgia Geol. Survey Bull. 54, p. 32. Trenton limestone is about 150 feet thick in northwest Georgia where it is well exposed in Lookout Valley.

Phillip Fowler, 1950, Vermont Geol. Survey Bull. 2, p. 31–37, pl. 1. Group, in Castleton area, comprises (ascending) Orwell limestone, Whipple marble, and Hortonville slate. Appears to be depositional hiatus between uppermost Middlebury strata (Chazy) and the Trenton.

V. W. Fisher and G. F. Hanson, 1951, Am. Jour. Sci., v. 248, no. 11, p. 785–814. Evidence presented to substantitate 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. Thickness of Trenton in Saratoga area about 50 feet.

R. C. Hussey, 1952, Michigan Dept. Conserv., Geol. Survey Div. Pub. 46, Geol. Ser. 39, p. 13, 14. Trenton formation subdivided into Chandler Falls, Groos Quarry, and Haymeadow Creek members (all new). Overlies Bony Falls member (new) of Black River formation; underlies Bills Creek member of Richmond formation.

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. Middle Ordovician (Mohawkian) sediments in New York, Ontario, and Ottawa-St. Lawrence Lowlands have been interpreted for about 100 years as a sequence of successively younger formations, and all have been named as such. Reconstruction of paleoecological conditions indicates that Black River and Trenton groups were deposited contemporaneously. Each "formation" is a phase of deposition, of which the lithology and fauna reflect the environment. Black River sediments are near-shore equivalents of Trenton sediments. The Mohawkian was deposited in a transgressive sea, whereas the repetition of Mohawkian phases in the Cincinnatian in reverse order indicates a regressive sea. Terms Black

River and Trenton refer to rocks deposited contemporaneously and have no time significance.

W. H. Twenhofel and others, 1954, Geol Soc. America Bull., v. 65, no. 3, p. 247–298, chart 2. Terms Chazyan, Black River, and Trentonian used for stages of Middle Ordovician on correlation chart. Term Trenton limestone used in parts of Ontario, New York, Virginia, Tennessee, and Georgia.

R. L. Miller and W. P. Brosge, 1954, U.S. Geol. Survey Bull. 990, p. 67–70, pls. In most of the Appalachian Valley of Virginia, beds of Trenton, Eden, and Maysville age are predominantly shale and have been grouped together in one formation, Martinsburg shale. In westernmost belts of exposure in extreme southwest Virginia and adjacent Tennessee, beds of Trenton age are predominantly limestone and have been called Trenton limestone, and overlying shales of Eden and Maysville age have been called Reedsville shale. Application of name Trenton to the limestone beds is confusing inasmuch as underlying Eggleston limestone is believed to be of early Trenton age, and the still older beds here referred to Hardy Creek and Ben Hur limestones are believed to be of earliest Trenton age. Hence, limestones (post-Eggleston) of Trenton age in Powell and Wallen Valleys of southwest Virginia and adjacent Tennessee should be given a new formation name. However, old name Trenton limestone is retained for purposes of this report [Jonesville district, Virginia]. Formation consists predominantly of brown and dark-gray limestone; three bentonite beds present. Average thickness about 560 feet.

Named for exposures at Trenton Falls on West Canada Creek, Herkimer and Oneida Counties, N.Y.

Trenton Stage

Trentonian[1] Series or Epoch

Middle Ordovician: North America.

Original reference: A. W. Grabau, 1909, Science, new ser., v. 29, p. 351–356.

Marshall Kay, 1948, Am. Assoc. Petroleum Geologists Bull., v. 32, no. 8, p. 1401, 1411–1415. Mohawkian series divided into Bolarian below and Trentonian series. Term Bolarian preferred to series name Black Riverian. Original Trenton had practically content of present usage, though subsequently the name was applied to a period including the "Chazy," "Birdseye," "Black River," and "Trenton" epochs, and later "Trenton," "Utica," and "Hudson" epochs. Term Trentonian series was applied by Grabau (1909) containing essentially the rocks of original usage. 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; Rocklandian and Kirkfieldian are considered stages. In central Pennsylvania, Nealmont formation is equivalent, and subseries in Appalachians is referred to as Nealmontian, extending from base of Trentonian. Maximum lower Trentonian thickness is about 150 feet in New York and Ontario. Dimunition westward and eastward is partly by overlap; there are intervals of no deposition within the subseries as it approaches its disappearance at Canjoharie on Adirondack line at Mohawk River. Generally, there is southward divergence along axis of maximum thickness. In Pennsylvania, there is similar overlap on regional unconformity toward the southeast to minimum at Adirondack line in Path Valley northwest of Chambersburg, and divergence in Chambersburg limestone beyond. In Bellefonte district there are abrupt variations because of overlap on unconformity of local relief of tens of feet. Within area of outcrop of this region, there is isopachous trough that may be filling of a subsequent valley within cuesta of Curtin limestone, rather than continuation of Rideauan overlap southward in argillaceous facies in southwestern Virginia. Middle Trentonian includes rocks equivalent to Shoreham and Denmark limestones of New York or undivided Sherman Fall limestone. Middle Trentonian includes Shorehamian and Denmarkian stages. Upper Trentonian includes Cobourg limestone and disconformably overlying Holland Patent shale in northwestern New York, the latter passing into Collingwoodian calcareous shale and Gloucesterian black shale, mapped also as Billings and Eastview formations in Ontario. The Cobourg and Holland Patent become Utica black shale eastward, the change in facies and nature of stratigraphic change being abrupt but somewhat obscure. Only area on the southwest where there has been any separation of these higher units is in north-central Pennsylvania, where 700 feet of Coburn limestone and Antes black shale have been correlated. Holland Patent and Antes are commonly called "Utica" but represent only upper third of true Utica, most of which is Cobourgian.

Marshall Kay, 1956, Geol. Soc. America Bull., v. 67, no. 1, p. 84–99. Middle Ordovician limestones of Chazyan, Bolarian, and Trentonian series are exposed in western anticlines in Appalachian Mountains of West Virginia and Virginia northeast of New River. Trentonian rocks lie with disconformity on the Bolarian. In the southwest, the lower Trentonian is dominantly Moccasin argillite; northwestward, it changes into fossiliferous Nealmont limestone facies like that of Pennsylvania. In the southwest, Eggleston shale has basal quartz sandstone, and in the northwest it passes into Onego argillaceous limestone which resembles Oranda limestone of Appalachian Valley. Younger Trentonian has not been successfully divided and traced and is called the "Martinsburg," though in northeastern exposures it is essentially like Salona limestone of Pennsylvania. Base of Nealmont is judged to be basal Trentonian. In New York, and Ontario, Canada, Selby member of Rockland formation forms base of Trentonian.

G. A. Cooper, 1956, Smithsonian Misc. Colln., v. 127, pt. 1, p. 9, chart 1. In this report, term Trenton is used as a stage name. Occurs above Wilderness stage (new) of Mohawkian series. Stage is modified by removal of the Rockland which has mostly fossils derived from underlying Black River and Witten. Deposition of the Sherman Fall is thought to inaugurate Trenton stage.

Marshall Kay, 1958, Am. Jour. Sci., v. 256, p. 90, 91, 94 (table 3). Trentonian series has its base at contact of Selby member of Rockland formation on Chaumont limestone of Black River group in northwestern New York and eastern Ontario, Canada. Trentonian extends from top of Black River in northwestern New York to top of Utica. To the southwest, there is disagreement whether base of Trentonian is within upper Witten formation or at top. Cooper (1956) placed lowest Trentonian as well as Black River equivalents in his Wilderness stage. Trentonian series includes Rocklandian stage.

Marshall Kay, 1960, Internat. Geol. Cong., 21st, Copenhagen, pt. 7, p. 28–33. North American Ordovician comprises Canadian, Chazyan, Blackriverian, Trentonian, and Cincinnatian series. 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 the stages of Kay (1937; 1943; 1948): Rocklandian, Kirkfieldian, Shorehamian, Denmarkian, Cobourgian, Collingwoodian, and Gloucesterian. The lithic units are also time-stratigraphic, lithic differences reflecting physical conditions that are in turn recognizable in the successive faunas; also there are progressive changes in fauna that have time value. Probably term stages too high an order for named divisions of Trentonian; they can be considered substages of smaller number of stages. Suggested that Nealmontian be applied to Rocklandian and Kirkfieldian substages and that Shermanian be applied to Shorehamian and Denmarkian. Cobourg-Collingwood-Gloucester seems time-equivalent to Utica group, but name Utica is stongly associated with black shale facies. Hence, uppermost Trentonian stage is designated Pictonian stage originally given in more restricted sense by Raymond (1911 [1914, Canada Geol. Survey Rept. 1912]) and abandoned by him in 1921 (Geol. Soc. Canada Mus. Bull. 31); Pictonian contains Utica group of formations (Kay, 1943, Am. Jour. Sci., v. 241, no. 10; 1953, New York State Mus. Bull. 347). Boundary between Trentonian and Cincinnatian series has been defined variably because of selection of differing horizons in known successions, and varying correlations between type sections in separated areas. Boundary in North America is taken invariably as separating "Middle" and "Upper" Ordovician, although in European terms, assuming the Caradocian to be "Middle," the American boundary lies within the Cincinnatian under any definition of that series.

Trenton Falls series[1]

Ordovician: New York.

Original reference: T. A. Conrad, 1837, New York Geol. Survey 1st Ann. Rept., p. 165.

Salmon River.

**Tres Hermanos Sandstone Member** (of Mancos Shale)[1]

Upper Cretaceous: Central northern New Mexico.

Original references: C. L. Herrick, 1900, Am. Geologist, v. 25, p. 331–346; C. L. Herrick and D. W. Johnson, 1900, New Mexico Univ. Bull., v. 2, pt. 1, p. 3–63; pt. 2, p. 1–17.

C. B. Hunt, 1936, U.S. Geol. Survey Bull. 860–B, p. 41–43. East of Mount Taylor coal field, northwestern New Mexico, are three prominent sandstones in lower 350 feet of Mancos shale to which name Tres Hermanos sandstone has been applied in previous reports. Name was first used by Herrick and Johnson (1900), though without recording type locality. Sandstone No. 2 of present report is 75 feet thick and is most persistent of the three sandstones. It crops out as prominent capping of mesa or ridges over most of area east of Mount Taylor.

W. S. Pike, Jr., 1947, Geol. Soc. America Mem. 24, p. 32, 36, 65, 93. Discussion of intertonguing between marine Mancos and nonmarine Mesaverde strata in New Mexico, Arizona, and southwestern Colorado. One or more sandstones near base of Mancos at various localities in New Mexico have been called Tres Hermanos. Herrick and Johnson, who first applied term, did not give type locality. Original type locality is probably east of Tres Hermanos Buttes, three volcanic necks in Alamosa Creek valley, in sec.

26, T. 3 N., R. 7 W., where sandstones occur in similar stratigraphic position. Invasion of Upper Cretaceous sea in New Mexico is divided into at least two parts; minor regressions are recorded in Tres Hermanos sandstones. This is based on the probability that the Tres Hermanos is a tongue of the Dakota (?) and joins with it in a landward direction.

W. H. Tonking, 1957, New Mexico Bur. Mines Mineral Resources Bull. 41, p. 19, 20, 21 (fig. 6), pls. Discussion of Mancos shale and Mesaverde group in Puertecito quadrangle. Mancos shale is restricted to strata below Tres Hermanos(?) sandstone. Tres Hermanos(?) sandstone is tentatively assigned to Mesaverde group, but it may be more closely related to Dakota(?) sandstone. Tres Hermanos(?) conformably underlies La Cruz Peak formation (new) of Mesaverde group. Tres Hermanos(?) apparently pinches out to south in secs. 4 and 8, T. 2 N., R. 5 W.

D. B. Givens, 1957, New Mexico Bur. Mines Mineral Resources Bull. 58, p. 7–8, pl. 1. In Dog Springs quadrangle, Tres Hermanos member of Mancos is well-layered quartzose sandstone about 25 feet thick. Probably pinches out near west boundary of quadrangle.

C. H. Dane, 1959, New Mexico Geol. Soc. Guidebook 10th Field Conf., p. 85–91. Discussion of historical background of type locality of Tres Hermanos sandstone member of Mancos shale. Derivation and definition of name Tres Hermanos sandstone has been subject of confusion in the literature for many years. Herrick's original report is herein reviewed. It is clear from this report that Herrick applied name Tres Hermanos to three dark igneous plugs in north part of sec. 26, T. 3 N., R. 7 W., still known by that name, and that he described the mountain now known as D–Cross Mountain as Turtle Mountain. It is also clear that sandstone to which name Tres Hermanos was applied by Herrick also cropped out east of his Tres Hermanos Buttes and was "a band of sandstone with enormous concretions." Herrick gives thickness of this sandstone as 75 feet. Hunt's (1936) description of "sandstone No. 2" is comparable to sandstone described by Herrick and Johnson (1900). Although Lee (1917, U.S. Geol. Survey Prof. Paper 101) used name Tres Hermanos for zone of sandstones 150 feet thick, presumably including Hunt's three sandstones and intervening shale, it now seems best to restrict use of name to the single sandstone to which Herrick originally applied it (Hunt's sandstone No. 2 in Puerco Valley) and to those sandstones that can be correlated with it.

Type locality (Dane): North part of sec. 26, T. 3 N., R. 7 W., Socorro County. Name derived from Tres Hermanos Buttes.

Tresner Limestone

Pennsylvanian: Central eastern Illinois.

E. F. Taylor and G. H. Cady, 1944, Illinois Geol. Survey Rept. Inv. 93, p. 22–23. Name applied to limestone that lies about 175 feet above No. 7 coal bed.

Exposed in S½SE¼NE¼ sec. 10, T. 14 N., R. 11 W., near Tresner, Edgar County.

Tres Peidras Granite

Precambrian: Central northern New Mexico.

Fred Barker, 1958, New Mexico Bur. Mines Mineral Resources Bull. 45, p. 59–62, pl. 1. Unit, as exposed in type locality and along Tusas Canyon, is pink, flesh-colored, or reddish-orange faintly to well-foliated fine- to medium-grained quartz-microcline-albite-biotite-muscovite granite. Crude laminae and flattened knots of the two micas commonly well developed. Appears to have intruded Petaca schist and Mopping metavolcanic series (new). Formerly included in Tusas granite.

Exposed along lower Rio Tusas and in and around town of Tres Piedras. Other masses of this granite found east of Hopewell in sec. 33, T. 29 N., R. 7 E., and on lower east slope of Jawbone Mountain. Dikes of it near Hopewell.

Tres Pinos Sandstone[1]

Eocene, middle: Southern California.

Original reference: P. F. Kerr and H. G. Schenck, 1925, Geol. Soc. America Bull., v. 36, p. 470, 475.

I. F. Wilson, 1943, California Jour. Mines and Geology, v. 39, no. 2, p. 206–207, pl. 3. Described in San Benito quadrangle where it conformably overlies Los Muertos Creek formation (new). Exposed thickness about 900 feet; top of formation concealed by overlapping terrace deposits to southwest and San Benito gravels to southeast.

Probably named for exposures at or near Tres Pinos or Tres Pinos Creek, San Benito County.

**Tribes Hill Limestone** (in Beekmantown Group)[1]

Lower Ordovician: Central, eastern, and northern New York.

Original references: E. O. Ulrich and H. P. Cushing, 1910, Geol. Soc. America Bull., v. 21, p. 780–781; 1910, New York State Mus. Bull. 140.

R. R. 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 correlation revised in Champlain, Hudson, Mohawk, and St. Lawrence valleys. Lower "typical" Theresa is physically and faunally differentiated from "Upper Theresa" (now Heuvelton member of Tribes Hill); two marine cycles, represented by Tribes Hill formation (containing the Norton-Heuvelton, Fort Ann-Bucks Bridge, Benson-Ogdensburg members) and Cassin formation, constitute Beekmantown series.

D. W. Fisher and G. F. Hanson, 1951, Am. Jour. Sci., v. 249, no. 11, p. 808. In Saratoga region proper, rocks of Tribes Hill age are lacking due to offlap, removal by post-Canadian erosion or by facies change into Gailor dolomite (new). Thin representation of Tribes Hill sandy limestone is present to southwest in Amsterdam and Broadalbin quadrangles where it overlies Gailor dolomite.

D. W. Fisher, 1954, Geol. Soc. America Bull., v. 65, no. 1, p. 71–96. Name Tribes Hill restricted to limestone phase of Lower Canadian. Subdivided into (ascending) Fort Johnson, Palatine Bridge, Wolf Hollow, and Fonda members. Thickness about 145 feet. Underlies Chuctanunda Creek (new) formation. Wheeler separated Tribes Hill in Champlain Valley into Norton limestone, Fort Ann limestone, and Benson dolomite. Wheeler's subdivisions are poorly defined; he gives no type localities or sections, and application to Lower Ordovician of Mohawk Valley is untenable. New names for Mohawk Valley Canadian are necessary.

Named for exposures at Tribes Hill, Montgomery County.

†Tribune Limestone (in Chester Group)[1]

Mississippian: Western Kentucky and southeastern Illinois.

Original reference: E. O. Ulrich, 1904, Missouri Bur. Geology and Mines, v. 2, 2d ser., p. 109.

Named for Tribune, Crittenden County, Ky.

†Trickham Bed (in Graham Formation)[1]

Pennsylvanian: Central Texas.

Original reference: N. F. Drake, 1893, Texas Geol. Survey 4th Ann. Rept., pt. 1, p. 387, 402.

Wallace Lee *in* Wallace Lee and others, 1938, Texas Univ. Bur. Econ. Geology Pub. 3801, p. 120–121. Wayland shale member was called "Trickham shale" by Drake for Coleman County type locality, and "Wayland shale" by Plummer and Moore (1921) for locality in Stephens County. Although name "Trickham" has priority, name "Wayland" has been adopted because it has had much wider usage and is better established.

Named for Trickham, Coleman County.

Trident[1] (Formation)

Lower Mississippian: Montana.

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

Derivation of name not stated.

**Trimble Granite**[1]

Precambrian: Southwestern Colorado.

Original reference: W. Cross and E. Howe, 1905, U.S. Geol. Survey Geol. Atlas, Folio 131.

Occurs in large area surrounding Trimble Pass, La Plata County.

**Trimmers Rock Sandstone**[1] (in Susquehanna Group)

Trimmers Rock Member (of Fort Littleton Formation)

Upper Devonian: Central southern Pennsylvania.

Original reference: B. Willard, 1935, Geol. Soc. America Proc. 1934, p. 123.

Bradford Willard and A. B. Cleaves, 1938, Pennsylvania Geol. Survey, 4th ser., Bull. G–8, p. 15–16. Member of Fort Littleton formation. Overlies Losh Run shale member; underlies Parkhead sandstone member.

U.S. Geological Survey currently classifies the Trimmers Rock as a formation in Susquehanna Group on the basis of a study now in progress.

Named for Trimmers Rock, a hill 1½ miles east of Newport, Perry County.

Trincheras division[1]

Tertiary, late: Southeastern Arizona, and Sonora, Mexico.

Original references: E. T. Dumble, 1900, Am. Inst. Mining Engrs. Trans., v. 29; 1902, Am. Inst. Mining Engrs. Trans., v. 31.

In Cochise County, Ariz., and Sonora, Mex. Derivation of name not stated.

Trinidad lignitic group[1]

Cretaceous: Colorado.

Original reference: F. V. Hayden, 1875, U.S. Geol. and Geog. Survey Terr., Bull. 1, p. 402.

Typically developed at Trinidad, Las Animas County.

**Trinidad Sandstone**[1] (in Montana Group)

Upper Cretaceous: Southeastern Colorado and northeastern New Mexico.

Original reference: R. C. Hills, 1899, U.S. Geol. Survey Geol. Atlas, Folio 58.

R. L. Griggs, 1948, New Mexico Bur. Mines Mineral Resources Ground-Water Rept. 1, p. 33–34; G. H. Wood, Jr., S. A. Northrop, and R. L. Griggs, 1953, U.S. Geol. Survey Oil and Gas Inv. Map OM-141. In Colfax County, N. Mex., conformably overlies and interfingers with Pierre shale; conformably underlies and interfingers with Vermejo formation. Massive to thin-bedded, light-gray to light-buff, somewhat feldspathic sandstone. Thickness approximately 100 feet.

R. B. Johnson and G. H. Wood, Jr., 1956, Am. Assoc. Petroleum Geologists Bull., v. 40, no. 4, p. 709 (fig. 2), 710–712. In Raton basin, intertongues with underlying Pierre shale; tongues of Pierre wedge out in westerly direction, and tongues of Trinidad wedge out laterally in northerly and easterly directions. Conformably underlies Vermejo formation; tongues of Vermejo wedge out in easterly and northeasterly directions, and tongues of Trinidad wedge out west and northwest. Composed of buff to gray, slightly arkosic sandstone and thin interbeds of light tan to gray silty shale. Formation is absent in vicinity of Ute Park, N. Mex., and from this point northward it increases in thickness to 300 feet northwest of Walsenburg, Colo.

Named for exposures at Trinidad, Las Animas County, Colo.

†Trinity Formation[1]

Pre-Cretaceous: California.

Original reference: O. H. Hershey, 1901, Am. Geologist, v. 27, p. 226.

In Klamath Mountain region.

**Trinity Group[1] or Sand[1]**

Trinity division

Lower Cretaceous (Comanche Series): Texas, southwestern Arkansas, northwestern Louisiana, and central southern and southeastern Oklahoma.

Original reference: R. T. Hill, 1888, Science, v. 11, p. 21.

C. P. Ross, 1943, U.S. Geol. Survey Bull. 928–B, p. 53 (table), 66–83. Group, in Shafter region, Presidio County, comprises (ascending) Presidio and Shafter formations. Overlies Permian Cibolo formation; underlies Fredericksburg group.

R. W. Imlay, 1944, U.S. Geol. Survey Oil and Gas Inv. Prelim. Chart 3. In outcrops in southern Arkansas, group comprises (ascending) Pike gravel, Delight sand (new), Dierks limestone, Holly Creek formation, De Queen limestone, and Paluxy sand. In subsurface of Arkansas, Louisiana, and east Texas, comprises (ascending) Pine Island shale, James limestone, Rodessa formation, Ferry Lake anhydrite, Mooringsport formation, and Paluxy formation. In subsurface of south Texas comprises (ascending) Pearsall formation and Glen Rose limestone. In outcrops in central mineral region comprises (ascending) Travis Peak formation and Glen Rose limestone. Outcrops in north-central Texas comprise (ascending) basal sand, Glen Rose limestone, and Paluxy sand.

V. E. Barnes, 1948, Texas Univ. Bur. Econ. Geology Rept. Inv. 2, p. 5–12. Trinity group revised for central Texas as follows: Travis Peak formation with Sycamore sand and Cow Creek limestone members and Shingle Hills formation (new) with Hensell sand and Glen Rose limestone members.

Elliot Gillerman, 1953, U.S. Geol. Survey Bull. 987, pl. 1. As shown on map legend, Trinity group, in Eagle Mountains, Tex., comprises (ascending) Yucca formation, Bluff Mesa formation, and Cox sandstone.

F. E. Lozo and F. L. Stricklin, Jr., 1956, Gulf Coast Geol. Assoc., Geol. Soc. Trans., v. 6, p. 67–68. Outcrop basal Cretaceous of central Texas assigned to Trinity "group" has been historically divided into two lithofacies, an upper sequence of alternating shales and limestones called Glen Rose limestone or formation and a lower predominantly arenaceous clastic interval originally called Travis Peak sands. Evaluation of rock unit boundaries within Trinity division has revealed datum planes and disconformities that permit regrouping of lithic units on basis of cyclic repetitions of systematic deviations in type of sedimentation. With this concept of tectonic—sedimentary lithogenetic entities, Trinity stratal interval is divisible into three subdivisions herein referred to as lower, middle, and upper. These lithogenetic units, with limits at least in part at variance with boundaries of previously accepted formations or members, provide nonoverlapping subdivisions of section and are thus more significant for historical stratigraphic analysis. In gross sense, each unit may be considered a couplet consisting of basal terrigenous detritus phase, quartzose or argillaceous succeeded by carbonate phase often with evidence of extremely shallow turbulent terminal depositional conditions. Data indicate that recognition of Travis Peak "formation," as originally defined and long accepted, should be deleted from modern stratigraphic terminology. Advances in knowledge of physical relations of basal Cretaceous lithic units evolved from Paleozoic mapping by Barnes. Discoveries of localities where Cow Creek limestone was in direct contact with Paleozoic eliminated notion that the Sycamore passed imperceptibly into the Hensel [herein considered correct spelling]: as basal transgressive clastic. Barnes (1948) emended Travis Peak formation to include only Sycamore and Cow Creek. He proposed Shingle Hills formation as new upper Trinity combination to include Hensel and Glen Rose. These proposals parallel questionable practice increasingly prevalent in subsurface stratigraphic terminology to have "formations" represent restricted "time" intervals. Despite certain advantages in considering some cyclic subdivisions (for example those in Trinity) as "formations" and the phases as "members," the burden of more new names and predictable usage of these names in sense of paleontologically determined zones or sub-stages weigh against the practice. Reference outcrop section designated for Trinity division. Here Trinity division comprises (ascending) Sycamore sand (lower Trinity); Hammet shale (new), and Cow Creek limestone (middle Trinity); Hensel sand, Glen Rose limestone (lower), *Corbula* bed, and Glen Rose limestone (upper).

J. M. Forgotson, Jr., 1956, Gulf Coast Assoc., Geol. Soc. Trans., v. 6, p. 91–108; 1957, Am. Assoc. Petroleum Geologists Bull., v. 41, no. 10, p. 2328–2363. Purpose of report is to present correlation of formations within Trinity group (Comanchean Cretaceous) of Gulf Coastal Plain and to interpret tectonic frame work and paleogeography existing during Trinity deposition. Each correlation is based on time-stratigraphic unit defined by recognized formation boundaries in type area. Each unit is extended geographically by correlation of electrical log markers that are assumed to represent contemporaneously deposited beds. Trinity time-stratigraphic unit (group throughout most of area) represents interval below top of Glen Rose formation (as recognized near Austin, Tex.) or its time-stratigraphic equivalent and above top of Sligo formation (as recognized in subsurface of northern Louisiana) or its time-stratigraphic equivalent. Trinity unit subdivided into (ascending) Pearsall time-stratigraphic unit, Rodessa time-stratigraphic unit, Ferry Lake time-stratigraphic equivalent, Rusk time-stratigraphic unit (Rusk is new in this report) and, in areas where Ferry Lake is not recognizable, the undifferentiated Glen Rose (interval between top of Trinity unit and base of Rodessa unit). Term Paluxy formation used for sand unit which is time-stratigraphic equivalent of part of Walnut and Fredericksburg groups.

L. V. Davis, 1960, Oklahoma Geol. Survey Bull. 86, p. 20–26. Group, in McCurtain County, comprises (ascending) Holly Creek formation, De Queen limestone, and Paluxy sand. Basal division of Cretaceous rocks in county. Unconformably underlies Fredericksburg group.

Reference section (Trinity division): Hayes-Travis County area, Texas. Measured at localities in order of geologic sequence (ascending) Hammet Crossing section, Hamilton Pool, Craft Ranch, Murrah Ranch, and Shingle Hills. Named for exposures on Trinity Rivers of Texas.

Trinityan series[1]

Lower Cretaceous (Comanche): Arizona.

Original reference: C. R. Keyes, 1935, Pan-Am. Geologist, v. 64, no. 2, p. 128, 129, 139.

Triphammer Shale (in Ithaca Shale)

Triphammer shale member (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. Shale is upper unit in Ithaca shale. Underlies Enfield shale in Skaneateles and Cayuga Lakes area.

Occurs in Ithaca region.

**Trippe Limestone**[1]

Middle Cambrian: Western Utah.

Original reference: T. B. Nolan, 1930, Washington Acad. Sci. Jour., v. 20, no. 17, p. 421–432.

Named for exposures in Trippe Gulch, on south side of North Pass Canyon, Gold Hill district.

Triumph Conglomerate[1]

Pennsylvanian: Pennsylvania.

Original reference: J. F. Carll, 1875, Pennsylvania 2d Geol. Survey Rept. I, p. 38–40.

Exposed in hilltops at Triumph, Warren County.

Trivoli cyclothem[1] (in McLeansboro Group)

Trivoli cyclothem (in Modesto Formation)

Pennsylvanian: Illinois.

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

J. M. Weller and W. A. Newton, 1937, Illinois Geol. Survey Rept. Inv. 45, p. 9, 11. In sequence, occurs above Gimlet cyclothem and below Collinsville cyclothem (new). Thickness about 30 feet.

H. R. Wanless, 1957, Illinois Geol. Survey Bull. 82, p. 50 (fig. 22), 121–122, 193. Highest Pennsylvanian unit in western Illinois. Maximum thickness 37 feet at type exposure, top eroded. Overlies Exline cyclothem. Includes Trivoli sandstone and Trivoli limestone. Derivation of name and type locality given.

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 53 (table 2), pl. 1. In Modesto formation (new). In northern, western, southeastern, and eastern areas occurs above Gimlet cyclothem; in northern and western areas occurs below Hicks cyclothem; in southwestern area occurs below Carlinville cyclothem. Presentation of new rock-stratigraphic classification of Pennsylvanian strata in Illinois; cyclical classification is independent of rock-stratigraphic classification.

Type locality: Ravine draining northeast and north, near Trivoli, SW¼ sec. 3, T. 8 N., R. 5 E., Glasford quadrangle, Peoria County.

Trivoli Limestone (in McLeansboro Group)

Pennsylvanian: Central western Illinois.

H. R. Wanless, 1939, Geol. Soc. America Spec. Paper 17, p. 104. Marine limestone in lower McLeansboro.

H. R. Wanless, 1957, Illinois Geol. Survey Bull. 82, p. 50 (fig. 22), 123, geol. sections 8, 9. Light-gray fossiliferous buff-weathering limestone that occurs in massive bed. At type exposure of Trivoli cyclothem is 8 to 10 inches thick. Occurs near top of cyclothem above Trivoli (No. 8) coal.

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 38, 56 (table 3). Replaced by Cramer limestone member of Modesto formation (both new).

Type exposure (of cyclothem): Ravine draining northeast and north, SW¼ sec. 3, T. 8 N., R. 5 E., near Trivoli, Glasford quadrangle, Peoria County.

Trivoli Sandstone Member (of Modesto Formation)

Trivoli Sandstone (in McLeansboro Group)

Pennsylvanian: Southeastern, southwestern, western, and northern Illinois.

H. R. Wanless, 1957, Illinois Geol. Survey Bull. 82, p. 50 (fig. 22), 121, geol. sections 8, 9. Commonly light gray or blue gray, has rusty spots, and is medium to fine grained, thin to medium bedded, and micaceous. Commonly grades without break into underlying Gimlet gray shale, but locally cuts down through shale to rest on black limestone; in such places sandstone is somewhat more massive and resembles other channel sandstones of area. Thickness at type exposure of Trivoli cyclothem 15 feet.

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 37, 38, 49 (table 1), 69, pl. 1. Rank reduced to member status in Modesto formation (new). In southeastern area, occurs above West Franklin limestone member and below Chapel (No. 8) coal member; in southwestern area, occurs above Scottville limestone member and below Chapel (No. 8) coal member; western and northern area occurs above Exline limestone member and below Chapel (No. 8) coal member. Thickness 12 to 38 feet. Presentation of new rock-stratigraphic classification of Pennsylvanian strata in Illinois. Cyclical classification is retained but is entirely independent of rock-stratigraphic classification.

Type exposure: Ravine draining northeast and north, SW¼ sec. 3, T. 8 N., R. 5 E., near Trivoli, Glasford quadrangle, Peoria County.

**Tropic Shale[1] or Formation**

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, 102–105, 129–130, pl. 5. Formation described in Zion Park region where it is 400 to 1,250 feet thick; unconformably underlies Straight Cliffs sandstone and overlies Dakota(?) sandstone. Drab, sandy, argillaceous; many beds of sandstone, more abundant in lower part; beds of coal; marine, brackish-water, and fresh-water fossils. Exposed continuously across Kolob Terrace from Kanarra Mountain to Orderville and eastward across Skutumpah Terrace to Paria River.

Named for exposures at and around village of Tropic, Garfield County.

**Tropico Group**

Miocene(?) and Pliocene(?): Southern California.

T. W. Dibblee, Jr., 1958, Am. Assoc. Petroleum Geologists Bull., v. 42, no. 1, p. 135–139. Name applied to sequence of nonmarine sedimentary, pyroclastic, and volcanic rocks exposed in Rosamond Hills and originally described as Rosamond series by Hershey (1902), together with similar and probable correlative rocks of Tertiary age exposed in vicinities of Kramer borate area and in Kramer Hills in western Mojave Desert. Rocks of group are moderately deformed and rest on deeply eroded surface of pre-Tertiary granitic and metamorphic rocks that form crystalline basement complex of region, and are overlain unconformably by Quaternary alluvial sediments. Maximum exposed thickness about 2,800 feet. Group is divided into several lithologic units of local extent. In most sections lower unit is pyroclastic formation, with associated rhyolitic intrusions and flow breccias; upper unit is either fanglomerate or sequence of carbonate rocks, clays, and sandstones of lacustrine and fluviatile origin; basalt flows occur locally, mostly in middle part. Group is nonfossiliferous except at one locality where diatom remains in upper part suggest early Pliocene age. Lower unit is tentatively correlated with lithologically similar formations of known Miocene age in areas west and northwest. Formations that are locally distinct are: Gem Hill formation, Fiss fanglomerate, Bissel formation, Saddleback basalt, and Red Buttes quartz basalt.

Type section: In Rosamond Hills one-half mile west of Mojave-Tropico Road 1 to 2 miles north of Tropico mines, Rosamond quadrangle, in NE¼ sec. 2, T. 9 N., R. 13 W., San Bernardino Base and Meridian, Kern County. Most complete sections are at Antelope Buttes, Rosamond Hills, hills north of Bissell, at and near Castle Butte,. and in Kramer Hills; incomplete sections are at Soledad Mountain and Kramer borate area.

Troublesome Formation

Oligocene: Northwestern Colorado.

T. S. Lovering and E. N. Goddard, 1950, U.S. Geol. Survey Prof. Paper 223, p. 41. Name applied by A. H. Richards (unpub. thesis) to several hundred feet of light-gray to light-tan tuffaceous sands and clays in valley of Troublesome Creek. Contains both Oligocene and late Miocene or early Pliocene fossils.

J. D. Schlottman and L. E. Smith, 1954, U.S. Atomic Energy Comm. [Pub.] RME–1042, p. 8–9. Youngest Tertiary sediments in Middle Park Basin; lies unconformably on all older formations. Maximum thickness 960 feet, measured along Troublesome Creek north of U.S. Highway 40. Upper 800 feet consists of volcanic ash in beds as much as 30 feet thick, interbedded with clays and fluvial sands. Deposited during Oligocene time and reworked during Miocene and Pliocene.

Named for occurrence in valley of Troublesome Creek, near Kremmling in Middle Park, Grand County. Covers about 160 square miles.

Troublesome Creek Sandstone Member (of Jelm Formation)

Upper Triassic: Southeastern Wyoming.

R. G. Hubbell, 1956, Am. Assoc. Petroleum Geologists Bull., v. 40, no. 11, p. 2744–2748. Light gray to light buff fine-grained strongly crossbedded massive sandstone containing numerous large varicolored rounded frosted quartz and chert grains. Maximum observed thickness along southwestern flanks of Freezeout Hills 167 feet. Unconformably underlies Sundance formation.

Type section: Sec. 26, T. 24 N., R. 80 W., Carbon County in southwest Freezeout Hills, where it is well exposed.

**Trough Creek Limestone Member** (of Mauch Chunk Formation)[1]

Mississippian: Central Pennsylvania.

Original reference: I. C. White, 1885, Pennsylvania 2d Geol. Survey Rept. $T_3$, p. 73–76, 85.

J. M. Weller, 1948, Geol. Soc. America Bull., v. 59, no. 2, pl. 2 (column 102). Included in Chesterian series on correlation chart.

On south bank of Trough Creek in Huntingdon County three-fourths mile below Todd (Brick) mills, on Mr. Taylor's land.

Trousdale Shale[1] or Formation

Upper Devonian: Central Tennessee and Kentucky.

Original references: E. R. Pohl, 1930, Tennessee Acad. Sci. Jour., v. 5, no. 2, p. 56–63; 1930, Am. Jour. Sci., 5th, v. 20, p. 151–152.

Guy Campbell, 1946, Geol. Soc. America Bull., v. 57, no. 9, p. 857, 859, 860, 861, 866–868, 883. Basal bed of New Albany shale in Kentucky contains abundant *Schizobolus concentricus* Vanuxem through its entire thickness and is without *Leiorhynchus* assemblage that occurs above *Schizobolus* in Indiana. This change in faunal content becomes evident just south of Ohio River; *Schizobolus* shale prevails in Kentucky and Tennessee where it was described and named Trousdale shale by Pohl (1930). Since there is no apparent difference in this layer in this area, bed in Kentucky is identified as Trousdale. The Trousdale extends around Cincinnati arch to Olympian Springs where it pinches out and extends south into Tennessee. Has uniform thickness of about 10 feet. Overlies Portwood formation (new), where Portwood is present, and Hamilton limestone elsewhere. Overlain everywhere by Blackiston formation (new), and where contact is within the black shale of the two formations, the boundary can be approximately located by fossils in the Trousdale and can be determined definitely when joints in the two strata are exposed. From Estill County, Ky., north, the Olentangy shale, basal member of Blackiston, rests on Trousdale. In Tennessee, Trousdale lies below Dowelltown formation (new) of Chattanooga.

Derivation of name not stated. Map shows two towns named Trousdale, one in Sumner County Tenn., and one in Warren County.

Trout Creek Formation[1]

Miocene, upper: Southeastern Oregon.

Original reference: W. D. Smith, 1926, Oregon Univ. Commonwealth Rev., v. 8, p. 207–214.

H. D. MacGinitie, 1933, Carnegie Inst. Washington Pub. 416, p. 45. Plant fossils indicate upper Miocene age.

Type locality: Trout Creek on east side of Alvord Valley, southeastern part of Harney County.

**Trout Creek Sandstone Member** (of Iles Formation)[1]

Trout Creek Sandstone[1] (in Mesaverde Group)

Upper Cretaceous: Northwestern Colorado.

Original reference: N. M. Fenneman and H. S. Gale, 1906, U.S. Geol. Survey Bull. 297, p. 26.

N. W. Bass, J. B. Eby, and M. R. Campbell, 1955, U.S. Geol. Survey Bull. 1027–D, p. 157, pl. 19. Member consists of fine-grained massive cliff-forming sandstone about 100 feet thick. Occurs at top of formation above unnamed sandstone sequence containing coal beds. Conformably underlies Williams Fork formation.

Named for Trout Creek, on northeastern side of Twentymile Park, about 10 miles northwest of Yampa, Routt County. Typically exposed on north side of U.S. Highway 40 at Bear River, on both sides of road in Hayden Gulch.

Trout Creek Schists

Precambrian: Eastern Nevada and western Utah.

R. B. Nelson, 1959, Dissert. Abs., v. 20, no. 3, p. 997. Name appears only in stratigraphic section. Thickness 2,900 feet. Older than Cherry Canyon schists (new); younger than unnamed tectonitic dolomitic marble.

Stratigraphic section covers northern Snake Range and Kern Mountains in eastern Nevada and southern Deep Creek Range in western Utah.

**Troutdale Formation**[1]

Pliocene, lower: Northwestern Oregon and Washington.

Original reference: E. T. Hodge, 1933, Geol. Soc. America Bull., v. 44, no. 1, p. 157.

R. W. Chaney, 1944, Carnegie Inst. Washington Pub. 553, p. 323–351. Lower Pliocene, on basis of flora.

R. C. Treasher, 1942, Geologic map of Portland area, Oregon (1:96,000): Oregon Dept. Geology and Mineral Resources. In Portland area, overlies Columbia River lava and unconformably underlies Boring lava.

W. D. Wilkinson, W. D. Lowry, and E. M. Baldwin, 1946, Oregon Dept. Geology and Mineral Industries Bull. 31, p. 24–28. Described in St. Helens quadrangle, Oregon and Washington. Troutdale sediments traced from near Camas, Wash., across Columbia River from Troutdale, northwesterly into St. Helens quadrangle. As much as 600 feet of relatively unconsolidated conglomerate, sandstone, and silt, tentatively assigned to upper part of Troutdale, cover parts of quadrangle.

W. D. Lowry and E. M. Baldwin, 1952, Geol. Soc. America Bull., v. 63, no. 1, p. 7–14. Includes Portland Hills silt member (new) in upper part.

Lower part consists of sands, silts, and quartzite-bearing gravels. Also includes basaltic interbed referred to as Crown Point lava member. Although Pliocene sediments can be traced southward from Troutdale formation (as mapped by Treasher, 1942) into coalescing Molalla formation, it is desirable to retain Hodge's definition of Troutdale because not only have other names (Molalla formation and Fern Ridge tuffs farther south) been introduced but also composition of part of Troutdale is different, in that it contains quartzite pebbles. Troutdale sand and gravels are restricted to valley of lower Columbia River, but the somewhat younger Portland Hills silt is not and covers much of adjacent land. Williams (1916, Oregon Bur. Mines and Geology Mineral Resources, v. 2, no. 3) referred the sands and gravels to Satsop formation.

D. E. Trimble, 1955, (abs.) Geol. Soc. America Bull., v. 66, no. 12, pt. 2, p. 1667. Overlies Rhododendron formation of Hodge.

D. E. Trimble, 1957, U.S. Geol. Survey Geol. Quad. Map GQ–104. In Portland quadrangle, formation consists of conglomerate, sandstone, shale, and mudstone; tuffaceous in part. Thickness more than 1,100 feet. Overlies Columbia River basalt; underlies Boring lava. Lower Pliocene.

Named for gravels and sands deposited by ancestral Columbia River, which are well displayed near Troutdale, Multnomah County, Oreg.

Troutdale Granite[1]

Precambrian(?): Central northern Colorado.

Original references: J. Underhill, 1906, Colorado Univ. Studies, v. 3, no. 4, p. 272; 1906, Colorado Sci. Soc. Proc., v. 8, p. 103–122.

Named for town in Evergreen, Denver Mountain Parks quadrangle, Jefferson County.

Trout Pond Limestone[1]

Precambrian: Northern New York.

Original reference: H. L. Alling, 1918, New York State Mus. Bull. 199, p. 112, 114, fig. 25.

Occurs on George W. Smith property, south of Clintonville, Clinton County.

Trowbridge Coal Member (of Mattoon Formation)

Pennsylvanian: Central and southwestern 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 below Calhoun coal member (new) and above Opdyke coal member. Coal named by Cady (1948 Illinois Geol. Survey Bull. 62). Presentation of new rock-stratigraphic classification of Pennsylvanian strata in Illinois.

Type locality: About center of south line sec. 11, T. 10 N., R. 6 E., Shelby County.

Trowbridge Shale

Upper Jurassic: East-central Oregon.

R. L. Lupher, 1941, Geol. Soc. America Bull., v. 52, no. 2, p. 227 (table 1), 229, 263–265. Consists of black shale with large concretions. Thickness about 4,000 feet. Underlies Lonesome formation (new); overlies Snowshoe formation (new); base difficult to determine.

Type area: Trends northeast across South Fork Valley along Mowich anticline where beds dip steeply to southeast. Named for H. H. Trowbridge Ranch, at mouth of Rosebud Creek, in South Fork Valley, Crook County.

Troy Granite[1]

Precambrian: Central southern Oklahoma.

Original reference: C. H. Taylor, 1915, Oklahoma Geol. Survey Bull. 20.

Occurs along Rock Creek near town of Troy, Johnston County.

**Troy Quartzite**[1]

Precambrian: Central Arizona.

Original reference: F. L. Ransome, 1915, Washington Acad. Sci. Jour., v. 5, p. 380–385.

A. A. Stoyanow, 1936, Geol. Soc. America Bull., v. 47, no. 4, p. 474–475, 477 (table 1). Troy is differentiated from Apache group, not only because it overlaps Mescal limestone but because it carries Cambrian fossils and conformably underlies younger Middle Cambrian strata. Thickness 350 feet in Peppersauce Canyon where it underlies Santa Catalina formation and is disconformable above unnamed sandstone of Apache group.

N. E. A. Hinds, 1936, Carnegie Inst. Washington Pub. 463, p. 32. South of Roosevelt Dam, the Troy rests either on Roosevelt member (new) of Apache group or on unnamed basalt member that overlies Mescal limestone.

N. P. Peterson, 1954, U.S. Geol. Survey Geol. Quad. Map GQ–41. Mapped in Globe quadrangle. Underlies Martin limestone and overlies Mescal limestone of Apache group with disconformable contacts.

U.S. Geological Survey currently designates the age of the Troy Quartzite as Precambrian on the basis of a study now in progress.

Named for exposures on Troy Mountain, Ray quadrangle.

Troy Shales[1]

Troy Shale and Limestone Member (of Schodack Formation)

Lower Cambrian: Eastern New York.

Original reference: R. Ruedemann, 1914, New York State Mus. Bull. 169, p. 67–70.

Rudolf Ruedemann, 1942, New York State Mus. Bull. 331, p. 64, Term Schodack formation, in Catskill quadrangle, is extended to include as members beds that occur associated or even interbedded with it such as Zion Hill quartzite, Burden conglomerate, and Troy shale and limestone, which is for most part a mass of greenish, reddish-purplish shale in places with small beds of more or less calcareous quartzite.

Winifred Goldring, 1943, New York State Mus. Bull. 332, p. 64. In Troy and Cohoes quadrangles, Schodack formation includes (ascending) Bomoseen grit, Diamond Rock quartzite, Troy shale and limestone, and Schodack shale and limestone.

Exposed at Troy, N.Y., at dam in Poesten Kill, and other localities.

Truchas slate[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, 12.

Occurs at Picuris, north of Santa Fe, Santa Fe County. Derivation of name not stated.

**Truckee Formation**[1]

Pliocene: Northern and central western Nevada, eastern California, and southeastern Oregon.

Original reference: C. King, 1876, U.S. Geol. Expl. 40th Par. Atlas, map 5; 1878, U.S. Geol. Expl. 40th Par. Rept., v. 1, p. 412.

Age considered Pliocene on basis of study of molluscan fauna. Teng-Chien Yen, 1950, Am. Jour. Sci., v. 248, no. 3, p. 180–193.

G. A. Thompson, 1956, U.S. Geol. Survey Bull. 1042–C, p. 55–56, pl. 3. Formation described Virginia City quadrangle, Nevada, where it is composed of stream and lake deposits which occur in many disconnected areas; beds of diatomite common. Thickness uncertain; may be 3,000 feet or more in Chalk Hills but much less elsewhere. Underlies Lousetown formation; base intertongues with lower part of Kate Peak formation. Early Pliocene.

D. I. Axelrod, 1956, California Univ. Pubs. Geol. Sci., v. 33, p. 99–102, 141–142. Type area restudied. Here formation is represented by three unnamed members: lower, basalt tuff (palagonite) as much as 80 feet thick; middle, nearly pure diatomite, about 1,500 feet thick; upper, slabby gray limestones which range in thickness from 1 or 2 inches up to several feet, with some beds 20 to 30 feet, approximately 850 feet of section exposed. Underlies Lake Lahontan deposits; overlies Desert Peak formation (new). Pliocene; lower member late Clarendonian; middle, Hemphillian; upper, higher parts of which may be as young as Blancan. Misunderstanding of nature of formation in its type area has resulted in including in Truckee rocks in western area near California-Nevada border that represent a distinct formation.

Type section: Northeastern corner Hot Springs Range, 70 miles northeast of town of Truckee and 18 miles from Truckee River at its nearest point.

Truckhaven Rhyolite

Pliocene: Southern California.

T. W. Dibblee, Jr., 1954, California Div. Mines Bull. 170, chap. 2, p. 23 (fig. 2), 24, pl. 2. A lens of varicolored felsitic rock that was extruded along an adjacent east-west fault. Maximum thickness 100 feet. Wedges out southward into Canebrake conglomerate (new).

Crops out near Truckhaven, west of Salton Sea, Imperial County.

Trujillo Formation[1]

Cretaceous: Puerto Rico.

*See* **Trujillo Alto Limestone.**

**Trujillo Formation** (in Dockum Group)[1]

Upper Triassic: Northeastern Texas.

Original reference: C. N. Gould, 1907, U.S. Geol. Survey Water-Supply Paper 191, p. 20–29.

G. Maxwell, 1954, Panhandle Geol. Soc. [Guidebook] Spring Field Trips April 24 and May 1, p. 15. Thickness 20 to 25 feet in Potter County. Consists of one to five or more sandstones or conglomerates with interbedded red and gray shales. Overlies Tecovas formation.

Name for exposures on Trujillo Creek, Oldham County.

**Trujillo Alto Limestone**[1]

Upper Cretaceous: Puerto Rico.

Original reference: C. P. Berkey, 1915, New York Acad. Sci. Annals, v. 26, p. 21, 61.

R. C. Mitchell, 1954, Puerto Rico Univ. Agr. Expt. Sta. Tech. Paper 13, p. 36 (table 2), 47, 48 (table 4). Thickness 200 feet. Overlies Luquillo formation; underlies Figuera formation. Upper Cretaceous.

C. A. Kaye, 1959, U.S. Geol. Survey Prof. Paper 317–A, p. 7 (table), 9 (fig. 8), 20–22, pl. 2. Fossiliferous medium-bedded to massive limestone. Maximum thickness about 900 feet. Overlies Monacillo formation (new); underlies Figuera volcanics.

Named for outcrops in vicinity north of Trujillo Alto.

Trumbull facies (of Cleveland Shale)

*See* **Cleveland Shale.**

Trumbull Gneiss[1]

Precambrian (Grenville): Northern New York.

Original reference: H. L. Alling, 1918, New York State Mus. Bull. 199, p. 45, 127.

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 at base of sequence and below Hague gneiss.

Named from Trumbull Mountain, Essex County.

Trump Conglomerate

Pliocene(?): Central Colorado.

J. H. Johnson, 1937, (abs.) Colorado Univ. Studies, v. 25, no. 1, p. 77. A series of gravels and poorly consolidated conglomerates. Overlies Wagontongue formation (new). Late Pliocene.

J. T. Stark and others, 1949, Geol. Soc. America Mem. 33, p. 34 (table 7). 70–72, pl. 1. Estimated maximum thickness 500 feet. Pliocene(?).

Widespread along extreme southern end of South Park. Well exposed along pediments sloping up to Coffman Ridge in T. 14 S., R. 76 W., and along divide between Agate Creek and Badger Creek in secs. 14 and 23 in same township. Named from settlement of Trump, Park County.

Truro Limestone[1]

Pennsylvanian: Central southern Iowa.

Original reference: J. L. Tilton, 1897, Iowa Acad. Sci. Proc., v. 4, p. 52, 54.

Named for Truro, Madison County.

†Truro Series[1]

Pleistocene: Southeastern Massachusetts.

Original reference: N. S. Shaler, 1898, U.S. Geol. Survey 18th Ann. Rept., pt. 2, p. 541–593.

Named for occurrence in Truro, Barnstable County.

Truxton limestones[1]

Carbonic (Mississippian Series): Northwestern Arizona.

Original reference: C. R. Keyes, 1922, Pan-Am. Geologist, v. 38, p. 243, 251, 338.

Charles Keyes, 1936, Pan-Am. Geologist, v. 66, no. 3, p. 215 (chart). In Mississippian series. Underlies Elden limestones; overlies Simon limestones. Of Carbonic age.

Exposed in Grand Wash Cliffs and Yampai Cliffs overlooking Truxton Plateau, Mohave County.

Tryon Peak flows

Late Tertiary: Central eastern California.

H. G. Wilshire, 1957, California Univ. Dept. Geol. Sci. Bull., v. 32, no. 4, fig. 1. Named on map legend of Ebbetts Pass region. Younger than Silver Peak andesites and Raymond Peak andesites (both new).

Ebbetts Pass region is in Alpine County.

**Tsadaka Formation**

Eocene(?) and Oligocene: South-central Alaska.

F. F. Barnes and T. G. Payne, 1956, U.S. Geol. Survey Bull. 1016, p. 13, 19–20, pls. 1, 2. Poorly indurated coarse conglomerate characterized by boulders and cobbles of granite and diorite in matrix of granitic debris. Consists of at least 700 feet of interbedded silty sandstone, siltstone, pebbly sandstone, and fine to coarse conglomerate in Tsadaka Canyon. Sandstone beds are arkosic. Youngest bedrock formation in district; underlies relatively thin veneer of unconsolidated material in area immediately south of Wishbone Lake; unconformably overlies Wishbone formation (new). Represents uppermost conglomeratic beds on Wishbone Hill, mapped as Eska conglomerate by Martin and Katz (1912).

U.S. Geological Survey currently designates the age of the Tsadaka Formation as Eocene(?) and Oligocene on the basis of a study now in progress.

In Tsadaka Canyon on Moose Creek below Premier mine, Wishbone Hill district, Matanuska coal field; also on Wishbone Hill.

Tsegi Formation

Quaternary, upper: Northeastern Arizona.

J. T. Hack, 1941, Geog. Review, v. 31, no. 2, p. 262–263; 1942, Harvard Univ. Peabody Mus. Am. Archeology and Ethnology Papers, v. 35, no. 1, p. 51–53, fig. 29. Clay beds and silt beds common, but in general, formation contains more numerous gravel lenses, as though in part deposited by more torrential streams. Not cemented in most places, but here and there, especially in center of valley, hard, sandy clay beds contain calcium carbonate cement. Gray to brown. No artifacts found in formation, but several pieces of charcoal found below ruin of Kawaika-a, probably indicating human occupation of region during deposition of formation. Deposited before 1100 A.D. Above Awatovi, where formation is thick, it consists of two members separated by erosional unconformity. Below end of Antelope Mesa, formation becomes thin, suggesting that streams must have deposited all of their load before reaching lower part of valley. Underlies Naha formation (new); overlies Jeddito formation (new).

Type locality: In Tsegi Canyon, western Navajo country.

Tualatin Gravels

Pleistocene: Northwestern Oregon.

R. C. Treasher, 1942, Geologic map of the Portland area, Oregon (1:96,000): Oregon Dept. Geology and Mineral Resources. Consists of silt, grit, and gravel as much as 200 feet thick; represents piedmont fan deposition.

Form terraces along Tualatin River, Portland area.

Tub Springs 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. Sandstone, usually massive, about 20 to 50 feet thick. Overlies shale interval 110 to 200 feet thick which in turn overlies Low Gap sandstone (new) ; in Cross Mountain section, underlies 270 feet of shale containing minor amounts of sandstone.

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 near Tub Spring at top of Frozen Head Mountain above Petros, Fork Mountain quadrangle.

Tuckahoe Group (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. 3, p. 423–435.

Exposed in shafts and mines bordering Tuckahoe Creek, Goochland County, in vicinity of Gayton, Henrico County.

Tuckahoe Marble[1]

Precambrian: Southeastern New York.

Original reference: C. P. Berkey and J. R. Healy, 1912, Columbia Univ. Contr., v. 20, p. 1907–1912.

In Westchester County.

†Tucquan Gneiss[1]

Precambrian: Southeastern Pennsylvania.

Original reference: J. P. Lesley, 1892, Pennsylvania 2d Geol. Survey Summ. Final Rept., v. 1, p. 128–129, 136, 203, 204.

Probably named for exposures in broad, flat anticlinal arch whose axis crosses Susquehanna River at mouth of Tocquan [Tucquan] Creek (McCalls Ferry).

Tucson Sandstone[1]

Upper Cretaceous (Benton) : Southern central New Mexico.

Original reference: G. H. Hansen, 1931, George Washington Univ. Bull., Summ. doctoral theses, 1925–1928, p. 84.

Well exposed on Tucson Mountain, Sierra Blanca region.

Tucson Mountain chaos

Tertiary, lower to middle(?) : Southeastern Arizona.

J. H. Courtright, 1958, Arizona Geol. Soc. Digest, p. 7, 8. Characterized principally by abundance of large angular blocks of limestone, arkose, andesite porphyry conglomerate, and other rocks. In exposure one-half mile due south of Gates Pass, chaos consists of erratically positioned large rock blocks enclosed in series of thin-bedded conglomerates and silts. Underlies Cat Mountain rhyolite formation; unconformably overlies arkosic beds of probable Cretaceous age. Name credited to J. E. Kinnison (unpub. thesis).

J. E. Kinnison, 1959, Arizona Geol. Soc. Guidebook 2, p. 48–57. Includes two members—lower conglomerate member with poorly consolidated well-rounded reddish-brown cobble conglomerate at its base and well consolidated conglomerate with more numerous boulders in upper part, thickness about 150 feet, apparently only a local feature; and upper chaos member, characterized by blocks 10 to more than 200 feet in maximum dimension, with angular limestone conglomerate bodies erratically distributed throughout member, thickness of member 185 feet. Chaos overlies Amole group. Tentatively considered to be of probable early to middle Tertiary age.

Crops out extensively in Tucson Mountains, from which it derives its name, Pima County.

**Tucumcari Shale**

†Tucumcari Beds[1]

Tucumcari Shale Member (of Purgatoire Formation)

Lower Cretaceous: Northeastern New Mexico.

Original reference: W. F. Cummins, 1892, Texas Geol. Survey 3d Ann. Rept., p. 201–209.

Ernest Dobrovolny and C. H. Summerson, 1946, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 62. Member consists of gray shale and buff calcareous sandstone that contains nodules of argillaceous limestone and has thin basal sandstone. Contained fauna indicates Kiamichi and Duck Creek age. Name Tucumcari beds was originally used for this interval, but term included overlying unit here named Mesa Rica sandstone member. Unconformably overlies Morrison, Wingate(?), or Chinle formations.

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 0 to about 60 feet.

Named for Mount Tucumcari, northwestern Quay County.

Tucumcarian series

Mesozoic (Early Cretacic): New Mexico.

Charles Keyes, 1940, Pan-Am. Geologist, v. 74, no. 2, p. 105 (chart), 153–154. Comprises (ascending) Redondo, Pyramid, Fredericksburg, and Washita terranes.

Tuerto Gravel

Quaternary: North-central New Mexico.

C. E. Stearns, 1953, Geol. Soc. America Bull., v. 64, no. 4, p. 476, 477, pl. 1. Thickness 5 to more than 150 (300?) feet. Interbedded with basalt flows tentatively correlated with Cuerbio basalt. Younger than Santa Fe formation.

Brewster Baldwin, 1956, New Mexico Geol. Soc. Guidebook 7th Field Conf., p. 118 (fig. 2), 119. Mentioned in discussion of upper unit of Santa Fe group. Puye gravel, Ancha formation, and Tuerto gravel all rest with angular unconformity on Tesuque formation. These gravel units are 500, 300, and 150 feet in maximum thickness. Early Pleistocene.

In Galisteo-Tonque area, Sandoval and Santa Fe Counties.

**Tufts Quartzite Member** (of Cambridge Slate)[1]

Devonian or Carboniferous: Eastern Massachusetts.

Original reference: M. Billings, 1929, Am. Jour. Sci., 5th, v. 18, p. 101, 102, 106, 107, 111, 112.

Exposed in athletic field of Tufts College, Medford, Boston region, Suffolk County.

Tuira Formation

Miocene: Panamá.

Karl Sapper, 1937, Mittelamerika, Handbuch der regionalen Geologie: Heidelberg, v. 8, Abt. 4a, no 29, p. 132, 134 (correlation chart). Underlies Pucro sandstone. Equivalent to lower Gatún formation. Middle Miocene.

W. P. Woodring *in* R. Hoffstetter and others, 1960, Lexique Strat. Internat., v. 5, Amérique Latine, fasc. 2a, p. 349. Not properly defined. Miocene.

In Darién area.

**Tuktu Formation** (in Nanushuk Group)

Tuktu Member (of Umiat 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. 162, fig. 2. Member consists almost entirely of marine sandstone at type locality where it is about 1,000 feet thick and underlies Hatbox tongue (new) of Chandler formation (new). Northward, member thickens progressively to about 2,500 feet and includes part of marine equivalent of Hatbox tongue. Base of member coincides with base of Umiat formation (new) and base of Nanushuk group. Overlies Torok formation (new); underlies Topagoruk member (new) of Umiat formation.

R. L. Detterman *in* George Gryc and others, 1956, Am. Assoc. Petroleum Geologists Bull., v. 40, no. 2, p. 233–235, figs. 2, 5. Redefined as formation. Rocks form prominent south-facing escarpment along southern edge of Northern Foothills section. Northward across strike, formation grades abruptly into shale but is present 35 miles north of escarpment. More exact data on type locality given. Approximately 1,030 feet thick at type locality. Underlies Chandler and Grandstand (new) formations. Predominantly dirty-green to greenish-gray very fine- to fine-grained sandstone. Siltstone and silt shale form subordinate part of formation. Sandstone is commonly thin bedded, calcareous, highly argillaceous, and in places micaceous.

Type locality: On Chandler River where river cuts through Tuktu Bluff, a continuous south-facing escarpment that can be traced for many miles, lat 68°44′ N., long 152°18′ W.

**Tulare Formation**[1]

Pliocene and Pleistocene(?): Southern California.

Original reference: F. M. Anderson, 1905, California Acad. Sci. Proc., 3d ser., v. 2, p. 181.

W. P. Woodring, Ralph Steward, and R. W. Richards, 1940, U.S. Geol. Survey Prof. Paper 195, p. 13–22, pl. 3. Formation is nonmarine and consists principally of sandstone and conglomerate and toward base of fine-grained rocks in which fresh-water mollusks and fresh- and brackish-water diatoms are abundant. Exposed thickness 1,700 to 3,500 feet.

Underlies alluvium; overlies San Joaquin formation, base drawn just above youngest widespread marine deposits constituting upper *Mya* zone of San Joaquin. Youngest folded strata in Kettleman Hills. Named by Anderson (1905) but no type locality designated. Kettleman Hills have been regarded as type region (Arnold and Anderson, 1910, U.S. Geol. Survey Bull. 398) as exposures there were only ones described, and name was derived from Tulare Lake, shore of which at that time lay close to edge of North dome. Type section suggested.

F. F. Davis and D. W. Carlson, 1952, California Jour. Mines and Geology, v. 48, no. 3, p. 212, 221 (table). In Merced County, overlies Ora [Oro] Loma formation (new). Underlies upper Pleistocene lake beds called Peckham formation by Leith (1949).

L. I. Briggs, Jr., 1953, California Div. Mines Bull. 167, p. 12 (fig. 2), 48–49, pls. 1, 2, 3. Formation, in Ortigalita Peak quadrangle, consists of as much as 500 feet of gravel, sand, silt, and marly beds. Overlies Oro Loma formation. Lithologic similarity of Tulare to Oro Loma led Anderson and Pack (1915, U.S. Geol. Survey Bull. 603) to consider the formations as single unit, but separation can be made on lithology and structural characteristics. Oro Loma beds are folded with bedrock series, and Tulare strata extensively overlap all these units, including Franciscan formation. Formation postdates upper Pliocene orogeny and predates mid-Pleistocene orogeny, thus limiting time of deposition to Plio-Pleistocene.

Suggested type section: On La Ceja, one-fourth mile southeast of Avenal-Lenmoore Road, sec. 35, T. 21 S., R. 17 E., on east side of northern North dome. This is probably section studied by Anderson. Owing to overlap of alluvium, only lower part of formation is exposed. Name derived from Tulare Lake.

Tularosa Formation[1]

Tertiary or Quaternary(?): Southeastern New Mexico.

Original reference: C. L. Herrick, 1904, Am. Geologist, v. 34, p. 179, 187.

Derivation of name not stated.

Tularosa Malpais Lava

Recent: Central southern New Mexico.

L. R. Dice, 1940, Scientific Monthly, v. 50, p. 419–420. Large bed of black lava with total area of about 120 square miles. Thickness around edges usually about 10 to 20 feet, but in some places as much as 50 feet. In middle of its stream, lava must be thicker.

In Tularosa Basin, in belt roughly along line extending from Malpais Spring to Carrizozo.

**Tule Formation**[1]

Pleistocene: Northern Texas.

Original reference: W. F. Cummins, 1893, Texas Geol. Survey 4th Ann. Rept., pt. 1, p. 199–200, 203.

G. L. Evans and G. E. Meade, 1945, Texas Univ. Bur. Econ. Geology Pub. 4401, p. 493–495. Formation consists mainly of well-bedded gray unconsolidated sands and greenish-tan bentonitic clays. Beds of unaltered volcanic ash present locally. Thickness as much as 114 feet. Vertebrate fauna indicates intermediate Pleistocene age.

J. C. Frye and A. B. Leonard, 1957, Texas Univ. Bur. Econ. Geology Rept. Inv. 32, p. 21–24, strat. sections. Discussion of Cenozoic geology along eastern margin of Texas High Plains, Armstrong to Howard Counties. Name Tule formation is used as regional unit to include all deposits of Kansan Cycle in area of study. It is thus applied not only to relatively slack water fills of broad valleys that crossed High Plains area but also to high terrace deposits of same age that flank some of major stream canyons and to terrace deposits of equivalent age that occur beyond escarpment of High Plains. Thickness in type area 27 to 55 feet.

Named for Tule Canyon, Swisher County.

Tule Mountain Trachyandesite

Tertiary: Southwestern Texas.

J. D. Martinez, Edwin H. Statham, and L. G. Howell, 1960, Texas Univ. Bur. Econ. Geology Pub. 6017, p. 37, 42 (fig. 36). Incidental mention in paleomagnetic study of Tertiary volcanics in Big Bend National Park.

**Tule Spring Limestone**[1]

Lower Mississippian and Pennsylvanian: Southeastern Arizona.

Original references: W. Lindgren, 1905, U.S. Geol. Survey Prof. Paper 43; 1905, U.S. Geol. Survey Geol. Atlas, Folio 129.

A. A. Stoyanow, 1936, Geol. Soc. America Bull., v. 47, no. 4, p. 511–512. Lower 200 feet of unit carries Lower Mississippian fauna and upper 300 feet contains characteristic Pennsylvanian fossils.

Named for exposures around Tule Springs, at head of Tule Creek, Clifton quadrangle.

†Tulik 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. Composed principally of basalt porphyry flows 20 to 60 feet thick. Lavas vary in texture from finely granular to porphyritic and contain as much as 60 percent of phenocrysts, mainly bytownite feldspar with some olivine. Oldest lavas interfinger with late Crater Creek flows. Partly underlies veneer of Okmok ash (new).

F. M. Byers, Jr., 1959, U.S. Geol. Survey Bull. 1028–L, p. 308. Name Tulik abandoned. Replaced by informal name.

Makes up much of Mount Tulik, large slightly dissected parasitic cone on south flank of Okmok Volcano, on Umnak Island in eastern part of Aleutian Islands.

**Tulip Creek Formation**[1] (in Simpson Group)

Ordovician: Central southern Oklahoma.

Original references: F. C. Edson, 1930, Am. Assoc. Petroleum Geologists Bull., v. 14, no. 7, p. 947; C. E. Decker, 1930, Am. Assoc. Petroleum Geologists Bull., v. 14, no. 12, p. 1498–1505. Name credited to E. O. Ulrich.

R. W. Harris, 1957, Oklahoma Geol. Survey Bull. 75, p. 77–85, charts 1, 2, fig. 1. In chart (column 8, fig. 1) presented from manuscript before Geological Society of America at annual meeting in New York City in 1928, Ulrich introduced the Tulip Creek as a Simpson formation in stratigraphic interval between underlying McLish and overlying Criner formation. Decker (1930) published this chart. Ulrich (1929 [1930], U.S. Natl. Mus. Proc., v. 76, art. 21) published Simpson correlation chart showing Tulip Creek in stratigraphic position below the Criner, but overlying the

Falls, not McLish. He later (Edson, 1935, Am. Assoc. Petroleum Geologists Bull., v. 19, no. 8) proposed Cool Creek formation in stratigraphic position between Tulip Creek and Criner formations. Decker and Merritt (1931, Oklahoma Geol. Survey Bull. 55) placed Tulip Creek in stratigraphic position between subjacent McLish and superjacent Bromide, and subsequent stratigraphers have thus adopted it. Subdivisible into two parts: basal sandstone ("Wilcox" of type Tulip Creek locality), and an overlying section of shales and thin-bedded limestones and a few thin sandstones. Thickness at type section 395 feet (subdivisible into 175-foot basal sand and 235 feet of overlying green shales with thin limestones and occasional thin sandstone). Disconformable relationships with both underlying McLish and overlying Bromide formations. Ostracodal fauna indicates Black River age.

Type section: Along Tulip Creek, on southern side of Arbuckle Mountains, adjacent west side of U.S. Highway 77, north of Springer, Carter County.

†Tullahoma Formation[1]

Mississippian: Tennessee and western Kentucky.

Original reference: J. M. Safford and J. B. Killebrew, 1900, Elements of geology of Tennessee, p. 104, 143, 144.

Named for Tullahoma, Coffee County, Tenn.

**Tullock Member** (of Fort Union Formation)

Tullock Formation[1]

Paleocene: Eastern Montana, South Dakota, and Wyoming.

Original reference: G. S. Rogers and Wallace Lee, 1923, U.S. Geol. Survey Bull. 749, p. 29.

A. J. Collier and M. M. Knechtel, 1939, U.S. Geol. Survey Bull. 905, p. 10–11, pl. 3. Lance formation in McCone County, Mont., comprises two members—a lower Hell Creek, and an upper, Tullock. Footnote, page 10, states that since present report was written, Hell Creek and Tullock members have been raised to rank of formation in official classification of Geological Survey, Hell Creek being assigned to Cretaceous and Tullock to Cretaceous or Eocene.

Erling Dorf, 1940, Geol. Soc. America Bull., v. 51, no. 2, p. 230 (table 5). Discussion of relationship between floras of type Lance and Fort Union formations. In proposed revision of nomenclature, Tullock formation (equivalent to Ludlow formation and Cannonball marine member) is placed at base of Fort Union group. Eocene or Upper Cretaceous.

Erling Dorf, 1942, Carnegie Inst. Washington Pub. 508, p. 95–97. Deposits above Lance formation have been generally referred to Fort Union formation on basis of stratigraphic position, lithology, absence of dinosaurs, and presence of typical lower Eocene (Paleocene) flora. Contact between typical Lance and lowest unit of Fort Union group is traceable northward into Gillette coal field region, where it coincides with contact between Hell Creek and Tullock formations. Tullock formation was regarded by Dobbin and Barnett (1927, U.S. Geol. Survey Bull. 796–A), as elsewhere by others, as upper member of Lance. In Gillette coal field, as well as at its type locality and elsewhere, the Tullock is now known to contain plant remains of typical Paleocene Fort Union aspect. This conclusion is substantiated by southward extension of the Tullock of Gillette coal field into Fort Union beds above top of Lance formation, as defined in Lance Creek area. Lower unit of Fort Union group of Lance Creek area is equivalent to Tullock formation, which is traceable from its type locality in eastern Montana into area of Gillette coal field. Thickness of Tullock in Lance Creek area about 400 feet. Units above Tullock in Lance Creek area not studied.

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.

C. E. Dobbin, W. B. Kramer, and G. H. Horn, 1957, U.S. Geol. Survey Oil and Gas Inv. Map OM–185. Thickness of Tullock member, 1,110 feet, in southeastern part of Powder River Basin, Wyoming. Underlies unnamed unit in upper part of formation; overlies Lance formation.

W. J. Mapel, 1958, Wyoming Geol. Assoc. Guidebook 13th Ann. Field Conf., p. 200–201. Discussion of Powder River Basin. Fort Union formation as used herein comprises (ascending) Tullock, Lebo, and Tongue River members. Tullock has maximum thickness of about 1,100 feet in southern part of basin; thins northward to about 500 feet at Montana-Wyoming border, and to about 200 to 250 feet in northern Powder River and southern Rosebud Counties, Mont. Overlies Upper Cretaceous Hell Creek or Lance formation.

Named for exposures in valley of Tullock Creek, Treasure County, Mont.

Tullos Clay Member (of Yazoo Clay)

Eocene (Jackson): Central Louisiana.

H. N. Fisk, 1938, Louisiana Dept. Conserv. Geol. Bull. 10, p. 78 (fig. 6), 98–99. Series of clays ranging in thickness from 75 to 175 feet; on fresh exposure clays are deep blue gray but weather to drab yellow, or light gray. Grades into overlying Verda member (new) through sandy concretionary transition phase herein named Union Church; overlies Moodys Branch marl.

Well exposed in grade cuts of Missouri Pacific Railroad, half a mile southwest of Tullos station, La Salle Parish.

**Tully Limestone**[1]

Tully Limestone (in Susquehanna Group)

Middle Devonian: New York and Pennsylvania.

Original reference: L. Vanuxem, 1839, New York Geol. Survey 3d Rept., p. 278.

G. A. Cooper and J. S. Williams, 1935, Geol. Soc. America Bull., v. 46, no. 5, p. 781–868. Divided into several members in different areas: Apulia, Laurens, New Lisbon (new), Tinkers Falls (new), and West Brook (new).

G. A. Cooper and others, 1942, Geol. Soc. America Bull., v. 53, no. 12, pt. 1, p. 1786–1788, chart 4. On basis of new information, it seems best to regard Tully as Middle Devonian, and to make a stage, the Taghanic, to include it and its correlatives in the Midwest and the overlying Geneseo shale.

Wallace de Witt, Jr., and G. W. Colton, 1959, Am. Assoc. Petroleum Geologists Bull., v. 43, no. 12, p. 2816–2818. Tully limestone underlies Geneseo shale member of Genesee formation. Lenses of fossiliferous pyrite and marcasite as much as 7 inches thick and 1 inch to 10 feet long separate Genesee formation from underlying Moscow shale in most outcrops between Canandaigua Lake and Lake Erie. These lenses were named Tully pyrite by Loomis (1903, New York State Mus. Bull. 69) and Leicester marcasite member of Moscow formation by Sutton (1951). Although Tully limestone and Tully pyrite of Loomis had not been found in same outcrop, the pyrite and marcasite were considered to be older than, or equivalent in age to, the Tully limestone. Recently pyrite and marcasite lenses have been found at base of Geneseo shale overlying nodules of Tully limestone in Gage Gully on east side of Canandaigua Lake. Relation of rocks in this outcrop indicates that Tully pyrite of Loomis is younger than Tully limestone and appears to be part of Genesee formation.

H. H. Arndt and others, 1959, Geol. Soc. America Guidebook for Field Trips Pittsburgh Mtg., p. 3. At base of Susquehanna group.

Well exposed in town of Tully, Onondaga County, N.Y.

†Tulsa Group[1]

Pennsylvanian: Northeastern and central northern Oklahoma.

Original reference: C. N. Gould, D. W. Ohern, and L. L. Hutchison, 1910, Oklahoma State Univ. Research Bull. 3, p. 6, 10.

C. C. Branson, 1957, Oklahoma Geology Notes, v. 17, no. 11, p. 103. Abandoned by Oklahoma Geological Survey. Name applied to strata of Marmaton group.

Named for Tulsa County.

†Tuluga Member (of Schrader Bluff 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. Distinguished by abundant bentonite and tuff interbedded with light-colored sandstone and shale. In Fish Creek test well No. 1, member almost entirely marine except for one thin coal bed and associated sandstone. Maximum thickness estimated to be 2,200 feet in outcrop belt, but this thickness includes minor units of Tuluvak tongue (new) of Prince Creek formation (new). Underlies Sentinel Hill member (new); overlies Seabee member (new), both of Schrader Bluff formation.

C. L. Whittington *in* George Gryc and others, 1956, Am. Assoc. Petroleum Geologists Bull., v. 40, no. 2, p. 246. Rocks formerly included in Tuluga member placed in Seabee formation and newly defined Rogers Creek and Barrow Trail members of Schrader Bluff formation and name Tuluga member is abandoned.

Type locality: Schrader Bluff, which is best exposure of this member. Named from Tuluga River, which enters Anaktuvuk River at north end of Schrader Bluff. Also well exposed on Chandler River near confluence with Ayiyak River and on Colville River in Umiat area.

**Tuluvak Tongue** (of Prince Creek Formation)

Upper Cretaceous: Northern Alaska (surface and subsurface).

George Gryc, W. W. Patton, Jr., and T. G. Payne, 1951, Washington Acad. Sci. Jour., v. 41, no. 5, p. 166, figs. 2, 3. Lower part of (nonmarine) formation. Thickness 1,200 feet in Tuluvak Bluffs. Overlies Seabee member (new) of marine Schrader Bluff formation (new). Intertongues with Tuluga tongue (new) of Schrader Bluff formation.

C. L. Whittington *in* George Gryc and others, 1956, Am. Assoc. Petroleum Geologists Bull., v. 40, no. 2, p. 252–253, fig. 4. Nonmarine tongue is a wedge dividing marine rocks of Colville group into two easily recognizable formations—Seabee formation (redefined) below and Schrader Bluff formation (redefined) above.

Best exposed in Tuluvak Bluffs on Chandler River.

Tumbez Limestone

Middle Ordovician: Southwestern Virginia.

B. N. Cooper, 1945, Virginia Geol. Survey Bull. 66, p. 133–134, 156, pl. 23. Proposed for limestone equivalent to the typical Blackford in Russell County. The Blackford undergoes a distinct facies change along Clinch Mountain belt; shaly dolomitic beds are supplanted by predominantly coarse-grained limestone. In type section of the Tumbez, interbedding of coarse-grained limestones with the typical Blackford is well shown. Thickness at type section about 120 feet. Underlies Elway limestone; overlies "Knox" dolomite.

L. D. Harris and R. L. Miller, 1958, U.S. Geol. Survey Geol. Quad. Map GQ–111. In Duffield quadrangle, included in Blackford formation.

Type section: South of Tumbez, Russell County.

Tumbledown Gneiss

Age not stated: West-central Maine.

Kern Jackson, 1953, Maine State Geologist Rept. 1951–1952, p. 53, 66. Described as very coarse banded metasedimentary gneiss. Composed of alternate bands of micaceous quartzite and muscovite schist. Basic dikes cut across the gneissic structure.

Makes up bulk of Tumbledown and Jackson Mountains, Rumford quadrangle.

**Tumbling Run Member** (of Pottsville Formation)

Tumbling Run Formation (in Pottsville Group)

Lower Pennsylvanian: Eastern Pennsylvania.

G. H. Wood, Jr., and others, 1956, Am. Assoc. Petroleum Geologists Bull., v. 40, no. 11, p. 2673–2675, 2680–2683; 1957, U.S. Geol. Survey Coal Inv. Map C–43, sheet 1. Predominantly conglomerate and sandstone with less quantities of conglomeratic sandstone, siltstone, shale, and coal; conglomerate beds are coarser and less well sorted in lower part of member and proportion of sandstone, conglomeratic sandstone, siltstone, shale, and coal beds somewhat greater in upper part. Comprises basal 535 feet of formation at reference section herein designated. Underlies Schuylkill member (new). Conformably overlies Mauch Chunk formation; contact arbitrarily placed at top of uppermost sandstone, siltstone, or shale; at reference section of Pottsville, uppermost red shale, unit 0 (fig. 3), of Mauch Chunk lies directly below gray shale of unit 1 (fig. 3), basal bed of Pottsville and Tumbling Run member. Most geologists consider contact at type and reference sections to be local time boundary between Mississippian and Pennsylvanian systems. Regional stratigraphic studies indicate that there may be considerable intertonguing of facies between Tumbling Run member of Pottsville formation and Mauch Chunk formation; therefore it is possible that the time boundary, as recognized in type and reference sections, is in rocks of Mauch Chunk formation at some localities and in rocks of Pottsville formation at other places.

Carlyle Gray and others, 1960, Geologic map of Pennsylvania (1:250,000): Pennsylvania Geol. Survey, 4th ser. Mapped as formation in Pottsville group in anthracite region.

Type section: Basal part of Pottsville formation reference section, which is in road cut on east side of U.S. Highway 122, about 150 feet farther east than original type section of Pottsville which is on eastern side of Pennsylvania Railroad cut through water gap south of Pottsville, Schuylkill County.

Tumco Formation

Paleozoic or older: Southern California.

P. C. Henshaw, 1942, California Jour. Mines and Geology, v. 38, no. 2, p. 155–157, pl. 2. Fine-grained gray to pinkish-gray massive arkosite.

W. J. Miller, 1946, Geol. Soc. America Bull., v. 57, no. 5, p. 489, table 4. Older Precambrian(?).

Occurs in Tumco Valley in Cargo Muchacho Mountains, Imperial County.

Tumey Formation[1]

Tumey Sandstone Lentil (in Kreyenhagen Formation)

Oligocene: Southern California.

Original reference: E. R. Atwill, 1935, Am. Assoc. Petroleum Geologists Bull., v. 19, no. 8, p. 1192–1204.

John Zimmerman, Jr., 1944, Am. Assoc. Petroleum Geologists Bull., v. 28, no. 7, p. 953–976. In Ciervo Hills, Fresno County, the Kreyenhagen in outcrop contains three members: lower Kreyenhagen shale, Tumey sandstone lentil, and Tumey or upper Kreyenhagen shale. Sandstone crops out as lens about 9 miles long and up to one-half mile wide in shales of the Kreyenhagen.

J. E. Schoellhamer and D. M. Kinney, 1953, U.S. Geol. Survey Oil and Gas Inv. Map OM–128. In this report, all strata between Domengine sandstone and overlapping Temblor formation are included in Kreyenhagen shale. Atwill's sandstone unit of Tumey formation is here called sandstone member of Kreyenhagen. Area of report is Tumey and the Panoche Hills, Fresno County.

Type locality: In S½ sec. 16, T. 16 S., R. 13 E., Fresno County. Name derived from nearby Tumey Gulch.

†Tunangwant Conglomerate[1]

Upper Devonian: Southwestern New York and northwestern Pennsylvania.

Original reference: J. F. Carll, 1880, Pennsylvania 2d Geol. Survey Rept. $I_3$, p. 79.

G. A. Cooper and others, 1944, Geol. Soc. America Bull., v. 53, no. 12, pt. 1, p. 1742. Upper Devonian.

Named for exposures in New York along Tunangwant Creek, which flows north through Bradford, Pa., into New York. Exposed in hills bordering Tunangwant Creek, between Carrollton, N.Y., and Bradford, Pa.

Tunbridge 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 Tunbridge Township, Orange County, or some of villages of that name within township.

Tunitas Sandstone Member (of Purisima Formation)

Pliocene: Northern California.

R. M. Touring, 1959, Dissert. Abs., v. 20, no. 4, p. 1326. Maximum thickness 400 feet. Top member of formation; overlies Lobitos mudstone member (new).

Area of report is in Santa Cruz Mountains, 30 to 40 miles south of San Francisco.

Tunnel Creek Glacial Stage

Tunnel Creek Till

Pleistocene (Wisconsin): Northwestern Oregon.

T. P. Thayer, 1939, Oregon Dept. Geology and Mineral Industries Bull. 15, p. 20, 24–25. Defined as time during which Tunnel Creek till was deposited. Till is composed largely of angular blocks which bear few facets or striae.

Exposed in North Santiam River valley near Tunnel Creek [Marion County].

Tunnel Hill zone[1]

Precambrian: Northwestern 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. 6, 8, 12.

Named for exposures at Tunnel Hill, Oconee County.

Tunnel Peak Breccia, Dacite

Tertiary: Central California.

R. L. Rose, 1960, California Div. Mines Spec. Rept. 60, p. 15 (fig. 3), 16–17. Volcanic complex that consists of hornblende dacite surrounded by tuff breccia. Contact of breccia with Mehrten formation is nearly vertical and apparently breccia intrudes Mehrten. Tunnel Peak vent breccia shown on geologic map.

Complex, about 2,000 feet in diameter, makes up topographic prominence known locally as Tunnel Peak, Golden Gate Hill area, Calaveras County.

**Tunnel Point Sandstone**

Tunnel Point Beds[1]

Tunnel Point Formation

Oligocene, middle: Southwestern Oregon.

Original reference: W. H. Dall, 1898, U.S. Geol. Survey 18th Ann. Rept., pt. 2, p. 336–343.

C. E. Weaver and others, 1944, Geol. Soc. America Bull., v. 55, no. 5, p. 590, chart 11. Tunnel Point sandstone, 350 feet thick where exposed in sea cliffs north of Tunnel Point, is probably conformable on Bassendorf shale but is unconformable beneath Empire formation.

C. E. Weaver, 1945, Washington [State] Univ. Pubs. in Geology, v. 6, no. 2, p. 50–52. Type section of formation consists of 760 feet of concretionary and nodular sandstone, thickly bedded stratified sandstones, medium-grained sandstones and beds of interstratified sandstones, and shaly sandstones. Overlies Bassendorf formation; underlies Empire formation.

Type section (Weaver, 1944). In west limb of syncline at Coos Bay, Coos County.

†Tununk Sandstone Member (of Mancos Shale)[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 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. Tununk sandstone is yellowish-brown medium- to massive-bedded sandstone. Thickness 50 to 75 feet in section measured across Waterpocket fold near SW cor. T. 32 S., R. 8 E., at Bitter Creek divide, head of Halls Creek.

H. E. Gregory and R. C. Moore, 1931, U.S. Geol. Survey Prof. Paper 164, p. 108. Discussion of Kaiparowits region, Garfield and Kane Counties, Utah. Measured section, east side of Circle Cliffs, Garfield County, shows Tununk sandstone member of Mancos shale above "Tununk shale" of Gilbert and below "Blue Gate shale" of Gilbert. Thickness 65 feet.

C. B. Hunt, Paul Averitt, and R. L. Miller, 1953, U.S. Geol. Survey Prof. Paper 228, p. 80. Replaced by Ferron sandstone member of Mancos.

In Tununk Plateau, Henry Mountains region.

**Tununk Shale Member** (of Mancos Shale)

†Tununk Shale (in Mancos Shale)[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 present report his names for the shales are used in quotation marks because of doubt regarding the 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. "Tununk shale" consists of bluish-drab sandy shale grading to fossiliferous sandstone at base. Thickness 975 feet, measured section across Waterpocket fold near SW cor. T. 32 S., R. 8 E., at Bitter Creek divide, head of Halls Creek.

E. M. Spieker and J. B. Reeside, Jr., 1925, Geol. Soc. America Bull., v. 36, no. 3, p. 437. Discussion of Mancos shale in Wasatch Plateau. Mancos is divided into five members. Lower shale member, unnamed, is equivalent to "Tununk shale" of Gilbert's section in Henry Mountains and to Graneros and Greenhorn formations east of the Rockies. Underlies Ferron sandstone member which is faunal equivalent of Tununk sandstone of Gilbert's section in Henry Mountains.

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 structural basin shows Tununk shale member of Mancos shale underlies and grades into Ferron sandstone member; overlies Dakota sandstone. Thickness 550 feet.

C. B. Hunt, Paul Averitt, and R. L. Miller, 1953, U.S. Geol. Survey Prof. Paper 228, p. 37 (table), 79–80, pl. 1. Basal member of Mancos in Henry Mountains region; underlies Ferron sandstone member; overlies Dakota sandstone. Consists of dark-gray fissile shale containing a few thin beds of bentonite near base and top, and few thin, calcareous and shaly sandstone layers near middle; at top is series of interbedded sandstone and shale beds where member is transitional into overlying Ferron. Thickness 525 to 650 feet. Ferron sandstone of present report is Gilbert's (1877) Tununk sandstone.

Probably named for occurrences on Tununk Plateau, Henry Mountains.

Tununkian series[1]

Upper Cretaceous: Utah.

Original reference: C. R. Keyes, 1925, Pan-Am. Geologist, v. 43, p. 295.

†Tuolumne Group[1]

Triassic(?) and Jurassic(?): East-central California.

Original reference: N. L. Taliaferro, 1932, Geol. Soc. America Bull., v. 43, no. 1, p. 233–234.

N. L. Taliaferro, 1942, Geol. Soc. America Bull., v. 53, no. 1, p. 89. Amador group substituted for preoccupied name Tuolumne.

Named for Tuolumne County, in which group is well exposed.

**Tuolumne Intrusive Series**[1]

Cretaceous: Yosemite National Park.

Original reference: F. C. Calkins, 1930, U.S. Geol. Survey Prof. Paper 160, p. 121, map.

Includes named units (ascending) Sentinel Granodiorite, Half Dome Quartz Monzonite, Cathedral Peak Granite, and Johnson Granite Porphyry.

Named for exposures along Tuolumne River, Yosemite National Park.

**Tupelo Tongue** (of Coffee Sand)[1]

Upper Cretaceous: Northeastern Mississippi.

Original reference: L. W. Stephenson, 1917, Washington Acad. Sci. Jour., v. 7, p. 243–250.

L. W. Stephenson and W. H. Monroe, 1940, Mississippi Geol. Survey Bull. 40, p. 150–151. Thickness at type exposure 80 feet. Lower 50 feet consists of massive gray more or less calcareous, glauconitic sand with several widely separated ledges of calcareous sandstone; upper 30 feet is massive reddish ferruginous marine sand, grading downward into yellowish-green massive slightly glauconitic sand.

Type locality: Abandoned cut of Fulton Road on westward-facing slope of Old Town Creek Valley, sec. 33, T. 9 S., R. 6 E., 1½ miles east of Tupelo, Lee County.

**Tupper Complex**

Tupper Syenite[1]

Precambrian: Northern New York.

Original reference: H. P. Cushing, 1907, New York State Mus. 60th Ann. Rept., pt. 2, p. 476–482, 515, map.

U.S. Geological Survey has modified the name to Tupper Complex on the basis of a study now in progress.

Exposed about Tupper Lake, Franklin County.

Turkey Creek Beds (in Yegua Formation)[1]

Eocene: Eastern Texas.

Original reference: L. C. Reed and O. M. Longnecker, Jr., 1929, Texas Univ. Bull. 2901, p. 163–174.

Exposed on upper part of Turkey Creek and tributaries; also in North Turkey Creek, Brazos County.

**Turkey Creek Sandstone Member** (of Mineral Wells Formation)[1]

Turkey Creek Sandstone Member (of Keechi Creek Formation)

Middle Pennsylvanian: Central northern Texas.

Original references: F. B. Plummer and R. C. Moore, 1921, Texas Univ. Bull. 2132, p. 77–88, charts; 1922, Jour. Geology, v. 30, p. 25, 31.

M. G. Cheney, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 1, p. 66 (fig. 1), 87, 88. Reallocated to member status in Keechi Creek formation. Basal member of formation; underlies unnamed limestones; overlies unnamed sandstones and limestone that overlie Dog Bend limestone member of 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. Sandstone forms continuous trace from Parker County line to main east fork of Rock Creek and marks base of Keechi Creek formation. Thin to massive bedded, with faint evidences of crossbedding; no conglomerate observed in Parker County. Thickness 10 to 12 feet. Underlies unnamed shale and sandstone member; overlies unnamed shale member of Salesville formation.

Type locality: On Turkey Road, 2¼ miles northwest of Mineral Wells, Palo Pinto County.

Turkey Mountain Andesite

Quaternary: Northeastern New Mexico.

R. F. Collins, 1949, Geol. Soc. America Bull., v. 60, no. 6, p. 1033. Rock is gray-green fine-grained porphyritic andesite with ferromagnesian phenocrysts up to 10 mm. long forming 50 percent of rock. Not known whether hornblende andesite is dominant rock or a differentiation fraction.

At head of Slagle Canyon in sec. 16, T. 27 N., R. 25 E., 8 miles northwest of Chico in eastern Colfax County.

Turkey Mountain Flows (of Chico Phonolites)

Quaternary: Northeastern New Mexico.

R. F. Collins, 1949, Geol. Soc. America Bull., v. 60, no. 6, p. 1036. Gray-green fine-grained porphyritic phonolites with much local variation in size of orthoclase phenocrysts. Top surfaces of flows undulate gently and are covered with thin soil and phonolite joint blocks.

Comprise four flow areas around Turkey Mountain, 9 miles northwest of Temples Peak, Colfax County.

Turkey Mountain Member (of Hoosac Formation)

Cambrian or Lower Ordovician: Eastern Vermont.

J. B. Thompson, Jr., *in* M. P. Billings, John Rodgers, and J. B. Thompson, Jr., 1952, Geol. Soc. America Guidebook for Field Trips in New England, p. 41. Consists of amygdaloidal greenstone and greenstone schist, metamorphosed locally to epidote-amphibolite. Thickness 0 to 1,000 feet. Overlies Bull Hill member (new). At approximate position of Plymouth member (new) in Chester dome and on east limb of Green Mountain anticlinorium from Jamaica south. Not present at Ludlow.

Type locality and derivation of name not stated.

Turkey Ridge Sandstone Member[1] (of Marcellus Formation)

Middle Devonian: Central Pennsylvania.

Original reference: Bradford Willard, 1935, Geol. Soc. America Bull., v. 46, no. 2, p. 202–203.

H. H. Arndt, 1959, Geol. Soc. America Guidebook Pittsburgh Mtg., p. 4, 27. In Juniata, Mifflin, and Perry Counties, the Marcellus is subdivided into three members (ascending): Shamokin shale, Turkey Ridge sandstone, and Mahanoy shale. Thickness 103 feet in East Waterford section if the shaly beds exposed in syncline axis represent Mahanoy member. Northeast along strike, the Turkey Ridge member is persistent for 25 miles to type locality. East and southeast, it is included in base of Montebello formation.

Named for Turkey Ridge which separates Juniata and Perry Counties.

**Turkey Run Limestone Member** (of Pawhuska Formation)

†Turkey Run Limestone Member (of Buck Creek Formation)[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, 153.

M. C. Oakes, 1959, Oklahoma Geol. Survey Bull. 81, p. 49. In northern Osage County, the Pawhuska contains six limestone members (ascending) : Lecompton, Plummer, Deer Creek, Little Hominy, Pearsonia (new), and Turkey Run.

P. B. Greig, 1959, Oklahoma Geol. Survey Bull. 83, p. 25, 41–44. In Pawnee County, the Turkey Run is a single bed of dense gray fossiliferous limestone. Thickness 1½ to 3 feet. Overlies Lecompton limestone member; underlies Severy shale of Wabaunsee group.

Named for exposures near head of Turkey Run, in secs. 9, 16, and 17, T. 24 N., R. 8 E., Osage County.

Turkey Track limestone layer (in Richmond Group)[1]

Upper Ordovician: Southwestern Ohio.

Original reference: J. J. Wolford, 1930, Ohio Jour. Sci., v. 30, no. 5, p. 304.

Turlock Lake Formation

Pliocene, upper, and Pleistocene, lower: Central California.

S. N. Davis and F. R. Hall, 1959, Stanford Univ. Pub. Geol. Sci., v. 6, no. 1, p. 12, 13–16, pls. 2, 3. Name applied to oldest post-Mehrten formation in area (eastern Stanislaus and northern Merced Counties). Consists of sand, gravel, and silt. Thickness at type locality 51 feet; however, thickness is not definitely known due to difficulties in picking upper contact in subsurface; probable thickness shown on geologic cross section (pl. 3) ranges from 300 to 850 feet. Conformably overlies Mehrten formation; in some areas contact is sharp but in many places there is a transitional zone of decreasing andesitic material and increasing amounts of quartz, feldspars, and biotite. Crops out east of younger Riverbank formation (new); probably continuous with Laguna formation of Mokelumne area.

Type section: NW¼SE¼, SW¼SE¼, SE¼SW¼, NE¼SW¼ sec. 31, T. 3 S., R. 13 E., Cooperstown quadrangle; section consists of series of exposures on hill in Turlock Lake State Park, eastern Stanislaus County. Crops out in northwest-southeast trending belt of variable width.

Turnbull Conglomerate

Miocene and Pliocene: Southern California.

G. J. Bellemin, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 4, p. 652 (fig. 1), 655–656. Named as one of five conglomerates interbedded in Miocene and Pliocene shales of Puente Hills, Los Angeles County.

Named for its occurrence on north slope of Turnbull Canyon.

Turner cyclothem (in McLeansboro Group)

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 Turner limestone. Type locality given.

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 56 (table 3). Replaced by Trivoli cyclothem.

Type locality: NW¼NE¼ sec. 29, T. 33 N., R. 1 W., Putnam County.

Turner Limestone (in McLeansboro Formation)

Turner 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 Hicks limestone (new) and above Lonsdale limestone.

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 Turner cyclothem. Type locality given.

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 38, 56 (table 3). Replaced by Cramer limestone member of Modesto formation (both new).

Type locality: NW¼NE¼ sec. 29, T. 33 N., R. 1 W., Putnam County.

**Turner Sandy Member** (of Carlile 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, 1951, Am. Assoc. Petroleum Geologists Bull., v. 35, no. 10, p. 2187–2189. Consists of 185 to 260 feet of dark-gray noncalcareous shale with many lighter gray sandy shale partings that contain thin lenses of fine- to very fine-grained sandstone. Underlies Sage Breaks member; overlies unnamed member. Well exposed 6 miles north of Belle Fourche, Butte County, S. Dak.

Named for exposures along Turner Creek in Tps. 46 and 47 N., R. 64 W., Weston County, Wyo.

**Turner Creek Shale Member** (of Topeka 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. 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. 126 (fig. 22), 164; G. E. Condra, 1949, Nebraska Geol. Survey Bull. 16, p. 21; F. C. Greene and W. V. Searight, 1949, Missouri Geol. Survey and Water Resources Rept. Inv. 11, p. 18. Turner Creek shale member of Topeka formation; underlies Du Bois limestone member; overlies 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). Largely light- to bluish-gray massive shale that is in part calcareous with some interbedded lime nodules. Thickness 3½ feet, Fremont County; 6.1 feet in Pottawattamie County. Underlies Du Bois limestone member; where Du Bois is absent, underlies Holt shale member; overlies Sheldon limestone member.

Named for exposures on Turner Creek, southeast of Du Bois, Pawnee County, Nebr.

**Turners Falls Sandstone**

Triassic: Central 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 thinly bedded shaly red sandstone, locally micaceous. Near Bull Hill at south end of Mount Toby highland, brick-red sandstone and fine conglomerate occur. Thicker parts to north are finer grained, contain ripple marks, dinosaur tracks, and fossil fish. Unconformably underlies Mount Toby conglomerate; overlies Deerfield diabase. Most northern exposures in Mount Toby quadrangle and those in Greenfield quadrangle were mapped as Longmeadow sandstone by Emerson (1898, U.S. Geol. Survey Geol. Atlas, Folio 50) and as Chicopee shale by Emerson (1917, U.S. Geol. Survey Bull. 599). Southern continuations were previously included in Mount Toby conglomerate.

M. E. Willard, 1952, Bedrock geology of the Greenfield quadrangle, Massachusetts: U.S. Geol. Survey Geol. Quad. Map [GQ–20]. Includes gray to black thin-bedded sandy shale and grayish-red sandstone interbedded with sandy limestone in Greenfield quadrangle. Thickness 400 to 600 feet in central part of quadrangle. Continental origin.

Type locality: Vicinity of town of Turners Falls near northern boundary of Greenfield quadrangle. Well exposed along Massachusetts State Highway between Turners Falls and French King Bridge in Millers Falls quadrangle.

Turnley Hornstone[1] or Shale[1]

Precambrian (Belt Series) : Western central Montana.

Original reference: W. H. Weed, 1901, U.S. Geol. Survey 22d Ann. Rept., pt. 2, p. 434, map.

Occurs only on slopes above Turnley placer, in southwestern part of Elkhorn mining district, Elkhorn region.

Turpin Sandstone Member (of Grassy Creek Shale)

Upper Devonian: Northeastern Missouri.

M. G. Mehl, 1960, Denison Univ. Jour. Sci. Lab., v. 45, art. 5, p. 84–85. Name applied to sandstone at base of Grassy Creek shale. Sandstone commonly pale buff that becomes various shades of brown and reddish brown upon weathering. Physical properties vary considerably from place to place. Thickness 1 inch to as much as 15 inches or more. Conodont fauna indicates upper Devonian age comparable to that of the Hardin of Tennessee.

Type locality: At spring near roadside in NW¼SW¼NE¼ sec. 3, T. 52 N., R. 1 E., about 2½ miles northeast of community of Turpin, Pike County.

**Turquoise Granite**

Triassic or Jurassic: Southeastern Arizona.

James Gilluly, 1956, U.S. Geol. Survey Prof. Paper 281, p. 8, 65–67, pl. 5. Highly sericitic, silicified granite. Extremely altered. Poorly exposed; hence, its relations to adjacent formations can only locally be unequivocally determined. Exposures north and south of Brown's Peak clearly indicate that it intrudes Bolsa quartzite and Pinal schist. Boundaries with Gleeson quartz monzonite and Copper Belle monzonite porphyry (both new) are faults, and none of these three rocks show facies changes that are noticeably related to the contacts. Known to be of post-Cambrian age and is probably post-Paleozoic, but is older than period of thrust faulting that has affected region, as shown not only by the faults referred to but also by flat fault contact beneath block of Escabrosa limestone resting on it on south wall of Arroyo that divides Brown's Peak from Gleeson Hill. Relations with Sugarloaf quartz latite (new) uncertain, owing to intense sericitization that both rocks have undergone along their mutual contacts. Assigned to early Mesozoic.

Named for Turquoise Ridge, west of Courtland, in secs. 17, 20, and 23, T. 19 S., R. 25 E., on west slope of which it is widely exposed, central Cochise County.

Turtleback Complex[1]

Pre-Devonian-Late Mesozoic(?) : Northwestern Washington.

Original reference: R. D. McLellan, 1927, Washington Univ. Pub. in Geology, v. 2, p. 142–154.

W. R. Danner, 1960, (abs.) Geol. Soc. America Bull., v. 71, no. 12, pt. 2, p. 2056. Turtleback complex, described as a variety of intrusive rocks, offshoots of a late Jurassic batholith located on Vancouver Island, is now known to include many areas of an amphibolite gneiss complex intruded by diorite rocks of pre-Devonian. Granitic rocks thought to be early Mesozoic or later age also present. In addition are volcanic and sedimentary rocks of Devonian, early Permian, and middle and late Permian age.

Well exposed on Turtleback Mountain, San Juan Islands.

Tusas Granite

Precambrian (Proterozoic) : Central northern New Mexico.

Evan Just, 1937, New Mexico School Mines Bull. 13, p. 13 (table 1), 44–46, pl. 3. Varies greatly in composition and texture. In general, composed of medium-sized grains and is nonporphyritic. With exception of large dike north of Kiawa Mountains, granite south of Tusas Mountain is pink and noticeably lacking in ferromagnesian minerals. In dike and north of Tusas Mountain, rock is gray, contains a good deal of biotite, and varies from monzonite to quartz monzonite in composition. Probably intruded during Pueblo revolution. Intrudes all older Proterozoic rocks in area which are considerably altered.

Fred Barker, 1958, New Mexico Bur. Mines Mineral Resources Bull. 45, p. 59. Replaced by Maquinita granodiorite and Tres Piedras granite.

Part of large intrusive mass that is irregularly exposed along east side of Petaca area from Jawbone Mountain to Servilleta Plaza and in scattered inliers near Tres Piedras. Also outcrops at Ojo Caliente Mountain and in some of adjacent hills. In dike between Tusas and Kiawa Mountains, Rio Arriba County.

Tusayan series[1]

Carbonic: Northern Arizona.

Original reference: Charles Keyes, 1936, Pan-Am. Geologist, v. 66, no. 3, p. 215 (chart).

In Grand Canyon region.

†Tuscahoma Marl[1]

Eocene, lower: Southwestern Alabama.

Original reference: E. A. Smith and L. C. Johnson, 1887, U.S. Geol. Survey Bull. 43, p. 50.

Named for exposures at Tuscahoma, on Tombigbee River, in Choctaw County.

**Tuscahoma Sand**[1] **or Formation** (in Wilcox Group)

Eocene, lower: Southern Alabama, Georgia, and eastern Mississippi.

Original reference: E. A. Smith, 1888, Alabama Geol. Survey Rept. Prog. 1884–88, geographic map of Alabama.

L. D. Toulmin, Jr., 1944, Southeastern Geol. Soc. [Guidebook] 1st Field Trip, p. 9. Extends entirely across state of Alabama and consists of about 200 feet of unfossiliferous crossbedded sand and stratified sandy clay. In central and western Alabama, contains two fossiliferous marl beds, Greggs Landing marl and Bells Landing marl. Formation is here considered to include all the strata up to the base of the Bashi marl; it is thus extended to include the 3-foot lignite bed and overlying crossbedded sand and sandy clay strata, about 70 feet thick, that have been included heretofore in Bashi formation. Overlies Nanafalia formation.

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 Tuscahoma sand present in Georgia.

R. J. Hughes, Jr., 1958, Mississippi Geol. Survey Bull. 84, p. 166–177, pls. 1, 5. Tuscahoma sand described in Kemper County, Miss., where it is as much as 300 feet thick. Overlies Nanafalia formation; underlies Bashi marl member of Hatchetigbee formation. Wilcox group.

P. E. LaMoreaux and L. D. Toulmin, 1959, Alabama Geol. Survey County Rept. 4, p. 22, 124–141. Tuscahoma sand described in Wilcox County, Ala., where it includes all strata from top of Nanafalia formation to base of Bashi member of Hatchetigbee formation. Includes Greggs Landing marl member below and Bells Landing marl member above. Thickness about 275 feet.

Named for exposures at Tuscahoma, on Tombigbee River, in Choctaw County, Ala.

**Tuscaloosa Formation,**[1] **Gravel,** or **Group**

Upper Cretaceous: Coastal Plain from western Tennessee, northeastern Mississippi, and northwestern Alabama, across Alabama, Georgia, South Carolina, and North Carolina.

Original reference: E. A. Smith and L. C. Johnson, 1887, U.S. Geol. Survey Bull. 43, p. 18, 95–117, 136–138, pl. 11.

C. W. Cooke, 1936, U.S. Geol. Survey Bull. 867, p. 17–25. Formation is thought to include all strata of Upper Cretaceous age exposed at surface in South Carolina below Black Creek formation, but it is possible that beds older than the Tuscaloosa may some day be differentiated from these deposits in North Carolina and South Carolina. Term Tuscaloosa is herein substituted for name Middendorf formation as used by Cooke (1926, U.S. Geol. Survey Prof. Paper 140–E). Sand and gravel like those of Tuscaloosa formation and doubtless of same age make up at least the greater part of Cape Fear formation of North Carolina, which is now designated "Tuscaloosa," although it is possible that beds older than typical Tuscaloosa may be included in it. In South Carolina, the Tuscaloosa rests directly on crystalline rocks of the Piedmont without interposition of older Cretaceous deposits. Time interval represented by this unconformity includes all of Triassic, Jurassic, and Lower Cretaceous time, probably much of Paleozoic time, and perhaps early part of Upper Cretaceous.

Tom McGlothlin, 1944, Am. Assoc. Petroleum Geologists Bull., v. 28, no. 1, p. 40–43. Series of beds now called "Tuscaloosa formation" can be subdivided into two formations. In this report [Mississippi] these beds are referred to as lower Tuscaloosa and upper Tuscaloosa. There appears to be major unconformity between the two, with lower wedging out updip and being overlapped by upper. It would probably be logical to restrict term "Tuscaloosa" to those beds that are here assigned to upper Tuscaloosa, and give new name to lower beds, but name is not proposed in this report.

L. C. Conant and W. H. Monroe, 1945, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 37; W. H. Monroe, L. C. Conant, and D. H. Eargle, 1946, Am. Assoc. Petroleum Geologists Bull., v. 30, no. 2, p. 187–212. Rank raised to group to include (ascending) Cottondale, Eoline, Coker, and Gordo formations (all new). Overlies undifferentiated Paleozoic rocks; underlies McShan formation.

W. E. Belt, 1945, Geologic map of Mississippi (1:500,000): Mississippi Geol. Survey. Formation, undifferentiated, mapped in Mississippi.

Erling Dorf, 1952, Am. Assoc. Petroleum Geologists Bull., v. 36, no. 11, p. 2161–2184. An analysis of Cretaceous stratigraphy and paleobotany of Atlantic Coastal Plain. In South Carolina, plant-bearing beds of upper part of Cooke's (1936) Tuscaloosa formation are reassigned to Middendorf member of Black Creek formation, and are shown to be equivalent in age to lower Black Creek formation of North Carolina. Name "Tuscaloosa" is abandoned for beds in both North and South Carolina which are here referred to "Lower Cretaceous? (undifferentiated)".

C. W. Drennen, 1953, Am. Assoc. Petroleum Geologists Bull., v. 37, no. 3, p. 522–538. Group contains only two units of formational rank—lower unit, Coker formation, which is redefined to include all beds of pre-Gordo Tuscaloosa age, and upper unit, Gordo formation. Name Cottondale abandoned; Eoline reduced in rank to member of Coker formation.

D. H. Eargle, 1955, U.S. Geol. Survey Bull. 1014, p. 8–23, pls. 1, 2. Formation described in report on outcropping Cretaceous rocks of Georgia. Consists generally of coarse to gravelly and arkosic sand, and of subordinate beds of mottled clay and silt. Average thickness 250 feet. Overlies crystalline rocks; underlies Eutaw formation. Formation crops out in gradually narrowing east-northeastward-trending belt from Chattahoochee River near Columbus to Ocmulgee River near Macon; belt is about 11 miles wide in Chattahoochee River valley, 6 miles wide in Flint River valley, and 5 miles wide at Ocmulgee River.

R. G. Stearns, 1957, Geol. Soc. America Bull., v. 68, no. 9, p. 1077, 1093 (fig. 13). Subsurface data show that in northern Mississippi Embayment Cretaceous, Paleocene, and lower Eocene deposition occurred in single sedimentary cycle. Cycle began with Cretaceous deposition of nonmarine Tuscaloosa gravel, restricted in area.

G. E. Siple, 1957, Carolina Geol. Soc. Guidebook for the South Carolina Coastal Plain Field Trip Nov. 16–17, p. 3–5, geol. map. Formation in South Carolina consists typically of light-gray, white, or buff arkosic sand gravel interbedded with white, pink, brown, or purple clay. Formation broken by many local unconformities. Thickness 0 to 800 feet. Crops out in belt gradually widening from 10 to 40 miles, extending in northeasterly direction from Aiken County to Marlboro County. Map shows Tuscaloosa underlies Black Creek formation.

J. L. Stuckey and S. G. Conrad, 1958, North Carolina Div. Mineral Resources Bull. 71, p. 43–44; J. L. Stuckey, 1958, Geologic map of North Carolina (1:500,000): North Carolina Div. Mineral Resources. Described and mapped in North Carolina where it is oldest recognized formation exposed at surface in Coastal Plain. Underlies Black Creek formation; in some areas, covered by younger sediments of unknown age. Main outcrop lies along western part of Coastal Plain and extends southwest from Neuse River.

Named for Tuscaloosa, Tuscaloosa County, Ala., and Tuscaloosa (Black Warrior) River at Steele's Bluff and White's Bluff, Hale County, Ala.

**Tuscan Formation**

Tuscan Tuff[1]

Pliocene: Northern California.

Original reference: J. S. Diller, 1895, U.S. Geol. Survey Geol. Atlas, Folio 15.

C. A. Anderson and R. D. Russell, 1939, California Jour. Mines and Geology, v. 35, no. 3, p. 231–232, pl. 3. Formation consists of series of volcanic breccias, tuffs, volcanic gravels and sands, and tuffaceous clays. Maximum thickness about 1,000 feet. Greatest thickness occurs along eastern edge of formation, where only breccias are found. Thins in direction of Sacramento Valley, where gravels, sands, silts and clays are interbedded with the breccias. Contemporaneous with and interfingers with Tehama formation in their zone of junction. Nomlaki tuff member interbedded in both formations.

R. C. Treasher, 1947, (abs.) Geol. Soc. America Bull., v. 58, no. 12, pt. 2, p. 1257. In Tehama and Tuscan Buttes quadrangles, subdivided into five members (ascending): Supan tuff and sand, Bald Hill agglomerate, Seven-Mile tuff and sand, Iron Canyon agglomerate, and Sacramento tuff and sand.

Named for exposures at or near Tuscan Springs, Lassen Peak quadrangle.

**Tuscarora Sandstone[1] or Quartzite[1]**

Tuscarora Formation

Lower Silurian: Central southern and eastern Pennsylvania, western Maryland, western Virginia, and eastern West Virginia.

Original reference: N. H. Darton, 1896, U.S. Geol. Survey Geol. Atlas, Folio 28.

C. K. Swartz and others, 1942, Geol. Soc. America Bull., v. 53, no. 4, chart 3. Correlation chart shows Tuscarora (Clinch) sandstone in Albion series. Underlies Clinton group. Underlies Castanea sandstone in northern Pennsylvania.

F. M. Swartz, 1948, Pennsylvania Geologists Guidebook 14th Ann. Field Conf., supp., diagram (following p. 4), fig. 3. In Lewiston region, Pennsylvania, overlies Run Gap sandstone (new).

H. H. Arndt and others, 1959, Geol. Soc. America Guidebook Pittsburgh Mtg., p. 6, pl. 1. In central Pennsylvania, Tuscarora formation (the White Medina of Pennsylvania Second Geologic Survey) is gradational with overlying Rose Hill formation and transitional with underlying Juniata formation. Thickness 350 to 750 feet.

Named for Tuscarora Mountain which extends along border line of Juniata and Perry Counties, Pa.

**Tuscher Formation**[1] (in Mesaverde Group)

Tuscher Formation (in Wasatch Group)

Upper Cretaceous: Central eastern Utah.

Original reference: D. J. Fisher, 1936, U.S. Geol. Survey Bull. 852.

E. M. Spieker, 1946, U.S. Geol. Survey Prof. Paper 205–D, p. 140, 142. Measured section of post-Castlegate rocks on Green River between Desolation Canyon and Range Creek, Utah, shows Tuscher(?) formation, 215 feet thick, disconformable above Price River formation and below North Horn formation. This unit is almost certainly Tuscher formation of Fisher's (1936) section in eastern Book Cliffs. The place of the Tuscher in Price River-North Horn succession of the western Book Cliffs, however, is not settled. Stratigraphic evidence on Green River, as well as that observed by Fisher in the Book Cliffs, suggests alliance of the Tuscher with the overlying rather than the underlying strata. Present conclusion is that the Tuscher is a coarse basal phase of North Horn formation. This still leaves question concerning relationships to west. Along Green River, the Tuscher is disconformable on underlying Price River formation and contrastively different, whereas in western part of Book Cliffs there is no apparent break between the Price River and North Horn formations. Throughout eastern Book Cliffs, base of Tuscher marks first strong change in Cretaceous section above Mancos shale, and it would seem to signify break of regional importance.

M. D. Williams, 1950, Utah Geol. Soc. Guidebook 5, p. 104, 105. Assigned to Wasatch group (redefined).

J. D. Fisher, C. E. Erdmann, and J. B. Reeside, Jr., 1960, U.S. Geol. Survey Prof. Paper 332, p. 11 (table), 18–19, 60, 62–63. Little direct evidence of age of Tuscher is available; since it seems to be essentially equivalent to Hunter Canyon formation and appears to be older than undifferentiated North Horn and Flagstaff formations, it is here assigned to Mesaverde group and arbitrarily considered of Late Cretaceous age. Overlies Farrer formation. Thickness on Green River 215 feet; east of Green River 267 to 600 feet.

Named after canyon in T. 20 S., R. 17 E., Grand County. Makes continuous unit in Book Cliffs of Utah east of Green River.

**Tuscumbia Limestone**[1]

Upper Mississippian: Northern Alabama.

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

P. E. LaMoreaux, G. W. Swindel, Jr., and C. R. Lanphere, 1950, Alabama Geol. Survey Bull. 62, p. 24 (table 1), 26–27. Limestone units of Warsaw and St. Louis age are herein considered as a unit, for which name Tuscumbia limestone is applied. Thickness about 200 feet. Overlies Fort Payne chert; underlies Ste. Genevieve limestone.

G. W. Stose, 1952, Washington Acad. Sci. Jour., v. 42, no. 8, In Murphree Valley anticline, underlies Bangor limestone and overlies Fort Payne chert. Contains many lentils and thick beds of sandstone.

G. T. Malmberg and H. T. Downing, 1957, Alabama Geol. Survey County Rept. 3, p. 40–43. Described in Madison County where it is composed of about 150 to 200 feet of thin- to thick-bedded, gray, fine to coarsely crystalline, highly fossiliferous limestone with small amounts of gray to white chert occurring as irregular lenses and nodules. Includes rocks between Fort Payne chert and Ste. Genevieve limestone and is equivalent to St. Louis and Warsaw limestones of Mississippi Valley region.

Named for exposures at Tuscumbia, Colbert County.

Tushar Conglomerate

Cretaceous(?): Southwestern Utah.

R. R. Kennedy, 1960, Brigham Young Univ. Research Studies, Geology Ser., v. 7, no. 4, p. 26, 27, geol. map. Limestone conglomerate, light to dark gray, pebble-size to smaller, well cemented. Thickness 65 feet. Overlies Winsor formation, marked unconformity. Unconformable below Sevier River formation.

Measured section is in eastern Tushar Range, on north side of Tenmile Creek, sec. 36, T. 28 S., R. 4 W., 7 miles southwest of Marysvale, Piute County.

Tuskahoma Siliceous Shale Member (of Stanley Shale)

Tuskahoma Siliceous Shale Member (of Tenmile Creek Formation)

Mississippian: Southeastern Oklahoma.

August Goldstein, Jr., and T. A. Hendricks, 1953, Geol. Soc. America Bull., v. 64, no. 4, p. 431. Stanley shale is divided into four siliceous shale members (ascending): Basal Ten Mile Creek, Tuskahoma siliceous shale, Middle Ten Mile Creek, and Moyers. The Tuskahoma is typically carbonaceous and pyritiferous. With exception of the Tuskahoma, the names used in describing these beds are those originated by Harlton (1938), but they have been restricted to apply to the siliceous shale beds in instances where Harlton applied the name to the siliceous shale and the overlying sandstone and shale beds.

L. M. Cline, 1960, Oklahoma Geol. Survey Bull. 85, p. 25 (table 2), 30. Reallocated to member status in Tenmile Creek formation.

Type locality: Center of west side of sec. 22, T. 2 N., R. 20 E., Pushmataha County, approximately 4½ miles east of Tuskahoma on U.S. Highway 271. Crops out near Potato Hills.

Tusonimo Limestone (in Pàcheta Member of Lowell Formation)

Lower Cretaceous: Southeastern Arizona.

A. A. Stoyanow, 1949, Geol. Soc. America Mem. 38, p. 12. Gray weak arenaceous limestone, in places pinkish and earthy. Thickness 8 feet. Underlies Cienda limestone (new); overlies unnamed sandstone.

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.

**Tusquitee 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. 4.

G. W. Stose and A. J. Stose, 1949, Geol. Soc. America Bull., v. 60 no. 2, p. 284–285. In Murphy syncline, Keith (1907) and La Forge and Phalen (1913, U.S. Geol. Survey Geol. Atlas, Folio 187) mapped a white quartzite—the Tusquitee—which overlies Nantahala slate and underlies Brasstown schist and Valleytown formation. At most places, Keith mapped the quartzite in two parallel lenticular bands with anticlines of Nantahala slate between. These white quartzites are herein correlated with Big Butt quartzite, and the intervening slaty beds are regarded not as Nantahala slate but as part of the Big Butt quartzite equivalent to the fine-grained arkosic quartzite and argillite that separate the two quartzite beds of the Big Butt on Bald Mountain.

G. W. Crickmay, 1952, Georgia Geol. Survey Bull. 58, p. 27. Included in Talladega series believed to be Precambrian. Thickness 500 to 600 feet in Georgia.

Named for exposures in Tusquitee Mountains, Clay County, N.C.

Tusseyville Limestone

[Ordovician]: Central Pennsylvania.

R. R. Conlin and others, 1957, Geol. Soc. America Guidebook Ann. Mtg., Field Trips, p. [279] (pl. 3). Incidental mention in structure section. Underlies Bellefonte dolomite; overlies Salona limestone.

In section from Tyrone Gap to Birmingham.

Tuttle 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 sandstone, 5 to 50 feet thick, in Manning formation about 75 feet above Goodbread sandstone [member] (new). Separated from overlying Yuma sandstone member by shaly zone 30 to 60 feet thick. Renick (1936, Texas Univ. Bull. 3619) called unit Dilworth on assumption that it was equivalent to Dilworth sandstone of Gonzales County.

Type locality: In abandoned Southern Pacific right-of-way 1½ miles north of Piedmont, Grimes County.

Tutu 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. Relatively coarse volcanic wacke, composed almost entirely of unweathered Louisenhoj debris, with minor admixed limestone debris. Includes Coki Point megabreccia lithofacies (new). Congo Cay limestone member (new) present near top. Exposed thickness 6,000 feet. Overlies Outer Brass formation (new). May be older than or equivalent to Hans Lollik formation (new). Virgin Island group considered of Cenomanian age.

Report discusses geology of St. Thomas and St. John Islands.

**Tuxedni Group**

Tuxedni Sandstone[1] or Formation

Middle and Upper Jurassic: Central southern Alaska.

Original reference: G. C. Martin and F. J. Katz, 1912, U.S. Geol. Survey Bull. 485, p. 59, map, chart facing p. 30.

L. B. Kellum, 1945, New York Acad. Sci. Trans., ser. 2, v. 7, no. 8, p. 203 (table 1), 207, 209. Formation comprises (ascending) sandy shale with numerous stringers of shaly sandstone, 1,250 feet thick; Cynthia Falls member (new), 800 feet; sandy shale with stringers of shaly sandstone, 950 feet; and Tonnie sandstone member (new), 1,200 feet. Total thickness 4,000 feet. Overlies Kialagvik formation. Underlies Chinitna shale member of Shelikof formation on Iniskin-Chinitna Peninsula.

C. E. Kirschner and D. L. Minard, 1948, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 95 [1949]. Formation includes (ascending) lower siltstone member, Cynthia Falls sandstone member, Bowser member (new), and Tonnie siltstone member. Underlies Chinitna siltstone. Middle and Upper Jurassic.

R. W. Imlay, 1953, U.S. Geol. Survey Prof. Paper 249–B, p. 49, 51, table 5 facing p. 60. In most places, siltstones assigned to Tonnie member cannot be separated from overlying siltstones of Chinitna formation. Therefore, Tonnie reassigned to Chinitna. Age of formation given as Middle Jurassic.

U.S. Geological Survey currently classifies the Tuxedni as a group on the basis of work now in progress.

Type section: On south shore of Tuxedni Bay, Cook Inlet region.

Twelvemile Beds[1]

Tertiary: Southwestern Alaska.

Original reference: J. E. Spurr, 1898, U.S. Geol. Survey 18th Ann. Rept., pt. 3.

Exposed at junction of Twelvemile Creek and Mission Creek, Yukon gold district.

**Twelvemile Canyon Member** (of Arapien Shale)

Upper Jurassic: Central Utah.

E. M. Spieker, 1946, U.S. Geol. Survey Prof. Paper 205–D, p. 122, 125. Shale, gray in lower part, with prominent red blotches in main part, deep-red and salt-bearing member in upper 500 feet; beds of sandstone and gypsum in middle. Thickness about 7,000 feet. Basal member of Arapien; underlies Twist Gulch member (new). Base of Arapien not located in entire region south of Wasatch Mountains.

W. N. Gilliland, 1951, Nebraska Univ. Studies, new ser., no. 8, p. 10–15. Term Arapien shale restricted to Twelvemile Canyon member, and term Twist Gulch member raised to formational rank. Change credited to Hardy and Spieker (in preparation).

Named for outcrops in Twelvemile Creek west of Arapien Valley, Sanpete County.

**Twentymile Sandstone Member** (of William Fork Formation)[1]

Twentymile Sandstone[1] (in Mesaverde Group)

Upper Cretaceous: Northwestern Colorado.

Original reference: N. M. Fenneman and H. S. Gale, 1906, U.S. Geol. Survey Bull. 297, p. 27.

N. W. Bass, J. B. Eby, and M. R. Campbell, 1955, U.S. Geol. Survey Bull. 1027–D, p. 158, pl. 19. Member is commonly massive white ledge-forming sandstone about 100 to 200 feet thick. Occurs above lower unnamed member, about 1,000 feet thick, consisting of shale, sandstone, and coal beds and below upper unnamed member, about 200 feet thick, consisting of sandstone, sandy shale, shale, and coal.

Named for Twentymile Park, about 10 miles northwest of Yampa, Routt County.

**Twiggs Clay Member** (of Barnwell Formation)[1]

Eocene, upper: Eastern Georgia.

Original references: C. W. Cooke and H. K. Shearer, 1917, Georgia Geol. Survey Bull. 31, p. 14, 158–173; 1918, U.S. Geol. Survey Prof. Paper 120–C, p. 51–56.

P. E. LaMoreaux, 1946, Georgia Geol. Survey Bull. 50, pt. 1, p. 11–17. In northern Washington and southern Jones, Baldwin, and Hancock Counties, consists of about 25 feet of pale-green hackly fuller's earth clay; to south and southwest in western Washington and Wilkinson Counties, thickens gradually and locally includes 20 to 40 feet of green hackly clay which grades down into 10 feet of gray marl, which in turn grades at some localities into 15 feet of calcareous sand at base of member. Near type locality, attains maximum thickness of 80 feet. In western and northern part of Twiggs County, interfingers with Ocala limestone (Tivola tongue). Conformably underlies Irwinton sand member (new). Type locality stated.

J. F. L. Connell, 1958, Southwestern Louisiana Jour., v. 2, no. 4, p. 321, 325, 328. Basal part of Barnwell. Conformably underlies Irwinton sand member.

Type locality: At Pikes Peak Station on Macon, Dublin, and Savannah Railroad, Twiggs County.

**Twilight Granite**[1]

Precambrian: Southwestern Colorado.

Original reference: W. Cross and E. Howe, 1905, U.S. Geol. Survey Geol. Atlas, Folio 131.

F. H. T. Rhodes and J. H. Fisher, 1957, Am. Assoc. Petroleum Geologists Bull., v. 41, no. 11, p. 2514, 2518. Granite in most areas of its occurrence is light in color and intrudes schist; in localities where it underlies Ignacio quartzite, it is dark colored and contains abundant biotite which is oriented to give distinct foliation. Most contacts with Ignacio unconformable.

Composes Twilight Peak in Needle Mountains quadrangle.

Twilight Park Conglomerate

Upper Devonian: New York.

C. S. Prosser, 1899, New York State Geologist 17th Ann. Rept., p. 283–284. Incidental mention.

G. H. Chadwick, 1940, New York State Geol. Assoc. 16th Ann. Mtg. Field Guide Leaflets, p. 2. In list of formations in Catskill region below Onteora redbeds and above Kaaterskill sandstone. Cobbly puddingstone 40 feet thick.

G. H. Chadwick, 1944, New York State Mus. Bull. 336, p. 126, 130. Conglomerates at base of Onteora redbeds are Twilight Peak conglomerate of Prosser 1899.

Exposed in Twilight Park, one-half mile southeast of Haines' corners, Greene County.

Twin Bridges Limestone

[Eocene(?)] to Miocene: Central southern Idaho and northeastern Nevada.

F. B. Van Houten, 1956, Am. Assoc. Petroleum Geologists Bull., v. 40, no. 12, p. 2816 (fig. 6). Name appears only on stratigraphic chart.

Twin Buttes Member (of Bridger Formation)[1]

Eocene: Southwestern Wyoming.

Original reference: H. E. Wood 2d, 1934, Am. Mus. Nat. History Bull., v. 67, art. 5, p. 241–242.

H. E. Wood 2d, 1941, Geol. Soc. America Bull., v. 52, no. 1, p. 34, pl. 1. Bridgerian. Overlies Blacks Fork member.

Type locality: Henrys Fork Table and Twin Buttes. Name is taken from Twin Buttes, west of Green River and east of Henrys Fork Table, Sweetwater County.

**Twin Creek Limestone[1] or Formation**

Middle and Upper Jurassic: Southwestern Wyoming, southeastern Idaho, and northeastern Utah.

Original reference: A. C. Veatch, 1907, U.S. Geol. Survey Prof. Paper 56, p. 56, chart opposite p. 50, map.

R. W. Imlay, 1945, Am. Assoc. Petroleum Geologists Bull., v. 29, no. 7, p. 1020 (table 1), 1021, 1022. On basis of ammonite studies Twin Creek limestone, in Freedom quadrangle, southeastern Idaho, is assigned to Middle and Upper Jurassic.

H. D. Thomas and M. L. Krueger, 1946, Am. Assoc. Petroleum Geologists Bull., v. 30, no. 8, pt. 1, p. 1275–1277. In western Uinta Range, Twin Creek limestone overlies Nugget sandstone and underlies Preuss redbeds. Along Weber River, consists of 1,351 feet of light-gray limestone, sandy limestone, and calcareous shale. Thins eastward and in Lake Fork and Whiterocks Canyon area is replaced by Carmel redbeds.

Helen Foster, 1947, Am. Assoc. Petroleum Geologists Bull., v. 31, no. 9, p. 1565–1566. In Teton County, Wyo., limestone is about 475 feet thick; overlies Nugget sandstone and underlies Stump formation; the Preuss, which overlies Twin Creek farther west, not recognized in this area.

R. W. Imlay, 1950, Wyoming Geol. Assoc. Guidebook 5th Ann. Field Conf., p. 37–45. Described in mountains along west side of Green River basin. Overlies Nugget and underlies Preuss. Mainly medium-light-gray limestone with two persistent red members in its lower third. Comprises seven mappable members (A–G); member A is equivalent to Gypsum Spring formation (Love and others, 1945) and could properly be called Gypsum Spring member of Twin Creek. Thickens westward from about 800 to 3,000 feet. Term Twin Creek limestone should not be extended east of Darby-Absaroka line of thrusting because equivalent beds east of faulted area, such as exposed at Lower Slide Lake on Gros Ventre River, are much thinner, much less calcareous, and much more fossiliferous than the Twin Creek, and may more properly be classified according to terminology used in southern Montana or central Wyoming. This restriction does not apply to Nugget or Stump sandstones.

H. J. Bissell, 1952, Am. Assoc. Petroleum Geologists Bull., v. 36, no. 4, p. 579 (fig. 2), 597–598. Described in Strawberry Valley quadrangle, Utah. Equivalent in part to Carmel limestone, and name Carmel has been applied to it by some geologists. Thickness along West Fork of Duchesne River 950 feet. Overlies Navajo; underlies Entrada. Middle and Upper Jurassic.

R. W. Imlay, 1953, Intermountain Assoc. Petroleum Geologists [Guidebook] 4th Ann. Field Conf., p. 54–62. Report includes summary of lithologic and stratigraphic characteristics of the seven members of the Twin Creek, descriptions of some typical sections in western Wyoming and southeastern Idaho, and three lines of columnar sections.

E. R. Cressman, 1957, U.S. Geol. Survey Mineral Inv. Field Studies Map MF–118. As mapped in Snowdrift Mountain quadrangle, Caribou County, Idaho, consists of seven unnamed members with aggregate thickness of 2,510 feet. Overlies Nugget sandstone and underlies Preuss sandstone.

Named for exposures on Twin Creek between Sage and Fossil, Lincoln County, Wyo.

Twin Lakes Andesites[1]

Cenozoic: Northern California.

Original reference: Howel Williams, 1932, California Univ. Pub., Bull. Dept. Geol. Sci., v. 21, no. 8, p. 223–230, geol. map.

O. P. Jenkins, 1943, California Div. Mines Bull. 118, p. 686. Cenozoic.

J. A. S. Adams, 1955, Geochim. et Cosmochim. Acta., v. 8, p. 77 (table 2). Listed on table.

Twin Lakes are in Lassen Volcanic National Park.

Twin Lakes Formation

Pleistocene (Iowan-Tazewell) : 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. Underlies Lake Creek formation (new).

Twin Lakes region, Lake County.

Twin Lakes Glacial Substage

Pleistocene (Wisconsin) : Southern Rocky Mountains.

L. L. Ray, 1939, (abs.), Geol. Soc. America Bull., v. 50, no. 12, pt. 2, p. 2007; 1940, Geol. Soc. America Bull., v. 12, pt. 1, p. 1857–1858. Earliest of five substages of Wisconsin glaciation in southern Rocky Mountains. Followed by Home substage. Terminal moraines rare; evidence of ice advance based on patches of weathered till on valley walls above till of second substage.

Named for moraine at Twin Lakes in upper Arkansas Valley.

Twin Lakes Quartz Monzonite Porphyry[1]

Tertiary: Central Colorado.

Original reference: J. V. Howell, 1919, Colorado Geol. Survey Bull. 17.

Occurs on both sides of valley of Lake Creek below Everett and in vicinity of Twin Lakes, Lake County.

Twin Mountain Basalt

Late Cenozoic: Northeastern New Mexico.

Brewster Baldwin and W. R. Muehlberger, 1959, New Mexico Bur. Mines Mineral Resources Bull. 63, p. 132, pl. 15. Mentioned in discussion of Capulin basalts in Des Moines quadrangle. [Most of discussion refers to flows and basalts from Twin Mountain.]

Twin Mountains is elongate center cone that lies 3 miles southeast of Folsom, Union County.

**Twin River Formation**[1]

Eocene, upper, to Oligocene, upper: Northwestern Washington.

Original reference: R. Arnold and H. Hannibal, 1913, Am. Philos. Soc. Proc., v. 52, p. 579, 584, 604.

C. E. Weaver, 1937, Washington [State] Univ. Pubs. in Geology, v. 4, p. 117. Stratigraphic position of beds at Twin Rivers in upper part of Clallam County section of Oligocene and prevailing character of its molluscan fauna permit approximate correlation with Blakeley formation and elimination of newer term, Twin River formation.

J. W. Durham, 1944, California Univ. Dept. Geol. Sci. Bull., v. 27, no. 5, p. 113. Faunal studies indicate upper part of Twin River formation is younger than fossiliferous type Blakeley formation.

R. D. Brown, Jr., and H. D. Gower, 1948, Am. Assoc. Petroleum Geologists Bull., v. 42, no. 10, p. 2492–2512. Redefined to include mappable sequence of predominantly argillaceous sedimentary rocks exposed in northern Olympic Peninsula. Three mappable sequences recognized: lower member consisting of thin-bedded sandstone and siltstone, middle member of massive siltstone that grades westward into bedded siltstone and sandstone, and upper member composed chiefly of massive mudstone. Lenses of conglomerate present in places. Maximum thickness 17,500 feet, south limb of Clallam syncline. Overlies Lyre formation; underlies Clallam formation as used by Weaver. Mollusks and Foraminifera indicate an age range of late Eocene to early Miocene. Redefinition of Twin River, rather than Blakeley, is preferred because Blakeley has been used as lithologic term as well as faunal stage and has become so well entrenched in literature that any change in its stratigraphic and biostratigraphic connotation seems inadvisable. Some of rocks here included in Twin River have been described by Weaver (1937) as Lyre formation and Lincoln formation. Type locality, type section, and reference sections of redefined formation designated.

Type locality (Brown and Gower): Along Deep Creek, a north-flowing stream which enters Strait of Juan de Fuca at point about 3.4 miles west of mouth of West Twin River. Type section in Deep Creek is exposed from point 3,600 feet S. 41° W., from U.S. Forest Service road bridge across Deep Creek, northward to point on axis of local east-trending syncline, 700 feet east, 4,350 feet north of SW cor. sec. 20, T. 31 N., R. 10 W., Clallam County. Reference section: In stream bed and canyon of Lyre River, about 10 miles east of type locality on Deep Creek. In Lyre River, formation is exposed from point 950 feet south, 3,690 feet west of NE cor. sec. 10, T. 30 N., R. 9 W., to point 400 feet north, 1,050 feet west of SE cor. sec. 28, T. 31 N., R. 9 W.

Twin Sisters Dunite

Tertiary: Northwestern Washington.

Peter Misch, 1952, The Mountaineer, v. 45, no. 13, p. 4 (geol. map). An ultrabasic intrusive.

Twin Sisters Mountain is in Whatcom County.

Twisselmann Sandstone Member (of Monterey Formation)

Miocene, middle and upper: Southern California.

H. H. Heikkila and G. M. MacLeod, 1951, California Div. Mines Spec. Rept. 6, p. 4 (table 1), 5 (table 2), 11, 12–13, pl. 1. Name proposed for large sandstone lens occupying stratigraphic position equivalent in part to lower McDonald shale member and upper Gould-Devilwater shale member. Consists of friable silty to medium-grained sandstone, generally gray but locally rust mottled to tan; includes two shale beds in upper half and bioclastic reef 30- to 50-feet thick at base. In type area, has maximum thickness of 2,200 feet, conformably underlies McDonald shale member and unconformably overlies undifferentiated Cretaceous deposits; basal contact is marked locally by discontinuous massive bioclastic reef.

Type locality: Vicinity of C. Twisselman's deserted ranch building in NW cor. NE¼ sec. 14, T. 27 S., R. 18 E., Kern County.

**Twist Gulch Member** (of Arapien Shale)

Twist Gulch Formation

Upper Jurassic: Central Utah.

E. M. Spieker, 1946, U.S. Geol. Survey Prof. Paper 205–D, p. 122, 124, 125. Upper member of Arapien. Overlies Twelvemile Canyon member (new); underlies Morrison(?) formation. Siltstone and shale, red, in thin-bedded succession, with many thin beds of green-gray to white siltstone. Thickness 3,000 feet.

W. N. Gilliland, 1951, Nebraska Univ. Studies, new ser., no. 8, p. 10–15. Rank raised to formation.

Named for exposures on north side Salina Canyon above Twist Gulch, Sevier County.

Twobar Shale Member (of San Lorenzo Formation)

Eocene (Narizian): Western California.

E. E. Brabb, 1960, Dissert. Abs., v. 21, no. 5, p. 1163. Named as lower member of formation. Underlies Rices mudstone member (new).

Type section: Along Kings Creek, Big Basin area, Santa Cruz Mountains. Derivation of name not stated.

**Two Creeks Interstade**

Twocreekan Substage

Two Creeks Forest Bed

Two Creeks Intraglacial Substage

Pleistocene (Wisconsin): Eastern Wisconsin.

J. W. Goldthwait, 1907, Wisconsin Geol. Nat. History Survey Bull. 17, p. 61–62. Two Creeks forest bed may record an interval between early and late Wisconsin time; or it may mark interval between Calumet stage and readvance of ice sheet to Manistee moraine.

L. R. Wilson, 1932, Wisconsin Acad. Sci., Arts, and Letters, Trans., v. 27, p. 31–46. Bed is several inches thick and approximately 100 feet long. Lies between varved clays deposited during retreat of middle Wisconsin or "gray ice" and till of late Wisconsin or "red ice".

F. T. Thwaites, 1946, Outline of glacial geology: Ann Arbor, Mich., Edwards Bros., Inc., p. 75, 86. Referred to as Two Creeks interstadial between Valders glaciation and Cary glaciation.

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 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 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 and 11,800 years, and antedate Two Creeks interstadial dated at 11,400 years B. P.

R. J. Mason, 1958, Michigan Univ. Mus. Anthropology, Anthropol. Paper 11, p. 23. Two Creeks interstadial represents period between end of Mankato retreat and next and last glacial advance. Probably began about 12,000 years ago and lasted until about 11,000 B. P.; radiocarbon age determination.

J. C. Frye and H. B. Willman, 1960, Illinois Geol. Survey Circ. 285, p. 2 (fig. 1), 8–9. In classification proposed herein, Twocreekan is substage next younger than Woodfordian substage (new) and older than Valderan substage. It is based on Two Creeks forest bed of Wisconsin (Thwaites and Bertrand, 1957) and contains time of very short-lived retreat of glacier ice in Lake Michigan lobe. Has time span of no more than 1,500 radiocarbon years.

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. Two Creeks intraglacial substage separates older Mankato glacial substage from younger Valders glacial substage.

Exposed on shore of Lake Michigan, 2 miles east of Two Creeks, in secs. 11 and 13, T. 21 N., R. 25 E., Manitowoc County.

**Two Medicine Formation** (in Montana Group)[1]

Upper Cretaceous: Northwestern Montana.

Original reference: E. Stebinger, 1914, U.S. Geol. Survey Prof. Paper 90, p. 62–68.

J. B. Lyons, 1944, Geol. Soc. America Bull., v. 55, no. 4, p. 449 (fig. 2), 451–452. Formation, in northern end of Big Belt Mountains, is 1,000 feet thick; overlies Eagle sandstone and unconformably underlies Adel Mountain volcanics (new). Upper Cretaceous.

W. A. Cobban, 1955, Billings Geol. Soc. Guidebook 6th Ann. Field Conf., p. 115–116. Underlies Bearpaw shale; overlies Virgelle sandstone. Crops out on west flank of Sweetgrass arch. Thickness north of Dupuyer 2,125 feet. Almost entirely nonmarine and is largely mudstone that weathers pale greenish gray or gray.

G. W. Viele, 1960, Dissert. Abs., v. 21, no. 4, p. 853. In Flat Creek area, Lewis and Clark County, name Hogan formation is given to 2,477 feet of andesitic to latitic volcanic-rich sedimentary rocks which are stratigraphically equivalent to middle and upper Two Medicine formation. Hogan rests disconformably on lower fossiliferous Two Medicine.

Well exposed on Two Medicine River, between its mouth and Family post office, Glacier County.

Twomile Limestone (in Conemaugh Formation)[1]

Pennsylvanian: Southern West Virginia.

Original reference: I. C. White, 1885, The Virginias, v. 6, p. 8, 9.

R. C. Moore and others, 1944, Geol. Soc. America Bull., v. 55, no. 6, chart 6 (column 12). Twomile limestone shown on correlation chart below Morgantown sandstone and above Bakerstown coal. Conemaugh series.

Named for exposure on Twomile Run, below Charleston, Kanawha County.

Two Mile Member (of Crockett Formation)

Eocene (Claiborne) : Central Texas.

G. D. Harris, 1941, Texas Univ. Bur. Econ. Geology Mineral Resources Survey Circ. 33, p. 13, 14, 15–19. Crockett as exposed in Lee County divided into (ascending) Stone City, Wheelock, Two Mile (new), and Tabor (new) members. Two Mile is sequence of sand and clay with minor amounts of limestone and gypsum. Thickness as much as 19 feet. Name is from manuscript of H. B. Stenzel.

Exposed in Elm Creek valley for entire length of stream. Type locality and derivation of name not stated.

Twowells Sandstone Lentil (of Mancos Shale)

Upper Cretaceous : Northwestern New Mexico.

W. S. Pike, Jr., 1947, Geol. Soc. America Mem. 24, p. 22, 35–36. Hard massive tan to pinkish sandstone. Thickness from fraction of a foot to 35 feet. Within lower part of Mancos shale, 30 to 75 feet above its base.

Named from typical exposures near Two Wells in T. 12 N., R. 19 W., McKinley County.

**Tybo Shale**[1]

Cambrian : Central Nevada.

Original reference: H. G. Ferguson, 1933, Nevada Univ. Bull. v. 27, no. 3, p. 13–25.

W. H. Easton and others, 1953, Am. Assoc. Petroleum Geologists Bull., v. 37, no. 1, p. 148. Listed with names not included on chart of recommended revision of stratigraphic units in Great Basin. Reasons for omission usually are that names are incapable of being interpreted or are rejected synonyms. [Hales limestone and Swarbrick formation, noted by Ferguson, 1933, as overlying and underlying the Tybo are also omitted from chart.]

Exposed in Tybo Canyon, near Camp Tybo, Tybo district.

Tye Formation (in Clear Fork Group)[1]

Permian : Central and central northern Texas.

Original reference: W. E. Wrather, 1917, Southwestern Assoc. Petroleum Geologists Bull. 1, pl. opposite p. 96.

Probably named for Tye, Taylor County.

Tye Granite[1]

Jurassic : Central Washington.

Original references: W. S. Smith, 1915, School of Mines Quart., v. 36, p. 157 ; 1916, Jour. Geology, v. 24, p. 560.

Named for Tye River in Skykomish Basin.

**Tyee Sandstone**[1] or **Formation**

Eocene, middle : Western Oregon.

Original reference: J. S. Diller, 1898, U.S. Geol. Survey Geol. Atlas, Folio 49.

H. E. Vokes, P. D. Snavely, Jr., and D. A. Myers, 1951, U.S. Geol. Survey Oil and Gas Inv. Map OM–110. Described in Eugene area as Tyee formation since here beds include substantial proportion of mudstone. Thickness about 5,000 feet; base not exposed. Unconformably underlies Lorane shale member of Spencer formation (restricted).

H. E. Vokes, D. A. Myers, and Linn Hoover, 1954, U.S. Geol. Survey Oil and Gas Inv. Map OM–150. Described in Corvallis area where it overlies Kings Valley siltstone member of Siletz River volcanic series and underlies Spencer formation. Mapping in Corvallis-Monroe area indicates that Lorane shale member is more closely related to Tyee formation than to Spencer formation. Correlation is suggested between siltstone in upper part of Tyee in Monroe and Albany quadrangles and Lorane shale member of Spencer formation.

E. W. Baldwin, 1955, U.S. Geol. Survey Oil and Gas Inv. Map OM–162. Described in Marys Peak and Alsea quadrangles where it overlies Siletz River volcanic series, where it consists of thick series of rhythmically bedded sandstone and intercalated siltstone. This same sequence of sedimentary rocks is exposed along Yaquina River in Toledo quadrangle and was named Burpee formation by Schenck (1927). Recent mapping has shown that Burpee formation is equivalent at least in part, to Tyee formation. Inasmuch as name Tyee has priority, it is used in this report.

E. M. Baldwin, 1959, Geology of Oregon: Ann Arbor, Mich., Edwards Bros., Inc., p. 13. Near Lukiamute River appears to interfinger with Yamhill formation.

U.S. Geological Survey restricts the use of the term Burpee to its type locality. Elsewhere the term Tyee is used.

Type locality: Douglas County. Forms prominent escarpment from Tyee Mountain to Camas Valley.

Tyende sandstone[1]

Jurassic: Northwestern Arizona and southwestern Colorado.

Original reference: C. R. Keyes, 1936, Pan-Am. Geologist, v. 66, no. 1, p. 71–72.

Named for Tyende Arroyo, tributary of Rio San Juan, passing by north point of Black Mesa, near Kayenta settlement, Navajo County, Ariz.

**Tygee Sandstone** (in Gannett Group)[1]

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, 83.

V. R. D. Kirkham, 1924, Idaho Bur. Mines and Geology Bull. 8, p. 26–28. Section measured on Fall Creek, Fall Creek quadrangle, gives thickness of Tygee as 1,020 feet. Overlies Draney limestone; underlies Wayan formation. Thickness at type locality about 100 feet.

C. A. Moritz, 1953, Intermountain Assoc. Petroleum Geologists [Guidebook] 4th Ann. Field Conf., p. 68. In Fall Creek area, Bonneville County, Idaho, about 980 feet of Tygee beds are assigned to Bear River formation; section not complete.

H. R. Wanless, R. L. Belknap, and Helen Foster, 1955, Geol. Soc. America Mem. 63, p. 53, 56–57, pl. 21. Geographically extended into Wyoming where it forms uppermost beds of Gannett group. Overlies Draney limestone. Underlies Bear River formation. Units referred to as members of Gannett group. Lower Cretaceous.

R. B. Boeckerman and A. J. Eardley, 1956, Wyoming Geol. Soc. Assoc. Guidebook 11th Ann. Field Conf., p. 198. In Jackson Hole country, uppermost member of Gannett group. Consists of brownish-gray siltstone and rust-stained shale. Contains one or more reddish sandstone beds. Thickness 198 feet. Overlies Draney limestone member; unconformably underlies Bear River formation. Lower Cretaceous.

J. D. Vine, 1959, U.S. Geol. Survey Bull. 1055–I, p. 259 (table), 261–262. In Bonneville County, Idaho, Tygee sandstone conformably overlies Draney limestone and conformably underlies Bear River formation. Thickness 285 feet where measured on Skyline Ridge. Formation consists of interbedded red shale and gray to brown sandstone. Strata in Skyline Ridge section are overturned and dip 85° NE. The intense deformation may have caused formation to be thinner here than in a normal section. Limits of formation differ greatly from limits described by Kirkham (1924), who included beds in Tygee that are here called Bear River formation. Apparently Kirkham measured his section east of Fall Creek Ranger Station, where faulting has duplicated strata.

Named for Tygee Creek [Idaho], east of which, in T. 8 S., R. 46 E., it is well exposed.

Tyger zone[1]

Precambrian: Northwestern 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. 6, 7, 12.

Named for exposures on Tyger River.

Tyler Formation

Tyler Sandstone Member (of Heath Formation)

Tyler Sandstone Member (of Quadrant Formation)[1]

Mississippian or Pennsylvanian: Central northern Montana.

Original reference: O. W. Freeman, 1922, Eng. and Min. Jour.-Press, v. 113, no. 19, p. 827.

H. D. Hadley, P. J. Lewis, and R. B. Larsen, 1952, Billings Geol. Soc. Guidebook 3d Ann. Field Conf., p. 142. Referred to as member of Heath formation. Thickness 5 to 100 feet. Mississippian.

P. A. Mundt, 1956, Am. Assoc. Petroleum Geologists Bull., v. 40, no. 8, p. 1920–1925; 1956, Billings Geol. Soc. Guidebook 7th Ann. Field Conf., p. 46–47. Redefined as formation. Freeman used term primarily with reference to massive sands; as redefined, the Tyler also includes black, gray, and reddish shales within which the sandstone bodies occur; also includes marine limestone tongue locally present near top. Thickness where typically exposed in secs. 21, 22, and 27, T. 14 N., R. 21 E., Fergus County, 382 feet. Underlies Alaska Bench formation; unconformably overlies Heath formation. Unit has been referred to as Amsden, Heath, Heath-Amsden transition zone, nonmarine Heath and so forth. Mississippian. Uncertainty exists as to exact geographic position of Freeman's type locality. No Tyler rocks outcrop a mile west of present site of Tyler; nearest exposures are more than 3 miles south of Tyler School and outcrop at Durfee Creek dome which cannot be considered part of Middle Bench as mentioned by Freeman. Type section restated.

G. H. Norton, 1956, Billings Geol. Soc. Guidebook 7th Ann. Field Conf., p. 58, 62, figs. 5, 6, 7. Formation includes East Buffalo Creek limestone member and Bear Gulch limestone member of lentil (both new).

R. P. Willis, 1959, Am. Assoc. Petroleum Geologists Bull., v. 43, no. 8, p. 1948–1962. Formation in Montana area is limited in occurrence to central Montana trough and overlaps locally underlying Heath formation. Isopach pattern shows abrupt thinning toward north along Cat Creek trend, which may indicate truncation. Suggested that formation be divided into two members: lower characterized by predominantly dark-colored slightly calcareous shale, and upper containing predominantly red and maroon calcareous shales with abundant marine fauna. Division is made at base of the "A" zone, at which point the Tyler takes on more marine characteristics, and a trend change from east-west to southwest-northeast. Name Cameron Creek applied to upper member. The "A" zone denotes both the sand facies and its limestone equivalent; the limestone has been referred to as Bear Gulch member or tongue. This subdivision of Tyler is not everywhere applicable. Pennsylvanian (Morrow).

L. S. Gardner, 1959, Am. Assoc. Petroleum Geologists Bull., v. 43, no. 2, p. 335–337. Name Tyler formation not used in revision of Big Snowy group because, as expressed by Scott (1935, Jour. Geology, v. 43), the sands are neither a lithologic, paleontologic, or mappable unit over broad areas. Also name is twice preoccupied. Its type section as given by Mundt (1956) is a section of Heath and Cameron Creek formations made anomalous by local appearance of about 150 feet of gray to white sandstone bedded in black shale of the Heath and overlain by red shale of Cameron Creek formation. In this study, no regional unconformity was found within Big Snowy sequence. Erosional unconformity at base of Mundt's Tyler is believed to be widely spaced local channel cuts, each of which can be traced for a few hundred yards or a few miles, depending on the angle at which present outcrop cuts ancient channel before it dies out in normal sequence of marine shale and limestone.

Type section: Section mentioned by Freeman as exposed at east end of Middle Bench. This section is about 5 miles west of Tyler School (also site of old Tyler post office), at southeast end of Middle Bench, in S½ sec. 5, T. 12 N., R. 21 E., Fergus County.

Tyler Greensand Member (of Sparta Sand)[1]

Eocene, middle: Eastern Texas.

Original reference: E. A. Wendlandt and G. M. Knebel, 1929, Am. Assoc. Petroleum Geologists Bull., v. 13, p. 1359–1360.

Well exposed throughout city of Tyler, and west and northwest of Swan, Smith County.

Tyler Red Beds (in Monongahela Formation)[1]

Tyler redbed member

Pennsylvanian: Northern West Virginia and eastern Ohio.

Original reference: J. J. Stevenson, 1907, Geol. Soc. America Bull., v. 18, p. 30, 44.

M. T. Sturgeon and others, 1958, Ohio Geol. Survey Bull. 57, p. 158 (table 13), 177. Member of Benwood cyclothem in report on Athens County. Average thickness about 31 feet. Unit variable; grades laterally into either sandstone or shale, and fresh-water limestone and redbeds may be interbedded with either Sewickley sandstone or Benwood limestone. Monongahela series.

Named for prominence in area around Tyler County, W. Va.

**Tyler Slate**[1]

Precambrian (Animikie Series): Northwestern Wisconsin and northwestern Michigan.

Original reference: C. R. Van Hise, 1901, U.S. Geol. Survey 21st Ann. Rept., pt. 3, p. 338.

W. O. Hotchkiss, 1919, Eng. and Min. Jour., v. 108, p. 501, 506. Includes Pabst member.

U.S. Geological Survey currently considers the Tyler Slate a part of the Animikee Series.

Named for exposures at Tylers Fork, [Iron County, Wis.]

**Tymochtee Formation**

Tymochtee Shale[1] (in Bass Islands Group)

Upper Silurian: Western Ohio and southeastern Michigan, and southern Ontario, Canada.

Original reference: N. H. Winchell, 1873, Ohio Geol. Survey, v. 1, p. 633.

C. K. Swartz and others, 1942, Geol. Soc. America Bull., v. 53, no. 4, chart 3 (column 17). Correlation chart shows Tymochtee shale present in southern Ontario.

Wilber Stout, Karl Ver Steeg, and G. F. Lamb, 1943, Ohio Geol. Survey, 4th ser., Bull. 44, p. 124–125, chart facing p. 108. Dolomite, thin- to massive-bedded, gray to brown. Thickness indefinite approximately 125 to 175 feet. Overlies Greenfield formation; underlies Put-in-Bay dolomite. In Bass Island[s] group.

Named for exposures on Tymochtee Creek at Crawford, Wyandot County, Ohio.

**Tyner Formation**[1]

Middle and Upper Ordovician: Eastern Oklahoma.

Original reference: J. A. Taff, 1905, U.S. Geol. Survey Geol. Atlas, Folio 122.

G. G. Huffman and others, 1958, Oklahoma Geol. Survey Bull. 77, p. 14 (fig. 2), 16 (fig. 3), 22–24, pls. 2, 3, 4. Described on southwestern flank of Ozark uplift. Cram's (1930, Oklahoma Geol. Survey Bull. 40QQ) subdivisions of lower dolomite and green shale, middle green shale, and upper cherty dolomite limestone can be recognized throughout much of area. Exposed thicknesses vary from 8 feet near Blackgum to over 90 feet on Cornshell Mountain, sec. 25, T. 16 N., R. 22 E.; 79 feet near Qualls; both contacts exposed; thins northward by truncation and overlap of Chattanooga. Conformably overlies Burgen sandstone; conformably underlies Fite limestone in southern exposures, and near contact buff, dolomitic limestone alternates with white, lithographic limestone of Fite to form narrow transition zone. Precise age and correlation questionable; fossil evidence suggests that upper part of Tyner is equivalent in part at least with units which have been classed as Black River. Figure 2 shows unit in Champlainian series.

Named for exposures along Tyner Creek, a tributary of Barren Fork in northern Adair County, near town of Proctor.

**Tyonek Formation**[1]

Eocene: Southern Alaska.

Original reference: J. E. Spurr, 1900, U.S. Geol. Survey 20th Ann. Rept., pt. 7, p. 171–172, 184.

Exposed along shore of Cook Inlet southwest of Tyonek.

†Tyringham Gneiss[1]

Precambrian: Western Massachusetts.

Original reference: B. K. Emerson, 1898, U.S. Geol. Survey Mon. 29, p. 18.

Named for occurrence in Tyringham Township, Berkshire County.

†Tyrone Conglomerate[1]

Upper Ordovician: Central Pennsylvania.

Original reference: A. W. Grabau, 1909, Science, new ser., v. 29, p. 353, 355.

Typically exposed at Tyrone, Blair County.

**Tyrone Limestone**[1] (in High Bridge Group)

Tyrone Limestone Member (of High Bridge Limestone)

Middle Ordovician: Central Kentucky and western Virginia.

Original reference: A. M. Miller, 1905, Kentucky Geol. Survey Bull. 2, p. 9, 14.

A. C. McFarlan, 1943, Geology of Kentucky: Lexington, Ky., Kentucky Univ., p. 12–13; D. K. Hamilton, 1948, Econ. Geology, v. 43, no. 1, p. 40–41. Uppermost formation in High Bridge (Highbridge) group. Overlies Oregon limestone; underlies Curdsville limestone in Lexington group. Very pure limestone of birdseye or, in places, lithographic type; contains three bentonite beds. Thickness approximately 90 feet. May be wholly or in part Trenton in age.

C. W. Wilson, Jr., 1949, Tennessee Div. Geology Bull. 56, p. 46. Kentucky name Tyrone should not be used in central Tennessee; name Carters has priority.

J. L. Rich, 1951, Geol. Soc. America Bull., v. 61, no. 1, p. 18. Referred to as member of High Bridge limestone.

M. H. Ross and W. E. Moore, 1952, (abs.) Virginia Jour. Sci., v. 3, new ser., no. 4, p. 333–334. Geographically extended into Lee County, Va. Contains bryozoan fauna. Beds have previously been referred to Eggleston formation.

Named for Tyrone, Anderson County, Ky.

Tyson Formation

Tyson Member (of Monastery Formation)

Cambro-Ordovician: West-central Vermont.

P. H. Osberg, 1952, Vermont Geol. Survey Bull. 5, p. 42, 43, 44. Basal conglomerate and schistose sandstone member of Lower Cambrian Monastery formation (new). Thickness varies from featheredge to 600 feet. Underlies Battell member (new) of Monastery formation; overlies Mount Holly complex. Name attributed to Thompson (unpub. thesis, 1950).

W. F. Brace, 1953, Vermont Geol. Survey Bull. 6, p. 45–47. Rank raised to formation in Rutland area. Thickness as much as 600 feet. Underlies Grahamville formation (new); overlies Precambrian(?) Saltash formation (new) or Mount Holly complex.

Largest belt of exposures in valley of West Branch, 1 mile east of Bingo Camp in Rochester-East Middlebury area.

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Tyus Member (of Weches Formation)

Eocene, middle (Claiborne) : Eastern Texas.

H. B. Stenzel, 1938, Texas Univ. Bur. Econ. Geology Pub. 3818, p. 20 (table), 97, 100–104 [1939]. Gray powdery slightly glauconitic sparingly fossiliferous calcareous marl with numerous small irregular white to gray lime nodules, which unite in some places to form thin layers; includes gray limestone bench or limestone concretions; lime in form of limestone or nodules is outstanding component of member. Thickness 2 to 15 feet; average 9 feet; thickness increases along strike from southwest to northeast. Underlies Viesca member (new), boundary transitional; disconformable above Queen City sand.

Type locality: Cut of abandoned Houston & Texas Central Railroad, 0.4 mile north of Robbins crossroads, R. M. Tyus Survey, Leon County.

U Bar 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 massive- and thin-bedded limestone. Thickness approximately 2,000 feet. Underlies Mojado formation (new) ; overlies Hell-To-Finish formation (new).

Big Hatchet Peak quadrangle, Hidalgo County.

**Ucross Formation**

Recent(?) : Eastern Wyoming.

L. B. Leopold and J. P. Miller, 1954, U.S. Geol. Survey Water-Supply Paper 1261, p. 10. Consists of fresh rounded gravel including variety of rocks, mostly igneous and metamorphic. Pebbles average 1 to 2 inches in diameter. Formation contains occasional deeply weathered yellow- and red-stained pebbles. Upper few feet locally composed of silt and may contain lenses of clay. Upper 2 to 3 feet characteristically impregnated with large amounts of calcium carbonate and gypsum in form of strong white mottlings, concentrically-filled tubules, and hard nodules ⅛ to 1 inch in diameter. Underlies newly named Kaycee formation and disconformably overlies Arvada formation (new).

Type locality : In Clear Creek Valley, 1 mile south of Ucross.

Udall Limestone Lentil (in Geuda Springs Shale Member of Wellington Formation)

Permian: Southeastern Kansas.

W. A. Ver Wiebe, 1937, Wichita Municipal Univ. Bull., v. 12, no. 5, p. 13. Limestone several feet thick that occurs in Geuda Springs about 160 feet below Prairie Creek limestone lentil (new).

Well exposed near Udall in Maple Township, T. 30 S., R. 3 E., Cowley County.

**Uffington Shale Member** (of Conemaugh Formation)[1]

Uffington Shale (in Conemaugh Group)

Upper Pennsylvanian : Northern West Virginia and western Pennsylvania.

Original reference: I. C. White, 1903, West Virginia Geol. Survey, v. 2, p. 323.

W. O. Hickok 4th and F. T. Moyer, 1940, Pennsylvania Geol. Survey, 4th ser., Bull. C–26, p. 78, 88, fig. 21. Lowest member of Conemaugh group.

Underlies Lower Mahoning sandstone; overlies Upper Freeport coal. Thickness as much as 20 feet in Fayette County.

R. L. Nace and P. P. Bieber, 1958, West Virginia Geol. Survey Bull. 14, p. 22 (table 4). Listed in summary of stratigraphic section of Conemaugh formation in Harrison County.

Named for exposures at Uffington, Monongalia County, W. Va.

Uhalde Sandstone and Shale (in Panoche Group)

Upper Cretaceous: Central California.

M. B. Page, 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). Equal amounts of gray-brown shale and interbedded sandstone. Thickness 3,370 feet. Overlies Television sandstone (new); underlies Dosados sandstone and shale member of Moreno shale. Name credited to D. W. Sutton (unpub. thesis).

Type locality: Moreno Gulch, Fresno County. Name derived from Uhalde Canyon, secs. 4 and 9, T. 14 S., R. 11 E., and secs. 33 and 34, T. 13 S., R. 11 E.

**Uinta Formation**[1]

Eocene, upper: Northeastern Utah and Colorado.

Original reference: O. C. Marsh, 1871, Am. Jour. Sci., 3d, v. 1, p. 196.

H. E. Wood 2d, 1934, Am. Mus. Nat. History Bull., v. 67, art. 5, p. 241–242. Includes Wagonhound member below and Myton member above.

P. T. Walton, 1944, Geol. Soc. America Bull., v. 55, no. 1, p. 97 (table 1), 99 (table 2), 121–122. Central part of Uinta basin, just south of synclinal axis, is occupied by outcrops of Uinta formation. Consists of variegated shale interbedded with gray and buff sandstone. Thickness 1,648 to 1,800 feet. Conformably overlies Green River shale; conformably underlies Duchesne River formation.

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. Uinta formation comprises thick sequence of chiefly fluviatile beds but includes varying amount of lacustrine beds. Westward from Colorado State line to the Green River, where formation has been most studied, it contains three vertebrate faunal zones of middle to late Eocene age, and surface exposures indicate thickness of 1,500 to 2,000 feet. This sequence conformably overlies Green River formation and was formerly divided by U.S. Geological Survey into Bridger formation, consisting approximately of horizons A and B of Osborn and Peterson (1895, Am. Mus. Nat. History, v. 7) and Uinta formation, which was horizon C of Osborn and Peterson (1895). More general and recent usage has been to refer entire sequence to Uinta formation, which usage is followed in present report. Lowest part of sequence of fluviatile beds consists of a brown massive cross-bedded medium- to coarse-grained sandstone unit that overlies Green River formation for many square miles in vicinity of Evacuation Creek and White River north of Watson, Utah, in eastern part of Uinta basin. This sandstone unit, about 800 feet thick, contains some hard greenish-gray sandy mudstone interbedded with the sandstone and is lower unit of Bridger formation of Bradley (1931, U.S. Geol. Survey Prof. Paper 168).

Lower part of this sandstone unit, about 500 feet thick, contains few fossils, but according to Peterson (Riggs, quoting Peterson, 1912, Field Mus. Nat. History Pub. 159, Geol. Ser., v. 4), specimens of *Metarhinus* and *Sphenocoelus* were found near base; upper part is more fossiliferous and the two fossiliferous parts represent closely horizon A, lowest vertebrate faunal zone of the three recognized by Osborn and Peterson. There has been some uncertainty as to whether lowest part of Osborn and Peterson's horizon A should be placed in Uinta or underlying Green River. Despite this uncertainty, the unit has generally not been included in the Green River. An indefinite lower part of horizon A beds (lower beds of Bridger formation of Bradley) has been casually referred to as Wagonhound buff sandstones, but name Wagonhound member was proposed by Wood (1934) for lower part of Uinta formation (horizons A and B of Osborn and Peterson). Top of Evacuation Creek member of Green River is regarded as base of Uinta formation. This formation boundary rises stratigraphically toward center of basin. Much of lower part of fluviatile beds of the Uinta as exposed along Colorado-Utah line grades westward into beds that are in considerable part of lacustrine, playa, and mud-flat origin in an area of which Indian Canyon is the center. These beds, formerly considered saline facies of Green River formation, are here included as part of Uinta formation.

W. B. Cashion and J. H. Brown, Jr., 1956, U.S. Geol. Survey Oil and Gas Inv. Map OM–153. Thickness about 1,500 feet in Bonanza-Dragon area, Uintah County, Utah, and Rio Blanco County, Colo. Overlies Evacuation Creek member of Green River formation; underlies Duchesne River formation.

First described in Uinta Basin, Utah.

†Uinta Glacial Epoch[1]

Pleistocene (Wisconsin): Colorado.

Original references: W. W. Atwood and K. F. Mather, 1912, Science, new ser., v. 35, p. 315; 1912, Jour. Geology, v. 20, p. 388; 1912, Geol. Soc. America Bull., v. 23, p. 732.

Name derived from Uinta Mountains, Utah.

†Uinta Quartzite,[1] Sandstone,[1] or Group[1]

Precambrian: Northeastern Utah and northwestern Colorado.

Original reference: J. W. Powell, 1876, Geology of eastern portion of Uinta Mountains, p. 41, 42, 61, 70, 138, 139, 141–145.

Forms crest and core of main axis of Uinta Mountains and extends east into Colorado, nearly as far as junction of Little Snake and Yampa Rivers.

**Uinta Mountain Group[1]**

Precambrian: Northeastern Utah and northwestern Colorado.

Original reference: T. S. Lovering and others, 1935, Geologic map of Colorado.

G. E. Untermann and B. R. Untermann, 1949, Am. Assoc. Petroleum Geologists Bull., v. 33, no. 5, p. 685, 689 (table 1). In Green and Yampa River Canyons, group unconformably underlies Lodore formation. Thickness about 12,000 feet.

N. C. Williams, 1953, Am. Assoc. Petroleum Geologists Bull., v. 37, no. 12, p. 2737–2738. Group, in western Uinta Mountains, divided into (ascending) Mutual quartzite and Red Pine shale (new). Underlies Tintic quartzite (Pine Valley of previous reports).

W. R. Hansen, 1955, Wyoming Geol. Assoc. Guidebook 10th Ann. Field Conf., p. 25–27, pl. 1. Described in area between Clay Basin and Browns Park in Utah and Colorado. Consists predominantly of dark-red medium- to coarse-grained massive- to crossbedded siliceous sandstone and quartzite with considerable amounts of shale and conglomerate. Approximate thickness 20,600 feet; section is on west end of Cold Spring Mountain between Uinta fault on north and Browns Park on south, section incomplete. Overlies Red Creek quartzite with angular unconformity.

H. R. Ritzma, 1959, Utah Geol. and Mineralog. Survey Bull. 66, p. 18–19, 20. Core of Uinta Range exposes more than 20,000 feet of Precambrian quartzitic sandstone and argillite, the Uinta Mountain group. Proposed that older Precambrian rocks of previous studies, the Red Creek quartzite (or complex), are metamorphosed equivalents of Uinta Mountain group sediments. Group rests with apparent unconformity on contorted and faulted Red Creek complex. Unconformably underlies Lodore formation. Area of report, Daggett County.

Most widely exposed unit in Uinta Mountain area. Crops out in almost continuous exposures from one end of range to the other, a distance west to east of about 140 miles, in a belt 15 or 20 miles or more wide. Forms main divide and major peaks of range proper as well as greater part of chain of hills north of Green River between Flaming Gorge and Vermilion Creek, including Goslin, O-Wi-Yu-Kuts, and Cold Spring Mountains.

Uintan Age

Eocene: North America.

H. E. Wood 2d and others, 1941, Geol. Soc. America Bull., v. 52, no. 1, p. 10, pl. 1. Provincial time term, based on Uinta formation of northern Utah, that is, time of deposition of Uinta A–C, inclusive (pl. 1), with included faunas. Covers interval between Bridgerian and Duchesnean ages. Report defines 18 provincial time terms based on mammal-bearing units for North American continental Tertiary. [For sequence see under Puercan.]

Ulatisian Stage

Eocene, middle: 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 Narizian stage above and Juniperan [Juniperian] stage.

V. S. Mallory, 1959, Lower Tertiary biostratigraphy of the California Coast Ranges: Tulsa, Okla., Am. Assoc. Petroleum Geologists, p. 40–44, 76–78, 96–98, fig. 7, tables. Spans interval between Penutian stage (name proposed to replace Juniperian stage) below and Narizian stage above. Includes two zones, *Vaginulinopsis mexicana* below and *Amphimorphina californica* above. Interval is essentially represented by most of Laiming's (1939, 6th Pacific Sci. Cong. Proc., v. 2) "B-Zones". At base is the megafossiliferous "Domengine" and at top is the "Transition Zone" of molluscan terminology.

Type is in strata mapped by Boyd (1949, unpub. thesis) as Vacaville shale in vicinity of Dunn's Peak along Ulatis Creek, Vaca Valley quadrangle, Solano County.

Ulm coal group (in Wasatch Formation)[1]

Eocene: Eastern Wyoming and southeastern Montana.

Original reference: J. A. Taff, 1909, U.S. Geol. Survey Bull. 341, p. 123–150.

Named because of their best known occurrence in vicinity of Ulm, on Burlington Railroad in Sheridan County, Wyo.

Ulm Formation[1]

Eocene: Eastern Wyoming and southeastern Montana.

Original reference: R. L. Nace, 1936, Wyoming Geol. Survey Bull. 26, p. 104.

Named for Ulm, Sheridan County, Wyo.

Ulsterian Group[1]

Ulsterian Series

Ulsterian Stage

Lower and Lower or Middle Devonian: North America.

Original reference: J. M. Clarke and C. Schuchert, 1899, Science, new ser., v. 10, p. 874–878.

Bradford Willard, 1939, *in* Bradford Willard, F. M. Swartz, and A. B. Cleaves, Pennsylvania Geol. Survey, 4th ser., Bull. G–19, p. 131 (footnote). Term Ulsterian stage in New York includes the Onondaga and Schoharie, but not the Esopus which is classed with the Oriskany. If used here [Pennsylvania], it would embrace Onondaga group which includes the so-called Esopus of eastern Pennsylvania. No Schoharie is recognized in the State. Such usage being inapplicable, term Stroudsburgian stage is introduced from Stroudsburg, Monroe County, where the group may be observed at its best, for eastern Pennsylvania.

G. A. Cooper and others, 1942, Geol. Soc. America Bull., v. 53, no. 12, pt. 1, chart 4. As shown on correlation chart, Devonian comprises (ascending) Ulsterian, Erian, Senecan, Chautauquan, and Bradfordian (in part) series. Ulsterian comprises (ascending) Helderberg, Deerpark (new), and Onesquethaw (new) stages. Lower and Lower or Middle Devonian.

Named for Ulster County, N.Y.

**Ultima Thule Gravel Member** (of Holly Creek Formation)

†Ultima Thule Gravel Lentil (of Trinity Formation)[1]

Lower Cretaceous (Comanche Series): Southwestern Arkansas.

Original reference: H. D. Miser and A. H. Purdue, 1918, U.S. Geol. Survey Bull. 690–B.

R. W. Imlay, 1944, U.S. Geol. Survey Oil and Gas Inv. Prelim. Chart 3. Referred to as Ultima Thule gravel member of Holly Creek formation. Subsurface equivalents discussed.

J. M. Forgotson, Jr., 1957, Am. Assoc. Petroleum Geologists Bull., v. 41, no. 10, p. 2333 (fig. 2), 2339. Ultima Thule gravel lentil represents surface equivalent of lower part of Rodessa formation.

Exposed near Ultima Thule, De Queen quadrangle, Sevier County.

**Ulupau Tuff**[1] (in Honolulu Volcanic Series)

Pleistocene, upper: Oahu Island, Hawaii.

Original reference: C. K. Wentworth, 1926, Bernice P. Bishop Mus. Bull. 30, p. 85–90.

G. A. Macdonald and G. A. Davis *in* Jacques Avias and others, 1956, Lexique Strat. Internat., v. 6, Océanie, fasc. 2, p. 133. Gray to brown partly palagonitized tuff forming Ulupau Cone. Contains fragments of reef limestone. Thickness more than 500 feet. Cut by nepheline basalt dike. Unconformably underlies Kii Point limestone and beach deposits of plus 25-foot (Waimanalo) stand of sea. Has been referred to as Ulupau Head tuff (Winchell, 1947, Geol. Soc. America Bull., v. 58, no. 1).

Named for Ulupau Head, tuff cone at north end of Mokapu Peninsula. Covers about 0.3 square mile on northeast coast of Oahu, about 12 miles northwest of Makapuu Head.

**Umatac Formation**

Umatac Andesite

Miocene, lower: Mariana Islands (Guam).

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. 57–58]. Basal rock of island. Typically pillow lava with amygdaloidal structures and intercalated green tuffs and agglomerates. Cut by dikes. Underlies Bolanos (Balanos) beds. Thick stratum of Santa Rosa beds intercalated between Umatac and Bolanos beds. Eocene.

S. Hanzawa *in* Jacques Avias and others, 1956, Lexique Strat. Internat., v. 6, Océanie, fasc. 2, p. 64. Aquitanian.

U.S. Geological Survey currently classifies the Umatac as a formation and designates its age as lower Miocene on the basis of a study now in progress.

Typically exposed at Umatac coast, Guam.

**Umbrella Hill Formation**

Middle Ordovician: North-central Vermont.

A. L. Albee, 1957, U.S. Geol. Survey Geol. Quad. Map GQ–102. Quartz- and slate-pebble conglomerate. Friable calcareous gray slate separates conglomerate bands at top and bottom. Underlies Moretown formation with apparent conformity; overlies Stowe formation unconformably.

W. M. Cady, 1960, Geol. Soc. America Bull., v. 71, no. 5, pl. 3. Middle Ordovician.

Typically exposed on and near Umbrella Hill along east-central border of Hyde Park quadrangle. Also exposed in Hardwick quadrangle to the east.

†Umiat Formation (in Nanushuk Group)

Lower and Upper Cretaceous: Northern Alaska.

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. Inshore facies of the marine formation consists of relatively clean sandstone that grades northeast through argillaceous sandstone into shale of offshore facies. Thickness about 5,000 feet. Lower part is marine shale similar to shale of Torok formation (new) which it overlies. Underlies Schrader Bluff formation (new). Tongues into nonmarine Chandler formation (new) to the south. Divided into two new members, Tuktu below and Topagoruk above. Lower part is Lower Cretaceous; upper part probably also Lower Cretaceous.

R. W. Imlay and J. B. Reeside, Jr., 1954, Geol. Soc. America Bull., v. 65, no. 3, chart (facing p. 246). Age shown on chart as Lower and Upper Cretaceous.

George Gryc and others, 1956, Am. Assoc. Petroleum Geologists Bull., v. 40, no. 2, p. 211, 233. Name abandoned.

Named from marine part of section below 750 feet in Umiat test well No. 1, in vicinity of Umiat, Colville River region.

**Umpqua Formation**[1]

Eocene, lower to middle: Southwestern Oregon and northern California.

Original reference: J. S. Diller, 1898, U.S. Geol. Survey Geol. Atlas, Folio 49.

C. E. Weaver and others, 1944, Geol. Soc. America Bull., v. 55, no. 5, p. 589, chart 11. Correlation chart shows Umpqua formation below Tyee formation in Roseburg and Comstock areas, Oregon. States type section.

J. E. Allen and E. M. Baldwin, 1944, Oregon Dept. Geology and Mineral Industries Bull. 27, p. 13, 19, pls. 1, 5. In Coos Bay quadrangle, formation consists of more than 1,800 feet of tuffaceous sandstone and shale with thick lenticular basalts and pyroclastic. Overlies sediments, schists, and volcanics tentatively correlated with Franciscan-Knoxville group of California. Underlies Tyee sandstone in northeastern part of quadrangle. In some areas, underlies Coaledo formation. Middle Eocene.

Howel Williams, 1949, California Div. Mines Bull. 151, p. 18, pl. 1. Mapped in Macdoel quadrangle, California.

F. G. Wells, 1956, U.S. Geol. Survey Geol. Quad. Map GQ–89. Described in Medford quadrangle, Oregon-California. Forms floor of most of Bear Creek valley from Siskiyou, where it is faulted against volcanic rocks of Western Cascades, north to Rogue River. Western boundary follows trend of foothills of Cascade Range. Maximum thickness about 8,000 feet. Predominantly medium-grained sandstone with some shaly and conglomerate layers. Disconformably overlies Hornbrook formation; in northern part of area, grades into overlying Colestin and Roxy formations (both new) but to south is separated from them by angular discordance. Eocene.

U.S. Geological Survey currently considers the Umpqua Formation lower Eocene in age.

Type section: Along north Umpqua River about 17 miles northeast of Roseburg, Douglas County, Oreg.

Umpqua Group[1]

Eocene: Southwestern Oregon.

Original reference: T. Condon, 1902, The Two Islands: Portland, Oreg., The J. K. Gill Co.

Named for association with Umpqua Valley, Douglas County.

Unadilla Formation[1]

Upper Devonian: East-central New York.

Original reference: C. S. Prosser, 1903, Am. Geologist, v. 32, p. 380–384.

G. A. Cooper and others, 1942, Geol. Soc. America Bull., v. 53, no. 12, pt. 1, chart 4. Shown on correlation chart as Unadilla shale and sandstone. Underlies Oneonta redbeds; overlies Gilboa sandstone. Genesee group.

Bradford Willard and R. E. Stevenson, 1950, Am. Assoc. Petroleum Geologists Bull., v. 34, no. 12, p. 2274. Onteora redbeds grade laterally westward into Unadilla marine sandstones and sandy shales. Unadilla listed under Portage group.

Named for Unadilla River below New Berlin village, Chenango County.

Uncas Shale[1]

Permian: Central northern Oklahoma.

Original reference: D. W. Ohern and R. E. Garrett, 1912, Oklahoma Geol. Survey Bull. 16, p. 10.

Named for exposures in vicinity of Uncas, Kay County.

Uncle Israels Granite

Age not stated: Southeastern Maine.

G. H. Chadwick, 1944, New York Acad. Sci. Trans., ser. 2, v. 6, no. 6, p. 172. Name proposed for white granite with cataclastic texture. Occurs as sills.

Occurs on Mount Desert Island and Bartlett Island, Hancock County.

**Uncle Sam Porphyry**

Eocene(?) to lower Pliocene(?): Southeastern Arizona.

B. S. Butler, E. D. Wilson, and C. A. Rasor, 1938, Arizona Bur. Mines Bull. 143, Geol. Ser. 10, p. 24–25, pl. 3. Rock designated as quartzite latite porphyry. Buff or rusty brown where weathered but dark gray on fresh fractures. Characteristic feature of rock is blotchiness or unevenness of texture due to variations in crystallinity of groundmass. Intrusive into sandstone and shale of Bisbee group west of Ajax Hill, and intrudes volcanic breccias and flows southwest toward Charleston.

James Gilluly, 1945, Am. Jour. Sci., v. 243, no. 12, p. 647–651. Intrusive into Bronco volcanics (new), Bisbee formation, and locally, into Naco limestone. At Bronco Hill and point about 1½ miles to the southeast, it is cut by Schieffelin granodiorite. Probably early Tertiary age.

James Gilluly, 1956, U.S. Geol. Survey Prof. Paper 281, p. 94–99, pl. 5. Mapped in central Cochise County as Tertiary—Eocene(?) to lower Pliocene(?). Locally invades Colina limestone and Epitaph dolomite.

Forms Uncle Sam Hills 2½ miles southwest of Tombstone and the Three Brothers, and is general country rock of State of Maine, Merrimac, San Pedro, and Montezuma mines. Occupies extensive area in western part of Tombstone district and extends westward toward Charleston, Cochise County.

Uncompahgran Quartzite

*See* **Uncompahgre Formation.**

Uncompahgran System

Precambrian: Western United States.

N. E. A. Hinds, 1936, Carnegie Inst. Washington Pub. 463, p. 58, 134. Strata in western United States formerly classed as Algonkian are divisible into two groups (Uncompahgran and Beltian) separated by considerable time interval during which orogenic deformation, intrusion of granite, and deep erosion occurred. The older group, for which periodic and system term Uncompahgran is suggested, includes the Needle Mountains group of San Juan Mountains, southwestern Colorado; Mazatzal quartzite of central Arizona; and Cottonwood series of Wasatch, Uinta, Oquirrh, and other ranges of northern Utah. Uncompahgran formations are chiefly quartzite, with subordinate amounts of quartzitic conglomerate and slate.

Named from fine exposures of rocks of this type in Uncompahgre Canyon, San Juan Mountains, Colo.

**Uncompahgre Formation** (in Needle Mountains Group)[1]

Precambrian: Southwestern Colorado.

Original reference: W. Cross and E. Howe, 1905, U.S. Geol. Survey Geol. Atlas, Folio 120.

N. E. A. Hinds, 1940, 6th Pacific Sci. Cong. Proc., p. 290 (table). Cited as Uncompahgran quartzite.

W. S. Burbank and C. T. Pierson, 1953, U.S. Geol. Survey Circ. 236, p. 3. In Uncompahgre Canyon on western flank of San Juan Mountains, formation consists of alternate layers of quartzite and black slate from 50 to several thousand feet in thickness. Neither bottom nor top of series exposed.

Well exposed in Uncompahgre Canyon, Silverton and Ouray quadrangles.

†Uncompahgre Interglacial Interval[1]

Pleistocene: Southwestern Colorado.

Original reference: W. W. Atwood and K. F. Mather, 1912, Jour. Geology, v. 20, p. 392–409.

Underwood Formation (in New Albany Shale)

Underwood Shale Member (of New Albany Shale)

Mississippian (Kinderhookian): Southeastern Indiana and northern Kentucky.

Guy Campbell, 1946, Geol. Soc. America Bull., v. 57, no. 9, p. 835, 840 (fig. 3), 849–851, 858. Underwood formation lies between Falling Run member of Sanderson formation (both new) and Henryville shale (new). At type locality, consists of soft greenish 6-inch fossiliferous shale with layer of phosphatic nodules at top.

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 locality: On south Ester Farm, in SE¼ sec. 21, T. 2 N., R. 8 E., 2 miles east of Underwood, Clark County, Ind. Noted at Pine Lick, 1 mile northwest of Loretto, Marion County, Ky.

Underwood Lava[1]

Tertiary(?): Southern Washington.

Original reference: I. A. Williams, 1916, Oregon Bur. Mines and Geol., Min. Res. Oreg., v. 2, no. 3, p. 108, 115–117.

In vicinity of Underwood, Skamania County.

Underwood Mountain Lava

Pliocene: Northwestern Oregon and southwestern Washington.

W. D. Lowry and E. M. Baldwin, 1952, Geol. Soc. America Bull., v. 63, no. 1, pl. 2. Name appears on chart only. Younger than Hood River conglomerate.

Underwood Mountain located on north side of Columbia River in Washington, near Hood River, Oreg.

**Unga Conglomerate**[1]

Miocene: Southwestern Alaska.

Original reference: W. H. Dall and G. D. Harris, 1892, U.S. Geol. Survey Bull. 84, p. 234.

P. S. Smith, 1936, U.S. Geol. Survey Prof. Paper 182, p. 27. Section about 200 feet thick was measured by Dall in 1872 on Unga Island, where series consisted largely of conglomerates with some shales and sandstones containing in places abundant marine fossils. Also recognized at other places in same general region as on shores of Balboa and Herendeen Bays and Port Moller. At Port Moller, beds attain thickness of at least 1,000 feet. In type area, Unga conglomerate appears to rest conformably on highest recognized Eocene stratum but this is not believed to be normal relation, as beds usually show much less deformation than the Eocene deposits.

Type area: Unga Island.

**Ungalik Conglomerate**[1]

Lower Cretaceous: Central western and central Alaska.

Original reference: P. S. Smith and H. M. Eakin, 1911, U.S. Geol. Survey Bull. 449, p. 55.

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.

Exposed on steep-faced cliffs along Ungalik River and forms most of prominent range of hills between river and coastal plain from Bonanza Creek north to about 1 mile below Camp A17; Nulato-Norton Bay district, Lower Yukon River region.

Unibon Shale[1]

Upper Cretaceous: Puerto Rico.

Original reference: D. R. Semmes, 1919, New York Acad. Sci. Scientific survey of Porto Rico and Virgin Islands, v. 1, p. 69, 74.

J. D. Weaver, 1956, *in* R. Hoffstetter and others, Lexique Strat. Internat., v. 5, Amérique Latine, fasc. 2b, p. 345. Upper Cretaceous. Light porous shale, with foraminifera. Exact stratigraphical position and distribution not known.

Type locality: At junction of Morovis trail and Unibon River in northern part of island.

**Unicoi Formation**[1] (in Chilhowee Group)

Lower Cambrian(?): Eastern Tennessee, northwestern 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. 27–28, 37–41. In this report [northeastern Tennessee], basal clastic group of Lower Cambrian series is divided into Unicoi, Hampton, and Erwin formations. Other formation names have been used in region, and various names have been given to group as a whole. Terms Unicoi formation, Hampton shale, and Erwin quartzite were originally applied by Keith (1903, U.S. Geol. Survey Geol. Atlas, Folio 90; 1905, Folio 118; 1907, Folio 151) to broad lithologic units; Unicoi consisting dominantly of arkose and conglomerate, Hampton of shale, and Erwin of quartzite. However, formation boundaries, when based on lithologic character alone, are not of same age from place to place; also, the different rock types are so interbedded that none of the formations consists of a single rock type. In this report, boundaries of the formations are placed at top or bottom of widely traceable beds in such manner that formations are convenient units of mapping. Lithologic titles of formations are abandoned, although their gross character corresponds approximately to Keith's original intention. Top of Unicoi is placed at top of thick unit of arkosic and vitreous quartzite which lies at rather constant interval of 2,500 to 3,000 feet below base of Shady dolomite. Upper surface of arkosic and vitreous quartzite is easily recognized and is persistent horizon that is probably of same age everywhere.

G. W. Stose and A. J. Stose, 1944, Am. Jour. Sci., v. 242, no. 7, p. 389. Discussion of Chilhowee group and Ocoee series of southern Appalachians. With present knowledge, it is not possible to decide which formation, if any, in Chilhowee type section represents Unicoi formation, but it is evident that lower part of that formation which contains the basalt flows is not present because neither Hayes (1895, U.S. Geol. Survey Geol. Atlas, Folio 20) nor Keith (1895, U.S. Geol. Survey Geol. Atlas, Folio 16; 1896, Folio 25) describe such flows in the section.

P. B. King, 1949, Am. Jour. Sci., v. 247, no. 8, p. 519 (table 1), 521. Basal formation of Chilhowee group in northeastern Tennessee and southwest Virginia. Underlies Hampton shale; overlies volcanics of Mount Rogers area.

S. S. Oriel, 1950, North Carolina Div. Mineral Resources Bull. 60, p. 12, 13. 18–20, pl. 1. Rocks mapped by Keith (1904, U.S. Geol. Survey Geol. Atlas, Folio 116) as quartzite lentil and lower part of Nichols slate and as Cochran conglomerate are all included in Unicoi formation of present report [Hot Springs Window]. Top is placed above thick-bedded to massive vitreous and coarsely feldspathic quartzites that underlie lower shale member of Hampton formation; boundary is sharp and distinct. Lower contact is here defined as base of lowermost conglomeratic bed above the Sandsuck. Boundary difficult to recognize because slates are interbedded with Unicoi conglomerates and there are lenses of coarse conglomerate in upper part of Sandsuck. Formation thickens southwestward, from 1,400 feet on south side of Lovers Leap Ridge to 2,600 feet along East Fork Shut-in Creek; 2,250 feet along Spring Creek. Northwest of window and in overlying thrust sheet are rocks which are herein assigned to Unicoi as Keith did in his Asheville folio (1904); Stose and Stose (1947) assign these rocks to Great Smoky quartzite of Ocoee series, or Snowbird as mapped by Keith. Two sets of formation names for Lower Cambrian clastic rocks are in current usage in eastern Tennessee and western North Carolina. Northeast Tennessee names, Unicoi, Hampton, and Erwin, are used here 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.

H. W. Ferguson and W. B. Jewell, 1951, Tennessee Div. Geology Bull. 57, p. 11 (table 1), 12 (table 2), 21–28, pl. 1. Described in Del Rio district, Cocke County, where it is 1,825 feet thick in Stone Mountain thrust block and about 5,000 feet thick in Meadow Creek Mountain thrust block. Overlies Sandsuck formation; underlies Hampton formation. In all but Stone Mountain and Neddy Mountain thrust blocks of Del Rio thrust sheet that contain Unicoi sediments, a bed of coarse-grained quartzite about 50 feet thick occurs about 1,000 feet or more from top of formation. This unit is here named Moccasin Gap member. In several blocks of Del Rio thrust sheet, the Unicoi above the Moccasin Gap quartzite can be separated into upper shale member and upper quartzite member. In this report, Unicoi, Hampton, and Erwin formations are referred to as clastic group of Lower Cambrian age. The Unicoi represents about same stratigraphic interval as the Cochran as mapped by Keith (1904, U.S. Geol. Survey Geol. Atlas, Folio 116).

John Rodgers, 1953, Tennessee Div. Geology Bull. 58, pt. 2, p. 34–38; pt. 1, pls. Described and mapped in eastern Tennessee where it is basal formation of northeastern sequence of Chilhowee group. Keith was not consistent in his mapping of Unicoi. In Asheville Folio (1904, U.S. Geol. Survey Geol. Atlas, Folio 116), he mapped beds now assigned to Unicoi as quartzite lentil in Nichols slate or even as Nebo quartzite. In Roan Mountain Folio (1907, U.S. Geol. Survey, Geol. Atlas, Folio 151), he mapped much of Unicoi as Hiwassee slate and Snowbird formation. Safford (1869, Geology of Tennessee) varied his usage, placing the beds in the Ocoee where they are obviously conglomeratic but retaining them in the Chilhowee where they are more quartzitic. In present usage, top of formation is taken at top of conglomeratic beds, whether quartzitic or not, beneath fairly persistent layer of argillaceous shale that has been recognized in most areas. Underlies Hampton formation. Thickness ranges from 2,000 to 5,000 feet; variation in thickness probably result of deposition on uneven floor.

R. O. Bloomer and H. J. Werner, 1955, Geol. Soc. America Bull., v. 66, no. 5, p. 594–595, pl. 1. Described in Blue Ridge region of central Virginia where it is as much as 500 feet thick and consists of volcanics and intergradational conglomeratic graywackes, subgraywackes, pebbly arkoses, and pebbly quartzites. Conformably underlies Harpers formation; owing to overlap overlies Late Precambrian and basement complex formations. Chilhowee group.

A. J. Stose and G. W. Stose, 1957, Virginia Geol. Survey Bull. 72, p. 78–98, pl. 1. Described in Gossan lead district where it is at base of Cambrian. Thickness about 1,700 feet. Underlies Hampton shale; unconformably overlies Precambrian rocks described as injection complex, and Mount Rogers volcanic series.

J. L. Stuckey and S. G. Conrad, 1958, North Carolina Div. Mineral Resources Bull. 71, p. 38–39; J. L. Stuckey, 1958, Geologic map of North Carolina (1:500,000): North Carolina Div. Mineral Resources. Formation in North Carolina is predominantly sandstone, quartzite, and conglomerate with interbedded shale and slate. Thickness 1,400 to 2,600 feet. Basal formation of Chilhowee group; underlies Hampton formation.

P. B. King and H. W. Ferguson, 1960, U.S. Geol. Survey Prof. Paper 311, p. 28, 36–40, pls. 1, 12. Described in northeasternmost Tennessee where it underlies Hampton formation and overlies units of Mount Rogers volcanic group. Formation is mass of arkosic coarse-grained and conglomeratic sandstone, with some beds of vitreous quartzite and shale, as well as amygdaloidal basalt. Thickness as much as 5,000 feet. At type section, herein designated, formation is about 2,000 feet thick and consists mostly of thick-bedded arkosic sandstone and quartzite but includes two basalt layers. Above the upper basalt are several beds of massive vitreous quartzite and two of sedimentary greenstone. Lower part of section contains coarse conglomerate.

Type locality: On Nolichucky River, southeast of Unaka Springs, Unicoi County, Tenn.

Union Formation[1]

Pleistocene: Western Kentucky.

Original reference: L. C. Glenn, 1912. Kentucky Geol. Survey Rept. Prog. 1910–1911, p. 26.

Named for Union County.

Union Limestone[1]

Pennsylvanian: Southeastern Nebraska.

Original reference: G. E. Condra and N. A. Bengston, 1915, Nebraska Acad. Sci. Pub., v. 9, no. 2, p. 7, 13, 37.

Exposed in old quarry at Union, Cass County, in valley side in NW¼ sec. 22, T. 10 N., R. 13 E., and 1½ miles southwest of Union, in secs. 33 and 28, T. 10 N., R. 13 E.

Union Limestone (in Greenbrier Limestone[1] or Series)

Mississippian (Meramecian): Southeastern West Virginia and southwestern Virginia.

Original reference: D. B. Reger, 1926, West Virginia Geol. Survey Rept. Mercer, Monroe, and Summers Counties, p. 450, 467.

P. H. Price and E. T. Heck, 1939, West Virginia Geol. Survey Greenbrier County, p. 272; J. M. Weller and others, 1948, Geol. Soc. America Bull., v. 59, no. 2, chart 5 (columns 98, 99). Limestone in Greenbrier series. Underlies Greenville shale; overlies Pickaway limestone.

D. B. Reger, 1950, Am. Assoc. Petroleum Geologists Bull., v. 34, no. 9, p. 1911. In southern West Virginia counties and southwestern Virginia, intermediate sandstone and shale between the Gasper and Fredonia largely disappear; hence, term "Union" limestone was applied to both of these calcareous units.

Type locality: At west edge of Union, Monroe County, W. Va.

Union Shale[1]

Upper Devonian: Western central Montana.

Original reference: W. H. Weed, 1901, U.S. Geol. Survey 22d Ann. Rept., pt. 2, p. 434, 438, map.

Occurs in Queen Gulch, also near Union mine, at head of Alpreston Gulch, Elkhorn region.

Union Church transition phase (of Tullos Member of Yazoo Clay)

Eocene (Jackson): Central Louisiana.

N. H. Fisk, 1938, Louisiana Dept. Conserv. Geol. Bull. 10, p. 78 (fig. 6), 99–100. Alternating thin beds of sandy silts and clays which in upper 20 feet of section contain large light-brown concretions or slabs of fossils cemented by limonite. Occurs between Tullos member and overlying Verda member.

Well exposed at Union Church, in center of sec. 30, T. 10 N., R. 2 E., La Salle Parish.

Union Corners Granite[1]

Precambrian: Southeastern New York.

Original reference: W. J. McGee, 1894, Geologic map of New York prepared under direction of James Hall.

In Bronxville, New York City.

Union Dairy member (of Hoxbar Formation)[1]

Pennsylvanian: Central southern Oklahoma.

Original reference: C. W. Tomlinson, 1928, Oklahoma Geol. Survey Bull. 40Z, p. 15.

Named for Union Dairy Hill, in NE¼ sec. 7, T. 5 S., R. 2 E., Carter County.

Union Mountain 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), 2181, 2182–2183. Diverse unit characterized by abundant quartz sand either in sandy dolomite or as vitreous siliceous quartz arenite or quartzite, but also including white crystalline dolomite and dark crinoidal dolomite. Thickness approximately 700 to 800 feet in southern part of area; 830 feet at type section; nearly 1,200 feet in northern part of Pinyon Range. Overlies McColley Canyon member (new); underlies Telegraph Canyon member (new).

Type locality: Crest of Union Mountain, in Pinyon Range, northeastern part of Mineral Hill quadrangle.

Union Peak Lavas

Pliocene to Pleistocene, lower: Southwestern Oregon.

Howel Williams, 1942, Carnegie Inst. Washington Pub. 540, p. 22–25, 130, pl. 3. Lavas from Union Peak, volcano which became extinct either before Mount Mazama began to develop or shortly thereafter. Toward the north and east, Union Peak lavas pass beneath Mount Mazama; in other directions, they merge into identical lavas from other sources. Huckleberry lavas at Huckleberry Mountain may have issued from fissures at base of Union Peak volcano. [Diller and Patton, 1902, U.S. Geol. Survey Prof. Paper 3, described Union Peak andesite area.]

Union Peak is south and west of Crater Lake.

**Union Springs Member** (of Marcellus Shale)[1]

Middle Devonian: Central New York.

Original reference: G. A. Cooper, 1930, Am. Jour. Sci., 5th, v. 19, p. 132, 218, 219.

G. A. Cooper and others, 1942, Geol. Soc. America Bull., v. 53, no. 12, pt. 1, p. 1745, chart 4. Bakoven shale represents easternmost known facies of Union Springs shale. In Cayuga Lake region, the Union Springs is black limestone, but in eastern central New York it is sooty-black shale. In Catskill region, the Union Springs is dark sandy shale with *Paracardium* and *Buchiola*. Basal member of Marcellus; underlies Cherry Valley limestone member; overlies Onondaga.

Type section: Upper part of Woods quarry, 1 mile south of Union Springs, Cayuga County.

Union Station Shale Member (of Chanute Formation)

Pennsylvanian (Missouri Series): Northwestern Missouri.

J. R. Clair, 1943, Missouri Geol. Survey and Water Resources, 2d ser., v. 27, pl. 1. Red, green, gray clayey shale, sandy at top. Thickness 8 to 25 feet in Jackson County; 10 to 24 feet in Cass County. Underlies Paola limestone member; overlies Cement City limestone member.

R. C. Moore, 1948, Am. Assoc. Petroleum Geologists Bull., v. 32, no. 11, p. 2031 (fig. 4), 2032. Settlement of the "Iola problem" has led to a number of changes in Missouri Survey's classification of middle and upper Kansas City beds so as to bring interstate agreement in nomenclature. Union Station shale member of Chanute formation is suppressed because it is a synonym of Chanute as a whole.

Type locality and derivation of name not given.

Uniontown cyclothem

Pennsylvanian (Monongahela Series) : Southeastern Ohio.

M. T. Sturgeon and others, 1958, Ohio Geol. Survey Bull. 57, p. 158 (table 13), 182–185. Embraces interval between Lower Uniontown cyclothem (new) below and Little Waynesburg cyclothem (new) above. Normal succession includes six members (ascending) : Lower Uniontown shale and sandstone, Uniontown redbed, Uniontown limestone, Uniontown underclay, Uniontown (No. 10) coal, and Uniontown roof shale. In Athens County, Uniontown commonly rests on Arnoldsburg coal and roof shale and extends uninterrupted to top of Uniontown roof shale. Where Lower Uniontown cyclothem is developed, base of Uniontown is considered to overlie Lower Uniontown coal. Arnoldsburg sandstone and Ritchie redbed members of Lower Uniontown cyclothem are continuous laterally, irrespective of presence or absence of Lower Uniontown coal horizon, and these names are carried in the Uniontown wherever its boundary is placed over Arnoldsburg coal horizon. Thickness of Uniontown varies with position of its lower boundary; average thickness where boundary is placed at Arnoldsburg coal zone 33 feet; 15 feet wherever Lower Uniontown cyclothem occurs. 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.

Uniontown Limestone[1]

Pennsylvanian: Southeastern Kansas.

Original reference: R. C. Moore, 1932, Kansas Geol. Soc. Guidebook 6th Ann. Field Conf., p. 97.

Derivation of name not stated.

**Uniontown Limestone Member** (of Monongahela Formation)[1]

Uniontown Limestone (in Monongahela Group)

Uniontown 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. 55–104, 286, 292.

W. O. Hickok 4th and F. T. Moyer, 1940, Pennsylvania Geol. Survey, 4th ser., Bull. C–26, p. 100, 123, 124 (fig. 29). Overlies Arnoldsburg sandstone; underlies Uniontown coal which in turn underlies Uniontown sandstone. Included in Monongahela group.

D. L. Norling, 1958, Ohio Geol. Survey Bull. 56, p. 10 (fig. 3), 82–83, geol. map. In Morgan County, Uniontown limestone and shale member (Monongahela series) consists of limestone and calcareous shale or calcareous shale with limestone layers. Average thickness 4 feet. Underlies Arnoldsburg sandstone and shale member; separated from underlying Uniontown sandstone and shale member by Uniontown (No. 10) coal.

M. T. Sturgeon and others, 1958, Ohio Geol. Survey Bull. 57, p. 158 (table 13), 184. Limestone member of Uniontown cyclothem in report on Athens County. Term in its present usage indicates fresh-water limestone between Arnoldsburg sandstone and Uniontown coal bed, for this lithology is not present in Lower Uniontown-Uniontown coal bed interval. Limestone is closely associated with underlying Ritchie redbed as it frequently interbeds with or grades laterally into them. Thickness varies from few inches to 20 feet, but in places member is totally absent and its position occupied by redbeds. Monongahela series.

Named for exposures at Uniontown, Fayette County, Pa.

Uniontown Member (of Monongahela Formation)[1]

Pennsylvanian: Western Pennsylvania.

Original reference: M. E. Johnson, 1929, Pennsylvania Geol. Survey Topog. and Geol. Atlas 27, p. 31.

Name derived from occurrence near Uniontown, Fayette County.

Uniontown redbed member

Pennsylvanian (Monongahela Series): Eastern Ohio.

M. T. Sturgeon and others, 1958, Ohio Geol. Survey Bull. 57, p. 148 (table 13), 184. Member of Uniontown cyclothem in report on Athens County. Name is intended to apply to this lithology only where it is underlain by Lower Uniontown coal bed. Where Lower Uniontown coal bed is absent, this member is coalesced with Ritchie redbed of Lower Uniontown cyclothem. Thickness 14 feet.

Name derived from cyclothem.

Uniontown roof shale member

Pennsylvanian (Monongahela Series): Eastern Ohio.

M. T. Sturgeon and others, 1958, Ohio Geol. Survey Bull. 57, p. 158 (table 13), 185. Member of Uniontown cyclothem in report on Athens County. Thickness a few inches to a little more than 1 foot. Wherever present, member is clay shale, laminated or massive, that grades vertically into shale. Overlies Uniontown (No. 10) coal member. Uppermost member of cyclothem.

**Uniontown Sandstone Member** (of Monongahela Formation)[1]

Uniontown Sandstone (in Monongahela Group)

Uniontown sandstone and shale member

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

Original reference: I. C. White, 1891, U.S. Geol. Survey Bull. 65, p. 58–59.

W. O. Hickok 4th and F. T. Moyer, 1940, Pennsylvania Geol. Survey, 4th ser., Bull. C–26, p. 100, 124 (fig. 29), 125. Underlies Lower Waynesburg limestone; separated from Uniontown limestone by Uniontown coal. Included in Monongahela group.

D. L. Norling, 1958, Ohio Geol. Survey Bull. 56, p. 10 (fig. 3), 84, geol. map. In Ohio, Uniontown sandstone and shale member (Monongahela series) occupies interval between Uniontown (No. 10) coal below and Waynesburg limestone and shale member above. In Morgan County, consists of 20 to 40 feet of sandstones, sandy shales, and red shales.

M. T. Sturgeon and others, 1958, Ohio Geol. Survey Bull. 57, p. 158 (table 13), 184. Member of Little Waynesburg cyclothem in report on Athens

County. White (1891) proposed this name for sandstone that occurs 60 to 70 feet below Waynesburg coal bed, because of its relation to underlying Uniontown coal. In West Virginia, a shale facies at this position has been designated Annabelle shale by Hennen and Reger (1913). In Athens County, member is highly variable in thickness, rock type, and prominence. Invariably member rests directly on or is separated from Uniontown coal bed by only a few inches of shale. It is most resistant unit between Sewickley sandstone and Little Waynesburg coal bed. Average thickness 21½ feet. Monongahela series.

Named for association with Uniontown coal, although it is not prominent at Uniontown, Fayette County, Pa.

Uniontown underclay member

*See* Uniontown cyclothem.

Union Valley Formation (in Springer Group)

Union Valley Sandstone Member (of Wapanucka Formation)[1]

Pennsylvanian: East-central Oklahoma.

Original reference: R. V. Hollingsworth, 1934, Geol. Soc. America Proc. 1933, p. 364.

B. H. Harlton, 1938, Am. Assoc. Petroleum Geologists Bull., v. 22, no. 7, p. 854 (fig. 1), 889–895. Formation (in Springer group) includes Stapp conglomerate member (new) at base. Thickness about 360 feet. At typical exposure in Ouachitas, consists of gray to dark-gray shale and intercalated massive and thin-bedded greenish-yellow fine to medium subangular sandstone. Underlies Round Prairie formation (new); overlies Wesley shale (new) in Jackfork group. Union Valley was initial deposit of Morrow time; unconformity at base of Union Valley, which in Ouachitas is marked by Stapp conglomerate, is proper horizon to draw base of Morrow.

J. C. Barker, 1951, Tulsa Geol. Soc. Digest, v. 19, p. 180–183. Formation described in Lawrence uplift where it is about 30 feet thick. Overlies "Springer" shale; underlies Wapanucka formation.

L. M. Cline, 1956, Tulsa Geol. Soc. Digest, v. 24, p. 103. Overlying Wesley siliceous shale and underlying Johns Valley shale in Ouachitas is persistent fossiliferous sandstone containing fragments of crinoid columnals, brachiopods and bryzoans, and plant fragments. Harlton (1938) correlated this sandstone with Union Valley sandstone which, at its type locality east of Ada, contains goniatite fauna of basal Morrow age. Inasmuch as overlying Johns Valley shale contains Caney goniatite fauna of Mississippian age, this fossiliferous sandstone must be older than type Union Valley.

B. H. Harlton, 1959, *in* The geology of the Ouachita Mountains—a symposium: Dallas, Tex., Dallas Geol. Soc. and Ardmore Geol. Soc., p. 132. Unit termed Union Valley sandstone by Harlton (1938) is here renamed Game Refuge formation.

Type locality: Outcrops near Union Valley Schoolhouse, Pontotoc County.

**Unionville Granodiorite**

Upper Cretaceous: Southwestern Montana.

Adolph Knopf, 1957, Am. Jour. Sci., v. 255, no. 2, p. 81, 90–91, map facing p. 88. Hypersthene-bearing augite-hornblende (basic) granodiorite that is dark and heavy and resembles diorite. Represents earliest intrusion of Boulder bathylith.

Well exposed south and southeast of Helena. Named for small village south of Helena, Lewis and Clark County.

Unionville Sandstone[1]

Pennsylvanian: Northwestern Illinois.

Original reference: J. Shaw, 1873, Illinois Geol. Survey, v. 5, p. 147–149.

Named for outcrop at Unionville, Whiteside County.

United Verde Diorite[1]

Precambrian: Central Arizona.

Original references: L. E. Reber, Jr., 1920, Am. Inst. Mining Engrs.; 1922, Am. Inst. Mining Metall. Engrs. Trans., v. 66, p. 3–26, map.

L. E. Reber, Jr., 1938, Arizona Bur. Mines Bull. 145, Geol. Ser. 12, p. 59. Mentioned in report on mineralization in Jerome district.

Probably named for United Verde mine, Jerome district.

Unity Group

Upper(?) Devonian: Southwestern New Hampshire.

C. A. Chapman, 1942, Geol. Soc. America Bull., v. 53, no. 6, p. 897, 898, 902. Name proposed for plutonic rocks of Oliverian magma series in the Unity dome. Similar to Croydon group which consists of fine- to medium-grained biotite gneiss. Quartz diorite is most common rock type.

Composes core of Unity dome in southeastern part of Claremont quadrangle.

**Universal Limestone Member** (of Dugger Formation)

Middle Pennsylvanian: Southwestern Indiana.

C. E. Wier, 1951, U.S. Geol. Survey Coal Inv. Map C–9. About 3 feet thick; commonly in two benches separated by few inches of shale; both benches arenaceous and locally grade into calcareous sandstone. Occurs between Coals VI and VII in Sullivan and Greene Counties and between Coals Vb and VII in Vermillion and Vigo Counties.

Type locality: Half mile south of Universal, small town in southern Vermillion County, in NW¼SW¼ sec. 31, T. 4 N., R. 9 W.

University Beds[1]

Quaternary: Central northern New Mexico.

Original reference: K. Bryan, 1909, New Mexico Univ. Bull., Geol. Ser., v. 3, no. 1.

Form considerable part of Sandia Mesa, extending from Menaul School south to mouth of Power House Arroyo and to east in wedge shape to eastern limit of area in Albuquerque region.

University Mesa Marl (in Fredericksburg Group)[1]

Lower Cretaceous (Comanche Series): Western Texas.

Original reference: W. S. Adkins, 1933, Texas Univ. Bull. 3232, p. 271, 328, 339, 347.

L. W. Stephenson, 1942, Geol. Soc. America Bull., v. 53, no. 3, chart 9. University Mesa clay shown on correlation chart above Comanche Peak limestone and below Kiamichi clay.

Pecos County.

**Unkar Group**[1]

Unkar Series

Precambrian (Grand Canyon Series) : Northern Arizona.

Original reference: C. D. Walcott, 1894, U.S. Geol. Survey 14th Ann. Rept., pt. 2, pl. 60.

J. F. Mason, 1948, Geol. Soc. America Bull., v. 59, no. 4, p. 350. Incidental mention of Unkar series.

C. E. Van Gundy, 1959, Geol. Soc. America Bull., v. 62, no. 8, p. 953, 954, pl. 1. Lower group of Grand Canyon series. Stratigraphically restricted, upper part reassigned to Nankoweap group. Thickness in Basalt Canyon, 5,684 to 6,138 feet. Disconformably underlies Nankoweap group.

Named for outcrops in Unkar Valley, Grand Canyon region.

**Unkpapa Sandstone**[1]

Upper Jurassic: Western South Dakota.

Original reference: N. H. Darton, 1899, Geol. Soc. America Bull., v. 10, p. 393.

1952, Billings Geol. Soc. Guidebook 3d Ann. Field Conf., p. 144. Generalized columnar section of Black Hills shows Unkpapa sandstone overlying Sundance formation and underlying Morrison and where Morrison pinches Lakota. Soft massive fine-grained sandstone 0 to 225 feet thick.

W. J. Mapel and G. B. Gott, 1959, U.S. Geol. Survey Mineral Inv. Field Studies Map MF–218. Maximum thickness about 250 feet in Angostura Reservoir and Cascade Springs quadrangles, South Dakota. Thins westward and in Flint Hill and Minnekahta quadrangles pinches out under Morrison formation. Underlies Lakota formation.

Named for Unkpapa Peak, at head of Calico Canyon, northwest of Buffalo Gap, Custer County.

**Upham Member** (of Montoya Dolomite)

Upham Dolomite or Limestone (in Montoya Group)

Upham Member (of Second Value Formation)

Upper Ordovician: Southwestern New Mexico and western Texas.

V. C. Kelley and Caswell Silver, 1952, New Mexico Pubs. in Geology 4, p. 11, 31 (table), 51–59–60, fig. 4. Massive-bedded medium-gray- to brownish-gray-weathering dolomite. Microcrystalline to coarsely crystalline and medium to dark gray on fresh exposure. Detrital quartz grains present as scattered grains, thin lentils, and irregular vertical streaks. Where present, chert occurs as scattered nodules of irregular shape. Thickness 20 to 80 feet. Underlies Aleman formation (new) ; overlies Cable Canyon sandstone (new) with gradational contact. Montoya group.

F. E. Kottlowski and others, 1956, New Mexico Bur. Mines Mineral Resources Mem. 1, p. 7, 23–25. Upham dolomite described in San Andres Mountains where it is 115 feet thick in Rhodes Canyon, 77 feet in Hembrillo Canyon, and 104 feet in Ash Canyon. Overlies Cable Canyon sandstone; underlies Aleman dolomite. Montoya group.

R. H. Flower, 1958, Roswell Geol. Soc. Guidebook 11th Field Conf., p. 70. Rank reduced to member of Second Value formation.

H. J. Howe, 1959, Am. Assoc. Petroleum Geologists Bull., v. 43, no. 10, p. 2285–2332. Montoya group described in Trans-Pecos region, Texas.

Upham formation (limestone or dolomite) constitutes basal formation of group in areas where Cable Canyon sandstone is missing. Along southeast-facing escarpment of Baylor Mountains, a 116-foot interval composed of fine-grained sandstones and argillaceous dolomites (probably Simpson) is present between Lower Ordovician El Paso dolomite and upper Trentonian(?) Upham limestone.

Type locality: Cable Canyon section opposite Sierrite mine in NW¼ sec. 10, T. 16 S., R. 4 W., Caballo Mountains.

†Upland Formation[1]

Pleistocene: Southern and eastern Nebraska.

Original reference: A. L. Lugn and G. E. Condra, 1932, Geol. Soc. America Bull., v. 43, no. 1, p. 190.

G. E. Condra, E. C. Reed, and E. D. Gordon, 1950, Nebraska Geol. Survey Bull. 15–A, p. 22; J. C. Frye and A. B. Leonard, 1952, Kansas Geol. Survey Bull. 99, p. 87; D. R. Hill and J. M. Tompkin, 1953, U.S. Geol. Survey Bull. 1001, p. 25. Replaced by Sappa formation (new).

Named for outcrops along West Branch of Thompson Creek, about 2½ miles west of Upland, Franklin County.

Upper Bakerstown cyclothem

Pennsylvanian (Conemaugh Series): Southeastern Ohio.

M. T. Sturgeon and others, 1958, Ohio Geol. Survey Bull. 57, p. 95 (table 11), 123–129. Embraces interval between Anderson cyclothem below and Harlem cyclothem above. Normal succession includes four members (ascending): Cow Run sandstone, Ewing limestone, Upper Bakerstown underclay and coal. Thickness about 30 feet. Only the two basal members are present in Athens County. In Ohio, coal from which this cyclothem is named has heretofore been called Barton coal; Flint (1951) used name Barton for cyclothem under discussion. Waagé (1950, Maryland Dept. Geology, Mines and Water Resources Bull. 9) stated that Barton coal is equivalent to Upper Bakerstown coal of Maryland and that true Barton coal is above Ames limestone, which is contrary to Condit's (1912, Ohio Geol. Survey Bull. 17, 4th ser.) interpretation. Name Upper Bakerstown is used here since Condit's correlation is in error. In area of this report. Conemaugh series is discussed on cyclothemic basis; 15 cyclothems are named. [For sequence see Mahoning cyclothem.]

Present in Athens County.

Upper Brush Creek cyclothem

Pennsylvanian (Conemaugh Series): Southeastern Ohio.

M. T. Sturgeon and others, 1958, Ohio Geol. Survey Bull. 57, p. 95 (table 11), 111 (map 12), 112–113. I. C. White (1878) applied name Brush Creek to marine shale and limestone at position of Lower(?) Brush Creek limestone. Brush Creek is now applied to series of different beds comprising two more or less complete cyclothems which are now designated Lower Brush Creek and Upper Brush Creek. Upper Brush Creek embraces interval between Lower Brush Creek cyclothem below and Wilgus cyclothem above. Normal succession includes four members (ascending): Upper Brush Creek shale and (or) sandstone, Upper Brush Creek underclay, Upper Brush Creek coal, and Upper Brush Creek limestone. Thickness 27 feet. Heretofore, Upper Brush Creek members have been discussed in reports along with Lower Brush Creek members.

Little attention has been given to nonmarine members of Upper Brush Creek cyclothem, although double nature of Brush Creek limestone had long been recognized. In area of this report, Conemaugh series is discussed on cyclothemic basis; 15 cyclothems are named. [For sequence see Mahoning cyclothem.]

Present in Athens County.

Upper Brush Creek limestone member

Pennsylvanian (Conemaugh Series) : Eastern Ohio.

M. T. Sturgeon and others, 1958, Ohio Geol. Survey Bull. 57, p. 95 (table 11), 113. Member of Upper Brush Creek cyclothem in report on Athens County. Average thickness 2 feet.

Upper 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), 112. Member of Upper Brush Creek cyclothem in report on Athens County. Thicknesses of nonmarine shale and sandstone lying between Brush Creek limestones vary from 5 to 40 feet; average thickness 22 feet.

Upper Brush Creek underclay member

Pennsylvanian (Conemaugh Series) : Eastern Ohio.

M. T. Sturgeon and others, 1958, Ohio Geol. Survey Bull. 57, p. 95 (table 11), 12. Member of Upper Brush Creek cyclothem in report on Athens County. Thickness 8 inches to more than 4 feet.

†Upper Freeport Clay (in Allegheny Formation)[1]

Upper Freeport clay or underclay 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, 1951, Ohio Geol. Survey, 4th ser., Bull. 48, p. 55–56, table 1, strat. sections. Included in Upper Freeport cyclothem (new) in Perry County, Ohio. Thickness ranges from less than 6 inches to 14 feet and averages 5 feet. Overlies Upper Freeport limestone; underlies Upper Freeport coal. In Allegheny series where limestone is missing and clay at this horizon is as thick as 14 feet, the Upper Freeport is probably in contact with Bolivar clay.

D. L. Norling, 1958, Ohio Geol. Survey Bull. 56, p. 22–23. Upper Freeport clay measured in sections 23 and 34, T. 14 N., R. 14 W., in western York Township, Morgan County. In section 34, Upper Freeport (No. 7) coal is underlain by 4 feet of poorly exposed gray to dark-gray clay shale with some sandy material near base. In northwestern corner of section 23, the coal is underlain by about 6 inches of dark-gray clay and by 1½ feet of crossbedded sandstone, which may be top part of Upper Freeport sandstone, or may represent more sandy phase of Upper Freeport clay member. Upper Freeport limestone not recognized definitely in Morgan County. Allegheny series. Cyclothemic classification not used in this report.

M. T. Sturgeon and others, 1958, Ohio Geol. Survey Bull. 57, p. 48 (table 7), 90. Upper Freeport underclay present in Athens County.

Name derived from town of Freeport, Armstrong County, Pa.

Upper Freeport cyclothem

Pennsylvanian (Allegheny Series) : Southeastern Ohio.

N. K. Flint, 1949, Ohio Acad. Sci. [Guidebook] 24th Ann. Field Conf., p. 12, 16. Incidental mention in road log.

N. K. Flint, 1951, Ohio Geol. Survey, 4th ser., Bull. 48, p. 55–57, table 1, geol. map. Includes (ascending) Freeport limestone, 2 feet; Upper Freeport clay, 5 feet; Upper Freeport (No. 7) coal; and unnamed shale. Occurs above Bolivar cyclothem and below Mahoning cyclothem of Conemaugh series. In area of this report, 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), 88–92. Topmost cyclothem in Allegheny series in Athens County. Occurs above Bolivar cyclothem. Comprises (ascending) Upper Freeport shale and (or) sandstone, Upper Freeport limestone, Upper Freeport underclay, and Upper Freeport (No. 7) coal members. Uffington shale member not known in Athens County but is considered topmost member of cyclothem and, for purposes of description, topmost member of Allegheny series. In this report, Allegheny series comprises 13 cyclothems. [For complete sequence see Brookville cyclothem.]

Name derived from town of Freeport, Armstrong County, Pa.

†Upper Freeport Limestone Member (of Allegheny Formation)[1]

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

Original reference: F. Platt and W. G. Platt, 1877, Pennsylvania 2d Geol. Survey Rept. $H_3$ p. 316.

R. E. Lamborn, 1951, Ohio Geol. Survey, 4th ser., Bull. 49, p. 27–28. Discussion of limestones of eastern Ohio. From 3 to 12 feet below base of Upper Freeport coal is an irregular bed of limestone which Rogers (1855, Geology of Pennsylvania, v. 2) called Freeport limestone in northwestern Pennsylvania and which Newberry apparently described as White limestone in Mahoning County, Ohio (1878, Ohio Geol. Survey v. 3). In his report on Lawrence County, Pa., White (1879, Pennsylvania 2d Geol. Survey Rept. $Q_2$), renamed Butler limestone, which underlies Lower Freeport coal and which was not recognized by Rogers, the Lower Freeport and the Freeport limestone of Rogers, the Upper Freeport. This terminology has been generally accepted in reports dealing with geology of coal measures in Pennsylvania, West Virginia, and Ohio.

M. T. Sturgeon and others, 1958, Ohio Geol. Survey Bull. 57, p. 48 (table 7), 90. Upper Freeport limestone included in Upper Freeport cyclothem. In this report [Athens County], Upper Freeport limestone is limited to fresh-water limestone at or near base or within Upper Freeport underclay. Average thickness 1¼ feet. Separated from base of Upper Freeport coal by 2 to 4 feet of underclay. Allegheny series.

Name derived from town of Freeport, Armstrong County, Pa.

†Upper Freeport Sandstone[1]

Pennsylvanian: Western Pennsylvania.

Original reference (Butler—Upper Freeport sandstone) : I. C. White, 1878, Pennsylvania 2d Geol. Survey Rept. Q, p. 40–71, 130.

D. L. Norling, 1958, Ohio Geol. Survey Bull. 56, p. 20–21. U.S. Geological Survey and Pennsylvania Geological Survey have adopted name Butler for unit herein termed Upper Freeport sandstone and shale member. In Ohio, term Upper Freeport sandstone and shale has been used and is established firmly in the literature. Thickness about 28 feet in Morgan County [this report]. Below Bolivar clay member and above Lower Freeport (No. 6–a) coal member. Allegheny series.

M. T. Sturgeon and others, 1958, Ohio Geol. Survey Bull. 57, p. 48 (table 7), 88. Interval between Bolivar underclay and Upper Freeport limestone and underclay is occupied by Upper Freeport shale and (or) sandstone member [of Upper Freeport cyclothem]. Thickness 5 to 28 feet. Allegheny series. Area of report, Athens County.

R. L. Nace and P. P. Bieber, 1958, West Virginia Geol. Survey Bull. 14, p. 22 (table 5). Upper Freeport sandstone listed in table of recognizable named members of Allegheny formation in Harrison County.

Name derived from town of Freeport, Armstrong County, Pa.

†Upper Kittanning Clay[1]

Upper Kittanning underclay member

Pennsylvanian: Pennsylvania, Ohio, and West Virginia.

[Original reference]: M. G. Wilmarth, 1938, U.S. Geol. Survey Bull. 896, p. 2221.

J. B. McCue and others, 1948, West Virginia Geol. Survey, v. 18, p. 16. Upper Kittanning underclay lies immediately beneath Upper Kittanning coal. Thickness 3 to 9 feet. Occurs a few feet above Hardman clay. Allegheny series.

M. T. Sturgeon and others, 1958, Ohio Geol. Survey Bull. 57, p. 48 (table 7), 78. Upper Kittanning underclay included in Upper Kittanning cyclothem. Light to dark-gray thin impure clay. Thickness 2 to 18 inches. Occurs above Upper Kittaning shale and (or) sandstone member and below Upper Kittanning coal member.

Upper Kittanning cyclothem

Pennsylvanian (Allegheny Series): Eastern Ohio.

N. K. Flint, 1951, Ohio Geol. Survey, 4th ser., Bull. 48, p. 51. Consists of Upper Kittanning coal and underlying shale or sandstone. An uncertain unit in Ohio column. No evidence is found for its presence in area of this report [Perry County].

M. T. Sturgeon and others, 1958, Ohio Geol. Survey Bull. 57, p. 48 (table 7), 76–78. Embraces interval between Middle Kittanning cyclothem below and Lower Freeport cyclothem above. Incomplete. Includes (ascending) Upper Kittanning shale and (or) sandstone, Upper Kittanning underclay, and Upper Kittanning coal members. Thickness about 14 feet. In area of this report [Athens County], Allegheny series is discussed on cyclothemic basis; 13 cyclothems are named. [For sequence see Brookville cyclothem.]

Type area (Upper Kittanning coal): Vicinity of Kittanning, on Allegheny River, in Armstrong County, Pa. Coal is also present in Maryland.

Upper Kittanning Limestone (in Allegheny Formation)[1]

Pennsylvanian: Western Pennsylvania and northern West Virginia.

Original reference: J. J. Stevenson, 1878, Pennsylvania 2d Geol. Survey Rept. $K_3$.

Fayette and Westmoreland Counties, Pa.

Upper Kittanning Marine Shale

*See* Kittanning Formation.

Upper Kittanning shale and (or) sandstone member

Pennsylvanian (Allegheny Series) : Eastern Ohio.

M. T. Sturgeon and others, 1958, Ohio Geol. Survey Bull. 57, p. 48 (table 7), 78. Upper Kittanning shale and (or) sandstone member included in Upper Kittanning cyclothem in report on Athens County. Average thickness 12½ feet. In absence of Upper Kittanning coal and underclay, it is impossible to distinguish this member from overlying shale and sandstone, and it is treated as part of Lower Freeport cyclothem in this report.

Upper Little Pittsburgh cyclothem

Pennsylvanian (Conemaugh Series) : Southeastern Ohio.

M. T. Sturgeon and others, 1958, Ohio Geol. Survey Bull. 57, p. 94 (table 11), 155 (map 19), 156–157. Uppermost cyclothem recognized. Occurs above Lower Little Pittsburgh cyclothem (new). Normal succession includes five members (ascending) : Upper Little Pittsburgh sandstone, Upper Little Pittsburgh redbed, Upper Little Pittsburgh limestone, Upper Little Pittsburgh underclay, and Upper Little Pittsburgh coal. Thickness about 33 feet. Two Little Pittsburgh cyclothems underlie Pittsburgh (No. 8) coal in parts of northern Appalachian coal basin. In general, these 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 area of this report, Conemaugh series is 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.

Upper Little Pittsburgh Limestone[1]

Upper Little Pittsburgh limestone member

Pennsylvanian (Conemaugh Series) : Western Pennsylvania and eastern Ohio.

Original reference: J. P. Leslie, 1878, Pennsylvania 2d Geol. Survey Rept. Q, p. 305–308.

M. T. Sturgeon and others, 1958, Ohio Geol. Survey Bull. 57, p. 94 (table 11), 157. Limestone associated with Upper Little Pittsburgh coal, here called Upper Little Pittsburgh limestone, is poorly developed in Athens County. Average thickness 2½ feet. Upper Little Pittsburgh cyclothem. Conemaugh series.

Upper Little Pittsburgh redbed member

Pennsylvanian (Conemaugh Series) : Eastern Ohio.

M. T. Sturgeon and others, 1958, Ohio Geol. Survey Bull. 57, p. 94 (table 11), 157. Redbed phase of Upper Little Pittsburgh cyclothem is designated Upper Little Pittsburgh redbed member in this report [Athens County]. Overlies Upper Little Pittsburgh sandstone member and separated from Upper Little Pittsburgh coal by that coal's associated limestone and underclay where these are present. Average thickness about 11 feet. Conemaugh series.

Upper Little Pittsburgh sandstone member

Pennsylvanian (Conemaugh Series) : Eastern Ohio.

M. T. Sturgeon and others, 1958, Ohio Geol. Survey Bull. 57, p. 94 (table 11), 156–157. Basal member of Upper Little Pittsburgh cyclothem. Average thickness 18 feet. Underlies Upper Little Pittsburgh member of cyclothem. Condit (1912) named a sandstone closely underlying the Pittsburgh coal, the Bellaire for town of Bellaire, Ohio. He stated that it [the sandstone] "is prominent in Pennsylvania where it has been called Lower Pittsburgh sandstone." Stout (in Bownocker and Dean, 1929 [1930], Ohio Geol. Survey, 4th ser., Bull. 34) placed Bellaire sandstone in Upper Little Pittsburgh cyclothem rather than in its correct position as correlative of Lower Pittsburgh sandstone, that is, as basal member of Pittsburgh cyclothem. Unless it can be demonstrated that Lower Pittsburgh sandstone is absent in type area of the Bellaire, then Stout's correlation of Bellaire sandstone is in error.

Upper Little Pittsburgh underclay member

Pennsylvanian (Conemaugh Series) : Eastern Ohio.

M. T. Sturgeon and others, 1958, Ohio Geol. Survey Bull. 57, p. 94 (table 11), 157. Gray to dark-gray silty micaceous clay about 1 foot thick. Underlies Little Pittsburgh coal. Upper Little Pittsburgh cyclothem. Conemaugh series.

Upper Little River Limestone[1]

Lower Cretaceous (Comanche Series) : Southwestern Arkansas.

Original reference: R. T. Hill, 1888, Arkansas Geol. Survey Ann. Rept. 1888, v. 2, p. 111, 188.

Named for exposures on Little River at Oklahoma State line.

Upper Mahoning redbed member

*See* Mahoning Red Bed (in Conemaugh Formation) and Mason cyclothem.

†Upper Mahoning Sandstone (in Conemaugh Formation)[1]

Upper Mahoning Sandstone (in Conemaugh Group)

Upper 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 4th and F. T. Moyer, 1940, Pennsylvania Geol. Survey, 4th ser., Bull. C–26, p. 91, fig. 21. Upper Mahoning sandstone lies above Mahoning coals and below Brush Creek strata. Shale replaces sandstone in many areas. Conemaugh group.

D. L. Norling, 1958, Ohio Geol. Survey Bull. 56, p. 29–30. In Ohio, Upper Mahoning sandstone and shale member occupies interval between Mahoning coal and Mason clay or coal. Average thickness about 28 feet in Morgan County [this report]. Allegheny series. Cyclothemic classification not used.

M. T. Sturgeon and others, 1958, Ohio Geol. Survey Bull. 57, p. 95 (table 11), 104–106. Upper Mahoning shale and (or) sandstone member included in Mason cyclothem in report on Athens County. Average thickness of interval 30 feet. Lowermost member of cyclothem. Occurs below

Upper Mahoning redbed member. Occurs above Lower Mahoning coal member of Lower Mahoning cyclothem. Allegheny series.

Name taken from Mahoning Creek(s) in Indiana and Jefferson Counties, Pa.

Upper Mercer cyclothem

Pennsylvanian (Pottsville Series) : Ohio.

N. K. Flint, 1951, Ohio Geol. Survey, 4th ser., Bull. 48, p. 36. Includes (ascending) Upper Mercer shale and (or) sandstone (contains Little Red Block ironstone) ; Upper Mercer clay ; and Upper Mercer (No. 3a) coal. Occurs above Middle Mercer cyclothem and below Bedford cyclothem.

Generally inconspicuous throughout Ohio and not recognized in area of this report, Perry County.

Upper Mercer flint and limestone member

*See* Bedford cyclothem.

Upper Mercer Iron Shales (in Pottsville Formation)[1]

Pennsylvanian : Western Pennsylvania and eastern Ohio.

Original reference: I. C. White, 1879, Pennsylvania 2d Geol. Survey Rept. $Q_2$.

Upper Mercer Limestone (in Pottsville Formation)[1]

Pennsylvanian : Western Pennsylvania and eastern Ohio.

Original reference: I. C. White, 1879, Pennsylvania 2d Geol. Survey Rept. $Q_2$.

R. E. Lamborn, 1951, Ohio Geol. Survey, 4th ser. Bull. 49, p. 24. White (1879) discarded term Mahoning of Rogers (1858, Geology of Pennsylvania, v. 2, pt. 1) and renamed unit Upper Mercer. Orton (1884, Ohio Geol. Survey, v. 5) accepted White's usage of this term for Ohio although he had previously referred in reports to the Upper Mercer as Gore limestone. Member is composed of hard compact dense-textured limestone of dark-bluish-gray to gray-black color with varying amounts of black flint. Thickness varies from a few inches to nearly 10 feet; average thickness a little in excess of 1 foot. Occurs from 15 to 40 feet above Lower Mercer limestone. Pottsville series.

Named for Mercer, Mercer County, Pa.

Upper Mesa Formation or Gravels

Pleistocene : Southwestern Idaho and southeastern Oregon.

V. R. D. Kirkham, 1931, Jour. Geology, v. 39, 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, and Payette Counties, Idaho, and Malheur County, Oreg.

Upper Pittsburgh cyclothem

Pennsylvanian (Monongahela Series) : Southeastern Ohio.

M. T. Sturgeon and others, 1958, Ohio Geol. Survey Bull. 57, p. 159 (table 13), 166–167, 168 (map 21). Embraces interval between Pittsburgh cyclothem (new) below and Redstone cyclothem (new) above. Thickness about 12 feet. Includes Upper Pittsburgh coal member, occurrence of which breaks normal cyclical sequence of strata that extend from roof shale of Pittsburgh coal bed to roof shale of Redstone coal bed into two cyclothems, Upper Pittsburgh and Redstone. 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. Occurrences sparse.

**Upper Pittsburgh Limestone Member** (of Conemaugh Formation)[1]

Upper Pittsburgh limestone member

Upper Pennsylvanian: Western Pennsylvania, eastern Ohio, and northern West Virginia.

Original reference: I. C. White, 1878, Pennsylvania 2d Geol. Survey Rept. Q.

D. L. Norling, 1958, Ohio Geol. Survey Bull. 56, p. 10 (fig. 3), 63–65, geol. map. In Morgan County, Upper Pittsburgh limestone member (Conemaugh series) is immediately subjacent to Pittsburgh (No. 8) coal or separated from it by a few inches or feet of Pittsburgh clay; overlies Bellaire sandstone and shale member or separated from it by Upper Little Pittsburgh clay shale member. Thickness as much as 40 feet; commonly 15 to 20 feet.

M. T. Sturgeon, 1958, Ohio Geol. Survey Bull. 57, p. 159 (table 13), 161–163. Rogers (1858, Geology of Pennsylvania, v. 2, pt. 1) used name Pittsburgh for limestone immediately below Pittsburgh coal. It is thought that Rogers' original definition included Little Pittsburgh limestones as well. This limestone in Pittsburgh cyclothem is now generally called Upper Pittsburgh limestone, and is so called in this report [Athens County]. Average thickness 11 feet. In Pittsburgh cyclothem, Upper Pittsburgh limestone member occurs above Lower Pittsburgh redbed member and below Pittsburgh underclay and coal member. Monongahela series.

Named for its occurrence with Pittsburgh coal in western Pennsylvania.

Upper Pittsburgh Sandstone[1]

*See* **Pittsburgh Sandstone Member** (of Monongahela Formation) and Upper Pittsburgh shale and sandstone member.

Upper Pittsburgh shale and sandstone member

Pennsylvanian (Monongahela Series): Eastern Ohio.

M. T. Sturgeon and others, 1958, Ohio Geol. Survey Bull. 57, p. 159 (table 13), 167–169. Rogers (1858, Geology of Pennsylvania, v. 2) designated conspicuous sandstone strata that occur between Pittsburgh and Redstone coal beds along Conemaugh and Loyalhanna streams in Pennsylvania as Upper Pittsburgh sandstone. Coarse clastic material at this position has been similarly designated by Ohio and West Virginia Geological Surveys. In Ohio, this member is commonly represented by sandy shale containing sandstone interbeds with local variations of prominent sandstone. In Athens County, this unit is predominantly shale and siltstone. Average thickness 19 feet. Basal member of Redstone cyclothem. Underlies Redstone redbed member. Monongahela series.

Upper Sewickley Sandstone

Upper 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. 199–200. Sewickley sandstone (White, 1891) is herein renamed Upper Sewickley sandstone in contradistinction to Lower Sewickley ledge belonging immediately under Sewickley coal.' Massive arenaceous sandstone 40 to 60 feet thick. In Marion and Monongalia Counties. Overlies Sewickley coal.

D. L. Norling, 1958, Ohio Geol. Survey Bull. 56, p. 77–78. Upper Sewickley sandstone and shale member (Monongahela series) in Ohio overlies Meigs Creek coal and underlies Benwood limestone and shale member. As described by White (1891, U.S. Geol. Survey Bull. 65), this is unit accepted as Sewickley sandstone by U.S. Geological Survey. U.S. Geological Survey does not recognize the term Lower Sewickley, and inasmuch as that term is used in Ohio to designate sandstone and shale subjacent to Meigs Creek coal, it follows that the term Upper is necessary to designate the sandstone superjacent to that coal. Upper Sewickley member is present in only part of Morgan County [this report]. Thickness 4 to 34 feet. Monongahela series.

**Upper Washington Limestone Member** (of Washington Formation)[1]

Upper Washington Limestone

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

Original reference: J. J. Stevenson, 1876, Pennsylvania 2d Geol. Survey Rept. K, p. 45–47.

R. E. Lamborn, 1951, Ohio Geol. Survey, 4th ser., Bull. 49, p. 39, 40. In Ohio, Upper Washington limestone is recognized only over small areas in Belmont and Monroe Counties; elsewhere its horizon is occupied by sandstones and shales. Thickness ranges from a few inches to 23 feet. Closely overlain by Jollytown "A" coal, basal member of Greene series. In Belmont County, lies about 100 feet above 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.

Named for exposures near Washington, Washington County, Pa.

**Upshur Sandstone**[1]

Middle Pennsylvanian: Northeastern West Virginia.

Original reference: J. A. Taff and A. H. Brooks, 1896, U.S. Geol. Survey Geol. Atlas, Folio 34.

Covers large part of Upshur County.

**Upson Clay**[1]

Upper Cretaceous (Gulf Series): Southern Texas.

Original reference: E. T. Dumble, 1892, Geol. Soc. America Bull., v. 3, p. 224–230.

L. W. Stephenson, 1937, U.S. Geol. Survey Prof. Paper 186–G, p. 135 (fig. 7). As shown on correlation chart of exposed sediments of Austin and lower Taylor age in Gulf Coastal Plain, Upson clay occurs above Austin chalk and below San Miguel formation; interfingers with Anacacho limestone.

Named for Upson, Maverick County.

Upton Sandstone 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. 2), 140, 142, 143 (fig. 2), 145 (fig. 3). Where well exposed, consists of light-yellowish- to bluish-gray fine-grained calcareous well-bedded sandstone 450 feet thick. Uppermost member of formation; overlies Judd shale member (new); underlies Henefer formation. Name credited to D. W. Trexler (unpub. thesis).

Named for exposures near settlement of Upton, 7 miles east of Coalville, Summit County.

**Urbana 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. Green ferruginous quartzose chlorite phyllite with green slaty layers, and is probably pyroclastic facies of associated metabasalt; contains many sericitic quartzite layers, some thin calcareous layers, and infolded quartzite similar to that associated with Ijamsville phyllite (new). Underlies Sugarloaf Mountain quartzite (new). Precambrian(?).

A. J. Stose and G. W. Stose, 1946, Maryland Dept. Geology, Mines and Water Resources [Rept. 12] Carroll and Frederick Counties, p. 69–71, 121–126. Overlies Sams Creek metabasalt (new) in southern part of Frederick County. North of U.S. Highway 40, from point 1½ miles east of New Market westward to point 1 mile east of Bartonsville, phyllite is in narrow infolds in metabasalt. South of highway it extends southward in three parallel belts to Frederick-Montgomery County line. Western of these belts is widest and contains synclinal mass of Sugarloaf Mountain quartzite which overlies Urbana phyllite. On west side of main belt, the Urbana is in contact with Ijamsville phyllite; from a point 2 miles south of Park Mills to Frederick County line, Triassic sedimentary rocks overlie the phyllite on its western border. On the east side, the Urbana lies adjacent to the Ijamsville. North of U.S. Highway 40, the Urbana grades northward into the Ijamsville. Sugarloaf Mountain syncline encloses Ijamsville and Urbana phyllites 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. Stose and Stose divided this phyllite into the Ijamsville and Urbana. Although this division may be valid, it is difficult to map contacts accurately, and they are here considered to be part of the Harpers. Area is interpreted as anticlinal dome.

A. J. Stose and G. W. Stose, 1951, Geol. Soc. America Bull., v. 62, no. 6. p. 697–699. Discussion of article by Scotford. Stose and Stose interpret area as synclinal.

U.S. Geological Survey currently considers the age of the Glenarm series to be Lower Paleozoic(?).

Named from Urbana, Frederick County, Md. Mapped in a belt 4 miles wide, adjacent to Sugarloaf Mountain; has been traced a maximum of 12 miles northeastward to narrow tongues, where it apparently interfingers with the metabasalt.

Utah Metals Limestone[1]

Pennsylvanian: Utah.

Original reference: O. P. Peterson, 1924, Am. Inst. Mining Metall. Engineers Trans., v. 70, p. 908–926.

Probably named for mine in Bingham district.

**Ute Limestone**[1]

Middle Cambrian: Northeastern Utah and southeastern Idaho.

Original reference: C. King, 1876, Am. Jour. Sci., 3d, v. 11, p. 477.

Charles Deiss, 1938, Geol. Soc. America Bull., v. 49, no. 7, p. 1113–1114, 1116, 1117 (fig. 4), 1120–1121. Walcott's (1908, Smithsonian Misc. Colln., v. 53, no. 1804) Blacksmith Fork section emended. Thickness 685 feet. Shale at base of formation cannot be correlated with Spence shale of Idaho. Overlies Langston limestone; underlies Blacksmith dolomite (emended).

G. B. Richardson, 1941, U.S. Geol. Survey Bull. 923, p. 9–10, pls. 1, 6. Described in Randolph quadrangle, Utah, where it is 480 to 585 feet thick and considered to include Spence shale member. Overlies Langston limestone and underlies Blacksmith limestone.

J. S. Williams and G. B. Maxey, 1941, Am. Jour. Sci., v. 239, no. 4, p. 280, 281; J. S. Williams, 1948, Geol. Soc. America Bull., v. 59, no. 11, p. 1133. Restricted to exclude Spence shale member, which is herein reallocated to Langston formation.

G. B. Maxey, 1958, Geol. Soc. America Bull., v. 69, no. 6, p. 653–654, 670 (fig. 2), 671–672, 673 (fig. 3). Maximum thickness is 745 feet at High Creek, Utah; estimated thickness 790 feet at Promontory Point, Utah.

Type locality: Slopes of Ute Peak, near forks of East Fork, east of Paradise, Cache County, Utah.

**Ute Canyon Tongue** (of Cliff House Sandstone)

Upper Cretaceous: Northwestern New Mexico.

P. T. Hays and A. D. Zapp, 1955, U.S. Geol. Survey Oil and Gas Inv. Map OM–144, sheet 1. In central part of Barker dome-Fruitland area, the Cliff House sandstone consists of two massive sandstone bodies separated by approximately 350 feet of shaly sandstone. Upper sandstone thins northeastward and in northeastern part of area is represented by thin sandy stratum not differentiated from enclosing Lewis shale. This wedge is called Ute Canyon tongue.

Stratigraphic relations of this sandstone wedge well displayed in exposures in Ute Canyon in southeastern part of Ute Mountain Indian Reservation, San Juan County.

†Ute Pass Dolomite

Upper Cambrian(?): Central Colorado.

J. C. Maher, 1950, U.S. Geol. Survey Oil and Gas Inv. Prelim. Chart 39. Name applied to dolomite unit which rests with gradational contact on Sawatch sandstone and underlies Manitou limestone (as restricted in this report). Thicknesses of 8½ to 16 feet measured in Gove Canyon, Williams Canyon, and Missouri Gulch. There is little difference in lithologic character of formation at these localities. Red glauconitic coarsely crystalline dolomite predominates although a few feet of pinkish-buff coarsely crystalline dolomite is present at top in Williams Canyon exposure. Amount of sand in dolomite beds appears to increase to north because outcrop in Gove Canyon is very sandy and that in Williams Canyon only slightly sandy. In Missouri Gulch section, formation consists of sandy micaceous dolomite beds in lower part, separated by 6 inches of brown platy shale from nonsandy dolomite beds in upper part. Paper-thin green shale partings present near middle of formation in Williams Canyon.

R. R. Berg and R. J. Ross, Jr., 1959, Jour. Paleontology, v. 33, no. 1, p. 106–108. Term abandoned. On basis of faunal correlations, unit formerly called Ute Pass at Williams Canyon is reassigned to lower part of Manitou formation. On basis of lithology and stratigraphic position, Ute Pass of Missouri Gulch is correlated with Peerless formation.

Type section: In Williams Canyon, NW¼ sec. 32, T. 13 S., R. 67 W., Ute Pass area, El Paso County.

Utica Clay (in Carbondale Formation)

Pennsylvanian: Northern Illinois.

H. R. Wanless, 1939, Geol. Soc. America Spec. Paper 17, p. 25, 106. Fire clay in lower part of Carbondale formation. Extends from La Salle Third vein (Colchester No. 2) coal down to base of Pennsylvanian.

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 56 (table 3). Term discontinued.

Occurs near Utica, La Salle County.

†Utica Limestone[1]

Silurian: Southeastern Indiana.

Original reference: W. W. Borden, 1874, Indiana Geol. Survey 5th Ann. Rept., p. 143, 172.

Quarried at Utica, on Ohio River, in Clark County.

Utica Quartz Monzonite Porphyry[1]

Tertiary: Central northern Colorado.

Original reference: F. G. Worcester, 1921, Colorado Geol. Survey Bull. 21, p. 31–32.

Occurs as dike extending for about one-half mile southeast from Utica mine in Boulder County.

**Utica Shale**[1]

Upper Ordovician: New York and Michigan, and Ontario, Canada.

Original reference: E. Emmons, 1842, Geology of New York, pt. 2, div. 4, geol. 2d dist., p. 116–118, 183, 278, 319, 397, 429.

G. M. Kay, 1937, Geol. Soc. America Bull., v. 48, no. 2, p. 233–302. Nomenclature of Utica shales is complex and confusing. At type locality, the Utica is probably wholly upper Utica, but, in sections a few miles east of city, the formation is separable into three faunal divisions. Lower two are probably of Cobourg age, but upper seems equivalent to Deer River and Atwater Creek shales of northwestern New York and to Collingwood and Gloucester formations of Ontario. Thus, a single member of the Utica, when traced laterally, becomes equivalent to two formations. It is confusing to consider the zones of the Utica as members of the formation. Nowadaga member has been defined as "lower Utica or zone of *Climacograptus typicalis*" (Hall). Loyal Creek member has been defined as "middle Utica, or zone of *Dicranograptus nicholsoni*" Hopkinson. Holland Patent member is "upper Utica, or zone of *Climacograptus pygmeus*" and *Glossograptus quadrimucronatus timidus* of Ruedemann. Overlies Canajoharie.

Marshall Kay, 1960, Internat. Geol. Cong. 21st, Copenhagen, pt. 7, p. 31. Pictonian stage of Trentonian series contains Utica group of formations.

Named for exposures at Utica, Oneida County, N.Y.

Utley Metarhyolite[1]

Precambrian: Central southern Wisconsin.

Original reference: S. Weidman, 1898, Wisconsin Geol. Nat. Hist. Survey Bull. 3, Sci. ser. 2, p. 4–31.

O. E. Gram, 1947, Jour. Geology, v. 55, no. 5, p. 427–438. Porphyritic meta-rhyolite. Phenocrysts of quartz and feldspar range from less than one-sixteenth to three-eighths inch in diameter. Groundmass uniformly aphanitic and almost glassy in hand specimen, and of very dark to black color.

Consists of rounded knoblike area more than 100 feet high at Utley, Green Lake County.

**Utopia Limestone[1] Member** (of Howard Limestone)

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

Original reference: R. C. Moore, 1932, Kansas Geol. Soc. Guidebook 6th Ann. Field Conf., p. 21, 94, 96.

R. C. Moore, 1936, Kansas Geol. Survey Bull. 22, p. 209. Uppermost member of Howard limestone. Underlies White Cloud shale; overlies Winzeler shale member of Howard limestone. Type locality designated.

G. E. Condra, 1949, Nebraska Geol. Survey Bull. 16, p. 19. Mentioned as occurring in Iowa.

R. C. Moore and others, 1951, Kansas Geol. Survey Bull. 89, p. 57 (fig. 22), 61–63. Gray to brown limestone and sandy limestone resembling coquina in many outcrops. Consists of two or more limestones and ostracode-bearing shale in parts of the State. Thickness ranges from less than 1 foot to maximum of about 16 feet.

F. C. Greene and W. V. Searight, 1959, Missouri Geol. Survey and Water Resources Rept. Inv. 11, p. 20. Church, Winzeler, and Utopia members distinguishable in Missouri.

Type locality: Just east of village of Utopia, sec. 5, T. 25 S., R. 11 E., Greenwood County, Kans.

Utuado Complex

Post-Lower Cretaceous, pre-lower Miocene: Puerto Rico.

R. C. Mitchell, 1956, Am. Assoc. Petroleum Geologists Bull., v. 40, no. 12, p. 2972. Incidental mention.

**Uvalde Gravel[1]**

Uvalde Formation

Pliocene(?): Southern Texas.

Original reference: R. T. Hill, 1891, Am. Geologist, v. 7, p. 368.

R. W. Mathis, 1944, Jour. Sed. Petrology, v. 14, no. 2, p. 87. Formation near Austin consists almost wholly of rounded flint cobbles and boulders and occasional limestone pebbles. Accumulations of this material are extensive coastward from Balcones fault. In vicinity of Austin, accumulations are on hilltops at elevations up to 320 feet above river level; they are not at definite level and do not form continuous deposit. Delaney gravel (new) tops hill 245 feet above river level on Delaney Ranch; this is lower than Uvalde formation.

A. W. Weeks, 1945, Am. Assoc. Petroleum Geologists Bull., v. 29, no. 12, p. 1695 (fig. 1), 1703 (fig. 8), 1704–1707. Uvalde gravels discussed with Quaternary deposits of Texas Coastal Plain. Uvalde is restricted to deposits herein described, though it is possible that Uvalde of other geologists perhaps included writer's [Weeks] Uvalde as well as remnants of older terrace deposits which are no longer in place and which have come down from higher levels as erosion progressed. Writer [Weeks] does not agree with Mathis' (1944) views on Uvalde formation or Delaney gravel; Delaney gravel may have come down from higher levels as erosion progressed and therefore may not be in place. Uvalde occurs between terrace deposits termed Bastrop Park and Asylum. Pleistocene.

H. R. Blank and others, 1952, Texas Univ. Bur. Econ. Geology Rept. Inv. 12, p. 10 (table 1), 16. Upland gravel (Uvalde formation), as much as 1 foot thick, unconformably overlies Pecan Gap formation and unconformably underlies Brazos River terraces near Waco. Pliocene(?).

Named for occurrences in vicinity of Uvalde, Uvalde County.

Uvalde Phonolite[1]

Eocene(?): Southern Texas.

Original reference: T. W. Vaughan, 1900, U.S. Geol. Survey Geol. Atlas, Folio 64, p. 4, maps.

Occurs at Inge Mountain. Named for Uvalde, Uvalde County.

Uvas Basalt or Basaltic Andesite

Miocene: Southwestern New Mexico.

F. E. Kottlowski, 1953, New Mexico Geol. Soc. Guidebook 4th Field Conf., p. 32 (map), 40, 144, 145, 148 (chart). Dark-gray glassy rock. Interbedded with scoria and basaltic tuffs, as much as 145 feet thick near Las Cruces. Underlies Santa Fe group; overlies Bell Top formation (new).

In Las Cruces region of Rio Grande Valley.

Uvas Conglomerate Member (of Tejon Formation)

Eocene: Southern California.

J. G. Marks, 1941, (abs.) Geol. Soc. America Bull., v. 12, pt. 2, p. 1922; 1943, California Div. Mines Bull. 118, pt. 3, p. 535, 536 (fig. 232), 537 (fig. 233). Listed as basal member of Tejon formation in type area of Tejon. Thickness 110 feet. Conformably underlies Liveoak member (new); unconformably overlies basement complex.

Type locality: Grapevine Canyon, Tehachapi Mountains, Kern County.

**Uwekahuna Ash** (in Puna Volcanic Series)

Pleistocene or Recent: Hawaii Island, Hawaii.

J. B. Stone, 1926, Bernice P. Bishop Mus. Bull. 33, p. 27–28. Ash bed in wall of Kilauea caldera. Thickness 1 inch to 7 feet. At northeast end of exposure, bed is 3 feet thick and consists of gravel and a few lava-coated bombs; beneath Uwekahuna intrusive body is 6½ feet of ash having basal layer of medium-coarse black ash overlain by a second gravel stratum, and at top about 8 inches of yellow ash; at southwest end of exposure, ash bed lies on surface of unconformity in the lavas.

G. A. Macdonald, 1949, U.S. Geol. Survey Prof. Paper 214–D, p. 65, 67–68. Included in Puna volcanic series. Recent.

D. A. Davis and G. A. Macdonald *in* Jacques Avias and others, 1956, Lexique Strat. Internat., v. 6, Océanie, fasc. 2, p. 134. Pleistocene or Recent.

Type locality: West wall of Kileau caldera at Uwekahuna Bluff.

Vaca Triste Sandstone Member (of Salado Formation)

Permian (Ochoa): Subsurface in southeastern New Mexico and western Texas.

J. E. Adams, 1944, Am. Assoc. Petroleum Geologists Bull., v. 28, no. 11, p. 1600 (fig. 2), 1610. Fine-grained orange-red sand about 10 feet thick. Occurs between 1,555 and 1,565 feet in type well.

Type well: Continental's King well 1, sec. 26, T. 25 S., R. 32 E., Lea County, N. Mex. Name derived from Vaca Triste Draw.

Vacaville Shale

Eocene, lower or middle: Northern California.

C. W. Merriam and F. E. Turner, 1937, California Univ. Pubs., Dept. Geol. Sci. Bull., v. 24, no. 6, p. 95 (fig. 1), 98 (table 1). Named on correlation chart. Occurs below unit termed Domengine (?). Middle Eocene.

N. L. Taliaferro, 1951, California Div. Mines Bull. 154, p. 129 (table), 133. Vacaville shales considered equivalent to Capay formation in age (lower Eocene).

Named for occurrence at Vacaville, Solano County.

Vadito Formation

Precambrian: Central northern New Mexico.

Arthur Montgomery, 1953, New Mexico Bur. Mines Mineral Resources Bull. 30, p. 8 (fig. 2), 21–31, pl. 1. In general it comprises lower conglomerate member—thickness about 2,000 feet, and upper schist member—thickness about 2,500 feet. Lower member consists of quartzite and conglomerate interlayered with flows and sills. Upper schist member consists of quartz schists, phyllites, and granulites interlayered with thick flows and sills of various kinds of amphibolite. Younger than Ortega formation in Picuris area. Intruded by Embudo granite (new).

Named after village of Vadito, located near southeastern corner of Picuris range, and several miles south of excellent outcrops of rocks of this formation. Occurs in southern third of Picuris range, Taos County. Best exposures within 1-mile radius of Harding mine.

Valcour Limestone[1] or Formation

Ordovician (Chazyan): Western Vermont and eastern New York.

Original reference: H. P. Cushing, 1905, New York State Mus. Bull. 95.

Philip Oxley and Marshall Kay, 1959, Am. Assoc. Petroleum Geologists Bull., v. 43, no. 4, p. 817–853. Formation included in Valcourian stage (new), Shazyan series. Thickness about 250 feet. Includes Hero member below and Beech member above (both new). Overlies Crown Point formation; underlies "Lowville" limestone. Reference section designated.

Reference section: Exposures on hill 0.6 mile southwest of Rutland Railroad Station of South Hero Vt. Forms northern and southeastern shores of Valcour Island.

Valcourian Stage

Ordovician (Chazyan): North America.

Marshall Kay, 1958, Am. Jour. Sci., v. 256, no. 2, p. 91, 94 (table 2). Chazy has long been divided into three lithologic and faunal zones (Brainerd and Seely, 1888, Am. Geologist, v. 2) which were given "substage" names Day Point, Crown Point, and Valcour (Cushing, 1905, New York State Mus. Bull. 95). As stages, these have been called Dayan, Crownian, and Valcourian by Oxley (unpub. ms.).

Philip Oxley and Marshall Kay, 1959, Am. Assoc. Petroleum Geologists Bull., v. 43, no. 4, p. 833–838. In Champlain Valley, Chazy series is separable into Dayan, Crownian, and Valcourian stages, distinguished by faunal criteria. Each stage has several lithologic facies. Reefs are prevalent.

**Valders Stade**

Valderan Substage

Valders Glacial Substage

Pleistocene (Wisconsin): Northeastern Wisconsin.

F. T. Thwaites, 1943, Geol. Soc. America Bull., v. 54, no. 1, p. 121, 136–141. Wisconsin drift is divisible into deposits of Cary below and Valders substages. Name Valders proposed because of uncertainty of former correlations across brush- and forest-covered region around Lake Superior. Drift of Valders age is distinguished from Cary till by its red color and higher clay content; this lithologic criterion is not easily applicable in the northern part of district.

F. T. Thwaites, 1946, Outline of glacial geology, Ann Arbor, Mich., Edwards Bros., Inc., p. 75. Valders and Cary glaciations separated by Two Creeks interstadial.

M. M. Leighton, 1957, Jour. Geology, v. 65, no. 1, p. 108–109. Valders considered a substage of the Wisconsin succeeding the Mankato substage.

R. J. Mason, 1958, Michigan Univ. Mus. Anthropology, Anthropol. Paper 11, p. 22 (map 4), 23–25. Radiocarbon age determination places Valders maximum around 10,700 B. P. (before present); correlated with red drift in Wisconsin and Michigan. Two Creeks interstadial placed between Mankato and Valders substages.

J. C. Frye and H. B. Willman, 1960, Illinois Geol. Survey Circ. 285, p. 2 (fig. 1), 9. In classification proposed herein, Valderan substage is defined as youngest time-stratigraphic subdivision of Wisconsinan stage in Lake Michigan lobe. Base is defined as base of Valders till (Thwaites, 1946; Thwaites and Bertrand, 1957 Geol. Soc. America Bull., v. 68, no. 7) of eastern Wisconsin that overlies Two Creeks forest bed. Substage terminated with final dissipation of Wisconsinan continental glacier, even though glacial till representative of entire time span does not occur in Lake Michigan basin. Substage includes alluvial deposits made during time of rising sea level that is thought to have reached its present position of equilibrium about 5,000 years ago. Deposits of glacial till or of loess of Valderan age not known to occur in Illinois.

M. M. Leighton, 1960, Jour. Geology, v. 68, no. 5, p. 529, 549. Mankato-Valders intraglacial substage is herein named Two Creeks.

Name amended to Valders Stade to comply with Stratigraphic Code adopted 1961.

Name based on exposure in quarry at Valders, Manitowoc County.

**Valdez Group**[1]

Upper Mesozoic(?) : Central southern Alaska.

Original reference: F. C. Schrader, 1900, U.S. Geol. Survey 20th Ann. Rept., pt. 7, p. 408–410, 413.

F. H. Moffit, 1954, U.S. Geol. Survey Bull. 989–E, p. 236, 242–247, 275, pl. 8. 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. Valdez dominantly graywacke, argillite, and slate. Measured in thousands of feet. Part of the rocks assigned to Valdez group, in mountains north of Prince William Sound, not older than Late Cretaceous.

Typified by sedimentary rocks exposed about Port Valdez, Prince William Sound region.

**Vale Formation** (in Clear Fork Group)[1]

Lower Permian : Central and central northern Texas.

Original reference: J. W. Beede and V .V. Waite, 1918, Texas Univ. Bull. 1816, p. 47.

R. I. Dickey, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 1, p. 42. Consists of Bullwagon dolomite at top and about 350 feet of red shale below; grades westward in subsurface as a unit so that thickness of basal red shale becomes less and less as amount of dolomite, gray shale, and anhydrite increases, although formation maintains its thickness of about 390 feet.

M. G. Cheney, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 1, p. 66 (fig. 1). Underlies Choza formation; overlies Arroyo formation. Includes Bullwagon dolomite member at top. Leonard series.

Named for old post office on Ballinger-Maverick Road, on east side of Valley Creek, Runnels County.

Valencian 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, 12.

Valentine Formation[1]

Valentine Member (of Curtin Formation)

Middle Ordovician : Central and central southern Pennsylvania.

Original reference: R. M. Field, 1919, Am. Jour. Sci., 4th ser., v. 48, p. 404, 414–417, 422.

G. M. Kay, 1943, Econ. Geology, v. 38, no. 3, p. 194 (table 2), 197. Rank reduced to member status in upper part of Curtin limestone (new). Overlies Valley View member (new). Underlies Nealmont limestone. Thickness at Bell Mine. Bellefonte, about 91 feet. Contains thin yellow clay—

metabentonite "A" at base; about 25 feet of very light-gray white-weathering dense laminated limestone; and about 66 feet of very light white-weathering dense heavy-ledged massive limestone ("Bellefonte Ledge") at top. Restricted to outcrop belts northwest of line from east of Lock Haven and Rebersburg to north of Millheim, Spring Mills, Lemont, and Stormstown, in Clinton and Centre Counties. Regional unconformity at base of overlying Nealmont gradually reduces unit toward line of extinction. Black River group.

Named for small hamlet and forge near Bellefonte, Centre County.

Valentine Formation (in Ogallala Group)

Valentine Member (of Ogallala Formation)

Valentine Beds[1]

Pliocene: Northwestern Nebraska, western Kansas, and southwestern South Dakota.

Original reference: E. H. Barbour and H. J. Cook, 1917, Nebraska Geol. Survey, v. 7, pt. 19, p. 173.

R. A. Stirton and P. O. McGrew, 1935, Am. Jour. Sci., 5th ser., v. 29, no. 170, p. 125–132. Three late Tertiary faunas representing two epochs were found in one formation near Valentine, Nebr., and following faunal names have been applied: Niobrara River, upper Miocene; Burge, lower Pliocene; and Valentine, transitional from lower to middle Pliocene.

F. W. Johnson, 1936, Am. Jour. Sci., 5th ser., v. 31, no. 186, p. 467–475. Paper reestablishes original and proper usage of name Valentine beds as designating lower part of Ogallala formation of Valentine area, northern Nebraska. Vertebrate fauna from these beds is known as Valentine fauna. Fine-grained sands and clays of Valentine beds are overlain by Burge sands, a name proposed for the fine- to coarse-grained sands and gravels in which Burge fauna typically occurs. Overlying the Burge is the cap rock bed that lithogically resembles typical Ogallala of southwestern Nebraska. Valentine beds are 175 to 225 feet thick and unconformably overlie Brule(?) clay of Oligocene(?) age. Lower part of Valentine beds is composed of loose channel sands, and it is in these beds that Valentine fauna occurs at type locality. In most places, the loose sand is overlain by beds of greenish-gray massive sandstones (upper Valentine beds). These massive sands are not very fossiliferous in Valentine area. The beds were called Fort Niobrara formation by Osborn (1918), but Valentine was used by Thorpe (1922, Am. Jour. Sci., 5th ser., v. 3) and other writers. Simpson (1933, Am. Mus. Nat. History Bull., v. 57, art. 3) recognized Valentine as having priority over Fort Niobrara and more firmly established the name in its correct usage. Name Valentine was first used erroneously when it was applied to upper fauna in area by Cook (1933, Nebraska Geol. Survey Paper 5). Stirton (1933, Am. Jour. Sci., ser. 5, v. 26, no. 156) assigned name Valentine to upper fauna in region and substituted term Niobrara River fauna for fauna from lower beds (Valentine beds). Usage of term Valentine when applied to upper fauna of area is incorrect. Term Valentine should be used to designate lower beds of area and their included fauna. Type locality designated.

A. L. Lugn, 1938, Am. Jour. Sci., 5th ser., v. 36, no. 213, p. 220–227. Discussion of Valentine problem and presentation of table of Tertiary stratigraphic divisions acceptable in Nebraska and Kansas. Tertiary is divisible into four lithologic groups (ascending): White River, Arikaree (redefined). Hemingford (new), and Ogallala redefined to include (ascending) Valentine, Ash Hollow, Sidney, and Kimball formations. Valentine formation, in Nebraska, includes *Stipidium* fossil seed zone; Burge channel member, and "Burge" fauna at top; the true Valentine fauna occurs well down in the formation. Thickness 175 to 225 feet. Overlies Hemingford group which includes Sheep Creek formation at top. Pliocene.

M. K. Elias, 1942, Geol. Soc. America Spec. Paper 41, p. 134–139. Lower formation in Ogallala group. In type area, formation is composed largely of unconsolidated layers of greenish silty marl sand and sandy silt and very few local lenses of diatomaceous marl and light bluish-gray volcanic ash. Lowermost described occurrence of mammalian fauna is at so-called Railroad quarries on south side of Niobrara River south of Valentine, Nebr. This is Niobrara River fauna of Stirton and McGrew (1935). Channel sands from which this fauna has been collected are herein designated Niobrara River channel. Arboreous floral described by Chaney and Elias (1936, Carnegie Inst. Washington Pub. 476) from lower part of Valentine formation of White Bluff locality occurs in bed of diatomaceous marl herein designated Brown County bed. Highest known fauna in Valentine comes from Burge channel quarries. Seems best not to consider the Burge a channel member of the Valentine, but merely a channel within the undivided Valentine. Underlies Ash Hollow formation.

R. C. Moore and others, 1951, Kansas Geol. Survey Bull. 89, p. 20. Uppermost member of Ogallala formation in Kansas. Underlies Ash Hollow member. Maximum thickness 140 feet. Early Pliocene and possibly late Miocene. Major unconformity marks base of Tertiary rocks. They are known to rest on all subdivisions of Comanchean series (Cretaceous) and on Permian redbeds.

S. G. Collins, 1960, Geology of the Patricia quadrangle (1:62,500): South Dakota Geol. Survey. Lower formation in Ogallala group. Consists mostly of light-gray and light-olive-greenish, fine to medium, very poorly consolidated feldspathic or arkosic sand. Estimated thickness at least 175 feet. Grades upward into conformably overlying Ash Hollow formation. Underlies Harrison formation of Arikaree group.

Type locality: On south side of drainage cut between old and new railroad grades in NE¼ sec. 17, T. 33 N., R. 27 W., Cherry County, Nebr. Named for town of Valentine in Cherry County.

**Valentine Limestone** or **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.

J. C. Hazzard, 1954, Am. Assoc. Petroleum Geologists Bull., v. 38, no. 5, p. 881, 884 (fig. 3). Geographically extended into Nopah Range, Inyo County, Calif., where it is 690 feet thick, overlies Ironside(?) member and underlies Crystal Pass limestone member. Suggested that name Stewart Valley limestone be abandoned and that Devonian beds ascribed to it be assigned to Crystal Pass and Valentine members of Sultan.

U.S. Geological Survey currently designates the age of the Sultan Limestone and its members as Middle and Upper Devonian.

Well exposed east of Valentine mine in sec. 23, T. 25 S., R. 58 E., Clark County, Nev.

**Valera Shale Member** (of Belle Plains Formation)[1]

Valera Shale and Anhydrite (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 here given group status.

R. C. Moore, 1949, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 80, sheet 2. Member of Belle Plains formation. An unfossiliferous dark-blue clay shale unit, 25 to 50 feet thick, that occurs next above Jagger Bend limestone member. Well expressed topographically along most of its outcrop, but near Colorado River upper boundary of unit is ill. defined. Underlies Bead Mountain limestone member.

P. T. Stafford, 1960, U.S. Geol. Survey Bull. 1081–G, p. 274. Valera shale member is 65 to 180 feet thick in Brazos River valley. Overlies Jagger Bend limestone member; underlies Bead Mountain limestone member.

Named from town of Valera, west-central Coleman County.

Vallecito Basalt

Quaternary: North-central New Mexico.

H. T. U. Smith, 1937, (abs.) Geol. Soc. America Proc. 1936, p. 103. Named as third in series of seven Quaternary formations in area. Younger than Canones andesite; older than Black Mesa basalt.

Occurs in Abiquiu quadrangle, Rio Arriba County.

**Vallecito Conglomerate** (in 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. Thickness 2,000 feet; underlies Uncompahgran quartzite.

Named for exposures on both sides of Vallecito Creek for about 1 mile north from south boundary of Needle Mountains quadrangle.

Vallecitos Rhyolites

Precambrian (Proterozoic): Central northern New Mexico.

Evan Just, 1937, New Mexico School Mines Bull. 13, p. 13 (table 1), 44, pl. 3. A number of rhyolite and trachyte flows, contained in Hopewell series and Ortega quartzite. Trachyte subordinate to rhyolite in amount. In some places, flows are somewhat schistose, but characteristically their original textures (aphanitic ground masses with distinct phenocrysts up to a quarter inch in diameter) have been well preserved and flow banding is well developed. Range in color from deep pink to brick red. Flows are as much as three-fourths mile thick. Thicknesses presumably represent aggregates of flows rather than single flows.

Exposed in mountainous area between towns of Petaca and Vallecitos, Rio Arriba County.

Vallejo Formation

Eocene or Oligocene: Central southern Colorado.

J. E. Upson, 1941, Am. Jour. Sci., v. 239, no. 8, p. 577–589. Consists of fine-grained unconsolidated but compact silt and clay with thin lenses of cemented sand and fine gravel, and thick layers of coarse gravel containing rounded cobbles. Whole formation stained dark-red in marked contrast to other beds of region. Thickness from 0 to 500 feet. Rests on Precambrian basement rocks; in some places, it underlies unnamed volcanics believed to be mid-Tertiary in age, in other localities, it unconformably underlies Hinsdale beds.

Named from Vallejo Creek in whose valley characteristics of the beds are well displayed. Apparently restricted to the Culebra Re-entrant along west flank of Culebra Range.

**Vallenar Formation**[1]

Middle Devonian: Southeastern Alaska.

Original reference: A. H. Brooks, 1902, U.S. Geol. Survey Prof. Paper 1, p. 40–52, map.

Mapped as broad belt on west side of Gravina Island, but was positively identified only at Vallenar Bay, Ketchikan region.

†Valley Limestone[1]

Cambrian and Ordovician: Eastern Pennsylvania to northern Virginia.

Original reference: P. Frazer, Jr., 1883, Pennsylvania 2d Geol. Survey Rept. $C_4$, p. 99–100, 112–144.

Named for Great Valley of Appalachian region, of which Shenandoah Valley is a part.

†Valley Forge Quartzite[1]

Lower Cambrian: Southeastern Pennsylvania.

Original reference: F. Bascom, 1904, Am. Jour. Sci., 4th, v. 17, p. 143.

Philadelphia region.

Valley Head Sandstone[1]

Upper Devonian: Eastern West Virginia.

Original reference: D. B. Reger, 1928, Am. Jour. Sci., 5th, v. 15, p. 50–57.

G. A. Cooper, 1942, Geol. Soc. America Bull., v. 53, no. 12, pt. 1, chart 4. Shown on correlation chart above Elkins sandstone and below Hendricks sandstone.

Well exposed at village of Valley Head, Randolph County.

Valley Heads Drift

Valley Heads Substage

Pleistocene (Wisconsin): Southwestern New York.

Paul MacClintock and E. T. Apfel, 1944, Geol. Soc. America Bull., v. 55, no. 10, p. 1145 (fig. 1), 1159–1161, pl. 1. Based primarily on lithologic differences, three Wisconsin drift sheets are recognized (ascending): Olean, Binghamton, and Valley Heads, Valley Heads drift covers inner, or north edge of Binghamton drift in area of this report [southwestern New York].

L. C. Peltier, 1949, Pennsylvania Geol. Survey, 4th ser., Bull. G–23, p. 4 (table 1), 16 (fig. 5). Referred to as Valley Heads substage in discussion of glacial geology of Susquehanna River terraces.

Derivation of name not given. Valley Heads moraine enters New York from west and is continuation of Lake Escarpment morainic system (Leverett, 1902, U.S. Geol. Survey Mon. 41).

Valley Mountain facies (of Flagstaff Formation)

Paleocene, upper: Central Utah.

W. N. Gilliland, 1951, Nebraska Univ. Studies, new ser., no. 8, p. 26–28, pl. 11. In general, Flagstaff formation in Valley Mountains grades from dominantly yellow and gray with some red dense lacustrine limestone in northern area to dominantly red and pink, partly arenaceous limestone with some sandstone and conglomerate in southern area. Southern type of lithology continues into Pavant Plateau and becomes more clastic. Formation thickens southward from over 1,100 feet in Hayes Canyon to about 1,400 feet in southern Valley Mountains. Divisible into five lithologic units, three of which may be coincident with faunal zones—units A and B tend to thin southward, whereas C and E thicken in the same direction. Unit D is missing in southern Valley Mountains. Overlies North Horn formation; underlies Colton formation.

In Valley Mountains, Gunnison quadrangle, Sevier and Sanpete Counties. All five (A–E) lithologic units clearly exposed in Picket Canyon.

**Valley Spring Gneiss**[1]

Precambrian (Llano Series): Central Texas.

Original reference: T. B. Comstock and E. T. Dumble, 1890, Texas Geol. Survey Ann. Rept., p. lvi, 274, pl. 3.

V. E. Barnes, 1946, Texas Univ. Bur. Econ. Geology Pub. 4301, p. 56 [1945]. Intruded by Big Branch Gneiss.

Virgil Barnes, Frederick Romberg, and W. A. Anderson, 1954, Internat. Geol. Cong., 19th, Algiers 1952, Comptes rendus, sec. 9, pt. 9, p. 152–153. Oldest Precambrian rocks in Llano uplift are mostly light-colored, highly feldspathic metasediments named Valley Spring gneiss, followed by dark-colored metasediments, including amphibolite, mica schist, graphite schist, and some marble, all of which are included in Packsaddle schist. These rocks are highly folded, and during folding it is believed the igneous rocks were intruded which were metamorphosed into Red Mountain gneiss and dioritic Big Branch gneiss. Date of intrusion of perioditic rocks, now serpentized into Coal Creek serpentine, in relation to Big Branch gneiss not satisfactorily determined. Town Mountain granite invaded the already deformed metasediments and was followed by Oatman Creek granite, Sixmile granite, and Llanite, the latter being the youngest.

Named for Valley Spring, Llano County.

**Valley Springs Formation**[1]

Miocene, upper(?): Northern California.

Original reference: A. M. Piper and others, 1939, U.S. Geol. Survey Water-Supply Paper 780, p. 34 (table), 71–80, pl. 1.

J. H. Eric, A. A. Stromquist, and C. M. Swinney, 1955, California Div. Mines Spec. Rept. 41, p. 16–18, pls. 1, 3. Described in Angels Camp quadrangle as interbedded white to light-gray rhyolite tuff and gravel containing pebbles and cobbles of rocks of pre-Tertiary age. Maximum thickness about 200 feet. Unconformably underlies Mehrten formation; unconformably overlies auriferous river gravel of Eocene(?) age. Miocene(?).

Type section: West slope of Valley Springs Peak, 1½ miles northwest of Valley Springs, near center sec. 11, T. 4 N., R. 10 E., Calaveras County.

**Valleytown Formation**[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. 4.

G. W. Stose and A. J. Stose, 1949, Geol. Soc. America Bull., v. 60, no. 2, p. 285. Green phyllite, slate, and ottrelite-mica schist overlie Big Butt (Tusquitee) quartzite in Murphy syncline. Keith (1907) separated these rocks into Brasstown schist and Valleytown formation. Only locally is there lithologic criteria for separating these rocks into two formations. The phyllites and schists for the most part are closely folded and have prominently developed schistosity which obscures the bedding so that, on stratigraphic evidence available, they are not readily divisible. In this report, these two formations are treated as Valleytown formation, the more widely used name.

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. 48–51. In Mineral Bluff quadrangle, Ga., Keith's (1907) sequence is not entirely applicable. Rocks mapped by LaForge and Phalen (1913, U.S. Geol. Survey Geol. Atlas, Folio 187) as Valleytown formation belong to four formations: Brasstown, Andrews schist, Nottely quartzite, and Mineral Bluff (new). As originally defined, the Valleytown is without definite lower boundary and is lithologically indistinguishable from underlying beds, therefore name Valleytown is not retained. Rocks between Tusquitee quartzite and Murphy marble all conform to Keith's description of the Brasstown and they are renamed Brasstown formation.

J. L. Stuckey and S. G. 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. Lower Cambrian(?).

Named for exposures in vicinity of Valleytown, Cherokee County, N.C.

Valley View Member (of Curtin Limestone)

Middle Ordovician (Trentonian): Central Pennsylvania.

G. M. Kay, 1943, Econ. Geology, v. 48, no. 3, p. 194, 197–200. Lower member of Curtin limestone (new). An impure cherty fine- to medium-textured heavy ledge, in part, gray limestone with argillaceous partings and interbeds. Contains four metabentonites (B–E); top of member is at base of metabentonite A. Thickness 52 feet in type section. Remarkably constant in character and thickness from Nippenose Valley, south of Jersey Shore, to Pleasant Gap and western end of Bellefonte district. Underlies redefined Valentine member in type section; also underlies Nealmont limestone. Overlies Stover member of Benner limestone. Persists to limit of distribution of Curtin, though bevelled by unconformably overlying Nealmont near limit.

G. M. Kay, 1944, Jour. Geology, v. 52, no. 1, p. 20–21. Beds between metabentonites E and D have been termed "Lemont member of Carlim". Upper part of unit has been classified as "Lowville." It is preferable to use a local name since precise correlation with Lowville of New York uncertain. Unit has also been included in an expanded "Valentine formation".

Type section: In quarry wall south of headframe of Bell mine of American Lime and Stone Company at Bellefonte, Centre County. Named from hamlet 2 miles southwest of Bell mine.

Valmeyer Series[1]

Mississippian: Mississippi Valley.

Original reference: R. C. Moore, 1933, Historical geology; New York, McGraw-Hill Book Co., p. 261–264.

J. M. Weller, 1939, Kansas Geol. Soc. Guidebook 13th Ann. Field Conf., p. 131, 132. Series is sequence of dominantly limestone strata, which succeed each other conformably except upon flank of Ozark area where several unconformities have been recognized. Overlies Kinderhook series unconformably in Mississippi Valley and overlaps those beds onto strata as old as Ordovician. Includes Osage and Meramec groups.

L. E. Workman and Tracey [Tracy] Gillette, 1956, Illinois Geol. Survey Rept. Inv. 189, p. 12. Illinois Geological Survey accepts the name Valmeyer series to include Osage and Meramec groups.

Name derived from southern Illinois where rocks of series are well exposed.

Valmont Dolomite

Upper Ordovician: South-central New Mexico.

L. C. Pray, 1953, Am. Assoc. Petroleum Geologists Bull., v. 37, no. 8, p. 1897 (fig. 2), 1899 (fig. 4), 1900 (fig. 5), 1902, 1906–1911. Name proposed for strata consisting predominantly of light-gray-weathering thin- to medium-bedded sublithographic dolomite lying between underlying cherty member of Montoya formation and generally massive darker and more coarsely crystalline dolomite termed "upper member of Fusselman limestone" by Darton (1917, U.S. Geol. Survey Prof. Paper 108–C). Thickness 150 to 225 feet. A few feet of argillaceous dolomite from 40 to 70 feet above base divides formation into two members. Fossils from lower member are upper Ordovician, those from upper member are indeterminate as Upper Ordovician or Silurian. Underlies Fusselman (?) formation.

L. C. Pray, 1958, West Texas Geol. Soc. Guidebook Field Trip Nov. 6, 7, 8, p. 35. Valmont dolomite is equivalent to Cutter dolomite of Caballo Mountains, and latter term has priority on basis of date of publication.

Type section: On northeast side of Alamo Canyon in SE¼SW¼SW¼ sec. 6, T. 17 S., R. 11 E., Sacramento Mountains, Otero County. Name derived from station of Valmont on Southern Pacific Railroad in sec. 14, T. 18 S., R. 9 E., about 10 miles south of Alamogordo.

**Valmonte Diatomite 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. 143.

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), 33–35, pl. 1. Relatively pure diatomaceous strata. Diatomite occurs as layers of laminae of varying thickness; in some areas, thinly laminated diatomite forms units several feet thick alternating with massive diatomaceous mudstone; in other areas, entire exposed thickness consists of laminated diatomite and diatomaceous shale containing varying proportions of diatoms. Thickness 300 to 500 feet. Underlies Malaga mudstone member; overlies Altamira shale member.

Type region: Along lower course of Agua Negra Canyon, southeast of Valmonte residential district, where diatomite is quarried and processed. Palos Verdes Hills area, Los Angeles County.

**Valmy Formation**

Lower, Middle, and Upper Ordovician: North-central Nevada.

R. J. Roberts, 1951, Geology of the Antler Peak quadrangle, Nevada: U.S. Geol. Survey Geol. Quad. Map [GQ-10]. Interbedded quartzite, chert, argillite, slate, and a little intercalated greenstone (altered andesitic lava). Quartzites thick-bedded to massive, medium to coarse grained. Chert is gray, green, brown, and black with argillite interbeds and partings. Intercalated greenstones include pillow lavas. Thickness estimated at more than 3,000 feet, may be as much as 5,000 feet. In thrust contact with Comus formation (new). Middle(?) Ordovician.

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]. Type locality designated.

R. J. Roberts and others, 1958, Am. Assoc. Petroleum Geologists Bull., v. 42, no. 12, p. 2823 (fig. 5), 2832-2833. Lower, Middle, and Upper Ordovician.

Type locality: North Peak, 8 miles south of Valmy, a station on the Southern Pacific Railway, Golconda quadrangle.

Valparaiso Till or Drift

Pleistocene (Wisconsin): Northeastern Illinois.

J. H. Bretz, 1939, Illinois Geol. Survey Bull. 65, pt. 1, p. 52, 53, 55. A till about 10 feet thick; overlies Lemont drift (new).

Leland Horberg and P. E. Potter, 1955, Illinois Geol. Survey Rept. Inv. 185, p. 9 (fig. 2), 10, 12. Differentiated from overlying Tinley drift primarily on basis of morphology and areal relations; in a few places, such as Worth gravel pit [near Chicago], the two tills occur together stratigraphically; here they are differentiated by unconformity with basal gravel and greater abundance of Devonian shale pebbles in Tinley.

Named for town of Valparaiso, Ind., which is situated on Valparaiso moraine.

Valverde flags[1]

Upper Cretaceous (Gulf Series): Southern Texas.

Original reference: E. T. Dumble, 1892, Geol. Soc. America Bull., v. 3, p. 221, 229, 230.

Named for Val Verde County.

Val Verde Tonalite

Jurassic(?): Southern California.

R. W. Wilson, 1937, Am. Mineralogist, v. 22, no. 2, p. 122-130. Coarse-grained rock, medium dark in color, and varying only slightly in composition throughout district. Constant feature is presence of abundant dark fine-grained rounded inclusions that vary from a few inches to several feet in diameter. In some places inclusions occur in swarms making up 50 percent or more of rock.

E. F. Osborn, 1939, Geol. Soc. America Bull., v. 50, no. 6, p. 921–950. Discussion of structural petrology of Val Verde tonalite. Name credited to F. L. Ransome (1932, unpub. rept.). Footnote states that Val Verde tonalite is same as Perris quartz diorite of Dudley (1935).

W. J. Miller, 1946, Geol. Soc. America Bull., v. 57, no. 5, p. 481, table 4. Plutonic sequence lists Perris and Estelle quartz diorite (Val Verde tonalite) as older than Lakeview quartz monzonite and younger than Virginia quartz norite. Late Mesozoic.

E. S. Larsen, Jr., 1948, Geol. Soc. America Mem. 29, p. 58. In this report, name Bonsall tonalite replaces name Val Verde tonalite as used by Osborn (1939).

Crops out in Val Verde district, a part of the Perris fault block in Riverside County. Probably named for railroad station of Val Verde.

**Vamoosa Formation**[1]

Pennsylvanian (Virgil Series) : Central Oklahoma.

Original reference: G. D. Morgan, 1924, Bur. Geol. [Oklahoma] Bull. 2, p. 125–128, pls. 3, 27, map.

M. C. Oakes, 1951, Tulsa Geol. Soc. Digest, v. 19, p. 119 (fig. 1), 121 (fig. 2), 122. Unconformably overlies Tallant formation (new). Includes Cheshewalla sandstone at base.

W. F. Tanner, 1953, Am. Assoc. Petroleum Geologists Bull., v. 37, no. 8, p. 2046–2050. Unconformably overlies Hilltop formation (new).

E. R. Ries, 1954, Oklahoma Geol. Survey Bull. 71, p. 80–84, pl. 1. In type area, Vamoosa conformably overlies Belle City limestone and is overlapped by overlying Ada so that only lower shale and about 30 feet of clastic part of formation are exposed near town of Byng. In Okfuskee County, the Vamoosa strike-overlaps Tallant and Barnsdall formations and is conformably overlain by "Pawhuska" formation. Discovery of unconformity at base of lowermost conglomerate of Vamoosa necessitates redefinition of formation. Vamoosa (as used by Morgan) is herein redefined and restricted so that its lower boundary is extended upward to unconformity at base of lowermost conglomerate (Boley conglomerate member, new) in formation. Thickness 650 to 690 feet in Okfuskee County. This unconformity makes it possible to establish a natural boundary for base of formation and also establishes natural Missouri-Virgil series boundary.

W. F. Tanner, 1956, Oklahoma Geol. Survey Bull. 74, p. 89–98, pls. 1, 2. Described in Seminole County where it consists of a sequence of shales, sandstones, and chert conglomerates, thinning southward as result of numerous periods of erosion. Coarsest conglomerates are in middle and lower parts of formation. Three highest members of formation have been mapped across northern and central parts of county as Pawhuska or Lecompton limestone by some geologists. This report does not so consider them; they, like the overlying Pawhuska of Okfuskee County, are truncated by overlying Ada formation at more or less regular intervals. Thickness 125 to 550 feet. Includes Boley conglomerate member at base. Unconformably overlies Hilltop formation.

W. F. Tanner, 1956, Oklahoma Geol. Survey Circ. 40, p. 39–54, pl. 1. Lower part of Vamoosa formation described in Osage County where it consists of gray-green, blue-green, and maroon shale, sandstone and siltstone, and thin limestones. Thickness 250 to 310 feet. Named and mapped members include (ascending) Cheshewalla sandstone, Bowring limestone (new), Kiheki sandstone (new), Labadie sandstone, Cochahee sandstone, Bowhan sandstone, Jonesburg sandstone, Wynona sandstone, and Oread limestone. Overlies Tallant formation.

K. E. Masters, 1957, Shale Shaker, v. 7, no. 5, p. 8, 10. Bird Creek limestone considered upper bed of Vamoosa in Prague area, Lincoln and Pottawatomie Counties, Okla.

M. C. Oakes, 1959, Oklahoma Geol. Survey Bull. 81, p. 43–47, pls. 1, 2. In present usage, base of Vamoosa is at base of lowest conglomerate of Morgan's Vamoosa in Stonewall quadrangle and at base of similarly situated conglomerate and sandstone northward to Kansas-Oklahoma line. Top of formation from Kansas-Oklahoma line to North Canadian River, is at base of Lecompton limestone member of Pawhuska formation. South of North Canadian River, top of formation is at base of Ada formation. Thickness in Creek County 220 to 400 feet. Unconformably overlies Tallant formation; conformably underlies Pawhuska. South of Canadian River, unconformably overlain by Ada formation. Not known that unconformity at base of Ada extends north of North Canadian River but, if it does so, it is in rocks younger than Vamoosa formation, in rocks of Vanoss formation of this report.

P. B. Greig, 1959, Oklahoma Geol. Survey Bull. 83, p. 25 (table 2), 26 (fig. 6), 27–37, pls. 1, 2, 3. Formation in Pawnee County extends upward from Missouri-Virgil unconformity to base of Lecompton limestone member of Pawhuska. Thickness about 400 feet. Contains no conglomerate or coarse clastic beds. Many thick sandstone members present in southern part of county wedge out northward in width of one township. Others can be traced completely across county and continue into Osage County and southern Kansas with little change in thickness; still others thicken northward from little or no representation in Pawnee County to prominent sandstones in central and northern Osage County. Table 2 lists (ascending) Cheshewalla sandstone, Kiheki sandstone, Cochahee sandstone. Wynona sandstone, Oread limestone, and Kanawaka shale members. Of these only Kanawaka and Wynona can be positively identified. Formation included in Douglas-Shawnee group, Virgil series.

Named for exposures about one-half mile east of village of Vamoosa, Seminole County.

Vamos Vamos Beds[1]

Eocene or Oligocene: Panamá.

Original reference (Vamos Á Vamos): R. T. Hill, 1898, Harvard Coll. Mus. Comp. Zoology Bull., v. 28, no. 5, p. 179–180, 206–207.

W. P. Woodring, 1957, U.S. Geol. Survey Prof. Paper 306–A, p. 22–23; *in* R. Hoffstetter and others, 1960, Lexique Strat. Internat., v. 5, Amérique Latine, fasc. 2a, p. 349. Vamos Á Vamos beds are now interpreted as marine deposits in lower part of Bohio formation. Name should be Vamos Vamos.

Vamos Vamos is now submerged locality on French Canal, C.Z. Site is off northeast coast of present Barro Colorado Island.

Vanar Hills Volcanics

Tertiary: Southeastern Arizona.

Elliot Gillerman, 1958, New Mexico Bur. Mines Mineral Resources Bull. 57, p. 69–70, table 1, pl. 1. Flows, vitric tuffs, crystal tuffs, and pitchstone;

pinkish-gray latitic rocks, with phenocrysts of feldspar and biotite in an aphanitic hypocrystalline groundmass. Rock is similar, except for texture, to latite porphyry dikes and sills which intrude most of the rocks in the area. Probably middle or late Tertiary. Younger than Steins Mountain quartz latite porphyry (new) ; believed to be older than Weatherby Canyon ignimbrite (new).

Crop out in Vanar Hills, north of Arizona State Highway 68, in northwest corner of mapped area in central part of Peloncillo Mountains, Cochise County. Extend northward for undetermined distance.

**Van Bibber Shale Member** (of South Platte Formation)

Lower Cretaceous : North-central Colorado.

K. M. Waagé, 1955, U.S. Geol. Survey Prof. Paper 274–B, p. 31–33, figs. 10, 17, 19. Dark-gray refractory shale and silty shale with interbeds of fine-grained sandstone. Persistent kaolinitic marker at base of main refractory shale bed. Thickness at type section is 50 feet which is thickest of the many sections measured; more commonly member ranges from 35 to 45 feet thick. Unconformably underlies unnamed first sandstone subunit of South Platte formation (new) ; overlies Kassler sandstone member (new) of South Platte formation.

Type section: Composite of adjacent exposures on scarp of hogback, between 200 and 500 yards north of Van Bibber Creek; southernmost of these exposures, showing the main clay bed, is in airhole of Golden Fire Brick Co. mine. Named for exposures in vicinity of Van Bibber Creek, Golden quadrangle, Jefferson County.

**Van Buren Formation**[1]

Van Buren Member (of Gasconade Dolomite)

Lower Ordovician : Southeastern Missouri.

Original reference: H. S. McQueen, 1930, Insoluble residues as a guide in stratigraphic studies: Missouri Bur. Geology and Mines, separate.

O. R. Grawe, 1945, Missouri Geol. Survey and Water Resources, 2d ser., v. 30, p. 55–56. Basal zone of Gasconade is the 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 140 to 200 feet thick. In reports in which term Van Buren is used, term Gasconade is restricted to the upper cherty dolomite. In this report, Gasconade is used in unrestricted sense to include all strata between Eminence and Roubidoux.

W. H. Twenhofel and others, 1954, Geol. Soc. America Bull., v. 65, no. 3, chart 2 (column 52). Shown on correlation chart as member of Gasconade dolomite.

R. D. Knight, 1954, Kansas Geol. Soc. Guidebook 17th Ann. Field Conf., p. 57. [Reprinted as Missouri Geol. Survey and Water Resources Rept. Inv. 17.] Gunter sandstone is considered member at base of Gasconade. Term Van Buren not used in Missouri.

Name derived from town of Van Buren, Carter County. Well exposed along U.S. Highway 60 west of Van Buren.

Vanceburg Black Shale[1]

Mississippian : Northeastern Kentucky.

Original reference: E. Orton, 1880, Review of strat. geology of eastern Ohio, p. 21, table.

Probably named for Vanceburg, Lewis County.

Vanceburg facies (of New Providence Formation)

Vanceburg sandstone facies[1] (of Cuyahoga Formation)

Vanceburg sandstone facies (of Logan Formation)

Lower Mississippian: Northern Kentucky and southern Ohio.

Original reference: J. E. Hyde, 1915, Jour. Geology, v. 23, p. 657, 758–763.

P. B. Stockdale, 1939, Geol. Soc. America Spec. Paper 22, p. 77, 134, pl. 6. Vanceburg facies is northeasternmost one of New Providence formation in Kentucky; limited on outcrop to west-central and northern Lewis County. Thickness in vicinity of Vanceburg about 275 feet. Includes (ascending) Henley shale, Buena Vista siltstone, Rarden shale, Vanceburg siltstone, and Churn Creek shale members of formation. Considered Lower Mississippian.

F. T. Holden, 1941, Illinois Acad. Sci. Trans., v. 34, no. 2, p. 173; 1942, Jour. Geology, v. 50, no. 1, p. 41 (table 2), 53, 54 (fig. 3), 62–64. In Ohio, considered facies of Logan formation. Includes Buena Vista sandstone, Rarden shale, Vanceburg siltstone, Churn Creek, and Vinton sandstone members. Lies to west of Scioto Valley shale facies.

J. E. Hyde, 1953, Ohio Geol. Survey Bull. 51, p. 3 (table 1), 25. Here considered facies of Cuyahoga formation. Editor's note states 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 Rarden, Vanceburg, Churn Creek and most of Portsmouth shale in Logan formation.

Well developed in vicinity of Vanceburg, Ky., and Buena Vista Ohio.

Vanceburg Sandstone Member (of Cuyahoga Formation)[1]

Vanceburg Siltstone Member (of Logan Formation)

Vanceburg Siltstone Member (of New Providence Formation)

Lower Mississippian: Northern Kentucky and southern Ohio.

Original reference: J. E. Hyde, 1915, Jour. Geology, v. 23, p. 656, 657, 665. 758, 763, 768.

P. B. Stockdale, 1939, Geol. Soc. America Spec. Paper 22, p. 77, 134, pl. 6. Hyde's "Vanceburg member" is retained for the series of even-bedded siltstones constituting bulk of New Providence formation in area of Vanceburg facies. Just how much of the column should be included in this member and where stratigraphic limits should be placed are subject to question. Overlies Rarden shale member; underlies Churn Creek shale member. Considered Lower Mississippian.

F. T. Holden, 1941, Illinois Acad. Sci. Trans., v. 34, no. 2, p. 173; 1942, Jour. Geology, v. 50, no. 1, p. 41 (table 2), 62–63. Vanceburg siltstone member included in Vanceburg facies of Logan formation in Ohio. Thickness 80 to 150 feet. Overlies Rarden shale member; underlies Churn Creek member, no dependable horizon separates the two, the distinction being made on the basis of the larger sandstone content of Vanceburg.

J. E. Hyde, 1953, Ohio Geol. Survey Bull. 51, p. 3 (table 1), 25. Here considered member of Cuyahoga formation in area of Vanceburg facies.

Editor's note states 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 correlation would necessitate placing Rarden, Vanceburg, Churn Creek, and most of Portsmouth shale in Logan formation.

Well developed in vicinity of Vanceburg, Ky., and Buena Vista, Ohio.

Van Cleve Flow (of Capulin Basalt)

Van Cleve Flow (of Clayton Basalt)

Quaternary: Northeastern New Mexico.

R. F. Collins, 1949, Geol. Soc. America Bull., v. 60, no. 6, p. 1031. Dark-gray fine-grained vesicular olivine basalt.

Brewster Baldwin and W. R. Muehlberger, 1959, New Mexico Bur. Mines Mineral Resources Bull. 63, p. 133, 137, 144. East of type locality, Clayton basalt consists of many long tongues. The basalt flows 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 give rise to these basalts are unknown.

Nineteen mile flow from northeast flank of Sierra Grande east and northeast to Van Cleve, sec. 7, T. 29 N., R. 32 E, Union County.

†Vancouver Group[1]

Upper Cretaceous: Southwestern British Columbia, Canada, and northwestern Washington.

Original reference: C. A. White, 1889, U.S. Geol. Survey Bull. 51, p. 33.

Probably named for Vancouver Island, B.C.

Vanderburg Sandstone (in Dixon Formation)

Vanderburg Sandstone (in Henshaw Formation)[1]

Pennsylvanian: Western Kentucky.

Original reference: L. C. Glenn, 1912, Kentucky Geol. Survey Rept. Prog. 1910 and 1911, p. 26.

H. R. Wanless, 1939, Geol. Soc. America Spec. Paper 17, p. 106. A division of Dixon formation, between Mount Gilead shale above and Bald Hill shale. [Apparently so designated by Glenn, 1922, Kentucky Geol. Survey, 6th ser., p. 5.]

Named for Vanderburg, Webster County.

**Vandever Member** (of Crab Orchard Mountains Formation)

**Vandever Shale** (in Lee Group)[1]

Vandever Formation (in Crab Orchard Mountains Group).

Vandever Member (of Lee Formation)

Lower Pennsylvanian: Eastern Tennessee and northern Georgia.

Original reference: Charles Butts, 1916, Tennessee Geol. Survey Resources of Tennessee, v. 6, p. 107–110.

H. R. Wanless, 1939, (abs.) Geol. Soc. America Bull., v. 50, no. 12, pt. 2, p. 1941. Listed as member of Lee formation.

V. H. Johnson, 1946, Coal deposits of Sand and Lookout Mountains, Dade and Walker Counties, Georgia: U.S. Geol. Survey Prelim. Map Geographically extended into northern Georgia where it is 150 to 200 feet thick; overlies Bon Air sandstone and underlies Rockcastle sandstone.

C. W. Wilson, Jr., J. W. Jewell, and E. T. Luther, 1956, Pennsylvanian geology of the Cumberland Plateau: Tennessee Div. Geology [folio], p. 4, 19, pls. 2, 3, 4. Originally named Vandever shale, but presence of large amounts of sandstone in unit along eastern edge of Walden Ridge makes term formation more applicable. Over most of Walden Ridge, consists of three units: lower shaly part, prominent middle sandstone or conglomerate, and upper shaly part. Thickness less than 100 to more than 400 feet: near Vandever, where exposed along axis of an anticline, about 250 feet. Includes Lantana coal near base and Morgan Springs coal near top. Included in Crab Orchard Mountains group (new); underlies Rockcastle conglomerate; overlies Newton sandstone.

U.S. Geological Survey currently classifies the Vandever as a member of Crab Orchard Mountains Formation on the basis of a study now in progress.

Named for exposures at Vandever, Cumberland County, Tenn.

Vandusen cyclothem

Pennsylvanian (Pottsville Series): Southeastern Ohio.

N. K. Flint, 1951, Ohio Geol. Survey, 4th ser., Bull. 48, p. 29, table 1, geol. map. Includes (ascending) Vandusen shale and (or) sandstone, 10 feet thick, clay, coal, and Lowellville or Poverty Run limestone (absent in Perry County). Occurs above Bear Run cyclothem and below Lower Mercer cyclothem. In area of this report, Pottsville series is described on cyclothemic basis; 10 cyclothems are named; [For sequence see Anthony cyclothem.]

Exposed in southeastern Perry County.

Vandusen Shales

Pennsylvanian (Pottsville Series): Eastern Ohio.

R. E. Lamborn, C. R. Austin, and Downs Schaaf, 1938, Ohio Geol. Survey, 4th ser., Bull. 39, p. 67 (chart), 88–99. Vandusen shale horizon extends from top of Vandusen coal to base of Lower Mercer coal. Sandstones locally present. Average thickness about 24 feet.

N. K. Flint, 1951, Ohio Geol. Survey, 4th ser., Bull. 48, p. 29. Vandusen shale and (or) sandstone included in Vandusen cyclothem.

Type locality and derivation of name not given.

Van Etten[1] zone

Upper Devonian: South-central New York.

Original reference: H. S. Williams, 1907, Jour. Geology, v. 15, p. 97, 108, 109.

G. A. Cooper and others, 1942, Geol. Soc. America Bull., v. 53, no. 12, pt. 1, chart 4. Shown on correlation chart as Van Etten zone in Enfield formation. Occurs above Juliand zone.

Exposed along railroad cuts at Van Etten, Chemung County.

**Vanhem Formation** (in Sanborn Group)

Pleistocene and Recent: Southwestern Kansas.

C. W. Hibbard, 1949, Michigan Univ. Mus. Paleontology Contr., v. 7, no. 4, p. 69 (fig. 1), 84–87. Proposed for sediments laid down during cycle of deposition which followed entrenchment of streams into Kingsdown and older formations. Includes following lithologic units (ascending): (1) sand and gravel; (2) silt, (3) silt to clayey silt, and (4) loess. Thickness at type section 68 feet. Type section of the Vanhem is the section given by Smith (1940) as a typical section of the Kingsdown. Most exposures previously referred to or mapped as Kingsdown silt are of deposits younger than the Kingsdown formation and are part of the Vanhem.

C. W. Hibbard, 1958, Am. Jour. Sci., v. 256, no. 1, p. 55 (fig. 1). Upper formation in Sanborn group in southwestern Kansas.

Type locality: In N½ sec. 13, and S½ sec. 12, T. 30 S., R. 23 W., Pyle Ranch, on north side of Bluff Creek, Clark County; type section is along west bluff of a small tributary of Bluff Creek in secs. 12 and 13, T. 30 S., R. 23 W.

**Van Horn Sandstone**[1]

Precambrian (?) : Western Texas.

Original reference: G. B. Richardson, 1904, Texas Univ. Min. Survey Bull. 9, p. 28.

P. B. King, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 1, p. 145 (table), 152–153. Van Horn sandstone, as defined by Richardson, included red arkosic sandstones below and white quartzose sandstones above; the two parts were supposed to be conformable. Subsequent work has shown that the two parts of original formation are separated by well-marked unconformity. Proposed here to restrict name Van Horn to lower red arkosic part of original formation. Upper part included in Bliss sandstone. Maximum thickness of restricted Van Horn about 700 feet. Rests on truncated edges of Allamoore (new) and Hazel formations. Cambrian and Precambrian.

P. B. King and P. T. Flawn, 1953, Texas Univ. Bur. Econ. Geology Pub. 5301, p. 21 (table 1), 24, 25, 90–97. Precambrian (?).

Named for Van Horn, El Paso County.

Vanhornsville Sandstone[1]

Silurian (Niagaran) : Central New York.

Original reference: G. H. Chadwick, 1918, Geol. Soc. America Bull., v. 29, p. 327–368.

Exposed at Vanhornsville, Herkimer County.

Vann Quartzite (in Chilhowee Group)

Lower Cambrian : Northwestern North Carolina.

G. W. Stose and A. J. Stose, 1947, Am. Jour. Sci., v. 245, no. 10, p. 626, 627, 629. Thick-bedded arkosic quartzite, shale, and hard feldspathic light-gray quartzite 1,200 to 1,400 feet thick. Underlies Sandsuck shale; unconformable above Precambrian granite gneiss, Keith [1904, U.S. Geol. Survey Geol. Atlas, Folio 116] used name Snowbird formation in this area.

S. S. Oriel, 1950, North Carolina Div. Mineral Resources Bull. 60, p. 13 (table 3), 26. Vann quartzite is included in Snowbird formation in this report.

G. W. Stose and A. J. Stose, 1949, Geol. Soc. America Bull., v. 60, no. 2, p. 300 (table 4). Table 4 lists Vann quartzite as late Precambrian.

Named from exposure at Vann Cliff on Spring Creek, near Hot Springs, Madison County.

†Van Nest Gap Gneiss[1]

Precambrian : Northern New Jersey.

Original reference: N. E. A. Hinds, 1921, Am. Jour. Sci., 5th, v. 1, p. 355–364.

Occurs at Van Nest Gap, near Oxford Furnace, Warren County.

Van Oser Member (of Jordan Sandstone)

Van Oser Submember (of Jordan Member of Trempealeau Formation)

Upper Cambrian (St. Croixian) : Southeastern Minnesota and southwestern Wisconsin.

C. R. Stauffer, G. M. Schwartz, and G. M. Thiel, 1938, (abs.) Geol. Soc. America Bull., v. 49, no. 12, p. 1902; 1939, Geol. Soc. America Bull., v. 50, no. 8, p. 1238 (table 2), 1240. Coarse massive gray to white sandstone. Overlies Norwalk member. Forms uppermost division of St. Croixian series in Minnesota. Commonly overlain by Oneota dolomite. Has been referred to as *Tellerina-Saukiella* zone in Minnesota classification.

C. R. Stauffer and G. A. Thiel, 1941, Minnesota Geol. Survey Bull. 29, p. 48–49. Thickness about 40 feet at type locality of Jordan sandstone. Overlies Norwalk member.

G. O. Raasch, 1952, Illinois Acad. Sci. Trans., v. 45, p. 93. In Stoddard quadrangle, Wisconsin, considered submember of Jordan member of Trempealeau formation.

Probably named for exposures on Van Oser Creek, Scott County, Minn.

**Vanoss Formation** (in Pontotoc Group)[1]

Pennsylvanian (Virgil Series) : Central southern Oklahoma.

Original reference: G. D. Morgan, 1924, Bur. Geology [Oklahoma] Bull. 2, p. 133–137, pls. 3, 27, map.

W. E. Ham, 1954, Am. Assoc. Petroleum Geologists Bull., v. 38, no. 9, p. 2040–2044. The four principal conglomerates in the Arbuckle Mountains region are divisible into two general groups, older consisting of "Franks" and Deese, and younger consisting of Collings Ranch (new) and Vanoss. Each group is characterized by rocks of which the pebbles and cobbles in the conglomerates are composed. The Vanoss (youngest) contains granite feldspar, and vein quartz from Precambrian rocks that were exposed only after the highest uplift and deepest erosion of the Arbuckles. Formation consists of lower conglomerate member and an upper shale member. Combined maximum thickness about 1,550 feet. Conglomerate member has maximum thickness of 650 feet and is restricted to northern edge of mountains in area between Sulphur and Hennepin. Northward from Sulphur, the conglomerate member disappears by interfingering into shale member whereas, westward and southward around Arbuckle anticline it is overlapped by shale member. In area south of Sulphur, the Vanoss overlies Deese conglomerate. At most places, the rocks have gentle dips and are nonfaulted, although in a few areas they dip as much as 40° and are cut by small faults whose displacement dies out upward in conglomerate sequence. Collings Ranch and Vanoss conglomerates rest with pronounced angular unconformity on older rocks that were steeply folded during culmination of Arbuckle orogeny.

W. F. Tanner, 1956, Oklahoma Geol. Survey Bull. 74, p. 103–108, pl. 1. Described in Seminole County where it overlies Ada formation or completely cuts out the Ada and rests on Arbuckle group. Underlies Permian

Konawa formation, locally unconformable. Consists of shales and sandstones, and in southern part of county, limy arkosic sandstones and conglomerates. Thickness 140 to 550 feet, thickening southward.

M. C. Oakes, 1959, Oklahoma Geol. Survey Bull. 81, p. 51–52, pl. 1. In this report [Creek County], term "Vanoss" applies to all rocks from top of Lecompton limestone member of Pawhuska formation up to top of Pennsylvanian system, which, in northern Oklahoma and southern Kansas, is top of Brownville limestone. Term as so applied probably includes not only Morgan's (1924) Vanoss but also his Ada formation and lower part of his Konawa formation. Rocks to which term "Vanoss" is here applied crop out in a band 6 to 12 miles wide from North Canadian River, in northeastern Pottawatomie County and southwestern Okfuskee County, northeastward to Kansas-Oklahoma line in north-central Osage County. Maximum thickness in county about 300 feet. Intergrades laterally with Pawhuska formation and contains and interfingers with units named in northern Oklahoma and in Kansas, notably the Bird Creek and Wakrusa limestones.

Named for exposures in Vanoss, T. 3 N., R. 4 E., Pontotoc County.

Vanport flint, limestone, or shale member

*See* **Vanport Limestone** (in Allegheny Group) and Scrubgrass cyclothem.

**Vanport Limestone** (in Allegheny Group)

**Vanport Limestone Member** (in Allegheny Formation)[1]

Vanport Limestone Member (of Clarion Formation)

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

Original reference: I. C. White, 1878, Pennsylvania 2d Geol. Survey Rept. Q, p. 60–66.

N. K. Flint, 1951, Ohio Geol. Survey, 4th ser., Bull. 48, p. 44–45, table 1. Vanport member of Scrubgrass cyclothem in report on Perry County. Composed of either milky-colored flint or chert, crystalline limestone, sandy limestone, calcareous limestone, or very fossiliferous shale. Flint facies dominates all others whereas limestone facies is more localized than any other. Thickness 4 inches to 2½ feet. Overlies Scrubgrass coal. Underlies Ferriferous member, Allegheny series.

R. L. Nace and P. P. Bieber, 1958, West Virginia Geol. Survey Bull. 14, p. 22 (table 5). Vanport limestone listed with recognizable members of Allegheny formation in Harrison County.

G. C. Williams, 1960, Jour. Paleontology, v. 34, no. 5, p. 910 (fig. 2). Member of Clarion formation. Above Clarion sandstone member and below Lower Kittanning sandstone. Allegheny group.

Named for exposures at Vanport, Beaver County, Pa.

Van Schaick[1] zone

Middle Ordovician: Eastern New York.

Original reference: R. Ruedemann and G. H. Chadwick, 1935, Science, new ser., v. 81, p. 400.

In Mohawk Valley.

Van Vacter Gypsum Member (of Blaine Formation)

Permian: Southwestern Oklahoma.

G. L. Scott, Jr., and W. E. Ham, 1957, Oklahoma Geol. Survey Circ. 42, p. 17 (fig. 3), 26–28, pl. 1. Name applied to gypsum bed at top of Blaine formation (redefined). In type area, Van Vacter consists of lower and upper division of massive white and pink granular gypsum, respectively 14 and 18 feet thick, separated by 4 feet of red shale. Maximum thickness about 50 feet. Overlies Mangum dolomite member; underlies Dog Creek shale.

Type area: Along west branch of Boggy Creek, center E½ sec. 10 and center W½ sec. 11, T. 8 N., R. 22 W., about 2 miles northwest of Van Vacter ranchhouse, Beckham County.

Van Valkenurg Beds

[Recent?]: Central eastern Florida.

E. H. Sellards, 1940, Geol. Soc. America Bull., v. 51, no. 3, p. 381–385. Proposed for deposit of sand and muck that overlies Melbourne bone bed; contact erosional unconformity. Contains vertebrate fossils, human remains, and pottery. Thickness as much as 7 feet.

Irving Rouse, 1950, New York Acad. Sci. Trans., ser. 2, v. 12, no. 7, p. 220–222. Article correlates cultural periods with geologic intervals. The Valkenburg includes Malabar I (in part), Malabar II, St. Augustine, and Seminole. Malabar I may be dated between 750 and 1150 A.D.

Van Vleck Sands

Oligocene: Southern Texas (subsurface)

Alexander Deussen and K. D. Owen, 1939, Am. Assoc. Petroleum Geologists Bull., v. 23, no. 11, p. 1617, 1630 (fig. 5), 1631 (fig. 6), 1634. Name suggested for thick body of sands, now commonly called the "Frio" in subsurface, that lie below a marine Oligocene shale wedge and above the Vicksburg. Approximately 2,900 feet thick; occupies interval between 8,100 and 11,000 feet below sea level in type well.

Typically displayed in well No. 21 (Skelly Oil Co., Cobb No. 14–B), at Van Vleck, Matagorda County.

**Vaqueros Sandstone**[1] or **Formation**

Vaqueros Stage

Oliogcene(?) and Miocene, lower: Southern California.

Original reference: H. Hamlin, 1904, U.S. Geol. Survey Water-Supply Paper 89.

Thomas Clements, 1937, Am. Assoc. Petroleum Geologists Bull., v. 21, no. 2, p. 215, 216, (fig. 1). Formation, in Tejon quadrangle, overlies Sespe formation and underlies Temblor formation, marked angular unconformity.

R. M. Kleinpell, 1938, Miocene stratigraphy of California: Tulsa, Okla., Am. Assoc. Petroleum Geologists, p. 7–9, fig. 4. Vaqueros formation rests directly on quartz diorites of Santa Lucia Range; apparently attains thickness of about 4,000 feet; neither top nor bottom of formation at type locality has as yet been exactly defined. Underlies Monterey shale. Zemorrian and lower Saucesian.

J. E. Eaton, U. S. Grant, H. B. Allen, 1941, Am. Assoc. Petroleum Geologists Bull., v. 25, no. 2, p. 195–199, 204–205 (fig. 3), 212–213, 216–224, fig. 8. Discussion of Miocene of Caliente Range and environs. Marine Miocene of California is transgressive series, essentially conformable basinward, but revealing strandward two oscillations which respectively inaugurate and divide its upper third. It comprises three nearly equal natural divisions—Vaqueros, Temblor, and Monterey stages—which approximate lower, middle, and upper Miocene. Each of these has a more or less distinctive epeirogenic history, fauna, and average physical aspect. Vaqueros stage is divisible into a lower and an upper substage by minor but usually perceptible change in fauna that coincided with an acceleration of transgression about the middle of Vaqueros time. 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. 1957–1958; 1943, California Div. Mines Bull. 118, pt. 3, p. 463–466. Type Vaqueros formation restricted and five new formations named in Vaqueros Valley. Formation below restricted Vaqueros are (ascending) Junipero sandstone, Lucia shale, The Rocks sandstone, and Berry conglomerate. Restricted Vaqueros consists of about 2,000 feet of marine sandstone and interbedded siltstone containing "Vaqueros" fossils. Subdivided into six members (A to F); upper member considered to be of lower Saucesian age and lower members Zemorrian. Separated from overlying Monterey by Sandholdt formation (new).

J. E. Allen, 1946, California Div. Mines Bull. 133, p. 18 (fig. 2), 26–30. Vaqueros group, in San Juan Bautista quadrangle, consists of fossiliferous sandstones and red beds as much as 1,800 feet thick (commonly less) which form highest points of rolling hills near town of San Juan Bautista. Conformably overlies Pinecate formation, contact determined only by lowest horizon containing Vaqueros fossils; unconformably underlies lavas and agglomerates.

C. J. Leith, 1949, California Div. Mines Bull. 147, p. 12 (fig. 2), 21, pl. 1. In Hollister quadrangle, which borders Quien Sabe quadrangle on west, Taliaferro (unpub. ms.) reports maximum of 225 feet of sandstone, gravel, and limestone containing upper Vaqueros fossils; these [sediments] rest on Cretaceous and are overlain by Quien Sabe volcanics. These sediments thin eastward and, at boundary of Hollister and Quien Sabe quadrangles, the Vaqueros in this area gives new evidence on extent of lower Miocene sea and provides definite evidence for delineating lower limit of age of overlying volcanics.

T. W. Dibblee, Jr., 1950, California Div. Mines Bull. 150, p. 31–32, pls. 1, 3. Formation, in southwestern Santa Barbara County, is as much as 900 feet thick. Underlies Rincon shale; overlies Sespe formation, and in some areas, Alegria formation (new), a marine facies of continental Sespe.

J. E. Upson, 1951, U.S. Geol. Survey Water-Supply Paper 1108, p. 13–14, table facing p. 12, pls. 1, 2. Exposed low on south flank of Santa Ynez Mountains and crops out in small bodies southwest of Santa Barbara and near coast of Summerland. Average thickness about 350 feet. Overlies Sespe formation; underlies Rincon shale. Lower Miocene.

M. L. Hill, S. A. Carlson, and T. W. Dibblee, Jr., 1958, Am. Assoc. Petroleum Geologists Bull., v. 42, no. 12 p. 2982 (fig. 5), 2983–2988. Discussion of Cuyama Valley-Caliente Range area. Lower Miocene marine sandstone and shale formation lying above Simmler (new) or older formations and conformably underlying Monterey shale or its time equivalent, is mapped as Vaqueros formation. Along northeast flank of La Panza Range, formation is composed almost entirely of standstone and averages about 500 feet in thickness. In Caliente Range, from Caliente Mountain northward, formation thickens to more than 7,000 feet and is made up of two members, here named Soda Lake shale below and Painted Rock sandstone above. Southeast of Caliente Mountain, consists of (ascending) Soda Lake sandstone, Soda Lake shale, and Painted Rock sandstone members. At southeastern end of the range and in Cuyama Badlands, the Vaqueros is about 700 feet thick and almost all sandstone. Thinning in this direction is in part the result of gradation of upper beds into overlying continental Caliente formation (new). In Salisbury Canyon, a sandstone 1,200 feet thick was mapped as Vaqueros by English (1916, U.S. Geol. Survey Bull. 621–M) ; it is here included in younger Branch Canyon formation (new).

U.S. Geological Survey currently designates the age of the Vaqueros as Oligocene(?) and lower Miocene on the basis of a study now in progress.

Type area: T. 20, T. 6 E., M. D. M., Junipero Serra quadrangle, Monterey County. Named for exposures on Los Vaqueros Creek.

**Vashon Stade**

**Vashon Drift**[1]

Vashon glacial epoch[1] or glaciation

Pleistocene (Wisconsin) : Western Washington.

Original reference: B. Willis, 1898, Geol. Soc. America Bull., v. 9, p. 111.

R. C. Newcomb, 1952, U.S. Geol. Survey Water-Supply Paper 1135, p. 18–26, 39–44, pls. 1, 2. Pleistocene deposits, in Snohomish County, consists, above sea level, of about 200 feet of Admiralty clay and as much as 1,000 feet of deposits of Vashon glaciation. The latter include as much as 300 feet of either clay or sand units of advance outwash, as much as 150 feet of till, and variable thicknesses of outwash-terrace and train material. Vashon drift includes Pilchuck clay and Esperance sand members (both new).

J. E. Sceva, 1957, U.S. Geol. Survey Water-Supply Paper 1413, p. 20–26, pls. 1, 3. Vashon drift, in Kitsap County, consists of advance outwash, till, and recessional outwash. Overlies Puyallup sand.

P. D. Snavely, Jr., and others, 1958, U.S. Geol. Survey Bull. 1053, p. 74–77, pl. 1. Vashon drift, consisting of outwash sand, gravel, and marginal terrace deposits, occurs above Logan Hill formation in Centralia-Chehalis district.

D. R. Crandell, D. R. Mullineaux, and H. H. Waldron, 1958, Am. Jour. Sci., v. 256, no. 6, p. 384–397. Pleistocene succession in Puget Sound Lowland is (ascending) Orting glaciation, Alderton nonglacial interval, Stuck glaciation (new), Puyallup nonglacial interval, Salmon Springs glaciation (new), erosion interval, and Vashon glaciation. According to Willis (1898) deposits of Vashon age include Vashon drift, Osceola tills, Oceola clays, and Douty gravels. Osceola till of Willis is now known to be a postglacial volcanic mudflow deposit from Mount Rainier. The Osceola clays and Douty gravels of Willis are glacial drift of Vashon age, and the two names are abandoned.

Named for occurrence on Vashon Island, Puget Sound region.

**Vasquez Formation**

Vasquez Series[1]

Oligocene and Miocene, lower(?): Southern California.

Original reference: R. P. Sharp, 1935, Pan-Am. Geologist, v. 63, no. 4, p. 314.

R. H. Jahns, 1939, Am. Jour. Sci., v. 237, no. 11, p. 820. In Mint Canyon-Bouquet Canyon area, Vasquez series underlies Tick Canyon formation (new).

L. F. Noble, 1953, Geology of the Pearland quadrangle, California: U.S. Geol. Survey Geol. Quad. Map [GQ–24]. Described as formation consisting of sedimentary and volcanic rocks, mostly well indurated and forming bold outcrops on mountain slopes south of San Andreas fault zone. Sediments lie at base of formation at one place but are absent elsewhere; they are well-bedded red sandstone, shale, and conglomerate composed mostly of granitic material but containing a few rhyolite cobbles. Volcanics constitute most of the formation and include lava flows of pyroxene basalt, andesite, dacite, and rhyolite and some interbedded tuff, ash, and breccia. Thickness more than 500 feet. Unconformably underlies Punchbowl formation (new); unconformably overlies basement rocks. Oligocene and lower Miocene(?).

G. B. Oakeshott, 1958, California Div. Mines Bull. 172, p. 23 (fig. 3), 59–62, pl. 1. Present north of San Gabriel fault. Formation distributed over several square miles of northeastern part of Soledad basin almost completely across northern part of San Fernando quadrangle. Occupies faulted structural basin plunging 25° to 40° toward the southwest from the northeastern corner of quadrangle. In upper Vasquez Canyon-Tick Canyon area, continuity of formation across quadrangle is interruped by exposure of gneissoid biotite-muscovite granite 1¼ miles wide between Mint Canyon fault and pre-Tick Canyon formation fault in Vasquez Canyon. Most complete and continuous section is in Escondido Canyon. Consists of total thickness of about 8,800 feet, comprised of 500 feet of basal conglomerate and sandstone lying on quartz-augite syenite at head of north branch of Escondido Canyon, 3,800 feet of basaltic volcanic rocks, and 4,500 feet of sandstone, shale, and conglomeraate, overlain unconformably by Mint Canyon formation at Agua Dulce Canyon. Also unconformably overlain by Tick Canyon formation, marked angular unconformity. In most places, it is in fault contact with granitic rocks; in several places, in northeastern corner of quadrangle, it lies unconformably on syenite and related hornblende diorite, both of probable Upper Jurassic or Lower Cretaceous age.

Named for outcrops at Vasquez Rock, in upper Agua Dulce Canyon, San Fernando quadrangle, Los Angeles County.

Vassalboro Sandstone[1] or Formation

Silurian(?): Southwestern Maine.

Original reference: E. H. Perkins and E. S. C. Smith, 1925, Am. Jour. Sci., 5th ser., v. 9, p. 204–228.

L. W. Fisher, 1941, Geol. Soc. America Bull., v. 52, no. 1, p. 124–125, table 1 facing p. 112. Termed a formation. Consists of massive bluish-gray sandstone, calcareous mica phyllite, biotite phyllite, and limestone and calcareous sandstone. Traced into Androscoggin formation near Litchfield. Silurian(?).

A. R. Cariani, 1959, Dissert, Abs., v. 19, no. 10, p. 2577. Correlates with Anson formation (new) on basis of similar lithology.

Well exposed in town of Vassalboro, Kennebec County.

Vatia Trachyte

Pleistocene(?): Samoa Island (Tutuila).

R. A. Daly, 1924, Carnegie Inst. Washington Pub. 340, p. 108–110, 129–130. Trachyte plug. Cuts older basalt flows. Pioarhyolite, Matafao, Papatele, Afono, and Vatia trachytes were erupted contemporaneously or nearly so.

H. T. Stearns, 1944, Geol. Soc. America Bull., v. 55, no. 11, p. 1285–1286 (table 1), 1304–1305. Vatia trachyte plug associated with Pago volcanics (new). Pliocene and early Pleistocene(?).

G. A. Macdonald *in* Jacques Avias and others, 1956, Lexique Strat. Internat., v. 6, Océanie, fasc. 2, P. 223. Pleistocene(?).

Crops out on Pola Island at northwest side of Vatia Anchorage. Total length about 3 kilometers; maximum width about 500 meters.

Vaucluse zone[1]

Precambrian: Northwestern South Carolina.

Original references: E. Sloan, 1905, South Carolina Geol. Survey geognostic map of South Carolina, advance copies; published in 1908, in Catalogue of mineral localities of South Carolina, South Carolina Geol. Survey, ser. 4, Bull. 2: 1907, Summary of mineral resources of South Carolina, p. 6, 9, 12.

Named for exposures at Vaucluse, Aiken County.

**Vaughn Member** (of Blackleaf Formation)

Lower Cretaceous: Northwestern Montana.

W. A. Cobban and others, 1959, Am. Assoc. Petroleum Geologists Bull., v. 43, no. 12, p. 2790–2791, 2792 (fig. 3); 1959, Billings Geol. Soc. [Guidebook] 10th Ann. Field Conf., p. 89 (fig. 1), 90. Characterized by light-colored highly bentonitic clay and sandstone of nonmarine origin. Mineral heulandite occurs as minute crystals, earthy masses, and short irregular veinlets throughout much of member and gives red color to so-called red speck zone. Basal part chiefly arkosic sandstone containing abundant petrified wood. Black carbonaceous shale forms top of member north of Great Falls. Thickness at type section 97 feet; thins eastward and thickens westward. Underlies Bootlegger member (new); overlies Taft Hill glauconitic member (new).

Type section: About 3½ miles northeast of Vaughn in low south-facing bluffs in NE¼ sec. 6, T. 21 N., R. 2 E., and SE¼ sec. 31, T. 22 N., R. 1 E. Named from village of Vaughn in sec. 24, T. 21 N., R. 1 E., Cascade County.

**Vaughn Hills Member** (of Worcester Formation)

Carboniferous: Eastern Massachusetts.

W. R. Hansen, 1956, U.S. Geol. Survey Bull. 1038, p. 1, 23–25, pl. 1. Proposed for those predominantly quartzitic rocks, previously undifferentiated, that lie at base of mica schist facies of Worcester formation in Harvard and Bolton area. The Vaughn Hills feathers out to north and northeast. Overlies Harvard conglomerate lentil.

Best exposed on southern of the two Vaughn Hills (locality from which it is named) in town of Bolton, Worcester County.

Veazie Formation

Age not stated: South-central Maine.

L. A. Wing, 1957, Maine Geol. Survey GP. and G. Survey 1, sheet 1. Bucksport formation (new) appears to be overlain by interbedded quartzites and slates which are referred to informally as Veazie formation by workers in area. Within this formation is a thin band of iron and manganese slate which closely resembles some of deposits in Aroostook County described by Miller (1947, Maine Geol. Survey Bull. 4). He described the majority of these deposits as of Silurian age and suggested that they may correlate with the Clinton.

Report covers parts of Hancock and Penobscot Counties.

Vecol limestone

[Upper Devonian] (Jeromian): Arizona.

C. R. Keyes, 1942, Pan-Am. Geologist, v. 77, no. 3, p. 228 (table). Lower part of Jeromian series (new). Thickness 250 feet. Underlies Sycamore sandstone; younger than Espinal limestone (new). Lower part of Jerome formation (of Stoyanow).

In Jerome region.

Vedder Greenstone[1]

Carboniferous: Southwestern British Columbia, Canada, and central northern Washington.

Original reference: R. A. Daly, 1912, Canada Geol. Survey Dept. Mines Mem. 38, maps 16, 17.

C. E. Weaver, 1937, Washington [State] Univ. Pubs. in Geology, v. 4, p. 16–17. Associated with rocks of Chilliwack series are greatly altered gabbroid masses which have been termed Vedder formation. Carboniferous.

Mapped on Vedder Mountain, British Columbia.

Veleno Member (of Cook Mountain Formation)

Eocene (Claiborne): Tamaulipas, Mexico, and western Texas.

J. M. Patterson, 1942, Am. Assoc. Petroleum Geologists Bull., v. 26, no. 2, p. 259 (fig. 2), 262–263. Name proposed for middle member of formation. Consists of alternating beds of shale and sandstone as differentiated from the practically solid sandstone members above and below. Sandstones are calcareous, fossiliferous, concretionary, and in many places glauconitic; shales are mainly carbonaceous, fossiliferous, and weather to characteristic chocolate color. Thickness 700 to 800 feet. Underlies Falcon sandstone member (new); overlies Garceno sandstone member (new).

Named for Arroyo Veleno (misspelled Boleno on topographic map), Zapata quadrangle. Member is exposed on Mexico side of the Rio Grande in vicinity of Zapata.

Velpen Limestone (in Carbondale Group)

Pennsylvanian: Southern Indiana.

J. M. Weller, L. G. Henbest, and C. O. Dunbar *in* C. O. Dunbar and L. G. Henbest, 1942, Illinois Geol. Survey Bull. 67, p. 32 (chart); C. L. Cooper, 1946, Illinois Geol. Survey Bull. 70, p. 16 (fig. 2). Shown on correlation chart at base of Carbondale group; stratigraphically below Houchin Creek [limestone].

Locality not given but may be in vicinity of Velpen, Pike County.

Venado Formation

Upper Cretaceous (Chico Series): Northern California.

J. M. Kirby, 1943, Am. Assoc. Petroleum Geologists Bull., v. 27, no. 3, p. 287–289, 291, 293. Predominantly sandstone with minor amounts of siltstone and shale; conglomerate layers particularly at or near base. Thickness 1,890 to 3,440 feet. Underlies Yolo formation (new); overlies Shasta series. Replaces preoccupied name Golden Gate formation (Kirby, 1942).

Type locality: In sec. 9, T. 17 N., R. 4 W., Colusa County. Named from village of Venado.

Venango Formation[1] (in Conewango Group)

Upper Devonian: Northern Pennsylvania and southern New York.

Original reference: J. P. Lesley, 1892, Pennsylvania 2d Geol. Survey Summ. Final Rept., v. 2, p. 1405–1406, 1438–1440, 1500–1506.

Bradford Willard, 1939. Pennsylvania Geol. Survey, 4th ser., Bull. C–19, p. 14, 243, 253. Formation in Conewango group comprises (ascending) Panama conglomerate, Amity shale, Bimber Run conglomerate, North Warren shale, Pope Hollow conglomerate, Saegerstown shale, Tuna-Kilbuck conglomerate lens, and Woodcock sandstone member. Underlies Riceville formation. Overlies Chadakoin formation of Conneaut group.

I. H. Tesmer, 1954, Dissert. Abs., v. 14, no. 12, p. 2317, 2318. Term Cherry Creek member proposed for succession of gray siltstones and shales which overlie Panama conglomerate member of Venango in Cherry Creek quadrangle, New York.

Name derived from Venango County, Pa.

Venango Group,[1] Stage,[1] monothem[1]

Devonian: Northwestern Pennsylvania.

Original reference: J. F. Carll, 1880, Pennsylvania 2d Geol. Survey Rept. $I_3$, Atlas, pl. 11.

W. M. Laird, 1941, Pennsylvania Topog. and Geol. Survey Prog. Rept. 126, p. 9–11. Devonian comprises Chautauquan and Conewango series. Conewango series includes Venango and Riceville stages. Venango stage includes Sandstone B which will probably be named Youghiogheny sandstone and Shale C which will probably be named Watering Trough shale.

Named for Venango County.

Venice Member (of Columbus Limestone)[1]

Middle Devonian: Northeastern and central Ohio.

Original reference: C. K. Swartz, 1907, Johns Hopkins Univ. Circ. 7, p. 62.

J. W. Wells, 1944, Geol. Soc. America Bull., v. 55, no. 3, p. 276 (fig. 1). Upper member of formation; overlies Marblehead member.

Named for Venice, Erie County.

Ventana sandstones[1]

Upper Triassic: Arizona, Colorado, and Utah.

Original reference: C. R. Keyes, 1922, Pan-Am. Geologist, v. 38, p. 250, 338.

Charles Keyes, 1936, Pan-Am. Geologist, v. 65, no. 1, p. 63 (table). Overlies Leroux limestones. Name spelled Vantana.

Named for Ventana Mesa, near Chinle, Apache County, northeastern Arizona.

Venteran Substage

Pennsylvanian (Desmoinesian): Missouri, Iowa, Kansas, Nebraska, and Oklahoma.

W. V. Searight and others, 1953, Am. Assoc. Petroleum Geologists Bull., v. 37, no. 12, p. 2748 (fig. 1), 2749. Named on northern Midcontinent composite stratigraphic column. Venteran substage together with overlying Cygnian substage (new) make up Desmoinesian stage. Comprises Seville limestone and lower "Cherokee" beds [Krebs group].

W. V. Searight, 1955, Missouri Geol. Survey and Water Resources Rept. Inv., 20, p. 10. Type locality and derivation of name.

Type locality: Venter Bluff on U.S. Highway 54, Cedar County, Mo.

Ventioner Beds (in Brad Formation)[1]

Pennsylvanian: North-central Texas.

Original reference: G. Scott and J. M. Armstrong, 1932, Texas Univ. Bull. 3224, p. 35.

Occurs on west side of Trinity River, upstream from mouth of Ventioner Creek, and exposed 1 mile west of Ventioner Creek bridge.

Ventura Formation[1]

Triassic(?): Central northern Washington.

Original reference: I. C. Russell, 1900, U.S. Geol. Survey 20th Ann. Rept., pt. 2, p. 100–137, map.

J. D. Barksdale, 1948, Northwest Science, v. 22, no. 4, p. 174. Red tuffaceous sandstones and shales named Ventura formation by Russell (1900) are included at base of newly defined Upper Cretaceous Midnight Peak formation.

Named for mining camp in mountains bordering Methow Valley, Okanogan County.

Ventura Sands[1]

Pliocene and Pleistocene: Southern California.

Original reference: C. M. Carson, 1925, Pan-Am. Geologist, v. 43, p. 265–270.

Well exposed in foothills between Ventura and Santa Paula, in Las Posas Hills, near Camarillo, on south and west flanks of South Mountain and in Simi Valley, Ventura County.

Venturian Stage

Pliocene: Southern California.

Manley Natland, 1953, Pacific Petroleum Geologist, v. 7, no. 2, p. 2. One of four stages, based on foraminiferal assemblages, in the Pliocene and Pleistocene of southern California. Includes interval between Wheelerian above and Repettian, below (both new). Venturian is equivalent to lower Pico as used by many geologists.

Venus formation

Precambrian (Chuaran series): Northern Arizona.

Charles Keyes, 1938, Pan-Am. Geologist, v. 70, no. 2, p. 107 (chart), 112. Dark brown and green shales. Thickness 600 feet. Underlies Marble limestone (new); overlies Oso beds (new).

Named from butte known as Venus Temple, Grand Canyon region.

†Vera Cruz Graphite Schist[1]

Precambrian: Southern Pennsylvania.

Original reference: B. L. Miller, 1911, Pennsylvania Topog. and Geol. Survey Rept. 4, p. 16.

Easton-Reading district.

Veraguas Crystalline Series[1]

Cretaceous(?): Panama.

Original reference: O. H. Hershey, 1901, California Univ. Dept. Geol. Bull., v. 2, p. 247.

W. P. Woodring *in* R. Hoffstetter and others, 1960, Lexique Strat. Internat., v. 5, Amérique Latine, fasc. 2a, p. 349. Volcanic and intrusive rocks. Cretaceous(?).

Present in range forming continental divide in Veraguas Province.

Verda Member (of Yazoo Clay)

Eocene (Jackson): Central Louisiana.

H. N. Fisk, 1938, Louisiana Dept. Conserv. Geol. Bull. 10, p. 100–102. A series of sparingly fossiliferous brackish-water lignitic clays, and interbedded silty sands, with intercalated lenticular marine sandstones, freshwater leaf-bearing silts, and marine clays. Aggregate average thickness 200 feet. Includes, in lower part, Saddle Bayou lentil (new) and in upper part Mossy Ridge and Zenoria lentils (both new) which occupy about same stratigraphic horizon. Grades into underlying Tullos member (new) through transitional phase herein named Union Church; gradationally underlies Danville Landing beds.

J. Huner, Jr., 1939, Louisiana Dept. Conserv. Geol. Bull. 15, p. 149 (fig. 7), 159–163. In Caldwell Parish, includes Myatt lentil (new) and Bayou Calamus lentil (new), both near middle of member.

Well exposed in vicinity of Verda and New Verda, Grant Parish.

**Verde Formation**[1]

Pliocene(?) or Pleistocene: Central Arizona.

Original reference: L. E. Reber, 1922, Am. Inst. Mining and Metall. Engineers Trans., v. 66, p. 3–26.

C. A. Anderson and S. C. Creasey, 1958, U.S. Geol. Survey Prof. Paper 308, p. 59–61, fig. 2. Age shown on map as Pliocene(?) or Pleistocene. Unconformably overlies Hickey formation (new) in Jerome area. Derivation of name given.

R. E. Lehner, 1958, U.S. Geol. Survey Bull. 1021–N, p. 557–563, pls. 45, 46, 47. Mutual relationship of Verde with Perkinsville formation (new) not demonstrated in Clarkdale quadrangle but they are tentatively correlated. Thickness as much as 2,000 feet.

Named from occurrence in Verde Valley in region about Clarkdale and Camp Verde, Yavapai County.

**Verden Sandstone Member** (of Marlow Formation)

Verden Sandstone[1]

Permian: Central southern and southwestern Oklahoma.

Original reference: N. Meland and R. D. Reed, 1924, Jour. Geology, v. 32, no. 2, p. 150–167.

P. B. King, 1942, Am. Assoc. Petroleum Geologists Bull., v. 26, no. 4, pl. 2. Shown on correlation chart as member of Marlow formation.

L. V. Davis, 1955, Oklahoma Geol. Survey Bull. 73, p. 65, fig. 4 (chart). Crossbedded dolomitic sandstone about 10 feet thick. Occurs near middle of formation.

H. D. Miser and others, 1954, Geologic map of Oklahoma (1:500,000) : U.S. Geol. Survey. As mapped, Marlow formation includes Doe Creek sandstone member in northwestern Oklahoma and Verden sandstone member in southwestern Oklahoma.

Named for exposures on buttes a few miles northwest of village of Verden, Grady County.

Verdi Beds (in St. Louis Limestone)[1]

Verdi Member (of St. Louis Limestone)

Mississippian (Meramec) : Southeastern Iowa.

Original reference: H. F. Bain, 1895, Am. Geologist, v. 15, p. 319.

J. M. Weller and A. H. Sutton, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 5, p. 813, 815. The St. Louis is divided into two members, Croton below and Verdi above. Verdi consists of dense gray limestone which grades locally into fine sandstone. Maximum thickness 35 feet. Unconformably overlain by Pella beds.

Named for exposures in old railroad quarry near Verdi Station, Washington County.

**Verdigris Limestone Member** (of Cabaniss Formation or Senora Formation)

Verdigris Formation (in Cabaniss Group or Cherokee Group)

Verdigris Limestone (in Cherokee Formation)[1]

Pennsylvanian (Des Moines Series) : Oklahoma, Kansas, and Missouri.

Original reference: C. D. Smith, 1928, Oklahoma Geol. Survey Bull. 40–U, map.

W. V. Searight and others, 1953, Am. Assoc. Petroleum Geologists Bull., v. 37, no. 12, p. 2748 (fig. 1). Verdigris formation in Cabaniss group shown on composite stratigraphic column of Desmoinesian rocks in northern midcontinent. Overlies Croweburg formation; underlies Bevier formation.

W. V. Searight *in* W. B. Howe and W. V. Searight, 1953, Missouri Geol. Survey and Water Resources Rept. Inv. 14, pl. 1. On generalized section of strata exposed in Carroll and Livingston Counties, Mo., Verdigris formation underlies Wheeler formation (new) and overlies Croweburg formation. Cabaniss group.

R. D. Alexander, 1954, Oklahoma Geol. Survey Circ. 31, p. 9, 13, 16 (fig. 2). Member of Senora formation in Oklahoma. Thickness 5 to 11 feet.

C. C. Branson, 1954, Oklahoma Geol. Survey Guide Book 2, p. 5. Listed as Verdigris coal cycle in Senora formation in Oklahoma. Includes shale, limestone, Verdigris black shale, Verdigris limestone, and Wheeler coal. Occurs above Croweburg coal cycle and below Bevier coal cycle.

W. B. Howe, 1956, Kansas Geol. Survey Bull. 123, p. 22 (fig. 5), 72–78 (measured sections). Formation includes beds above Croweburg coal and extending to top of Wheeler coal. Underlies Bevier formation; overlies Croweburg formation. Takes its name from widespread Verdigris ("Ardmore") limestone which is its most prominent member. In northern Missouri, formation includes the following members (ascending): thinly laminated light-gray clay shale, black fissile shale, Verdigris limestone, underclay, and Wheeler coal. In western Missouri and in Cherokee and Crawford Counties, Kans., underclay of Bevier coal lies directly on Verdigris limestone, and the Verdigris becomes uppermost member of formation in these areas. In eastern Labette County, Kans., and in northern Oklahoma, a succession of shale and sandstone beds occurs between Verdigris limestone and Bevier coal. Thickness as much as 53 feet. Cabaniss subgroup of Cherokee group.

J. M. Jewett, 1959, Graphic column and classification of rocks in Kansas: Kansas Geol. Survey. Verdigris limestone member of Cabaniss formation shown on correlation chart.

Name derived from Verdigris River in southern Rogers County, Okla.

**Verdos Alluvium**

Pleistocene (Kansan or Yarmouth): Northeastern Colorado.

G. R. Scott, 1960, Geol. Soc. America Bull., v. 71, no. 10, p. 1541–1542. Name applied to alluvial deposit lying 100 feet below older alluvium (Rocky Flats, new), and 100 feet above next younger alluvium (Slocum, new). Where typically exposed, it is a sheet, 16 to 35 feet, of brown well-stratified coarse sand containing some larger stones and volcanic ash bed. Unconformably overlies Mesozoic bedrock. Volcanic ash considered to be correlative with Pearlette ash.

Typically exposed in an outcrop on slope of pediment on Verdos Ranch, in NE¼NW¼SE¼ sec. 22, T. 6 S, R. 69 W., Littleton quadrangle.

Veredas Group

Pennsylvanian (Missouri Series): Central and southern New Mexico.

M. L. Thompson, 1942, New Mexico Bur. Mines Mineral Resources Bull., 17, p. 27 (table 2), 57–60. Term proposed for (ascending) Coane formation, Adobe formation, and Council Spring limestone (all new). Stratigraphic limits of group at type locality are top of Bolander group (new) of Des Moines series below and base of Hansonburg group (new) of upper part of Missouri series. Thickness about 125 feet at type locality.

Type locality: Northwest side of Oscura Mountains on west slope of range in eastern part of SE¼ sec. 36, T. 5 S., R. 5 E., Socorro County. Name derived from Canyon de las Veredas, in central part of Oscura Mountains.

**Verendrye Member** (of Pierre Shale)

Verendrye Beds or zone (in Sully Member of Pierre Shale)

Upper Cretaceous: Central South Dakota.

W. V. Searight, 1937, South Dakota Geol. Survey Rept. Inv. 27, p. 25–26, 31, pls. 2, 3. Zone, or beds, at top of Sully member (new) of Pierre formation. Consists of clay and shale beds underlying Virgin Creek member (new) and overlying manganiferous Oacoma zone of Sully. Thickness 170 to 180 feet.

D. R. Crandell, 1950, Am. Assoc. Petroleum Geologists Bull., v. 34, no. 12, p. 2340 (table 1), 2343, 2345. Rank raised to member of Pierre shale. Underlies Virgin Creek member; overlies DeGrey member (new).

Named from exposures under and above Verendrye monument, at Fort Pierre, Stanley County.

**Vergennes Sandstone Member** (of Spoon Formation)

Vergennes Sandstone Member (of Carbondale Formation)[1]

Middle Pennsylvanian: Southwestern and central western Illinois.

Original reference: E. W. Shaw and T. E. Savage, 1912, U.S. Geol. Survey Geol. Atlas, Folio 185.

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 33, 50 (table 1). Reallocated to member status in Spoon formation (new). In lower part of formation below Seahorne limestone member.

Type locality: N¼ sec. 11, T. 7 S., R. 3 W., Jackson County. Named for Vergennes.

†Verkin Shales[1]

Lower Triassic: Southwestern Utah.

Original reference: E. Huntington and J. W. Goldthwait, 1903, Jour. Geology, v. 11, p. 46–63.

Name probably derived from Verkin Creek, Washington County.

**Vermejo Formation**[1]

Upper Cretaceous: Northeastern New Mexico and southeastern Colorado.

Original reference: W. T. Lee, 1913, Am. Jour. Sci., 4th, v. 35, p. 531.

W. T. Lee, 1917, U.S. Geol. Survey Prof. Paper 101, p. 163–169. In Fremont County, Colo., includes Rockvale sandstone member.

W. T. Lee, 1924, U.S. Geol. Survey Bull. 752. In Raton coal field, New Mexico, includes Rail Canyon sandstone member.

R. L. Griggs, 1948, New Mexico Bur. Mines Mineral Resources Ground-Water Rept. 1, p. 33; G. H. Wood, Jr., S. A. Northrup, and R. L. Griggs, 1953, U.S. Geol. Survey Oil and Gas Inv. Map OM–141. In Colfax County, N. Mex., conformably overlies and interfingers with Trinidad sandstone; unconformably overlies Raton formation. Consists of interbedded coal, shale, siltstone, and sandstone. Maximum thickness about 85 feet.

R. B. Johnson and G. H. Wood, Jr., 1956, Am. Assoc. Petroleum Geologists Bull., v. 40, no. 4, p. 709 (fig. 2), 712. Formation rests conformably on Trinidad sandstone over most of Raton basin region. Tongues of Vermejo strata wedge out in easterly and northeasterly directions, and tongues of Trinidad wedge out west and northwest. Underlies Raton formation. Vermejo rocks consist of buff, gray, and dark-gray siltstone; buff, gray, and gray-green slightly arkosic sandstone; nearly black carbonaceous coaly and silty shale; and numerous coal beds. Thickness as much as 550 feet near East Spanish Peak. Formation absent near Raton, Van Houten, and Ute Park, N. Mex. Montana age.

Type locality: At southeastern extremity of Vermejo Park, N. Mex.

Vermilion facies (of Cleveland Shale)

*See* **Cleveland Shale.**

**Vermilion Granite**[1]

Precambrian: Northeastern Minnesota.

Original reference: F. F. Grout, 1923, Econ. Geology, v. 18, p. 253–269.

J. T. Stark and V. G. Sleight, 1939, Geol. Soc. America Bull., v. 50, no. 7, p. 1032 (table 2), 1036. Presumably contemporaneous with Kekequabic granites. Algoman(?).

F. F. Grout and others, 1951, Geol. Soc. America Bull., v. 62, no. 9, p. 1040. Intrudes Knife Lake series at hundreds of places and is clearly younger, but how much is not clear. Nowhere in contact with Animikie sediments to prove that it is older than Animikie. Magnetite associated with Vermilion granite pegmatites gives tentative age (Hurley, 1943, Geol. Soc. America Bull., v. 54, no. 3) of 750 million years.

Named for exposures on Vermilion Lake and along Vermilion River, northern St. Louis County.

†Vermilion Series,[1] Schists,[1] or Group[1]

Precambrian (Keewatin) : Northeastern Minnesota.

Original reference: N. H. Winchell and A. Winchell, 1887, Minnesota Geol. Nat. History Survey 15th Ann. Rept., p. 4, 192, 355–357.

Occur at northwestern extremity of Vermilion Lake and extend east from Vermilion Lake to Basswood Lake, Vermilion district.

†Vermilion Cliff Group[1]

Upper Triassic: Southwestern to northeastern Utah and northwestern Colorado.

Original reference: J. W. Powell, 1876, Geology of eastern portion of Uinta Mountains, p. 41, 52–54, 151.

Named for Vermilion Cliffs, to south of White Cliffs, near Paria, a little town on Paria River, Kane County, Utah.

†Vermilion Creek Group[1]

Eocene: Northwestern Colorado, northeastern Utah, and southwestern Wyoming.

Original reference: C. King, 1876, U.S. Geol. Expl. 40th Par., Atlas, maps 1, 2.

†Vermilion Lake Iron-Bearing Series[1]

Precambrian (Huronian) : Minnesota.

Original references: R. D. Irving, 1883, U.S. Geol. Survey 3d Ann. Rept., pl. 3, map; 1888, U.S. Geol. Survey 7th Ann. Rept., p. 440–441.

Vermilion Lake region.

**Vermilionville Sandstone Lentil** (in Carbondale Formation)[1]

Vermilionville Sandstone (in Carbondale Group)

Vermilionville Sandstone Member (of Carbondale Formation)

Middle Pennsylvanian: Northern and southern Illinois.

Original reference: G. H. Cady, 1919, Illinois Geol. Survey Bull. 37, p. 31, 56–58.

H. B. Willman and J. N. Payne, 1942, Illinois Geol. Survey Bull. 66, p. 123 (fig. 66), 127–128. Described in Marseilles, Ottawa, and Streator quadrangles as a sandstone in Carbondale group. Thickness 15 to 75 feet; variations in thickness result partly from the sandstone filling channels in underlying Canton shale and partly from the channellike depressions in top of sandstone. Included in Brereton cyclothem.

H. R. Wanless and Raymond Siever, 1956, Illinois Geol. Survey Circ. 217, p. 10. Type locality given.

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 34, 35, 48 (table 1). Member of Carbondale formation (redefined).

Name is extended from northern Illinois to equivalent sandstone in southern Illinois for which name Cuba sandstone has been used. Name Cuba preempted.

Type locality: SE part sec. 9, T. 32 N., R. 2 E., La Salle County. Named for outcrops along Vermilion River near Vermilionville.

†Vermont Formation[1] or Quartzite[1]

Lower Cambrian: Southwestern Vermont and western Massachusetts.

Original reference: J. D. Dana, 1873, Am. Jour. Sci., 3d, v. 6, p. 272–278.

Derivation of name not stated, but probably named for development in southern Vermont.

Vermont Quartz Diorite

Pre-Cretaceous(?): Southern California.

G. J. Neuerburg, 1953, California Div. Mines Spec. Rept. 33, p. 3, 7 (table 1), 10–11, pl. 1. A medium-grained quartz diorite in Vermont pluton. Present only in northern half of Mount Hollywood fault block, where it intruded and metamorphosed a complex of basalt, diabase, and gabbro. Suggested sequence of intrusion in area is Vermont quartz diorite, Lar quartz diorite (new) and Feliz granodiorite (new).

Occurs in Griffith Park area, city of Los Angeles. [Name probably derived from fact that it is near Vermont Ave., Los Angeles.]

Vernal[1] (shale)

Upper Jurassic: Montana.

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

Derivation of name not stated.

**Vernal Mesa Quartz Monzonite**

Vernal Mesa Granite[1]

Precambrian: Central western Colorado.

Original reference: J. F. Hunter, 1925, U.S. Geol. Survey Bull. 777.

Occurs near northwest end of Vernal Mesa and walls adjacent to part of Black Canyon, in Gunnison River region.

Verne cyclothem (in Saginaw Group)

Pennsylvanian: Southern Michigan.

W. A. Kelly, 1936, Michigan Dept. Conserv., Geol. Div. Pub. 40, Geol. Ser. 34, p. 159, 166, 177, 183, 190. Cyclical formation in Saginaw group. Contains Verne shaly limestone.

Named for Verne mine, sec. 23, T. 10 N., R. 4 E., Saginaw County.

Verne Shaly Limesone Member (of Saginaw Formation)

Pennsylvanian: Southern Michigan.

W. A. Kelly, 1936, Michigan Dept. Conserv., Geol. Div. Pub. 40, Geol. Ser. 34, p. 159, 166, 177, 183, 190. Verne shaly limestone member of Verne cyclothem. Limestone is persistent and makes it possible to divide Saginaw into pre- and post-Verne cyclical formations.

Michigan Geol. Soc., 1954, *in* Geologic cross section of Paleozoic rocks central Mississippi to northern Michigan: Tulsa, Okla., Am. Assoc. Petroleum Geologists, p. 28. Referred to as limestone member of Saginaw formation. Consists of a few feet of black highly argillaceous limestone that grades upward into a calcareous shale. Limestone is late

Pottsvillian in age and its fauna is more closely related to fauna of the Pottsville in Illinois than to fauna of same age in Ohio.

Type locality (cyclical formation): Verne mine, sec. 23, T. 10 N., R. 4 E., Saginaw County.

†Vernon Gneiss[1]

Upper Carboniferous or post-Carboniferous: Southeastern Vermont and western central Massachusetts.

Original reference: B. K. Emerson, 1898, U.S. Geol. Survey Mon. 29, p. 17, pl. 34.

Named for occurrence in Vernon Township, Vt.

Vernon Limestone[1]

Devonian: Southeastern Vermont and western central Massachusetts.

Original reference: B. K. Emerson, 1890, Am. Jour. Sci., 3d, v. 40, p. 365.

Occurs in Vernon Township, Vt.

**Vernon Shale** (in Salina Group)

Vernon Shale Member (of Salina Formation)[1]

Upper Silurian: Western to east-central New York.

Original reference: J. M. Clarke, 1903, New York State Mus. Handb. 19, p. 18–19, chart.

C. K. Swartz and others, 1942, Geol. Soc. America Bull., v. 53, no. 4, chart 3. Shown on correlation chart as shale in Salina group, Cayugan series. Overlies Pittsford shale; underlies Syracuse salt.

D. W. Fisher and L. V. Rickard, 1953, New York State Mus. Circ. 36, p. 10, fig. 1. Discussion of age of Brayman shale. The Brayman lies first upon Ordovician strata in type area and at Sharon Springs. West of Cherry Valley, it lies upon progressively younger strata of Middle and Upper Silurian. At western border of Richfield Springs quadrangle, the Lockport, Vernon, Camillus, and Bertie have all appeared in the section. Figure 1 shows the Vernon underlying the Camillus and overlying the Herkimer.

L. V. Rickard, 1955, New York State Geol. Assoc. Guidebook 27th Ann. Mtg., p. 7. Salina formation, in central New York, consists of two facies, Vernon red shales near base, and above, Camillus gray calcareous shales and dolomites with salt and gypsum beds.

W. P. Leutze, 1956, Am. Assoc. Petroleum Geologists Bull., v. 40, no. 7, p. 1693, 1694 (fig. 1). Underlies Syracuse formation where that formation outcrops in Onondaga and Madison Counties. Thickness about 300 feet. Salina group.

W. L. Kreidler, 1957, New York State Mus. Bull. 361, p. 6. Underlies Syracuse salt member of Camillus.

D. W. Fisher, 1957, New York State Mus. Bull. 364, p. 3–30. Discussion of Vernon shale in type area; reference section designated. The Vernon has been variously treated as a distinct formation or as a member of Salina formation and commonly considered to be 150 feet thick in type area. At least five distinct rock types are represented in strata classed as Vernon, but they are so interrelated that further differentiation into smaller units is not warranted from cartographic standpoint. The Vernon is here regarded as a phase of sedimentation (magnafacies) capable of geologic mapping; hence, it can properly be termed a formation.

Name "Pittsford shale" is suppressed and the discontinuous occurrence of greenish-black shale above Lockport dolomite is included in Vernon formation. Thickness at reference section 270 feet; contact with underlying Lockport not exposed, and section does not extend up to contact with overlying Camillus. Total estimated thickness of Vernon in type area 400 feet. Within New York, the Vernon is considered correlative of High Falls shale of Orange and Ulster Counties. Upper Silurian.

D. W. Fisher, 1959, New York State Mus. Sci. Service Geol. Survey Map and Chart Ser. 1. Included in Canastota(n) stage (new), Cayugan series.

Type locality: Vernon Township, Oneida County. Reference section: Downing Brook, which enters Oneida Creek from east 1.3 miles south of part of Sherrill known as Kenwood and 0.6 miles north of southern boundary of Oneida County. This is 2.3 miles south of intersection of New York Highway 5 and Kenwood-Sherrill Road.

Versailles Bed (in Richmond Group)[1]

Upper Ordovician: Southeastern Indiana and north-central Kentucky.

Original reference: A. F. Foerste, 1905, Science, new ser., v. 22, p. 150.

Named for Versailles, Ripley County, Ind.

**Vershire Schist**[1]

Ordovician: Northeastern Vermont.

Original reference: C. H. Richardson, 1906, Vermont State Geologist 5th Rept., p. 115.

Probably named for exposures in or near Vershire village or elsewhere in Vershire Township, Stafford quadrangle, in Orange County.

Vestal Limestone[1]

Ordovician (Chazyan): Central Tennessee.

Original reference: C. H. Gordon, 1924, Tennessee Dept. Ed., Div. Geol. Bull. 28, p. 35, 40.

G. A. Cooper, 1956, Smithsonian Misc. Colln., v. 127, pt. 1, p. 94. A marble about 150 to 200 feet thick near base of Sevier formation on south side of Knoxville. Has about same position as Meadow marble.

Named for exposures in town of Vestal, Knox County.

Veta Pass Limestone Member[1] (of Sangre de Cristo Conglomerate)

Pennsylvanian: South-central Colorado.

Original reference: F. A. Melton, 1925, Jour. Geology, v. 33, p. 812.

K. G. Brill, Jr., 1952, Geol. Soc. America Bull., v. 63, no. 8, p. 811 (fig. 1), 829. If, in its type section, top of member were drawn at Whiskey Creek Pass limestone (new), 3,138 feet would be more nearly correct for thickness of member than 2,100 feet as cited by Melton.

D. W. Bolyard, 1959, Am. Assoc. Petroleum Geologists Bull., v. 43, no. 8, p. 1911. Madera formation as used in this report replaces Veta Pass limestone member of Sangre de Cristo conglomerate of Melton (1925).

Type section: Along Placer Creek north of Russell post office, near La Veta Pass, Sangre de Cristo Range.

**Vick Formation**

Lower(?) Cretaceous: Central Alabama.

L. C. Conant, 1946, Am. Assoc. Petroleum Geologists Bull., v. 30, no. 5, p. 711–715. Semi-indurated sandstone and mottled brick-red and gray sandy clay unlike and apparently older than anything known in Tuscaloosa but younger than near-by Paleozoic rocks. Proposed that strata represented by these outcrops be tentatively designated Vick formation, of either Jurassic or Lower Cretaceous age. Several outcrops have between 20 and 50 feet of beds; composite section shows total thickness of about 100 feet represented. In some areas, unconformably overlain by coarse conglomeratic sandstone believed to be base of Eoline formation.

C. W. Drennan, 1953, Am. Assoc. Petroleum Geologists Bull., v. 37, no. 3, p. 536. Coker formation is extended to include all outcropping pre-Gordo sediments of Tuscaloosa group except those designated Vick formation by Conant (1946), which may be Tuscaloosa in age.

Type locality: Series of exposures along old Centerville-Randolph Road in SE¼SW¼ and SW¼SE¼ sec. 27, T. 23 N., R. 10 E., together with exposures in wall of 60-foot sink hole a quarter mile southwest of road exposures, in vicinity of Vick, Bibb County.

**Vicksburg Group**[1]

Vicksburg Formation

Oligocene: Gulf Coastal Plain.

Original reference: T. A. Conrad, 1848, Acad. Nat. Sci. Philadelphia Proc., v. 3, p. 280–299.

W. D. Chawner, 1936. Louisiana Dept. Conserv. Geol. Bull. 9, p. 94–110. Group exposed in northwestern Catahoula Parish in broad outcrop. Overlies Danville Landing zone of Jackson group. Contact is not distinct lithologic break, and contact line as mapped is based on uppermost appearance of Danville Landing fossils in various sections. Upper part of Vicksburg section unconformably overlain by Cassel Hill member of Catahoula.

A. N. Fisk, 1938, Louisiana Dept. Conserv., Geol. Bull. 10, p. 124–141. Outcrop of Vicksburg follows outcrop of Catahoula formation as narrow band from Rosefield, Catahoula Parish, to region north of Summerfield, Grant Parish. In the field, no definite contact can be drawn separating the Vicksburg from overlying continental siltstone of Catahoula or from underlying marine Jackson beds. Nor can any hard or fast line be drawn between similar beds within the Vicksburg sediments. However, beds can be separated into two interrelated members of sedimentation, a lower gypsiferous member and an upper sandy clay member with microfaunas characteristic of both Byram marl and Mint Spring marl.

F. F. Miller, 1940, Mississippi Geol. Survey Bull. 39, p. 12 (table), 23–24. Rank reduced to formation. Comprises Mint Spring facies, Glendon and Byram members. Overlies Jackson formation with disconformity; underlies Citronelle formation with disconformity.

F. S. MacNeil, 1944, Am. Assoc. Petroleum Geologists Bull., v. 28, no. 9, p. 1313–1354. Vicksburg group is restricted to middle part of the Oligocene, namely Marianna limestone (with Mint Spring marl member) and Byram formation (with Bucatunna clay and Glendon limestone members). Excluded from group are the three youngest Oligocene formations—Chickasawhay limestone, Suwannee limestone, and Flint River formation—and basal Oligocene formations—Forest Hill sand, and Red Bluff clay. Thus, the Vicksburg includes only beds for which name was intended, the fossiliferous Oligocene of Warren County, Miss. This restriction is not a new idea. Various geologists have suggested that the top, or bottom, or both, of the Oligocene be removed from the Vicksburg, some have suggested that the upper part is Miocene, and others that the lower part is Eocene.

C. W. Stuckey, Jr., 1953, Am. Assoc. Petroleum Geologists Guidebook Field Trips Houston Mtg., p. 25–27. Vicksburg group, overlying the Jackson, is accepted as lower part of Oligocene. There is disagreement as to upper boundary of Oligocene. The Vicksburg does not appear on surface in Texas because of overlap by Miocene beds. In subsurface of Texas, consists of about 500 feet of gray calcareous shales containing local sand lenses. Distinctive microfauna. Top is picked on *Textularia warreni*. Section overlying Vicksburg in subsurface is referred to as Frio.

Named from exposures at Vicksburg, Miss.

†Vicksburg (fossiliferous) Loam[1]

Recent(?) : Mississippi.

Original reference: T. A. Conrad, 1846, Am. Jour. Sci., 2d, v. 2, p. 212.

Vicksburg Stage, Age

Oligocene: Gulf Coastal Plain.

G. E. Murray, 1952, Am. Assoc. Petroleum Geologists Bull., v. 36, no. 4, p. 700–707. Since Vicksburg, in its present broad application, has no real lithologic unity and is applied in essentially a time-rock (time-stratigraphic) sense, it is proposed to recognize it as a stage, even though its exact isochronous boundaries are unknown and, except at its type locality, may never be precisely determined. Vicksburg stage and its corollary, Vicksburg age, should contain sediments deposited during stand of sea in Gulf and Atlantic coastal region as represented by type section of Vicksburg deposits at and in vicinity of Vicksburg, Miss., and their equivalents. Name Mosley Hill formation proposed for sediments at Sabine River equivalent to type Vicksburg. Harris (1902, Louisiana State Expt. Sta. Geol. Agr. Louisiana, pt. 6, Spec. Rept. 1) applied Vicksburg stage to sediments exposed in and around Rosefield, Catahoula Parish, La., and used term stage in essentially the modern concept.

E. C. Tonti, 1955, Dissert. Abs., v. 15, no. 8, p. 1372. Two sedimentary cycles identified in Vicksburg stage. Distinct disconformity marks upper and lower boundary of each unit. Lowermost cycle extends from disconformity at base of Mint Springs-Marianna formation to similar break at top of Byram formation as defined in this report. Uppermost cycle contains Bucatunna marl and clay facies extending to disconformity at base of overlying Catahoula and Chickasawhay formations. In each case, cycle contains a lower transgressive and an upper regressive unit. Term Vicksburg stage suggested to include at least those deposits mentioned and whatever variable, but equivalent facies might be determined elsewhere.

A. D. Warren, 1957, Gulf Coast Assoc. Geol. Soc. Trans., v. 7, p. 221–237. In Louisiana, the subsurface stratigraphic section between Anahuac stage and Vicksburg stage is named Frio stage.

Victor Andesite[1]

Tertiary: Nevada.

Original reference: T. B. Nolan, 1930, Nevada Univ. Bull., v. 24, no. 4, p. 16.

In Tonopah Extension mine, Tonopah district.

**Victor Formation**[1]

Pleistocene: Central California.

A. M. Piper and others, 1939, U.S. Geol. Survey Water-Supply Paper 780, p. 33 (table), 38–49, pl. 1. Fluviatile sand, silt, and gravel, in small part well sorted and well stratified. Thickness as much as 125 feet. Underlies Recent alluvium; overlies Arroyo Seco gravel (new); locally overlies Mehrten formation (new).

Type section: Pit in SW¼NE¼ sec. 3, T. 3 N., R. 7 E., 190 feet north of Southern Pacific Railroad at east edge of Bruella Road, Mokelumne area.

†Victoria 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 Victoria mine, Ontonagon County.

†Victoria 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 Victoria mine, Ontonagon County.

**Victoria Formation**

Victoria Quartzite[1]

Upper Devonian: Central northern Utah.

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

H. T. Morris, 1957, Utah Geol. Soc. Guidebook 12, p. 11 (fig. 3), 12–13. As currently defined by U.S. Geological Survey, formation includes all Victoria quartzite as originally defined, plus 70 to 80 feet of mottled coarse-grained dolomite, now known to be of Devonian age, that was formerly placed in lower part of Loughlin's Gardner dolomite. Thickness 250 to 300 feet. Overlies Bluebell dolomite; underlies Pinyon Peak limestone. Upper boundary of Victoria is placed at top of uppermost dolomite bed that underlies thin-bedded shaly limestones of the Pinyon Peak. This contact marks disconformity that is unimportant in East Tintic Mountains, but corresponds to major pre-late Late Devonian unconformity that is recognized in Stansbury Mountains, Oquirrh, central Wasatch, and eastern Uinta Ranges.

Named for Victoria mine, three-fourths mile south-southeast of Eureka.

†Victoria Formation, Clays,[1] or Shale[1]

Upper Cretaceous: Central Kansas.

Original reference: F. W. Cragin, 1896, Colorado Coll. Studies, v. 6, p. 50.

Named for exposures at Victoria, Ellis County.

Victoria Peak Massive Member (of Bone Spring Limestone)[1]

*See* **Victorio Peak** correct spelling.

**Victorio Peak Limestone**

Victorio Peak Gray Member (of Bone Spring Limestone)

Permian (Leonard Series): Western Texas and southeastern New Mexico.

Original reference: P. B. King and R. E. King, 1929, Am. Assoc. Petroleum Geologists Bull., v. 13, p. 921, 922, 925.

P. B. King, 1942, Am. Assoc. Petroleum Geologists Bull., v. 26, no. 4, p. 569, pl. 2; 1948, U.S. Geol. Survey Prof. Paper 215, p. 16–17, pl. 3. Referred to as Victorio Peak gray member. Consists of gray, calcitic limestone in thick, fairly even beds, 500 to more than 1,000 feet thick. Overlies unnamed black limestones in lower part of formation; underlies Cutoff shaly member (new).

Hugh Hay-Roe, 1957, Texas Univ. Bur. Econ. Geology Geol. Quad. Map 21. Formation described in Wylie Mountains and vicinity. Composed dominantly of dolomite. Mapped in four units: basal thin-bedded marly limestone; limestone member; marl member; dolomite member. Thickness 1,600 feet. Overlies Hueco limestone; underlies Seven Rivers limestone. Leonard-Guadalupe.

D. W. Boyd, 1958, New Mexico Bur. Mines Mineral Resources Bull. 49, p. 12–13, 62–63, pl. 1, strat. sections. Victorio Peak gray member mapped and described in Otero County, N. Mex.

Named for exposures on Victorio Peak, promontory of Sierra Diablo scarp, Texas.

Victorville Quartz Monzonite

Upper Jurassic: Southern California.

W. J. Miller, 1944, California Jour. Mines and Geology, v. 40, no. 1, p. 105–106. Typically very light gray, massive, medium grained, and almost totally devoid of dark minerals. Dikes of the quartz monzonite cut Oro Grande metasediments.

W. J. Miller, 1946, Geol. Soc. America Bull., v. 57, no. 5, p. 504. Cuts Bell Mountain quartz diorite (new).

Named for exposures north and northeast of Victorville, Barstow quadrangle, San Bernardino County.

Victory 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 Forreston member (new) and overlying Eldena member (new) of Nachusa formation (new).

Occurs in Dixon-Oregon area.

Victory Junction Shale Member[1] (of Stanton Limestone)

Pennsylvanian (Missouri Series): 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.

G. E. Condra and E. C. Reed, 1943, Nebraska Geol. Survey Bull. 14, p. 51. Rock Lake shale was named in Nebraska by Condra (1927) but was named Victory Junction shale by Newell (1935) for occurrences in Kaw Valley area, Kansas. On the basis of subsequent studies, it is agreed that original name is valid.

Named for Victory Junction in western part of Wyandotte County.

Vidae 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 those making up southern end of Vidae Ridge. They date back to time preceding maximum glaciation of Mount Mazama and are older than lavas of Llao Rock, Cleetwood Cove, Grouse Hill, and Redcloud Cliff. Vidae lavas thickens southward from probable vent to as much as 500 to 600 feet.

Vidae Ridge is on south side of Crater Lake.

**Vidrio Limestone Member** (of Word Formation)

Vidrio Massive 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. 655–656, pl. 2. Restricted to that part of former Vidrio member which is believed to be middle Guadalupe in age, and classed as member of Word formation. Capitan is restricted to that part of former Vidrio member or reef facies that is upper Guadalupe (post-Word) in age. Overlies and (or) interfingers with unnamed limestones or formation; underlies Capitan limestone in western part of Glass Mountains and Gilliam limestone in eastern part.

Unit is conspicuous part of Glass Mountains. Vidrio is Spanish word for glass and is often used among local Mexican population as a name for the mountains.

Vieja Group

Vieja Series[1]

Tertiary: Southwestern Texas.

Original reference: T. W. Vaughan, 1900, U.S. Geol. Survey Bull. 164, p. 78–81.

R. K. DeFord, 1958, Texas Jour. Sci., v. 10, no. 1, p. 13, 15 (fig. 3). Redefined as Vieja group; stratigraphically extended upward; subdivided. Vieja series of Vaughan is subdivided into five formations (descending): Chambers tuff, Buckshot ignimbrite, Colmena tuff, Gill breccia (all new), and Jeff conglomerate. Expanded upward to include four newly defined formations (ascending) Bracks rhyolite, Capote Mountain tuff, Brite ignimbrite, and Petan basalt. Group unconformably overlies Upper Cretaceous rocks; in many places contact is concordant, but in others Cretaceous rocks were folded or thrust-faulted prior to Vieja deposition.

Named for exposures in Vieja Mountains, Presidio County.

Viejas Gabbro-Diorite[1]

Upper Jurassic or Lower Cretaceous: Southern California.

Original reference: W. J. Miller, 1935, California Jour. Mines and Geology, v. 31, no. 2, p. 115–141, map.

Type occurrence: In Viejas Mountains, southern Peninsular Ranges, San Diego and Imperial Counties.

**Vienna Limestone**[1]

Vienna Limestone (in Elvira Group)

Upper Mississippian (Chester Series): Southern Illinois, southern Indiana, western Kentucky, and southeastern Missouri.

Original references: S. Weller, 1920, Jour. Geol., 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; J. M. Weller and A. H. Sutton, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 5, p. 766 (fig. 1), 836. Assigned to Elvira group (new). In standard Mississippian section, underlies Waltersburg sandstone and overlies Tar Springs sandstone. Youngest Chester formation recognized in Missouri where it is represented by thick residual chert on a few hilltops in southeastern Perry County.

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 Vienna limestone extended into Indiana and applied to shale and limestone interval underlying Waltersburg sandstone and overlying Tar Springs sandstone.

T. G. Perry and N. M. Smith, 1958, Indiana Geol. Survey Bull. 12, pl. 1. Vienna limestone shown on stratigraphic column of upper Chester rocks in Indiana as dark- to olive-green shale; locally contains dark-gray or brown thin beds of crystalline limestone. Thickness 5 to 15 feet. Term Elvira group not used in Indiana.

Named for exposures at Vienna, Johnson County, Ill., where it is exposed in some streets and in an old quarry just west of town.

Viesca Member (of Weches Formation)

Eocene, middle: Eastern Texas.

H. B. Stenzel, 1938, Texas Univ. Bur. Econ. Geology Pub. 3818, p. 20 (table), 97, 104–107. Composed of poorly bedded fossiliferous argillaceous and calcareous glauconite rock where fresh and of red and brown clays and clay-ironstones with fossil casts where weathered. Thickness varies from 5½ to a little more than 38 feet, average 26 feet. Underlies Therrill member (new) with boundary transitional; overlies Tyus member (new) with boundary transitional.

Type locality: Lee's Waterfall in Jose Maria Viesca survey, Leon County.

**Vigo Limestone Member** (of Shelburn Formation)

Upper Pennsylvanian: Southwestern Indiana.

C. E. Wier, 1952, Indiana Geol. Survey Prelim. Coal Map 1. Shown on columnar section as limestone near top of Shelburn formation. Occurs above Vigo coal.

Courtney Waddell, 1954, U.S. Geol. Survey Coal Inv. Map C–17. Limestone bed 1½ to 2½ feet thick near top of formation. Where weathered, limestone is dull gray and appears argillaceous; on fresh surface, appears to be made up of small aggregates of brown crystalline calcite in argillaceous matrix. Underlies a black fissile shale 8 to 10 inches thick. Separated from underlying Maria Creek member by a unit of thin-bedded gray-green nonfossiliferous sandy shale about 110 feet thick that contains a few thin local bands of iron concretions and several thin discontinuous coal beds, less than 1 foot thick. Derivation of name given.

D. J. McGregor, 1958, Indiana Geol. Survey Bull. 15, p. 46 (table 8). Stratigraphically below Murphys Bluff sandstone member.

Name from exposures along Prairie Creek near Vigo, center NW½NW¼ sec. 28, T. 10 N., R. 10 W., Sullivan County.

**Vilas Shale (in Lansing Group)**[1]

Vilas Shale Member (of Lansing Formation)[1]

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

Original reference: E. Haworth, 1898, Kansas Univ. Geol. Survey, v. 3, p. 51, 103.

R. C. Moore, 1948, Am. Assoc. Petroleum Geologists Bull., v. 32, no. 11, p. 2031 (fig. 4). Shale in Lansing group. Overlies Plattsburg formation; underlies Stanton formation. 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. 33. Thickness about 8 feet in Cass and Sarpy Counties, Nebr. Lansing group.

T. L. Welp, L. A. Thomas, and H. R. Dixon, 1957, Iowa Acad. Sci. Proc., v. 64, p. 419. In Madison and Adair Counties, Iowa, formation is 10 to 12 feet thick. Overlies Plattsburg formation; underlies Stanton formation(?).

H. G. Hershey and others, 1960, Iowa Highway Research Board Bull. 15, p. 24, fig. 5. Exposed only in Adair and Madison Counties where it is a 12-foot sequence of gray unfossiliferous shale overlying a maroon shale. Underlies Stanton limestone; overlies Plattsburg limestone. Lansing group.

Named for exposures in vicinity of Vilas, Wilson County, Kans.

Village Bend Limestone (in Mineral Wells Formation)[1]

Village Bend Member (of East Mountain Shale)

Pennsylvanian: 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). Reallocated to member status in East Mountain shale. Uppermost member of formation; overlies Capps limestone member; underlies Lake Pinto sandstone member of Salesville formation. Strawn-Canyon boundary placed at top of Village Bend limestone. Name Mineral Wells dropped in this report.

J. W. Shelton, 1958, Geol. Soc. America Bull., v. 69, no. 12, pt. 1, p. 1515–1524. Discussion of Strawn-Canyon boundary. In eastern Palo Pinto County, boundary is placed at base of Lake Pinto sandstone which overlies Village Bend limestone.

L. F. Brown, Jr., 1959, Am. Assoc. Petroleum Geologists Bull., v. 43, no. 12, p. 2866–2871. Discussion of problems of stratigraphic nomenclature and classification, Upper Pennsylvanian, north-central Texas—erecting series from groups, suppression of formations, redefining and raising rank of rock-stratigraphic units, and time-stratigraphic boundaries versus lithologic contacts.

Type locality: Exposure near west end of Village Bend of Brazos River 2¾ miles in direct line southeast of Palo Pinto, Palo Pinto County.

Villa Nueva Sandstone Member (of Fayette Formation)[1]

Eocene, upper: Tamaulipas, Mexico, and southern Texas.

Original reference: W. G. Kane and G. B. Gierhart, 1935, Am. Assoc. Petroleum Geologists Bull., v. 19, no. 9, p. 1387.

J. M. Patterson, 1942, Am. Assoc. Petroleum Geologists Bull., v. 26, no. 2, p. 259 (fig. 2), 270. In Texas, overlies Agua Verde shale member (new). Exposures limited. Thickness probably more than 100 feet in Starr County. Appears to be overlapped by Frio south of Zapata County line.

Derivation of name not stated.

**Vinalhaven Rhyolite**[1]

Vinalhaven Granite

Upper Silurian: South-central Maine.

Original reference: G. O. Smith, 1896, Geology of the Fox Islands, Maine, p. 12, 46–55.

H. W. Fairbairn and P. M. Hurley, 1957, Am. Geophys. Union Trans., v. 38, no. 1, p. 104 (table 7), 106 (table 9). Referred to as granite.

Occurs in northwestern part of Vinalhaven Island, Knox County.

**Vincentown Formation** (in Rancocas Group)

Vincentown Sand (in Rancocas Group)[1]

Paleocene: New Jersey.

Original reference: W. B. Clark, R. M. Bagg, and G. B. Shattuck, 1897, Geol. Soc. America Bull., v. 8, p. 316–338.

A. R. Loeblich, Jr., and Helen Tappan, 1957, Jour. Paleontology, v. 31, no. 6, p. 1113 (fig. 2), 1128 (fig. 5), 1129–1132. Age of formation given as Paleocene (Landenian). Determination made on basis of foraminiferal studies. 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 2), 186 (table 3), 199–200, 201 (table 4). Marl (formation) underlies Manasquan marl; overlies Hornerstown marl and occurs in belt immediately to southeast of it. Consists of calcareous phase and quartz phase with varying amounts of glauconite; the two phases are probably not traceable over great distances. Thickness at outcrop 25 to 100 feet; average dip 27 feet per mile. Opinion as to age is now divided between Paleocene (Midway) and Lower Eocene (Wilcox); general opinion now favors Paleocene dating.

S. K. Fox, Jr., and R. K. Olsson, [abs.] 1955, Jour. Paleontology, v. 29, no. 4, p. 736. Comparison of type Vincentown microfauna with Hornerstown and basal Vincentown assemblages reveals that type Vincentown is Eocene in age. It contains no diagnostic Paleocene forms.

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 Vincentown, Burlington County.

**Vindicator Rhyolite**[1]

Tertiary: Southwestern Nevada.

Original reference: F. L. Ransome, 1909, U.S. Geol. Survey Prof. Paper 66, p. 28, 37.

Well exposed on flanks of Vindicator Mountain, Goldfield district.

Vine Hill Sandstone

Paleocene: Northwestern California.

C. E. Weaver, 1953, Washington [State] Univ. Pubs. in Geology, v. 7, p. 19 (chart), 21–30, pls. 4B, 4C. Name applied to Paleocene rocks of Martinez area. Consists of massive medium- to coarse grained brown to reddish-brown glauconitic sandstone and minor amounts of interbedded silty shale formerly considered by several writers as Lower Martinez. Thickness at type section approximately 1,225 feet; beds dip from 70° to vertical toward southwest. Base of section [type section] as exposed in cuts along Santa Fe Railway does not represent lowermost part of Vine Hill. Basal beds, which occur farther to southeast in low hills are about 425 feet thick and consist of poorly exposed dark-brown gritty sandstone with interbedded layers of silty shale. Underlies Las Juntas shale (new); contact with underlying Cretaceous Chico not established. Vine Hill sandstone together with Las Juntas shale were mapped and described in San Francisco folio (Lawson, 1914) as Martinez group. At type section, Vine Hill sandstone is equivalent to basal sandstone part of Martinez group as that term was used by early investigators.

B. Y. Smith, 1957, California Univ. Pub. Geol. Sci., v. 32, no. 3, p. 143–144. Since Pacheco syncline is 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. Foraminifera described.

Type section: In east limb of Pacheco syncline in cuts along Santa Fe Railway immediately east of Pacheco Road, near Martinez, Contra Costa County. Exposed in limbs of northwest trending folds in hills between Southampton and Franklin faults from Franklin Ridge southeast to town of Walnut Creek. On west limb of syncline, concealed beneath surface along Southampton fault.

**Vineyard Formation**[1]

**Vineyard Interglaciation**

Vineyard interglacial stage[1]

Pleistocene: Southeastern Massachusetts and southeastern New York.

Original reference: J. B. Woodworth, 1896, U.S. Geol. Survey 17th Ann. Rept., pt. 1, p. 975–988.

C. W. Cooke and others, 1943, Geol. Soc. America Bull., v. 54, no. 11, chart 12. Correlation chart shows Vineyard formation younger than Manhassett formation. Wisconsin.

Name amended to Vineyard Interglaciation in compliance with Code of Stratigraphic Nomenclature (1960), article 40.

Named for occurrence on Martha's Vineyard.

Vineyard Series[1]

Upper Cretaceous to Pliocene: Southeastern Massachusetts.

Original reference: N. S. Shaler, 1888, U.S. Geol. Survey 7th Ann. Rept., p. 303–363, map.

Well exposed at both extremities of Marthas Vineyard.

**Vinini Formation**

Lower and Middle Ordovician: Central Nevada.

C. W. Merriam and C. A. Anderson, 1941, (abs.) Geol. Soc. America Bull., v. 52, no. 12, pt. 2, p. 1953; 1942, Geol. Soc. America Bull., v. 53, no. 12, pt. 1, p. 1693–1698. Quartzites, calcareous sandstones, cherty shales, cherts, and andesite flows and tuffs. Present in low-angle thrust plate above Pogonip limestone, Eureka quartzite, and Hanson Creek limestone in Roberts Mountains area. Vinini embraces at least two and possibly three formational divisions; for purposes of this report, divided into lower and upper divisions. Age established on the basis of graptolites.

T. B. Nolan, C. W. Merriam, and J. S. Williams, 1956, U.S. Geol. Survey Prof. Paper 276, p. 34–36. Discussed in stratigraphic section in vicinity of Eureka. Formation has been folded and cut by local minor thrust faults; both folds and thrust faults seem to be transgressed by unconformity at base of overlying Permian sequence.

Named from exposures along Vinini Creek, eastern slope of Roberts Creek Mountain, 25 miles northwest of Eureka, Roberts Mountains quadrangle.

Vinita Beds[1] or Sandstones (in Chesterfield Group)

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.

C. B. Brown, 1937, Virginia Geol. Survey Bull. 48, p. 16. Incidental mention in discussion of Triassic rocks in Goochland County.

Occur in James River bluff west of Vinita Station on Tomahawk Creek and crop out on east slope of Goat Hill near Vinita, Goochland County.

†Vinita Formation[1]

Pennsylvanian: Northeastern Oklahoma.

Original reference: D. W. Ohern, 1910, Oklahoma State Univ. Research Bull. 4, p. 12.

Named for Vinita, Craig County.

**Vinland Shale[1] Member** (of Stranger Formation)

Vinland Shale Member (of Plattford Formation)

Pennsylvanian (Virgil Series): Eastern Kansas 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]; N. D. Newell, 1935, Kansas Geol. Survey Bull. 21, p. 82.

R. C. Moore and others, 1951, Kansas Geol. Survey Bull. 89, p. 72–73. Member of Stranger formation. Gray clayey, calcareous and sandy shale, and locally some sandstone underlying Haskell limestone member; locally in Woodson County, Kans., dark-green layer occurs in middle part; north of Anderson and Coffey Counties, Kans., where Westphalia limestone member is absent, top of Upper Sibley coal is regarded as marking base of Vinland shale. Disconformity beneath sandstone at base of Vinland cuts out the Westphalia limestone locally in Coffey County. Thickness 9 to 50 feet.

G. E. Condra, 1949, Nebraska Geol. Survey Bull. 16, p. 30 In Nebraska, uppermost member of Plattford formation. Thickness 6 to 14 feet in outcrop area in Cass County where it rests unconformably on Stanton formation.

Type locality: About 2 miles northeast of Vinland, Douglas County, Kans.

**Vintage 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, 362, 363.

G. W. Stose and A. I. Jonas, 1938, Virginia Geol. Survey Bull. 51–A, p. 19, 20, 21. Proposed to extend names Vintage dolomite, Kinzers formation, and Ledger dolomite to comparable Lower Cambrian formations in area southeast of Austinville, Va. Section near Austinville shows Vintage dolomite overlying Erwin quartzite.

Well exposed in cut of Pennsylvania Railroad at Vintage, 15 miles east of Lancaster, Lancaster County, Pa.

Vinton Member[1] (of Logan Formation)

Lower Mississippian: Central Ohio.

Original reference: J. E. Hyde, 1912, History of Fairfield County and representative citizens, by C. C. Miller, p. 206–212.

F. T. Holden, 1941, Illinois Acad. Sci. Trans., v. 34, no. 2, p. 172–173; 1942, Jour. Geology, v. 50, no. 1, p. 41 (table 1), 59, 62, 64. Included in Pretty Run sandstone facies, Scioto Valley shale facies, and Vanceburg siltstone facies (all new) of Logan formation. In Pretty Run facies, overlies Allensville conglomerate member and underlies Rushville shale member; in Scioto Valley facies, overlies Portsmouth shale member; in Vanceburg facies, overlies Churn Creek siltstone. Lower Mississippian.

Named for Vinton County.

Vinton phase (of Otis Limestone)[1]

Middle Devonian: Central eastern Iowa.

Original reference: W. H. Norton, 1921?, Iowa Geol. Survey, v. 27, p. 377.

M. A. Stainbrook, 1944, Illinois Geol. Survey Bull. 68, p. 182, 185. "Vinton phase" is shown by its fossils to belong to Cedar Valley formation.

Exposed in quarries north of Vinton, Benton County, along Cedar River.

**Viola Limestone**[1]

Viola Limestone (in Patterson Ranch Group)

Middle and Upper Ordovician: Central southern and southwestern Oklahoma.

Original reference: J. A. Taff, 1902, U.S. Geol. Survey Geol. Atlas, Folio 79.

C. E. Decker, 1942, Oklahoma Acad. Sci. Proc., v. 22, p. 153, 154 (table 1). Basal formation in Patterson Ranch group (new). Overlies Bromide formation; underlies Fernvale.

C. E. Decker, 1952, Am. Assoc. Petroleum Geologists Bull., v. 36, no. 1, p. 101–102, 135 (table 5). Discussion of Athens graptolites in Viola limestone. Viola extends east of Arbuckle Mountains to northwest edge of Ouachita Mountains where it has been more complexly folded and more highly metamorphosed, part of the limestones having been silicified. From east edge of Arbuckle Mountains, Viola thickens from 200 to 500 feet and westward to more than 900 feet. Overlies Bromide formation. Of the 59 graptolites identified from the Viola, 48 are found in Athens. *Nemagraptus* present. Trentonian.

W. H. Twenhofel and others, 1954, Geol. Soc. America Bull., v. 65, no. 3, chart 2 (columns 54, 55). As shown on correlation chart overlies Bromide formation (limestone) in Arbuckle and Wichita Mountains. Black River-Trentonian.

W. E. Ham, 1954, Am. Assoc. Petroleum Geologists Bull., v. 38, no. 9, p. 2038–2039. Collings Ranch conglomerate (new) rests with marked angular unconformity on steeply dipping rocks of Arbuckle anticline. Viola limestone is listed among units exposed beneath the conglomerate.

H. D. Miser and others, 1954, Geologic map of Oklahoma (1:500,000): U.S. Geol. Survey. Mapped in central southern and southwestern Oklahoma.

G. A. Cooper, 1956, Smithsonian Misc. Colln., v. 127, pt. 1, p. 123–125. Information on Viola formation is relevant to the discussion of brachiopods forming subject of this monograph because of Decker's (1952) correlations of Athens shale of Virginia with part of Viola limestone of Oklahoma. Report of *Nemagraptus* in Viola is disturbing because it leads to correlation that is in distinct conflict with that indicated by other groups of animals. On the basis of brachiopods, lower Viola would be placed at the lowest with about middle Trenton. Decker makes same age assignment for the Viola, but this is inconsistent with his reported discovery of *Nemagraptus* fauna in lower part of Viola.

R. W. Harris, 1957, Oklahoma Geol. Survey Bull. 75, p. 100. Disconformably overlies Corbin Ranch formation (new).

Named for former village of Viola, near Bromide, Johnston County, which was located near outcrop of formation.

Violin Breccia (in Ridge Basin Group)

Miocene to Pliocene: Southern California.

J. C. Crowell, 1954, California Div. Mines Bull. 170, map sheet 7. Consists of rubble of gneiss blocks as much as 6 feet in diameter in muddy matrix, accumulated as talus or alluvial debris at base of San Gabriel fault scarp. Thickness 27,000 feet; extends along strike for maximum distance of 4,000 feet. Grades abruptly into finer grained Ridge Basin rocks on east. Underlies Hungry Valley formation; overlies Castaic formation (new).

Named for exposures on divide between Violin and Palomas Canyons, Ridge Basin area, Los Angeles and Ventura Counties.

Vipont Limestone

Carboniferous(?): Northwestern Utah.

V. E. Peterson, 1942, Econ. Geology, v. 37, no. 6, p. 471 (table 1). Consists of fine-grained crystalline blue-gray limestone, locally containing numerous small calcite stringers. Thickness 50 to 100 feet. Underlies newly named Wardlaw shale and overlies newly named Sentinell limestone.

In Ashbrook mining district on west side of Goose Creek Range.

Virden Formation

Upper Cretaceous: Northwestern New Mexico.

W. E. Elston, 1960, New Mexico Bur. Mines and Mineral Resources Geol. Map 15. Fanglomerate, fluvial conglomerate, tuffaceous sandstone, and gray shale. Contains plant fossils tentatively dated as late Cretaceous. Maximum thickness 4,000 feet. Stratigraphically above Colorado shale and below Datil formation.

Type locality: Sec. 16, T. 18 S., R. 20 W., Hidalgo County, Virden quadrangle.

**Virgelle Sandstone** (in Montana Group)[1]

**Virgelle Sandstone Member** (of Eagle Sandstone)[1]

Upper Cretaceous: Northwestern, central northern, and central southern Montana.

Original reference: E. Stebinger, 1914, U.S. Geol. Survey Prof. Paper 90, p. 62–68.

W. A. Cobban, 1955, Billings Geol. Soc. Guidebook 6th Ann. Field Conf., p. 108 (fig. 1), 114, 115. On northwest flank of Sweetgrass arch, Virgelle is considered of formation rank. Here it is a cliff-forming formation with average thickness of about 160 feet. Underlies Two Medicine formation; overlies Telegraph Creek formation. On northeast flank of Sweetgrass arch, considered member of Eagle sandstone. Thickness 95 to 210 feet. Underlies unnamed upper member; overlies Telegraph Creek formation.

Well exposed along Missouri River from town of Virgelle, a few miles below Fort Benton, Chouteau County, eastward.

Virgen [Virgin] series[1]

Tertiary, late: Southeastern California and southwestern Nevada. .

Original reference: C. R. Keyes, 1923, Pan-Am. Geologist, v. 40, p. 52, 61.

Occurs in Virgen Valley and in Furnace Canyon, Inyo County, Calif.

**Virgil Series**[1]

Upper Pennsylvanian: Kansas, Arkansas, Iowa, Missouri, Nebraska, and Oklahoma.

Original reference: R. C. Moore, 1931, Kansas Geol. Soc. Guidebook 5th Ann. Field Conf. correlation chart.

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 Pennsylvanian are designated as Morrowan, Lampasan, Desmoinesian, Missourian, and Virgilian.

R. C. Moore, 1948, Am. Assoc. Petroleum Geologists Bull., v. 32, no. 11, p. 2020–2022. Uppermost Pennsylvanian rocks, lying between post-Missourian disconformity and similar break occurring above horizon of Brownville limestone, which in northern midcontinent area is recognized to define Pennsylvanian-Permian boundary, are classified as Virgilian series. They are characterized by invertebrate faunas of intermediate nature between those of the Missourian and Lower Permian and are classed as composing upper part of zone of *Triticites*. As recognized by State Geological Surveys of northern midcontinent area, series comprises (ascending) Douglas, Shawnee, and Wabaunsee groups.

R. C. Moore and M. L. 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.

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 following series subdivision of the Pennsylvanian: Morrow, Atoka, Des Moines, Missouri, and Virgil. Virgil 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 (Missouri series).

Named for town in eastern part of Greenwood County, Kans.

Virgilian Series or Stage

*See* **Virgil Series.**

Virgilina Greenstone[1]

Virgilina Group[1] or Volcanic Group[1]

Precambrian: Central northern North Carolina and central southern Virginia.

Original reference: T. L. Watson, 1916, Virginia Geol. Survey geol. map of Virginia.

J. P. Meador, 1949, (abs.) Virginia Acad Sci. Proc. 1948–1949, p. 137. In eastern Lunenburg County, Va., Flat Rock Creek granite (new) lies between Virgilina greenstone and injected gneisses.

Rocks form Virgilina Ridge and are typically developed in and near town of Virgilina, Halifax County, Va.

**Virgin Limestone Member** (of Moenkopi Formation)[1]

Virgin Formation (in Moenkopi Group)

Lower Triassic: 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.

H. E. Gregory, 1948, Geol. Soc. America Bull., v. 59, no. 3, p. 226; 1950, U.S. Geol. Survey Prof. Paper 220, p. 48 (fig. 24), 52 (table), 60. Separated from underlying Timpoweap member (new) by unnamed lower red member about 200 feet thick. Thickness 8 to 116 feet.

S. J. Poborski, 1952, (abs.) Geol. Soc. America Bull., v. 63, no. 12, pt. 2, p. 1342; 1953, Plateau, v. 25, no. 4, p. 69–79; 1954, Geol. Soc. America Bull., v. 65, no. 10, p. 971–1006. Rank raised to formation in Moenkopi group herein rank raised. Boundary of formation is placed at base of lowest limestone layer; this limestone rests disconformably on either "lower red member" of Moenkopi or upon alpha member of Kaibab. Thickness as much as 213 feet..

Named for Virgin City [now Virgin], Washington County, Utah.

**Virgin Creek Member** (of Pierre Shale)

Upper Cretaceous: Central and southeastern South Dakota.

W. V. Searight, 1937, South Dakota Geol. Survey Rept. Inv. 27, p. 35–43, pl. 3. Includes all beds between Sully member (new) below and Mobridge member (new) above. Consists of gumbo-forming shale; zone of limestone concretions near top; many thin bentonites in lower part. Thickness 55 to 224 feet.

D. R. Crandell, 1950, Am. Assoc. Petroleum Geologists Bull., v. 34, no. 12, p. 2340 (table 1). Overlies Verendrye member (new); underlies Mobridge member.

H. E. Simpson, 1960, U.S. Geol. Survey Prof. Paper 328, p. 12 (table 1), 38–39. Thickness about 25 feet in Yankton area. Overlies Verendrye member; underlies Mobridge member.

Named from exposure in valley wall of Virgin Creek and in flats and hills above it, 1½ miles south of Promise, northeastern Dewey County.

Virginia Limestone Member (of Moenkopi Formation)[1]

*See* **Virgin Limestone Member** (of Moenkopi Formation)

Virginia Quartz Hypersthene Norite[1]

Late Mesozoic: Southern California.

Original reference: P. H. Dudley, 1935, California Jour. Mines and Geology, v. 31, no. 4, p. 491, 501.

W. J. Miller, 1946, Geol. Soc. America Bull., v. 57, no. 5, p. 481, table 4. In succession of intrusives Virginia quartz norite is older than Perris and Estelle quartz diorite (Val Verde tonalite) and younger than Gavilan Peak gabbro. Late Mesozoic.

Occurs in Perris fault block, Riverside County.

**Virginia Slate**[1] (in Animikie Group)

Precambrian: Northeastern Minnesota.

Original reference: C. R. Van Hise and C. K. Leith, 1901, U.S. Geol. Survey 21st Ann. Rept., pt. 3, p. 353, 360.

G. M. Schwartz, 1951, Geology of the Cuyuna Range: Minnesota Univ. Center for Continuation Study, Mining [Geology] Symposium [No. 2], p. 3. For most part, the Deerwood iron formation and Cuyuna slates have been considered to belong to the Virginia. This correlation has very little evidence to support it.

F. F. Grout and others, 1951, Geol. Soc. America Bull., v. 62, no. 9, p. 1021 (table 3), 1047–1050. Included in Animikie group. Unit is an argillite and graywacke; lacks slaty cleavage and is not dynamically metamorphosed; much of it is thin bedded, but graywacke is thick bedded. Thickness estimated to be 2,000 to 3,000 feet in Cook County, but on western Mesabi may be much greater. Data on unit based largely on drill-core information. Overlies Biwabik iron-formation; contact may or may not be conformable.

F. F. Grout and J. F. Wolff, 1955, Minnesota Geol. Survey Bull. 36, p. 3, 4, 7, 56, pl. 6. In Cuyuna district, includes South Range member (new).

Named Virginia slate because in its typical form it has been found in numerous test pits and drill holes west of town of Virginia, St. Louis County. Recently has been exposed on south side of Embarrass Lake mine near Aurora.

Virginia Blue Ridge Complex

Precambrian: South-central Virginia.

W. R. Brown, 1958, Virginia Div. Mineral Resources Bull. 74, p. 7–9, 48, pl. 1. Complex of schistose, gneissose, granitoid, and migmatitic rocks, which is older than Lynchburg and Swift Run formations. Comprises inner or core portion of Blue Ridge structural province in Virginia referred to variously as "injection complex," "granitized complex," and "basement complex." Principal units included are: Pedlar formation, Marshall gneiss, Lovingston gneiss and granite, Roseland anorthosite, and Moneta gneiss (with Reusens migmatite facies).

In Catoctin-Blue Ridge anticlinorium of Lynchburg quadrangle.

Virginia Creek Member (of Pierre Shale)

Probably lapsus for **Virgin Creek Member** (of Pierre Shale).

†Virginian[1]

Miocene: Maryland and Virginia.

Original references: A. Heilprin, 1883, Philadelphia Acad. Nat. Sci. Proc. 1882, p. 183–184; 1884, Philadelphia Acad. Nat. Sci. Jour. 2d ser., v. 9, pt. 1, p. 120.

Virginian Ridge Formation

Lower and Middle Cretaceous(?): Northwestern Washington.

J. D. Barksdale, 1948, Northwest Sci., v. 22, no. 4, p. 165, 169–171. Black siltstones, graywackes, and silica pebble conglomerates. Bulk of formation composed of spheroidally weathering black to dark-greenish siltstone occasionally interbedded with dark graywacke. Contains at least five beds of well-sorted pebble conglomerate from 10 to 30 feet thick. Complete absence of granitic debris characterizes conglomerates made up of well-rounded gray to black chert and white vein quartz pebbles. Basal conglomerate in some places several hundred feet thick. Approximately 12,000 feet of section above basal conglomerate. Rests unconformably on Newby formation (new) and grades into overlying Winthrop sandstone.

Type locality: In Wolf Creek and along Virginian Ridge between Wolf Creek and the west fork of Methow River in northwestern part of Methow quadrangle. Basal conglomerate best exposed along Twisp River 3½ miles west of Twisp.

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. Overlies Water Island formation (new), slight angular unconformity. Includes (ascending) Louisenhoj formation, Outer Brass limestone, Tutu formation, and Hans Lollik formation. Considered of Cenomanian age.

Report discusses geology of St. Thomas and St. John Islands.

Virgin Spring 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 phase of 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. 965–968, pl. 3. Mosaic of fault blocks composed mostly of dolomite, limestone, sandstone, quartzite, shale, and slate; prevailingly dark shades of brown and gray; consists essentially of later Precambrian and Cambrian formations but contains a few blocks of Tertiary volcanic rocks. Average thickness about 600 feet; maximum thickness more than 1,000 feet. Lies everywhere directly on the Amargosa thrust. Underlies Calico phase with which it is folded just as if the two units were beds in sedimentary series.

Occurs in Virgin Spring area near Death Valley. Name is derived from Virgin Spring, in Virgin Spring Canyon. Phase covers about 20 square miles in area mapped.

Virgin Valley Beds[1]

Virgin Valley Formation

Miocene: Northwestern Nevada and southeastern Oregon.

Original references: J. C. Merriam, 1907, Science, new ser., v. 26, p. 380–382; 1910, California Univ. Dept. Geology Bull., v. 6, no. 2, p. 33–36.

H. E. Wood 2d and others, 1941, Geol. Soc. America Bull., v. 52, no. 1, p. 35, pl. 1. Virgin Valley formation, late Hemingfordian or early Barstovian.

D. O. Cochran, 1959, Oregon Dept. Geology and Mineral Industries Bull. 50, p. 10 (chart), 14. Correlation chart shows Virgin Valley formation in Steens-Pueblo Mountain area, Oregon. Upper zone white to buff beds; ash and diatomaceous beds. Middle zone gray to yellow and brown shales and clays; carbonaceous shales, lignites, diatomaceous beds. Lower zone white to green, purple, and red clays and ash. Thickness 1,000 to 2,000 feet. Overlies Canyon rhyolite; underlies Danforth(?) formation. Miocene, Barstovian.

Virgin Creek drains valley in which beds occur in Nevada.

**Vishnu Schist[1]**

Vishnu Series

Precambrian: Northern Arizona.

Original reference: C. D. Walcott, 1889, Geol. Soc. America Bull., v. 1, p. 50.

Ian Campbell and J. H. Maxson, 1938, Carnegie Inst. Washington Year Book 37, p. 361–362. Vishnu series proposed for the 25,000 feet or more of metasediments, a usage which will restrict term "Vishnu schist," originally proposed by Walcott for entire Archean terrane. Type locality indicated.

C. A. Anderson, 1951, Geol. Soc. America Bull., v. 62, no. 11, p. 1333–1334. No name was given by Campbell and Maxson for metavolcanic rocks in Grand Canyon and until they complete their studies, it is desirable to retain Vishnu schist for all metasediments and metavolcanics older than Grand Canyon series.

Type locality: In lower canyon of Vishnu Creek, Grand Canyon region.

Vista Member (of White River Formation)

Oligocene (Whitneyan): Northeastern Colorado.

E. C. Galbreath, 1953, Kansas Univ. Paleont. Contr. 13, Vertebrata, art. 4, p. 15 (fig. 5), 16–18, 25. Beds composed of massive, tan silt with highly calcareous zone (the "white marker") at bottom; erosional disconformity at top. Thickness at type locality about 97 feet. Overlies Cedar Creek member (new); underlies Pawnee Creek formation.

Type locality: NE½ sec. 17, T. 11 N., R. 53 W., Logan County. Name derived from Vista triangulation station, SW¼ sec. 1, T. 11 N., R. 54 W., which is almost at center of Vista member exposures.

Vista Monzonite or Granodiorite Porphyry

Tertiary(?): Southwestern New Mexico.

W. E. Elston, 1957, New Mexico Bur. Mines Mineral Resources Bull. 38, p. 39, pl. 1. Gray-green granodiorite or monzonite intrusive of unknown age.

In sec. 21, T. 19 S., R. 9 W., in northern Cooks Range, near Vista fluorite mine, Dwyer quadrangle.

Vitrefrax Formation

Paleozoic or older: Southern California.

P. C. Henshaw, 1942, California Jour. Mines and Geology, v. 38, no. 2, p. 153–155, pl. 2. Comprises several indefinitely bounded lithologic units —quartz, kyanite schist, sericite schist.

W. J. Miller, 1946, Geol. Soc. America Bull., v. 57, no. 5, p. 489, table 4. Older Precambrian(?).

Occurs in Cargo Muchacho Mountains, Imperial County. Named for its best developed exposure in Bluebird quarry on Vitrefrax Hill.

Vivian Sandstone (in Pocohontas Group)

Vivian 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. 232.

H. R. Wanless, 1939, Geol. Soc. America Spec. Paper 17, p. 107. Sandstone in Pocahontas group.

Has been quarried east of East Vivian railway station, McDowell County.

Volcano Bay Basalt Flow (in 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, p. 15, pl. 2 (geol. map). Believed to be at most only a few hundreds of years old, because of its fresh blocky surface and lack of dissection. May have had its source on southeast flank of Mount Hague. Flow believed to have moved southwestward until it reached heads of two narrow southeastward-trending valleys carved in older Dushkin and Arch Point flows (new). Lava followed these two valleys until it flowed out on low plain at valley mouths where the two lava streams fanned out and coalesced. Much of flow has been capped by younger flow from Cone G.

Covers much of lowlands north of Dushkin and Long John Lagoons in vicinity of Pavlof Volcano, near end of Alaska Peninsula.

Volga shales[1]

Upper Ordovician: Iowa.

Original reference: C. R. Keyes, 1931, Pan-Am. Geologist, v. 55, p. 217–222.

Volta Formation (in Orestimba Group)

Upper Cretaceous: Central California.

R. D. Reed, 1943, California Div. Mines Bull. 118, pt. 2, p. 109 (table 6) [preprint 1941]. Listed on table as uppermost formation of Orestimba group. Name credited to F. M. Anderson.

Occurs in San Joaquin Valley.

Volusia Shale[1]

Upper Devonian: Western New York.

Original reference: G. H. Chadwick, 1923, Geol. Soc. America Bull., v. 34, p. 69.

I. H. Tesmer, 1955, New York State Mus. Sci. Service Circ. 42, p. 14. Volusia shale (Chadwick, 1923) bearing *Pugnoides duplicatus*, is here included in Dexterville member of Chadakoin formation.

Named for occurrence near Volusia, Chautauqua County.

**Voss Shale Member** (of Belle Plains Formation)

Permian: West-central Texas.

R. C. Moore, 1948, *in* M. G. Cheney, Abilene Geol. Soc. [Guidebook] Spring Field Trip, June 11–12, sheets 3, 4. Shown on columnar section. Underlies Jagger Bend limestone member; overlies Elm Creek limestone member.

R. C. Moore, 1949, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 80, sheets 1, 2. Thickness 10 to 50 feet. No complete outcrop found; partial exposures indicate that member consists mainly of yellowish and blue clay shale.

P. T. Stafford, 1960, U.S. Geol. Survey Bull. 1081–G, p. 273. Thickness 20 to 85 feet in Brazos River area. Overlies Elm Creek limestone member; underlies Jagger Bend limestone member.

Name derived from village of Voss, southwestern Coleman County, 9 miles south and 1 mile west of Valera.

Vowell 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. 1, 11, 19, pls. 2, 3, 4, 6, 8. Includes all strata between top of Redoak Mountain group (new) below and base of Cross Mountain group (new) above that is between top of Pewee coal and top of Frozen Head sandstone. Thickness 230 to 390 feet. Includes (ascending) shale interval, Pilot Mountain sandstone, shale interval, and Frozen Head sandstone.

Type locality: Cross Mountain, Lake City quadrangle, Anderson County. Name derived from Vowell Mountain, a spur on east side of Cross Mountain. Group is preserved only on higher mountains and, hence, has more restricted outcrop area than older groups.

**Vulcan Iron-Formation**[1] (in Menominee Group)

Precambrian (Animikie Series): Northern Michigan.

Original reference: C. R. Van Hise, 1899, U.S. Geol. Survey 19th Ann. Rept., pt. 3, p. 16; Mon. 36, p. xxv, xxvi.

H. L. James, 1958, U.S. Geol. Survey Prof. Paper 314–C, p. 30 (table 1), 35. Upper formation in newly defined Menominee group. Includes (ascending) Traders iron-bearing member, Brier slate member, Curry iron-bearing member, and Loretto slate member. Overlies Felch formation; underlies Goodrich quartzite of Baraga group (new).

Named for exposures in vicinity of West Vulcan, Menominee district, [Dickinson County].

**Waawaa Volcanics** (in Hualalai Volcanic Series)

Waawaa pyroclastic materials

Pleistocene(?): Hawaii Island, Hawaii.

C. K. Wentworth, 1938, Hawaiian Volcano Observatory 3d Spec. Rept., p. 86–87, 145. Pumiceous and dense, trachytic lapilli and ash in Puu Waawaa cone referred to as Waawaa pyroclastic materials.

H. T. Stearns and G. A. Macdonald, 1946, Hawaii Div. Hydrography Bull. 9, p. 138 (table), 143–148; D. A. Davis and G. A. Macdonald *in* Jacques Avias and others, 1956, Lexique Strat. Internat., v. 6 Océanie, fasc. 2, p. 134–135. Waawaa volcanics considered member of Hualalai volcanic series (new). Consist of trachyte flow and its source cone. Flow made up of several units 250 to 500 feet thick; exposed thickness 900 feet; base not exposed. Older than at least part of Pahala ash. Pleistocene(?).

Type locality: Puu Waawaa. Covers about 3 square miles on northern slope of Hualalai.

Wabash Formation[1]

Pennsylvanian: Southwestern Indiana.

Original reference: M. L. Fuller and F. G. Clapp, 1904, U.S. Geol. Survey Geol. Atlas, Folio 105.

R. C. Moore and others, 1944, Geol. Soc. America Bull., v. 55, no. 6, chart 6 (column 25). Shown on correlation chart as comprising (ascending) Parker limestone, Buffkin limestone, Graysville limestone, and Livingston limestone. Occurs above Inglefield sandstone and below Merom sandstone.

Named for exposures in bluff of Wabash River in Patoka quadrangle.

†Wabash Group[1]

Pennsylvanian: Indiana.

Original reference: G. H. Ashley, 1902, U.S. Geol. Survey 22d Ann. Rept., pt. 3, p. 273.

D. W. Franklin, 1944, Illinois Acad. Sci. Trans., v. 37, p. 86 (table 1). Shown on table as a group 250 to 300 feet thick above the Merom group.

Named for Wabash River, which cuts through the various formations.

†Wabash Stage[1] or Beds[1]

Pleistocene: Central Indiana.

Original reference: O. P. Hay, 1912, Smithsonian Misc. Colln., v. 59, no. 20, p. 13.

Type locality: About 4 miles east of Fairmount, Grant County. Named for Wabash River, where it is well developed in valley of river and its tributaries.

**Wabaunsee Group[1]**

Wabaunsee Formation[1]

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

Original reference: C. S. Prosser, 1895, Jour. Geology, v. 3, p. 688–697.

R. C. Moore, 1949, Kansas Geol. Survey Bull. 83, p. 165–196. Uppermost major division of Virgilian strata. As adopted by interstate conference of Geological Surveys, includes (ascending) Severy shale, Howard formation, White Cloud shale, Happy Hollow limestone, Cedar Vale shale, Rulo limestone, Silver Lake shale, Reading limestone, Harveyville shale, Elmont limestone, Willard shale, Tarkio limestone, Wamego shale, Maple Hill limestone, Langdon shale, Dover limestone, Dry shale, Grandhaven limestone, Friedrich shale, Jim Creek limestone, French Creek shale, Caneyville limestone, Pony Creek shale, and Brownville limestone. Overlies Shawnee group. Top drawn at prominent disconformity just above Brownville limestone. Comprises Sacfox, Nemaha, and Richardson subgroups. Agreed that nomenclature in the several States may be required to deviate from this standard section by combination or omission of terms where certain named rock units are not recognizable.

F. C. Greene and W. V. Searight, 1949, Missouri Geol. Survey and Water Resources Rept. Inv. 11, p. viii, 19–21. As redefined for Missouri, includes beds from top of Topeka formation to top of Pennsylvanian in Missouri, which is top of French Creek shale. Grandhaven limestone has not been identified in Missouri, and shale between Dover limestone and Jim Creek limestone is called Dry-Friedrich shale. Lower limestone of Tarkio has been considered base of Wabaunsee and lower limestone (Elmont) and Willard shale included in Shawnee group.

G. E. Condra, 1949, Nebraska Geol. Survey Bull. 16, p. 12–20. Nebraska follows interstate agreement on classification of Wabaunsee except in use of Pierson Point for Wamego, Morton formation for Grandhaven interval, and Wood Siding formation between French Creek formation and Brownville limestone. Thickness of group in Nebraska about 396 feet.

R. C. Moore and M. R. Mudge, 1956, Am. Assoc. Petroleum Geologists Bull., v. 40, no. 9, p. 2271–2278. Redefined. Includes ascending [Severy shale, Howard limestone], Scranton shale, Bern limestone (new), Auburn shale, Emporia limestone, Willard shale, Zeandale limestone (new), Pillsbury shale (new), Stotler limestone (new), Root shale (new), and Wood Siding formation.

P. B. Greig, 1959, Oklahoma Geol. Survey Bull. 83, p. 25 (table 2), 44–71. Uppermost group of Virgilian series. Currently group includes beds upward from top of Topeka (Turkey Run limestone) to top of Brownville limestone. In Kansas, Wabaunsee deposits are cyclic and similar to those of underlying Shawnee group. Southward these deposits lose much of their cyclic character, and although alternating marine and nonmarine beds are present in Pawnee County section, the rhythmic pattern of cyclic deposition is obscure. Key beds in group in Pawnee County are traceable northward into Kansas, and names of these beds are generally taken from Kansas section. When it comes to naming shale-sandstone sequences between key limestones of Pawnee County, modification of Kansas nomenclature is necessary. Most of limestones on which subdivision of Kansas section is based pinch out southward; hence, beds between any two key units of Pawnee County may represent several formations in Kansas section. Moore (1936, Kansas Geol. Survey Bull. 22) suggested that this situation be dealt with by applying hyphenated names in areas where missing key units make standard Kansas section inapplicable. Branson (1956, Oklahoma Geology Notes, v. 16, no. 11) proposed alternate solution to problem by giving names to each of shale-sandstone units between most extensive limestones of upper Pennsylvanian in north-central Oklahoma. Stratigraphic sequence to which each name applies becomes progressively greater southward as recognizable Kansas units disappear from section. Branson's revised nomenclature is followed in this report. Key beds of group in north-central Oklahoma are (ascending) Bird Creek, Wakarusa, Reading, Elmont, Grayhorse, and Brownville limestones. Names used in this report are (ascending) Severy shale, Bird Creek limestone, Hallett shale, Wakarusa limestone, Auburn shale, Emporia limestone with Reading limestone, Harveyville shale, and Elmont limestone members, Gano shale, Wood Siding formation with "Grayhorse" limestone, Pony

Creek shale, and Brownville limestone members. Wabaunsee outcrops cover most of central part of Pawnee County, forming belt up to 8 miles wide that strikes north-south across county.

H. G. Hershey and others, 1960, Iowa Highway Research Board Bull. 15, p. 10–14, fig. 5. Present only in Adams, Montgomery, Taylor, Page, and Fremont Counties. Group is predominantly shale with limestone, siltstone, minor sandstone units, and thin coal seams. The subgroups, Richardson, Nemaha, and Sac-Fox, are not well defined in Iowa and are not identified in this report, nor are major units broken down into members as they are in other groups of the Pennsylvanian. Because of predominance of shale within the group, exposures soon become slumped and overgrown; for this reason, some sections described by early workers have since become obscured. For example, youngest rocks to be described in Iowa was exposure on Mill Creek, south of Riverton (Smith, 1908, Iowa Geol. Survey, v. 19). Here French Creek shale, Jim Creek limestone, and Friedrich-Dry shale were exposed but are no longer visible. Younger rocks may be present beneath the drift between Hamburg and Thurman and east of Hamburg, but they are not exposed and have not been reported in drilling records. There is little to distinguish units as seen, and many correlations are necessarily on basis of sequence and not lithologic or paleontologic distinction. Strata are believed to thin considerably to northwest. Group includes (ascending) Severy shale, Howard limestone, White Cloud shale, Happy Hollow limestone, Cedar Vale shale, Silver Lake shale, Burlingame limestone. Soldier Creek shale. Wakarusa limestone, Auburn shale, Reading limestone, Elmont limestone, Willard shale, Tarkio limestone, Pierson Point shale, Table Creek shale, Dover limestone, Dry shale, Grandhaven limestone, Friedrich shale, Jim Creek limestone, and French Creek shale.

Named for exposures in Wabaunsee County, Kans.

**Waccamaw Formation**[1]

Pliocene, lower: Southern and eastern South Carolina and southern North Carolina.

Original reference: W. H. Dall, 1892, Wagner Free Inst. Sci. Trans., v. 3, pt. 2, p. 209–213.

H. E. LeGrand and P. M. Brown, 1955, Carolina Geol. Soc. Guidebook of Excursion in coastal plain of North Carolina Oct. 8–9, p. 11–12. In this report, Waccamaw is considered contemporaneous with Duplin marl and placed in Yorktown formation which is geographically extended into North Carolina. This reclassification made on the basis of the fact that 15 species of Ostracoda known to occur in Duplin marl occur in Waccamaw formation, and, in addition, no ostracod species have been found in the Waccamaw that do not occur in the Duplin. Yorktown is considered upper Miocene.

G. E. Siple, 1957, Carolina Geol. Soc. Guidebook for South Carolina Coastal Plain Field Trip No. 16–17, p. 20–22. Although age of the Waccamaw could be either latest Miocene or Pliocene, it is here included in the Pliocene until more conclusive evidence is found to the contrary.

Named for exposures along Waccamaw River, Horry County, S.C.

**Wachsmuth Limestone** (in Lisburne Group)

Lower Mississippian: Northern Alaska.

A. L. Bowsher and J. T. Dutro, Jr., 1957, U.S. Geol. Survey Prof. Paper 303–A, p. 4, 6, 17–24, figs. 2–4, pl. 2. Comprises four unnamed members at type locality (ascending): shaly limestone, 18 feet thick; crinoidal limestone, 179 feet; dolomite, 564 feet; and banded chert-limestone, 429 feet. Total thickness 1,230 feet. Underlies Alapah limestone (new) and overlies Kayak shale (new) both disconformably.

Type locality: On south slope of Mount Wachsmuth, from which limestone takes its name, Shainin Lake area, central Brooks Range.

†Wachusett Gneiss[1]

Upper Carboniferous or post-Carboniferous: Central northern Massachusetts.

Original reference: L. S. Burbank, 1876, Rept. on geol. map of Massachusetts, by W. O. Crosby, p. 43–52.

Wachusett Range in Worcester County region.

Waco Limestone[1]

Silurian (Niagaran): East-central Kentucky.

Original references: A. F. Foerste, 1905, Kentucky Geol. Survey Bull. 6, p. 145; 1906, Kentucky Geol. Survey Bull. 7, p. 10, 52.

C. K. Swartz and others, 1942, Geol. Soc. America Bull., v. 53, no. 4, chart 3. Correlation chart shows Waco limestone stratigraphically below Dayton limestone and above Lulbegrud conglomerate.

Named for Waco, Madison County.

Waddell 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. 280 (fig. 1), 281–282. Proposed for lower sandstone bed in Simpson group. Lies between depths of 6,143 and 6,231 feet in type well. Top occurs 280 feet below top of McKee sand (new) and about 355 feet above top of Ellenburger; these intervals vary somewhat in a widespread area.

Type well: Gulf Oil Corp. W. N. Waddell et al No. 1, sec. 4, Block B–27, PSL Survey, Crane County.

**Wading Branch Formation** (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 of medium-bedded dark clastic rocks, including sandy argillaceous rocks, siltstone, and coarse pebbly feldspathic sandstone; coarser rocks are poorly sorted, have a dark micaceous matrix, and are somewhat graded; a basal unit generally less than 100 feet thick, representing residual reworked clay, is present throughout much of the formation. Basal formation of group; underlies Longarm quartzite (new); contact gradational over several tens of feet; unconformably overlies earlier Precambrian granitic and gneissic rocks (Max Patch granite of Keith).

Type section: Along Pigeon River, 4½ miles southeast of Waterville. Named for Wading Branch Ridge west of Pigeon River about 5 miles southeast of Waterville, Haywood County. Traceable southwestward through several belts of outcrop as far as Cherokee.

†Wadmalaw Shell Marl[1] or phase[1]

Pleistocene: 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, 20–21.

Exposed south of Bees Ferry, at the Faber place, and along northerly shore of Stono and Wadmalaw inland waterway, at Cherokee, Bolton, and St. Andrews phosphate mines, and at base of Simmons Bluff, Charleston County.

**Wagnon Member** (of Pride Mountain Formation)

Upper Mississippian: Northern Alabama.

S. W. Welch, 1958, U.S. Geol. Survey Oil and Gas Inv. Chart OC–58. Series of limestones and shales. Includes lower part of strata referred to by Butts (1926) as Gasper formation. Thickness ranges from 70 feet at south Tuscumbia to 30 feet near Pride and averages about 50 feet. Underlies Southward Spring sandstone member and overlies Tanyard Branch member (new); both contacts sharp and conformable. At type locality of the Pride Mountain, where Southward Spring sandstone member is absent, underlies Sandfall member (new).

Named for exposure along road up Wagnon Mountain about 5 miles south of Pride, in south-central sec. 6, T. 5 S., R. 12 W., Colbert County.

Wagonhound Member[1] (of Uinta Formation)

Eocene: Northeastern Utah and southwestern Wyoming.

Original reference: H. E. Wood 2d, 1934, Am. Mus. Nat. History Bull., v. 67, art. 5, May 26, p. 241–242.

C. H. Dane, 1954, Am. Assoc. Petroleum Geologists Bull., v. 38, no. 3, p. 417. Mentioned in discussion of Uinta formation.

Name derived from Wagonhound Canyon which opens into White River, Utah.

Wagontire Formation[1]

Eocene(?): Central southern Oregon.

Original reference: W. D. Smith, 1926, Oregon Univ. Commonwealth Rev., v. 8, p. 207–214.

Type locality: Wagontire Mountain, northeastern part of Lake County.

Wagontongue Formation

Miocene(?): Central Colorado.

J. H. Johnson, 1937, (abs.) Colorado Univ. Studies, v. 25, no. 1, p. 77; J. T. Stark and others, 1949, Geol. Soc. America Mem. 33, p. 34 (table 7), 68–69, 173, pl. 1. Series of coarse sandstones, sandy clays, and conglomerates made up largely of reworked volcanic materials. Contains beds of volcanic ash. Thickness 110 to 500 feet. Underlies Trump conglomerate (new); overlies Antero formation (new).

Well exposed in two northward-facing cuts in secs. 29 and 30, T. 14 S., R. 75 W. Many good outcrops along Wagontongue Creek, from which unit takes its name, and small tributaries leading into it, especially in NE¼ sec. 6, T. 15 S., R. 75 W., Park County.

Wagonwheel Formation[1]

Oligocene or Oligocene(?): Southern California.

Original reference: H. R. Johnson, 1909, Science, new ser., v. 30, p. 63–64.

H. P. Smith, 1956, California Univ. Pubs. Geol. Sci., v. 32, no. 2, p. 65–108. Consists of three unnamed members, a lower sandstone, a middle argillaceous siltstone, and an upper glauconitic siltstone. Thickness about 470 feet. Unconformably underlies basal shale of Temblor; conformably overlies Welcome member of Kreyenhagen. Oligocene. Entire area of outcrop not more than 2¼ miles long and one-quarter mile wide.

Occurs in Devil's Den district, approximately 25 miles southeast of Avenal and 50 miles northwest of Taft, northwestern Kern County.

Wagon Yard Gypsum[1]

Wagon Yard Gypsum Member (of Dog Creek Formation)

Permian (Guadalupe): Western Texas.

Original reference: L. W. Storm, 1929, Texas Econ. Geol. Survey map of Stonewall County.

T. S. Jones, 1953, Stratigraphy of the Permian Basin of west Texas: West Texas Geol. Soc., p. 30, fig. 9. Shown on chart as top member of Dog Creek formation. Overlies Guthrie dolomite member; underlies Childress formation.

First used in Stonewall County.

Wahkiakum Formation[1]

Miocene, lower: Southwestern Washington.

Original reference: C. E. Weaver, 1912, Washington Geol. Survey Bull. 15, p. 10–12.

C. E. Weaver, 1937, Washington [State] Univ. Pubs. in Geology, v. 4, p. 100. Name abandoned. Unit considered part of Blakeley formation.

Occurs near head of Alockaman River, Wahkiakum County.

Wahluke Formation

Pleistocene: Central Washington.

G. F. Beck, 1936, Mineralogist, v. 4, no. 11, p. 12–14. Name applied to thin layer of sediments lying above a white lime-rock layer that lies within Columbia basalts, Ellensburg sediments, Wenas basalts, or Ringold sediments—whichever of these was exposed or truncated by post-Ringold surface. Wahluke sediments are fossiliferous, poorly cemented, flat lying, and crossbedded; locally contains lenses and horizons of sand. Includes Tiflis member (new) at top.

Named for typical exposure above undoubted Ringold at head of Beverly highway grade, about 1 mile south of Wahluke, Grant County.

Wahs Creek Shale (in Moran Formation)[1]

Permian: Central northern Texas.

Original reference: O. F. Hedrick, E. Owens, and P. A. Meyers, 1929, Texas Bur. Econ. Geology, geol. map of Shackelford County.

In Shackelford County.

Wahwah Limestone (in Pogonip Group)

Lower Ordovician (Canadian): Western Utah and east-central Nevada.

L. F. Hintze, 1951, Utah Geol. and Mineralog. Survey Bull. 39, p. 16–17, 51. Ledge-forming quartz silty calcisiltite. Thickness at type section

227 feet. Overlies Fillmore limestone (new); underlies Juab limestone (new).

R. E. Cohenour, 1959, Utah Geol. and Mineralog. Survey Bull. 63, p. 12 (table 1), 72–73, pl. 1. Described in Sheeprock Mountains where it is 456 to 476 feet thick; conformably overlies Fillmore limestone and conformably underlies Juab limestone. Included in Pogonip group.

Type section: Ibex, Millard County, Utah. Name derived from Wahwah (also spelled Wah Wah) Valley. Unit extends into east-central Nevada.

Wah Wah Springs Tuff Member (of Needles Range 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. Shows complete gradation upward from black vitrophyre at base to light-gray nonwelded ashy top. Thickness 700 to 800 feet. Basal member of formation; underlies Minersville tuff mmeber (new).

Named for occurrence south of Wah Wah Springs, 15 miles west of abandoned mining town of Frisco, Iron Springs district.

**Wahweap Sandstone**[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 200, p. 51 (table), 107–109, pls. 2, 4, 5. Described in Zion Park region where it overlies Straight Cliffs sandstone and underlies Kaiparowits formation. Most common beds of Wahweap are sandstones 5 to 10 feet thick, irregularly laminated and lenticularly stratified with highly arenaceous shale; some beds of considerable length are thick, uniformly massive, crossbedded, and consist of coarse and fine rounded grains of quartz; others combine to make series of thin evenly or roughly stratified beds; many sandstones change along strike from solid beds of uniform composition and texture to beds that include shalelike and iron concretions and into series of platy beds of various dimensions. Absence of continuous guide beds and scarcity of fossils in Wahweap and upper Straight Cliffs make it impracticable to draw definite division line between the two formations. Thickness of the two formations 600 to 1,200 feet.

Upper part of Wahweap Creek, Kane County, is cut in the formation.

**Waiaaka 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), 243–244, pl. 1. A persistent thin lava flow overlying Makapipi basalts (new); clinker layers interbedded in the lava may indicate two or more flows. Predominantly aa except in extreme southwestern part where it is pahoehoe. Prominent platy jointing parallel to flow planes. Average thickness 30 feet; 120 feet in test hole 47. Where Makapipi basalts have been removed by erosion, Waiaaka rests on gravel above Kula basaltic andesite (new). Locally overlain by Mossman basalt (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. 135. Pleistocene(?).

Named for occurrence along Waiaaka Gulch. Best exposed in Hanawi Gulch north of highway.

## Waianae Volcanic Series[1]

Pliocene(?) : 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. 135–136. Divided into lower, middle, and upper members. Lower predominantly olivine basalt, in thin flows of both aa and pahoehoe; middle consists of same rock types but in thick massive flows ponded in the caldera; upper predominantly basaltic andesite, with some flows of basalt and olivine basalt near base. Total thickness above sea level 4,025 feet; series presumably extends down to level of surrounding ocean, about 12,000 feet below sea level. On east side, overlapped with erosional unconformity by lavas of Koolau series. Pliocene(?).

No single type locality designated. Lower member well exposed in cliffs along lower Nanakuli and Lualualai Valleys and in Puu Heleakala; middle member exposed continuously from head of Nanakuli Valley around head of Lualualai and Waianae Valleys and in Keaau-Makaha Ridge overlaps lower member with erosional unconformity; upper member veneers most of eastern slope of Waianae Range. Crops out over area of about 100 square miles comprising most of Waianae Range on western side of island.

## Waiau Formation

Pleistocene to Recent: Hawaii Island, Hawaii.

C. K. Wentworth, 1938, Hawaiian Volcano Observatory 3d Spec. Rept., p. 36, 57–86. Consists both of central cinder cone phase and yellow tuff phase of pyroclastic materials produced by explosive eruptions from numerous vents in Mauna Kea summit area. Overlies Waimea formation (new).

D. A. Davis and G. A. Macdonald *in* Jacques Avias and others, 1956, Lexique Strat. Internat., v. 6, Océanie, fasc. 2, p. 136. Cinder cone and fresh ash phase now largely included in Laupahoehoe volcanic series and partly in Hamakua volcanic series; yellow tuff phase now considered part of Pahala ash. Pleistocene to Recent.

Slopes of Mauna Kea.

## Waihu Fanglomerate

Pleistocene: Hawaii Island, Hawaii.

H. T. Stearns, 1945, Geol. Soc. America Bull., v. 56, no. 3, p. 269, 270–273. Described by Wentworth and Powers (1939, 1941) as Waihu drift. It is here interpreted as laid down by floods caused by eruptions melting ice cap of Mauna Kea in early Wisconsin time. Well indurated, distinctly bedded and crossbedded. Forms fans 100 feet thick between altitudes 9,000 and 9,750 feet between Waikahalulu and Pohakuloa Gulches. Thins down slope and below 6,900 feet is only a few feet thick Stratigraphically lower than Makanaka drift and outwash.

Probably named from Waihu Springs, west of Pohakuloa Gulch. Exposed over area of about one-half square mile on south slope of Mauna Kea.

Waihu Stage and Drift

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. 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. Drift 25 to 30 feet thick.

H. T. Stearns, 1945, Geol. Soc. America Bull., v. 56, no. 3, p. 269. Of glacial deposits described by Wentworth and Powers, only Makanaka deposits can be accepted as definitely glacial. Waihu drift redefined as fanglomerate.

Drift occurs in vicinity of Waihu Springs, at 9,700 feet altitude west of Pohakula Gulch.

Wailuanui 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. 94, 95 (table). Dark-gray olivine pahoehoe basalt. Older than Ohia lava (new) but time relationship to Pauwalu lava (new), oldest basalt in series in Keanae Valley, not known. Each formation of series underlain by local erosional unconformity.

D. A. Davis and G. A. Macdonald *in* Jacques Avias and others, 1956, Lexique Strat. Internat., v. 6, Océanie, fasc. 2, p. 137. Pleistocene(?).

A narrow flow that descended west fork of Wailuanui Valley, in Keanae area.

Wailuku Volcanic Series

Pliocene(?): 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), 160–172, pl. 1. Primitive olivine basalts, at type locality composed of thin-bedded pahoehoe and aa dipping 15° E. Aa is mostly highly vesicular and lies in jointed beds 2 to 10 feet thick, underlain, overlain, and in places mixed with clinker beds 6 inches to 4 feet thick. In cliffs, thin beds weather to dark gray, red, red violet, and brown in contrast to overlying Honolua lavas (new) which weather to light gray and white. In some areas, apparently never covered by Honolua lavas. Separated from Lahaina lavas (new) by erosional unconformity.

G. A. Macdonald *in* H. T. Stearns and G. A. Macdonald, 1942, Hawaii Div. Hydrography Bull. 7, p. 314–320. Petrography discussed.

D. A. Davis and G. A. Macdonald *in* Jacques Avias and others, 1956, Lexique Strat. Internat., v. 6, Océanie, fasc. 2, p. 138. Pliocene(?).

Type locality: The 3,500-foot south wall of Iao Valley behind Wailuku. Exposed at surface on most of West Maui and in all deep canyons.

Waimea Agglomerate or Formation

Pleistocene: Hawaii Island, Hawaii.

C. K. Wentworth, 1938, Hawaiian Volcano Observatory 3d Spec. Rept., p. 38–39. Hummocky accumulations of agglomerate, 15 to 20 feet thick in places, underlying tuff of Waiau formation.

D. A. Davis and G. A. Macdonald *in* Jacques Avias and others, 1956, Lexique Strat. Internat., v. 6, Océanie, fasc. 2, p. 138. Now known to be fragmental tops of aa lava flows of Hamakua and Laupahoehoe volcanic series. Pleistocene.

Occurs on slopes of Mauna Kea from several miles southeast of Laupahoehoe to Waimea.

Waimea Conglomerate

Pliocene(?): Kauai Island, Hawaii.

N. E. A. Hinds, 1930, Bernice P. Bishop Mus. Bull. 71, p. 56, 65, 76. Coarse conglomerate 75 to 100 feet thick. Overlies lower Kauai lavas and underlies upper Kauai lavas.

D. A. Davis and G. A. Macdonald *in* Jacques Avias and others, 1956, Lexique Strat. Internat., v. 6, Océanie, fasc. 2, p. 138–139. Equivalent to part of Mokuone member of Makaweli formation. Pliocene(?).

Type locality: Bottom of Waimea Canyon between Waialae and Poomau Streams.

Waimea Volcanic Series

Pliocene and older: Kauai Island, Hawaii.

H. T. Stearns, 1946, Hawaii Div. Hydrography Bull. 8, p. 83 (fig. 22), 85–86. Forms main mass of Kauai; subdivided into extra-caldera, or lower member, and caldera filling, or upper member. Lower member composed of more than 3,500 feet of thin-bedded primitive-type olivine basalts dipping 5° to 20° away from ancient caldera; upper member composed of 4,000 feet of chiefly horizontal and massive olivine basalts laid down in summit caldera. Members separated by partly exhumed fault scarps more than 3,000 feet high and talus breccia. Waimea and Haupu volcanic series are separated by deep zone of weathering and angular erosional unconformity from Kolea series.

G. A. Macdonald, 1949, Geol. Soc. America Bull., v. 60, no. 10, p. 1555, 1557. Preoccupied name Waimea replaced by Waimea Canyon volcanic series.

Exposed in walls of Waimea Canyon.

**Waimea Canyon Volcanic Series**

Pliocene(?): Kauai Island, Hawaii.

G. A. Macdonald, 1949, Geol. Soc. America Bull., v. 60, no. 10, p. 1555, 1557. Proposed to replace preoccupied term Waimea volcanic series. Unconformable below Koloa volcanic series.

G. A. Macdonald, D. A. Davis, and D. C. Cox, 1954, Volcano Letter 526, p. 2; G. A. Macdonald and D. A. Davis *in* Jacques Avias and others, 1956, Lexique Strat. Internat., v. 6, Océanie, fasc. 2, p. 118. Includes Napali, Olokele, Haupu, and Makaweli formations.

G. A. Macdonald, D. A. Davis, and D. C. Cox, 1960, Hawaii Div. Hydrography Bull. 13, p. 21–52, table facing p. 20, pl. 1. Consists almost entirely of olivine basalt, with less abundant basalt poor in olivine, and picrite-basalt rich in olivine. All formations cut by small dikes. Exposed thickness about 8,650 feet. Comprises Napali, Olokele, Haupu, and Makaweli formations. Underlies Koloa volcanic series with profound erosional unconformity. Age not accurately known; contains no fossils; age determinations on basis of uranium-lead ratios, or similar methods, available. Latest lavas of series believed to be about 4 million years old; this places their extrusion in Pliocene. Stratigraphic table shows age Pliocene; map legend (p. 18) shows Pliocene(?); map legend (pl. 1) shows later Tertiary.

Type locality: In walls of Waimea Canyon. Exposed over most of island.

**Waiokamilo Basalt** (in Hana Volcanic Series)

Pleistocene(?): East Maui, 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, with some phenocrysts of plagioclase in dense fine-grained mass.

G. A. Macdonald and D. A. Davis *in* Jacques Avias and others, 1956, Lexique Strat. Internat., v. 6, Océanie, fasc. 2, p. 139. Pleistocene(?).

Lava followed valley of Waiokamilo Stream, and cascaded down cliff at eastern edge of Keanae Valley, building small lava fan.

Waiokawa Flow

Recent: Maui Island, Hawaii.

Grote Reber, 1959, Geol. Soc. America Bull., v. 70, no. 9, p. 1246 (fig. 1). A very recent flow.

On southwest side of Haleakala.

Wait Member (of Day Point Formation)

Ordovician (Chazyan): Northwestern Vermont and northeastern New York.

Philip Oxley and Marshall Kay, 1959, Am. Assoc. Petroleum Geologists Bull., v. 43, no. 4, p. 824 (fig. 3), 825 (fig. 4), 826 (fig. 5), 827, 845, geol. sections. Defined as 5 feet of medium to dark-gray finely laminated dense calcareous fine quartz sandstone to siltstone overlying Scott member (new) in cove at north end of Scott Point, Isle La Motte; underlies Fleury member (new). Member is irregularly divided by disconformity, blocks of lower beds forming pebbles in conglomerate above. The typical gray dense fine quartz sandstone grades eastward to dark quartz-silty shaly argillite with thin quartz sandy lenses. Thickens from type section to 15 feet on east shore of Isle La Motte; westward in New York, it is 5 feet at Wool Point and 3 feet southwest of Chazy; increases southward to about 28 feet on southern Valcour Island and 38 feet on South Hero.

Type locality: In Cove at Scott Point, Isle La Motte, Vt. Name derived from Wait Bay.

**Waits River Formation**

Waits River Limestone[1]

Waits River Limestone Member (of Memphremagog Formation)

Silurian and Devonian: East-central and northeastern Vermont and northwestern New Hampshire.

Original reference: C. H. Richardson, 1906, Vermont State Geologist 5th Rept., p. 79–115.

L. S. Currier and R. H. Jahns, 1941, Geol. Soc. America Bull., v. 52, no. 9, p. 1491, 1492, 1506. Formation is largely the Waits River limestone of earlier reports. Includes prominent beds of phyllite and quartzite. Ordovician(?).

C. G. Doll, 1945, Vermont State Geologist 24th Rept., p. 16, pl. 4. Rank reduced to member of Memphremagog formation in northeastern Vermont. Middle Silurian or Lower Devonian.

G. E. Moore, Jr., 1949, Geol. Soc. America Bull., v. 60, no. 10, p. 1618–1619, pl. 1. In Keene-Brattleboro area, New Hampshire-Vermont, Waits River formation crops out in north-south band along extreme western edge of area. Thickness 4,000 to 5,000 feet. Orfordville formation crops out in north-south belt between Northey Hill thrust on east and Waits River formation on west.

W. S. White and R. H. Jahns, 1950, Jour. Geology, v. 58, no. 3, p. 187–189, 192, fig. 2. Standing Pond amphibolite member is tentatively included in uppermost part of formation. In southern part of Strafford quadrangle, Standing Pond marks boundary between Gile Mountain and Waits River formations; farther north, occurs beneath calcareous beds in the Waits River.

C. G. Doll, 1951, Vermont Geol. Survey Bull. 3, p. 22. Name not used in northeastern Vermont because too comprehensive; in its place, three new names used: Ayers Cliff, Barton River, and Westmore formations.

M. P. Billings, 1956, The geology of New Hampshire, pt. 2, bedrock geology: Concord, New Hampshire State Plan. Devel. Comm., p. 6–8. Geographically extended to New Hampshire. Middle Ordovician(?); possibly Silurian and (or) Lower Devonian.

J. G. Dennis, 1956, Vermont Geol. Survey Bull. 8, p. 16–19, 25, 26–28. Summary of earlier uses of name. Contains Ayers Cliff member and Barton River member in northeastern Vermont.

W. M. Cady, 1956, U.S. Geol. Survey Geol. Quad. Map GQ–79. Age designated Silurian(?) and Devonian(?).

V. R. Murthy, 1957, Vermont Geol. Survey Bull. 10, p. 20, 23 (table 1), 24, 35–38, pls. Metasedimentary rocks of East Barre quadrangle divided into four mappable units. Previously, the western three units were included in one formation, the Waits River (Currier and Jahns, 1941). On basis of present study it is proposed that term Waits River formation be redefined and stratigraphic sequence modified as follows (ascending): Northfield slate (exposed in Barre quadrangle), Barton River formation (partly exposed in area), Westmore formation (type locality—Memphremagog quadrangle), Waits River formation (as newly restricted—type locality in this area), and Gile Mountain formation (type locality—Strafford quadrangle). If structural interpretation offered in this report is accepted, Westmore formation may be correlated with Gile Mountain and stratigraphic column modified as follows: Northfield slate, Barton River formation, Gile Mountain formation (equivalent to Westmore) and Waits River (as here restricted). Waits River is restricted in this area to essentially calcareous rocks in central and eastern parts of quadrangle. Stratigraphically younger than Westmore and Gile Mountain formations. Thickness 4,750 to 6,500 feet. Age may be Lower Devonian(?).

V. R. Murthy, 1958, Jour. Geology, v. 66, no. 3, p. 276–287. Rocks between Northfield slate and Gile Mountain formation in east-central Vermont can be divided into three mappable units. Western two units are continuous with Barton River and Westmore formations as defined in Memphremagog quadrangle to north. These units have been included in Waits River formation, a thick sequence of calcareous and noncalcareous rocks in Barre and East Barre quadrangles. Analysis of structural relations in area indicates possibility of correlating Westmore formation and Gile Mountain formation across limbs of major syncline, trough of which is occupied by calcareous unit in central part of East Barre quadrangle. If correct, this interpretation makes this calcareous unit the youngest in Paleozoic sequence in Vermont and calls for revision of stratigraphic sequence. Proposed that name Waits River formation be restricted to this youngest calcareous unit. Also that total section of rocks included under Waits River formation of Currier and Jahns (1941) be redefined as Barre group composed of Barton River, Westmore, and present Waits River.

L. M. Hall, 1959, Vermont Geol. Survey Bull. 13, p. 15, 19–28, 36–41, pls. 1–4. Formation present in two regions in St. Johnsbury quadrangle where it occupies more surface area than any other formation. Largest area is belt 4 to 9 miles wide that trends northeastward through quadrangle. Small area located in northwest portion. Includes Crow Hill member (new) and Standing Pond amphibolite member. Total thickness not known because lower contact is not exposed. Age not certain. Present information favors Waits River as being older than Gile Mountain formation.

Type locality: Waits River town, Orange County, Vt.

**Wakarusa Limestone Member** (of Bern Limestone)

Wakarusa Limestone (in Shawnee Group)

Wakarusa Limestone (in Wabaunsee Group)[1]

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

Original reference: J. W. Beede, 1898, Kansas Acad. Sci. Trans., v. 15, p. 30.

R. C. Moore and others, 1944, Geol. Soc. America Bull., v. 55, no. 6, chart 6 (column 32). Correlation chart shows Wakarusa limestone in Shawnee group in Missouri.

F. C. Greene and W. V. Searight, 1949, Missouri Geol. Survey and Water Resources Rept. Inv. 11, p. 20. Assigned to Wabaunsee group when that group was redefined for Missouri.

R. C. Moore and M. R. Mudge, 1956, Am. Assoc. Petroleum Geologists Bull., v. 40, no. 9, p. 2273 (fig. 1), 2277. Rank reduced to member status in Bern limestone (new). Overlies Soldier Creek shale member; underlies Auburn shale.

P. B. Greig, 1959, Oklahoma Geol. Survey Bull. 83, p. 53–54. As now defined, name Wakarusa is applied to first resistant limestone unit above Burlingame limestone in Kansas section. Fusulinid-bearing phase of Wakarusa extends into Oklahoma, where, in earlier reports, it was referred to as *Cryptozoon* limestone. Thickness in Pawnee County 2 to 9½ feet. Overlies Hallett shale; underlies Auburn shale. Wabaunsee group.

H. G. Hershey and others, 1960, Iowa Highway Research Board Bull. 15, p. 13, fig. 5. Consists of two blocky bluish-gray fine-grained limestone beds separated by thin gray crinoidal shale. Underlies Auburn shale; overlies Soldier Creek shale. Wabaunsee group.

Named for exposures along Wakarusa Creek immediately south of Auburn, Shawnee County, Kans. Well exposed on Kansas Highway 10, west of Topeka, in sec. 35, T. 11 S., R. 13 E., and along creek north of highway.

**Wakefield Marble**

Lower Paleozoic(?) (Glenarm Series): Western Maryland and southeastern Pennsylvania.

A. I. Jonas and G. W. Stose, 1938, Washington Acad. Sci. Jour., v. 28, no. 8, p. 346. Name applied to white finely crystalline marble which underlies and is interbedded with volcanic flows in western Piedmont of Maryland and York County, Pa.; in part of area it is beneath and infolded with albite-chlorite schist facies of Wissahickon formation. Occurs on northwestern side of Peach Bottom syncline; the Cockeysville marble underlies the Wissahickon on southeastern side of the syncline but, since equivalency of the two marbles is not established, name Wakefield is proposed. In some areas, grades into Silver Run limestone (new). Precambrian(?).

A. J. Stose and G. W. Stose, 1944, U.S. Geol. Survey Prof. Paper 204, p. 38–39, pl. 1. Described in Hanover-York district, Pennsylvania, where it is apparently oldest formation in region and underlies the albite-chlorite schist facies of Wissahickon. Estimated thickness in southern Pennsylvania and adjacent Maryland 100 feet.

A. J. Stose and G. W. Stose, 1946, Maryland Dept. Geology, Mines and Water Resources Carroll and Frederick Counties [Rept. 12], p. 58–62. Described in Carroll and Frederick Counties. Underlies Libertytown metarhyolite (new). No complete section of the Wakefield found; estimated thickness near Union Bridge 150 feet.

H. E. Vokes, 1957, Maryland Dept. Geology, Mines and Water Resources Bull. 19, p. 43 (table 7). Late Precambrian.

Carlyle Gray and others, 1960, Geologic map of Pennsylvania (1:250,000): Pennsylvania Geol. Survey, 4th ser. Probably Lower Paleozoic.

Named from Wakefield, Carroll County, Md.

†Wakulla Formation[1]

Miocene, lower: Northern Florida.

Original reference: L. C. Johnson, 1892, Geol. Soc. America Bull., v. 3, p. 128–132.

Exposed in vicinity of Wakulla Springs in Wakulla County.

**Walcott Tuff**

Pliocene, middle: Southern Idaho.

H. T. Stearns and Andrei Isotoff, 1956, Geol. Soc. America Bull., v. 67, no. 1, p. 23. Name proposed for unit that was formerly called Eagle Rock tuff (Stearns and others, 1938). Eagle Rock was used as locality name at the time but, because a basaltic tuff originated at Eagle Rock vent, confusion can be avoided in present report by renaming the tuff from Walcott Lake. Four phases recognized: dark-red brittle pitchstone, fine-grained pink and gray rock rock honeycombed with lithophysae, hard obsidian containing spherulites, and well-bedded glass shard tuff and loose white and gray ash. Thickness 50 to 70 feet.

Named from Lake Walcott, where an excellent section is exposed in east bank in SE¼ sec 29, T. 8 S., R. 30 E., Power County.

Walden Sandstone (in Pottsville Group)[1]

Pennsylvanian: Southeastern Tennessee, northeastern Alabama, and northwestern Georgia.

Original reference: C. W. Hayes, 1892, Alabama Geol. Survey Bull. 4, p. 49–51.

H. R. Wanless, 1946, Geol. Soc. America Mem. 13, p. 8, 9, 10, 45, 152. Includes Whitwell, Herbert, Eastland, Newton, Vandever, and Rockcastle formations of present Tennessee classification.

Named for exposures on Walden Ridge, Chattanooga, Pikeville, and Kingston quadrangles, southeastern Tennessee.

**Walden Creek Group**

Precambrian (Ocoee Series): Southeastern Tennessee.

P. B. King and others, 1958, Geol. Soc. America Bull., v. 69, no. 8, p. 953 (fig. 2), 955 (table 1), 961–962. Forms northern sequence of Ocoee series. A varied assemblage of argillaceous and silty rocks and quartz-pebble conglomerate, with locally prominent quartzite, limestone, and dolomite. Best defined sequence is south of English Mountain in eastern part of foothills, where rocks form a broad pattern of northeast-plunging folds that expose a section about 8,000 feet thick. Formations of group defined in this area are (ascending) Licklog (new), Shields (new), Wilhite, and Sandsuck. Overlain by Chilhowee group of Cambrian and Precambrian(?) age; in fault contact with Snowbird group on southeast; not in contact with Great Smoky group; northeast of Great Smoky Mountains, the Walden Creek is reported to overlie Snowbird group as part of a sedimentary sequence from basement rocks upward through Chilhowee group into the overlying Paleozoic. Group corresponds approximately to Wilhite slate, Citico conglomerate, and Pigeon slate as mapped by Keith (1895) and to his more inclusive Hiwasse slate of his later terminology (1904).

Named for Walden Creek, Sevier County, a western tributary of the West Fork of the Little Pigeon River, which drains southeast slope of Chilhowee Mountain and northern foothill belt, an area underlain by rocks of the group. Crops out in a belt a few miles to 8 miles wide in northwesternmost foothills of Great Smoky Mountains and extends along strike for many miles northeast and southwest.

Walden Hollow 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 the Monarch Valley. Younger than Hell Inlet glacial stage (new); older than Stillwater glacial stage.

Monarch Valley, Grand County.

†Waldo Formation[1]

Miocene, lower: Northern Florida.

Original reference: L. C. Johnson, 1888, Am. Jour. Sci., 3d, v. 36, p. 230–236.

Occurs near Waldo, Alachua County, at old Fort Harlee.

Waldo Granite

Devonian(?) or Carboniferous(?): South-central Maine.

J. M. Trefethen, 1941, (abs.) Geol. Soc. America Bull., v. 52, no. 12, pt. 2, p. 2020. Medium-textured porphyritic biotite granite.

Occurs in central part of Bucksport quadrangle.

†Waldrip division[1]

Pennsylvanian: Central Texas.

Original reference: E. T. Dumble, 1890, Texas Geol. Survey 1st Ann. Rept., p. lxvii, pl. 3.

Named for Waldrip, McCulloch County.

**Waldrip Shale Member** (of Pueblo Formation)

Waldrip Bed or Formation (in Cisco Group)[1]

Waldrip Limestone Member (of Harpersville Formation)[1]

Permian (Wolfcamp Series): Central Texas.

Original references: N. F. Drake, 1893, Texas Univ. Geol. Survey 4th Ann. Rept., pt. 1, p. 387, 412; F. B. Plummer, 1919, Am. Assoc. Petroleum Geologists Bull., v. 3, p. 133–145.

R. C. Moore, 1949, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 80, sheet 2. Reallocated to member status in Pueblo formation. Age designated as Permian. This reallocation made on basis of change of Pennsylvanian-Permian boundary. Top of Pennsylvanian is drawn in middle part of Cisco group and within sequence of rocks formerly designated as Harpersville formation. Use of Harpersville is suppressed, lower part of Harpersville being added to underlying Thirfty formation, which is classed as Pennsylvanian, and upper part being added to Pueblo, which is classed as Permian. In Colorado River valley, Waldrip consists of prominent red shale, yellowish to gray shale, light-gray to tan sandstone, and thin beds of hard blue-gray limestone. Thickness 40 to 55 feet. Lies 20 to 25 feet below Saddle Creek limestone member.

D. H. Eargle, 1960, U.S. Geol. Survey Prof. Paper 315–D, p. 58 (table 1), 75–76, pl. 27. Waldrip shale member of Pueblo was described by Drake (1893), who called it Waldrip bed, as consisting of blue clay, sandstone, coal, carbonaceous shale, and limestone. The beds of sandstone are mostly near the base of unit and are quite irregular in thickness. Three limestone beds near top of Waldrip, Drake designated by numbers 1, 2, and 3 beginning with lowest. Plummer and Moore (1921, Texas Univ. Bull. 2132) included in their Harpersville formation the beds later called Waldrip shale by Moore (1949), together with Saddle Creek limestone member. Bullard and Cuyler (1935, Texas Univ. Bull. 3501) restricted term Waldrip to about 115 feet of beds from base of No. 1 limestone to base of Saddle Creek limestone. Lower part of the unit to top of Chaffin limestone member of Thirty formation (their Breckenridge limestone) they found to be about 90 feet in thickness, and they called this part Lower Harpersville beds. Nickell (1938, Texas Univ. Bur. Econ. Geology Pub. 3801) found Waldrip beds of Drake to be 238 feet thick. Cheney (1940) placed upper boundary of Cisco series at unconformity in Harpersville formation above Waldrip-Newcastle coal zone and below *Schwagerina*-bearing Waldrip limestone No. 3. The beds underlying this systemic boundary and overlying his Chaffin formation he termed Obregon formation. Moore (1949) placed Permian-Pennsylvanian boundary 40 to 55 feet below top of Waldrip shale member, between limestones 1 and 2 of Drake. In survey for present report [Brown and Coleman Counties], no traceable horizon was found which could be considered boundary between Pennsylvanian and Permian. For purposes of this report, whole interval that Drake called Waldrip beds is considered Waldrip shale member of Pueblo. Underlies Saddle

Creek limestone member; overlies Chaffin limestone member of Thrifty formation.

Named for Waldrip, McCulloch County.

**Waldron Clay Member** (of Wayne Formation)[1]

**Waldron Shale**[1]

Middle Silurian: Southern Indiana, west-central Kentucky, and central Tennessee.

Original reference: M. N. Elrod, 1883, Indiana Dept. Geology and Nat. History 12th Ann. Rept., p. 106–111.

C. W. Wilson, Jr., 1949, Tennessee Div. Geology Bull. 56, p. 249–251. Waldron shale included in Wayne group. A gray or greenish-gray calcareous shale with occasional thin beds of limestone or argillaceous shale. Southward along Tennessee River, thins and changes character from place to place; at many localities it is tripartite, consisting of upper foot or so of red or gray shale or red or gray calcareous mudstone, middle thin bed of gray limestone, and lower thin zone of white clay-shale; south of Saltillo, consists of 18 inches of red earthy limestone or red calcareous mudstone; at Cerro Gordo and Swallow Bluff, consists of 1 foot of gray shale. Thickness between 2 and 5 feet; average 3 feet. Overlies Laurel limestone; underlies Lego limestone; where Lego is absent, 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, Waldron formation overlies Laurel formation and underlies Louisville formation. Consists of shale, blue gray, knotty, calcareous, locally fossiliferous. Thickness 0 to 10 feet. In Clinton group.

Named for Waldron, Shelby County, Ind.

†Waldron Sandstone (in Douglas Formation)[1]

Pennsylvanian: Northwestern Missouri.

Original reference: J. A. Gallaher, 1898, Missouri Bur. Geology and Mines Bienn. Rept., p. 52.

Named for exposures at Waldron, Platte County.

**Wales Group**[1]

Pre-Ordovician to Devonian: Southeastern Alaska.

Original reference: A. H. Brooks, 1902, U.S. Geol. Survey Prof. Paper 1, p. 40–52, map.

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 undifferentiated Paleozoic metamorphic rocks.

Occupies large area on Prince of Wales Island.

Walgreen 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., figs. 3, 15A. Shown on columnar section as underlying Stillman member (new) and overlying Dement member (new). Thickness about 6½ feet.

Occurs in Dixon-Oregon area.

Walhalla formation (in Kwaguntan series)

Precambrian: Northern Arizona.

Charles Keyes, 1938, Pan-Am. Geologist, v. 70, no. 2, p. 107 (chart), 114. Black shales having a thickness of about 200 feet. Underlies Nunkoweap sandstone (new); overlies Echo limestone (new).

Shales crop out under Walhalla Plateau from which they take their name; Grand Canyon region.

†Walker Beds[1]

Lower Cretaceous (Comanche Series): Central southern Kansas.

Original reference: F. W. Cragin, 1895, Am. Geologist, v. 16, p. 359.

Named for Walker's Draw, a well-known branch of Medicine Lodge River south of Belvidere, Kiowa County.

Walker Conglomerate and Sandstone[1]

Pennsylvanian: Western Missouri.

Original reference: F. C. Greene and W. F. Pond, 1926, Missouri, Bur. Geology and Mines, v. 19, 2d ser., p. 62–65.

Occurs only on crest of ridge which extends to northwest on Walker Mound, sec. 8, T. 36 N., R. 30 W., Vernon County.

Walker Formation[1]

Oligocene: Southern California (subsurface and surface).

Original reference: V. H. Wilhelm and L. W. Saunders, 1927, California State Mining Bur., v. 12, no. 7, p. 9, pl. 1.

T. W. Dibblee, Jr., and C. W. Chesterman, 1953, California Div. Mines Bull. 168, p. 12 (fig. 2), 33–35, pls. 1, 2, 3. Described in surface section. Consists of granitic sandstone, conglomerate, siltstone, and tuff breccia. Thickness at type section herein designated, 2,000 feet; thickens southwestward along strike to 2,950 feet and grades into Bealville fanglomerate (new) facies; thins northwestward, and in Cottonwood Canyon consists of about 200 feet of sand and gravel. At type section, overlies (Jurassic) quartz diorite conformably underlies Ilmon basalt (new); in Cottonwood Canyon (outside mapped area), conformably underlies Freeman-Jewett shale. Oligocene.

Otto Hackel and K. F. Krammes, 1958, San Joaquin Geol. Soc. [Guidebook] Spring Field Trip May 17, p. 10. Walker formation overlies basement complex in outcrop. To the west, subsurface Eocene rocks rest on basement, and it is apparent that Walker is land-laid equivalent of marine rocks of lower Miocene through upper Eocene.

Type section: Along southeast bank of Walker Basin Creek, 1 to 2 miles northeast of Bena, Breckenridge Mountain quadrangle, Kern County.

Walker Shale[1]

Upper Devonian: Southwestern Virginia.

Original reference: M. R. Campbell, 1894, Geol. Soc. America Bull., v. 5, p. 171, 177, pl. 4.

In Wythe, Montgomery, and Pulaski Counties. Named for Walker Mountain, Giles County.

Walker Mountain Sandstone Member (of Moccasin Formation)

Ordovician: Southwestern Virginia.

Charles Butts and R. S. Edmundson, 1943, Geol. Soc. America Bull., v. 54, no. 11, p. 1678. Name proposed for upper of two sandstones in formation. Thick-bedded gray quartzose rock 8 to 12 feet thick. Underlies Martinsburg formation.

G. A. Cooper, 1956, Smithsonian Misc. Colln., v. 127, pt. 1, p. 95. Butts and Edmundson did not designate type section. Exposure noted herein.

Named for exposures in southwestern end of Walker Mountain, Washington County. Well exposed along Keywood Branch Road about one-half mile north of Seven Springs and along Virginia Highway 91, about 1 mile northwest of McCall Gap, Washington County.

Walker Plain Basalt

Miocene: Northern California.

Anna Hietanen, 1951, Geol. Soc. America Bull., v. 62, no. 6, p. 586, 587. Youngest rock in area; hence, younger than Merrimac granodiorite, Bucks granodiorite, and Bald Rock granite (all new).

Occurs on both sides of old Quincy-Oroville Road extending south from Four Trees Junction, Merrimac area, Plumas National Forest.

Walker Ridge Sandstones[1]

Post-Franciscan and pre-upper Miocene: Northern California.

Original reference: W. Stalder, 1915, California State Mining Bur. Bull. 69, p. 447–449.

D. L. Everhart, 1950, California Jour. Mines and Geology, v. 46, no. 3, p. 388. Incidental mention in report on quicksilver mine in Sonoma County.

Named for exposures on Walker Ridge, Humboldt County.

Walker Ridge Shales[1]

Post-Franciscan and pre-upper Miocene: Northern California.

Original reference: W. Stalder, 1915, California State Mining Bur. Bull. 69, p. 447–449.

Named for Walker Ridge, Humboldt County.

Walkup Clay[1]

Eocene: Northern California.

Original reference: V. T. Allen, 1929, California Univ. Pub., Dept. Geol. Sci. Bull., v. 18, no. 14, p. 364, 403.

Occurs at Walkup pit, less than one-half mile east of Gladding McBean pit in Chico quadrangle.

Wall 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. 24, figs. 3, 12. Dolomite, argillaceous in upper part, with bentonite 3 feet above base. Thickness about 9 feet. Shown on columnar section as underlying Wyota member (new) and overlying Sherwood member (new).

Occurs in Dixon-Oregon area.

**Wallace Formation**[1] (in Piegan Group)

Precambrian (Belt Series): Northeastern Idaho and western Montana.

Original reference: F. L. Ransome, 1905, U.S. Geol. Survey Bull. 260, p. 277–285.

F. L. Ransome and F. C. Calkins, 1908, U.S. Geol. Survey Prof. Paper 62, p. 39–44, pl. 11. Thin-bedded bluish and greenish more or less calcareous shales, underlain by rapidly alternating thin beds of argillite, calcareous sandstone, impure limestone: these in turn underlain by gray-green siliceous argillites. Ripple marks, sun cracks, and so on, throughout. Thickness about 4,000 feet. Overlies St. Regis formation; underlies Striped Peak formation.

Russell Gibson, 1948, U.S. Geol. Survey Bull. 956, p. 13–16, pl. 1. Thickness as much as 17,000 feet in Libby quadrangle, Montana. Overlies Ravalli formation; underlies Striped Peak formation.

C. P. Ross, 1949, (abs.) Washington Acad. Sci. Jour., v. 39, no. 3, p. 112–113. Principal component of Piegan group has been variously called Siyeh, Newland, and Wallace limestone or formation, and these names are retained locally. In and near Coeur d'Alene region, the Wallace is the only representative of the group.

R. E. Wallace and J. W. Hosterman, 1956, U.S. Geol. Survey Bull. 1027–M, p. 584–585, pl. 48. Crops out over large part of Mineral County, Mont. Thickest section, about 6,500 feet, is exposed at head of Savenac Creek near Mount Bushnell on north flank of Savenac syncline; base of section here is fault contact. Commonly overlies St. Regis formation with contact transitional. Predominantly argillite.

A. B. Campbell, 1960, U.S. Geol. Survey Bull. 1082–I, p. 557–560, pl. 28. In St. Regis-Superior area, Montana, conformably underlies Spruce formation (new) of Missoula group; overlies St. Regis formation.

Well exposed at town Wallace, Coeur d'Alene district, Idaho.

Wallace shale

Cretaceous (Mid-Cretacic): Northwestern Kansas.

C. R. Keyes, 1941, Pan-Am. Geologist, v. 76, no. 4, p. 304 (chart). Name applied to upper formation in Buckskinian series. Consists of shales about 300 feet thick. Overlies Gove chalk; underlies unnamed interval below Arickaree formation of Rawlinsian series.

C. R. Keyes, 1941, Pan-Am. Geologist, v. 76, no. 5, p. 374, 376. Proposed for so-called Pierre shales of Kansas. Derivation of name given.

Name derived from Wallace County.

Wallace Creek Formation[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, 397. Consists of thin-bedded dark-gray to black limestones, with interbedded shale. Thickness about 250 feet. Overlies Strites Pond limestone; overlies Morgan Corners dolomite.

Exposed from northern part of St. Albans quadrangle, Vermont, across the international border for about 20 miles into Quebec.

Wallace Ledge Formation

Lower Cambrian: West-central Vermont.

E. P. Kaiser, 1945, Geol. Soc. America Bull., v. 56, no. 12, pt. 1, p. 1089, pl. 1. Gritty purplish slate in lower part and soft green slate with some purple slate above. Thickness about 100 feet. Underlies Zion Hill quartzite; overlies Schodack formation.

Named for exposure on western side of Wallace Ledge, Castleton Township, Rutland County. Occurs in northern end of Taconic Range.

†Wallala Beds[1] or Group[1]

*See* Gualala Group accepted spelling.

**Wall Creek Sandstone Member** (of Frontier Formation)[1]

Wall Creek facies (of Carlile Formation)

Wall Creek Member (of Carlile Formation)

Upper Cretaceous: Eastern Wyoming and western South Dakota.

Original reference: C. H. Wegemann, 1911, U.S. Geol. Survey Bull. 452, p. 43, 45.

E. P. Rothrock, 1949, South Dakota Geol. Survey Rept. Inv. 62, p. 17–19, fig. facing p. 4. Wall Creek member lies about 250 feet above base of Carlile in Fall River County. Where typically exposed, appears to consists of beds about one-fourth inch thick of alternating sand and black shale or carbonaceous matter. Thickness about 20 feet.

R. E. Stevenson, 1952, South Dakota Geol. Survey Rept. Inv. 69, p. 13, fig. 1. Facies of Carlile formation in southwestern Butte County. Facies (which is unit 1 of Turner member—Cobban, 1951, Am. Assoc. Petroleum Geologists Bull., v. 35, no. 10), lies about 86 to 126 feet above base of Carlile. Thickness 20 to 60 feet, thickens westward.

J. D. Haun, 1958, Wyoming Geol. Assoc. Guidebook 13th Ann. Field Conf., p. 85. In Powder River basin, top of Frontier is placed at top of Wall Creek sandstone member.

Named for exposures in escarpment 12 miles west of Salt Creek, which rims Powder River dome, forming lofty escarpment known locally as "The Wall." Also well exposed above Wall Creek stream, eastern Wyoming.

**Wallingford Dolomite**[1]

Wallingford Member (of Danby Formation)

Lower Cambrian: West-central Vermont.

Original reference: A. D. Hager, 1861, Rept. Geol. Vt., v. 2.

W. M. Cady, 1945, Geol. Soc. America Bull., v. 56, no. 5, p. 525, 535–536. Rank reduced to member at top of Danby formation. Upper Cambrian.

Type locality: Wallingford Township, Rutland County.

Wallington Limestone (in Clinton Group)

Middle Silurian (Ontarian): Western New York.

D. W. Fisher, 1959, New York State Mus. Sci. Service Geol. Survey Map and Chart Ser., no. 1. Name suggested for limestone formerly regarded as Reynales at Rochester and eastward. Thickness at type section 15 feet. Younger than type Reynales of Niagara and Orleans Counties and separated stratigraphically from it by Furnaceville hematite. Underlies lower Sodus shale.

Type section: Along east branch of Salmon Creek at Wallington, Wayne County.

†Wallkill Limestone[1]

Upper Cambrian and Lower Ordovician: Northern New Jersey.

Original reference: J. E. Wolff and A. H. Brooks, 1898, U.S. Geol. Survey 18th Ann. Rept., pt. 2, p. 443–454.

In vicinity of Franklin Furnace and Hamburg; also in Wallkill Valley, south of Franklin Furnace, Sussex County.

**Walloomsac Slate**[1]

Middle Ordovician: Southwestern Vermont, northwestern Massachusetts, and eastern New York.

Original reference: L. M. Pringle and E. B. Knopf, 1932, Am. Jour. Sci., 5th, v. 24, p. 268–269 (map), 274–275.

R. V. Cushman, 1950, New York State Water Power and Control Comm. Bull. GW–21, p. 9 (table 2), 11, pl. 2. In Rensselaer County, Walloomsac slate underlies broad areas in Hoosick-Berlin Valley and is everywhere separated from adjacent Lower Cambrian shale and grit by thrust faults. It lies in elongated belt east and southeast of Rensselaer Plateau where it forms most of Kinderhook Creek valley southward from Berlin to Columbia County boundary. Also underlies area that reaches from Eagle Bridge to Hoosick and extends eastward to Vermont boundary. Appears to rest conformably on uppermost blue phase of Stockbridge limestone. Thickness unknown. Stratigraphic position of the Walloomsac and fossils found in it indicate age that is probably equivalent to that of upper Normanskill shale of Hudson Valley.

P. H. Osberg, 1952, Vermont Geol. Survey Bull. 5, p. 116 (fig. 16). Correlation chart for Vermont shows Walloomsac slate overlies Stockbridge limestone. Middle Ordovician.

R. V. Cushman, 1953, New York State Water Power and Control Comm. GW–33, p. 10 (table 3), 15, pl. 2. In southeastern part of Washington County, there is an extensive massive known as Walloomsac slate. Massif consists of green to black smooth shale, schist, and soft slate. Included fossils indicate age equivalent to upper Normanskill. Thickness unknown. Probably separated from other Taconic rocks by thrust fault. Table 3 lists Walloomsac slate below Snake Hill formation.

J. A. MacFayden, Jr., 1956, Vermont Geol. Survey Bull. 7, p. 27–28, p. 16. In Bennington area, overlies Mount Anthony formation (new). Contact with underlying Canadian limestone appears to be locally conformable but over large area it marks major unconformity. Along eastern flank of Taconic Range lies in apparent normal stratigraphic succession on limestone section; southeastward, just north of Mason Hill, it overlies Upper Cambrian Clarendon Springs; on western flank of The Dome, a small remnant of the phyllite with one of the characteristic limestone lenses lies on Lower Cambrian Dunham dolomite. Middle Ordovician.

Named for extensive distribution in valley of Walloomsac River, west and northwest of Bennington, Vt., in both Bennington County, Vt., and Rensselaer County, N.Y.

**Walnut Clay** (in Fredericksburg Group)[1]

**Walnut Shaly Member** (of Goodland Limestone)[1]

Walnut Marl (in Fredericksburg Group)

Lower Cretaceous (Comanche Series): Northeastern Texas and southern Oklahoma.

Original reference: R. T. Hill, 1891, Geol. Soc. America Bull., v. 2, p. 504, 512.

L. W. Stephenson and others, 1942, Geol. Soc. America Bull., v. 53, no. 3, chart 9. Walnut shaly member in lower part of Goodland shown on correlation chart.

W. O. George, 1952, U.S. Geol. Survey Water-Supply Paper 1138, p. 14 (table 7), 21–22. Walnut clay described in Comal County, Tex., where it is lowest formation of Fredericksburg group. Conformably overlies Glen

Rose limestone; conformably underlies Comanche Peak limestone. In most places, represented by bed of sandy marl 3 to 5 feet thick.

H. D. Miser and others, 1954, Geologic map of Oklahoma (1:500,000): U.S. Geol. Survey. Walnut clay in Fredericksburg group, mapped in southeastern Oklahoma.

D. L. Frizzell, 1954, Texas Univ. Bur. Econ. Geology Rept. Inv. 22, p. 21–22. Foraminifera of Walnut clay described. Basal formation of Fredericksburg group. Underlies Goodland limestone. The Walnut is time-transgressing formation, laterally equivalent to Comanche Peak formation and in part to Edwards limestone.

V. E. Barnes, 1958, Texas Univ. Bur. Econ Geology Guidebook 1, p. 34. In Travis and Williamson Counties, includes Cedar Park limestone member.

B. F. Perkins, 1960, Geol. Soc. America Mem. 83, p. 9 (fig. 3), 11–15, pls. 1, 2. In this report [Fort Worth-Weatherford area], term Walnut marl is used for yellow and gray shell-bed-bearing marls delimited below by Paluxy sand and above by basal blue marl of Goodland formation. Consists of beds of shells of *Gryphaea mucronata* Gabb and *Exogyra texana* Roemer alternating with thin marl units. Thickness about 25 feet. Previous writers have placed upper and lower contacts of Walnut formation at various stratigraphic levels; as a result, reports of thickness of formation have ranged from 27 to 170 feet. Taff (1893 Texas Geol. Survey Ann. Rept. 4, pt. 1) assigned 170 feet to the formation (Texana limestone) and included about 15 feet of arenaceous marl that in this report is considered Paluxy and about 130 feet of limestone and marly limestone that in this report is considered Goodland. Hill (1901, U.S. Geol. Survey 21st Ann. Rept., pt. 7) assigned 130 feet to the formation and included 3 feet of sand herein considered Paluxy and more than 90 feet of marly limestone herein considered Goodland. Winton and Adkins (1920 [1919], Texas Univ. Bull. 1931) placed upper contact of Walnut at top of uppermost massive *Gryphaea mucronata* ledge, as is done in this report, but included in formation 100 feet of marl, sand, and shell ledges considered Paluxy in this report. Scott and Hawley (*in* Adkins, 1933 (Texas Univ. Bull. 3232) and Hawley and Smith (1933, Texas Univ. Bull. 3201) applied name Walnut in area west and northwest of Fort Worth to calcareous sediments including *Gryphaea marcouri* [*G. mucronata*] shell banks. This application was followed by Lozo (1944, Am. Midland Naturalist, v. 31, no. 3). Thompson (1935, Am. Assoc. Petroleum Geologists Bull., v. 19, no. 10) included in his definition of Walnut, arenaceous marls presently assigned to Goodland formation.

Named for Walnut (also called Walnut Springs), Bosque County, Tex.

†Walnut Shale[1]

Pennsylvanian: Eastern Kansas and northeastern Oklahoma.

Original reference: E. Haworth and J. Bennett, 1908, Kansas Acad. Sci. Trans., v. 21, pt. 1, p. 74.

Named for Walnut, Crawford County, Kans.

Walnut Wells Monzonite

[Tertiary]: Southwestern New Mexico.

A. M. Alper and Arie Poldervaart, 1957, Econ. Geology, v. 52, no. 8, p. 953, 954, 963, 965. Believed to be penecontemporaneous and derived from same magma as quartz monzonite-porphyry of Animas intrusive.

Occurs in vent 6 miles south of Animas stock, Walnut Wells quadrangle, Hidalgo County.

**Walston Silt**

Pleistocene (Yarmouth): Southeastern Maryland (subsurface and surface).

W. C. Rasmussen and T. H. Slaughter, 1955, Maryland Dept. Geology, Mines and Water Resources Bull. 16, p. 115 (table 17), 116–117. Lenticular unit of sand, silty sand, sandy silt, silt, clayey silt, silty clay, and clay, with organic material. Thickness from a fraction of a foot to as much as 57 feet at reference locality. Underlies unconformably Parsonsburg sand (new) and overlies unconformably Beaverdam sand (new).

Reference locality is a test hole, Wi–Cg 40, 2 miles north of Parsonsburg. Crops out in banks of Walston Branch, from which it takes its name, a tributary to Beaverdam Creek, Wicomico County.

Walter Johnson Sandstone Member (of Nowata Shale)

Pennsylvanian (Des Moines Series): Eastern Kansas, western Missouri, and northeastern Oklahoma.

J. M. Jewett, 1941, Kansas Geol. Survey Bull. 38, pt. 11, p. 292, 335. Name applied to lenticular sandstone in Nowata.

R. C. Moore and others, 1951, Kansas Geol. Survey Bull. 89, p. 96. Thin-bedded to massive sandstone in lower and middle part of Nowata. Thickness commonly 4 to 10 feet.

W. B. Howe, 1953, Missouri Geol. Survey and Water Resources Rept. Inv. 9, p. 9, 22. Name Walter Johnson applied to sandstone and siltstone, about 6 feet thick, in Nowata shale, in LaFayette County.

C. C. Branson, 1954, Oklahoma Geol. Survey Guide Book 2, p. 3. Stratigraphic column in northeastern Oklahoma includes Nowata shale with Walter Johnson sandstone member.

Named from Walter Johnson School in sec. 10, T. 35, S., R. 17 E., Montgomery County, Kans.

**Waltersburg Sandstone**[1] or **Formation**

Waltersburg Sandstone (in Elvira Group)

Upper Mississippian (Chester Series): Southern Illinois, southern Indiana, and western Kentucky.

Original references: S. Weller, 1920, Jour. Geology, v. 28, no. 4, p. 281–290; no. 5, p. 395–416; 1920, Illinois Geol. Survey Bull. 4.

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), 837. Assigned to Elvira group (new). In standard Mississippian section, underlies Menard limestone and overlies Vienna limestone.

C. A. Malott, 1942, Stratigraphy of Ste. Genevieve and Chester formations of southern Indiana: Ann Arbor, Mich., The Edwards Letter Shop, p. 7. Name Waltersburg sandstone extended into Indiana where it replaces Wickliff sandstone. Local Indiana names of upper Chester are dropped, and formations are given names of standard Chester column.

T. G. Perry and N. M. Smith, 1958, Indiana Geol. Survey Bull. 12, pl. 1. Waltersburg sandstone shown on stratigraphic column of upper Chester rocks in Indiana as gray to brown sandstone and gray to green-gray shale and silty shale. Thickness 30 to 60 feet. Term Elvira group not used in Indiana.

Named for exposures at Waltersburg, Pope County, Ill.

**Waltham Gneiss**[1]

Precambrian: Eastern Massachusetts.

Original reference: L. LaForge, 1932, U.S. Geol. Survey Bull. 839.

Occupies much of northern Waltham, southeast Lexington and Burlington, and northwest Woburn, in Middlesex County. Extends northeast into Lawrence and Salem quadrangles and southwest into Framingham and Franklin quadrangles.

Waltham Shale (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), 993. Panoche group (or formation) is subdivided into 10 units. Waltham shale is divided into lower unit and upper unit separated by Juniper Ridge sandstone (new). Upper Waltham may belong to Cachenian stage (new) and lower Waltham may belong to Delevanian stage (new). Name credited to J. Q. Anderson.

Occurs in Alcalde Hills, Coalinga-Ortigalito area, San Joaquin Valley.

**Wamego Shale Member** (of Zeandale Limestone)

Wamego Shale (in Wabaunsee Group)

Pennsylvanian (Virgil Series): Eastern Kansas and southeastern Nebraska.

G. E. Condra and E. C. Reed, 1943, Nebraska Geol. Survey Bull. 14, p. 42–43. Name applied to shale between Maple Hill limestone above and Tarkio limestone below. Thickness at type locality 15 to 18 feet. Replaces Pierson Point shale of Condra (1927). [See explanation under Pierson Point.]

G. E. Condra, 1949, Nebraska Geol. Survey Bull. 16, p. 15. Reference made to Pierson Point shale by Condra and Reed (1943) is in error; name Pierson Point retained and Wamego dropped.

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 limestone (new).

Type locality: In bluffs north of U.S. Highway 40, about 4 miles west of Wamego, Pottawatomie County, Kans.

**Wamsutta Formation**[1]

Pennsylvanian: Southeastern Massachusetts and eastern Rhode Island.

Original reference: J. B. Woodworth, 1899, U.S. Geol. Survey Mon. 33, p. 134, 141–158, pl. 17.

R. C. Moore and others, 1944, Geol. Soc. America Bull., v. 55, no. 6, chart 6 (column 5b). Age of lowermost part of formation shown as Mississippian; remainder is Pennsylvanian.

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]. Pennsylvanian. Appears to interfinger with both Rhode Island formation and Pondville conglomerate in southern part of Pawtucket quadrangle.

A. W. Quinn, 1952, Bedrock geology of the East Greenwich quadrangle, Rhode Island: U.S. Geol. Survey Geol. Quad Map [GQ–17]. Not recognized south of Greenwich Bay, R.I., where unit as mapped by Emerson (1917, U.S. Geol. Survey Bull. 597) is assigned to Rhode Island formation.

Wamsutta was name proposed but not actually adopted for North Attleboro, Mass., where Wamsutta Mills are located.

†Wamsutta Volcanics[1]

Carboniferous: Massachusetts.

Original reference: J. B. Woodworth, 1899, U.S. Geol. Survey Mon. 33, p. 155–156.

**Wanakah Formation** (in San Rafael Group)

Wanakah Marl Member (of Morrison Formation)

Wanakah Member (of Morrison Formation)[1]

Upper Jurassic: Southwestern Colorado and northwestern New Mexico.

Original reference: W. S. Burbank, 1930, Colorado Sci. Soc. Proc., v. 12, no. 6, p. 172.

M. I. Goldman and A. C. Spencer, 1941, Am. Assoc. Petroleum Geologists Bull., v. 25, no. 9, p. 1748 (fig. 2), 1749, 1952 (fig. 3), 1753 (table 1), 1754 (fig. 4), 1756 (fig. 5), 1762 (fig. 7). Restricted and termed marl member of Morrison. Consists of succession, 50 to 150 feet thick, of hard, calcareous, concretionary, sandy, red, argillaceous beds with some thin sandstones. Overlies Bilk Creek sandstone member (new); underlies Junction Creek sandstone member (new). [See La Plata sandstone.]

A. A. Baker, C. H. Dane, and J. B. Reeside, Jr., 1947, Am. Assoc. Petroleum Geologists Bull., v. 31, no. 9, p. 1668. Inasmuch as upper limit of beds that may be properly assignable to San Rafael group, rather than Morrison formation, is not yet definitely known in New Mexico, it seems desirable to extend into New Mexico and adjacent parts of northeastern Arizona, for these upper beds of San Rafael group, use of term Wanakah formation, which has been sharply discriminated from overlying Morrison in San Juan Mountain region of southwestern Colorado. Todilto limestone and gypsum, where present, are thus members of Wanakah formation.

E. B. Eckel, 1949, U.S. Geol. Survey Prof. Paper 219, p. 27 (table), 28–29. Term Wanakah formation is here applied to beds between Entrada and Junction Creek sandstones. Formation is equivalent to La Plata limestone and La Plata shale, as these terms are applied by miners, and to middle part of La Plata sandstone as defined in La Plata folio (no. 60) and other early reports on parts of southwestern Colorado. In La Plata district and elsewhere, rocks here placed in the Wanakah were formerly regarded as part of Morrison formation. As redefined, consists of (ascending) Pony Express limestone member, Bilk Creek sandstone member, and unnamed marl member. Thickness 25 to 150 feet. Overlies Entrada sandstone; underlies Junction Creek sandstone.

L. C. Craig and C. N. Holmes, 1951, New Mexico Geol. Soc. Guidebook 2d Field Conf., p. 94. Redefined to include Junction Creek sandstone member, which has been treated as member of Morrison formation and as separate formation.

G. O. Bachman, 1953, U.S. Geol. Survey Oil and Gas Inv. Map OM–137. In Mora County, N. Mex., conformably overlies Ocate sandstone (new); conformably underlies Morrison formation. Average thickness 25 feet.

J. W. Harshbarger, C. A. Repenning, and J. H. Irwin, 1957, U.S. Geol. Survey Prof. Paper 291, p. 39. In this report [Navajo country], unit herein assigned to Summerville formation, together with Todilto limestone, has been assigned to Wanakah formation by other workers.

R. L. Griggs and C. B. Read, 1959, Am. Assoc. Petroleum Geologists Bull., v. 43, no. 8, p. 2006. Name Bell Ranch formation applied to sequence of beds in Tucumcari-Sabinoso area believed by Wood, Northrop, and Griggs (1953, U.S. Geol. Survey Oil and Gas Inv. Map OM-141) to be equivalent of Wanakah formation.

Named for exposures in Wanakah mine, Ouray district, Colo.

Wanakah Member (of Ludlowville Shale)

Wanakah Shale[1] or Formation

Middle Devonian: Western and central New York.

Original reference: A. W. Grabau, 1917, Jour. Geology, v. 25, p. 338 (footnote).

R. G. Sutton, 1951, Rochester Acad. Sci. Proc., v. 9, no. 5-6, p. 364-369, pl. 1. In Batavia quadrangle, Wanakah and Ledyard members of Ludlowville were not separated as defined by Cooper (1930, Am. Jour. Sci., 5th ser., v. 19). 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 48 feet at Jacox Run near Geneseo. Overlies Ledyard formation; underlies Tichenor formation. Ostracodes discussed.

R. S. Boardman, 1960, U.S. Geol. Survey Prof. Paper 340, p. 4 (fig. 2), 5-6. Trepostomatous Bryozoa discussed.

Type section: In Wanakah and Lakewood Beach Cliffs along Lake Erie.

†Wando Clays and Sands[1]

Pleistocene: 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, p. 484; 1907, Summary of mineral resources of South Carolina, p. 12 (table).

Named for exposures along Wando River, between Charleston and Berkeley Counties.

Wanette division

Permian: Oklahoma.

D. A. Green, 1937, Am. Assoc. Petroleum Geologists Bull., v. 21, no. 12, p. 1518-1521. Named as lowermost of three time divisions of Permian of Oklahoma. Followed by the Minco division and Upper Red-Beds division. In central Oklahoma, the Wanette includes sediments from top of Brownville limestone to top of Stratford shale.

J. E. Adams and others, 1939, Am. Assoc. Petroleum Geologists Bull., v. 23, no. 11, p. 1677. Recommended that in Oklahoma term Wanette be dropped in favor of Wolfcamp series which in northern Oklahoma, Kansas, and Nebraska includes beds from disconformity immediately above Brownville limestone up to horizon near top of Herington limestone.

Reference locality, town of Wanette, Pottawatomie County.

**Wann Formation**[1] (in Ochelata Group)

Pennsylvanian (Missouri Series): Northeastern Oklahoma.

Original reference: D. W. Ohern, 1910, Oklahoma State Univ. Research Bull. 4, p. 28.

M. C. Oakes, 1939, Oklahoma Acad. Sci. Proc., v. 20, p. 105, 106 (fig. 2). Restricted and redefined to apply to all strata between top of Iola formation below and base of Torpedo sandstone above or base of Birch Creek limestone in areas where Torpedo sandstone was removed by pre-Birch erosion.

M. C. Oakes, 1951, Tulsa Geol. Soc. Digest, v. 19, p. 119–122. Underlies Barnsdall formation (new).

M. C. Oakes, 1952, Oklahoma Geol. Survey Bull. 69, p. 83–88. Described in Tulsa County where it is about 225 feet thick along north side of area and thickens southward uniformly to about 265 feet at southside of area. Progressive southward truncation at top, by Pre-Barnsdall erosion, and interfingering of lower part into Avant limestone member of Iola formation are offset by progressive southward increase in thickness of remaining parts of formation. Northward from area of this report, the Wann has been subdivided into four lithologic zones (ascending): basal shale; shale and thin platy limestones; limestone and calcareous, fossiliferous shale; and sandstone and shale. Upper limit of zone 3 is base of Clem Creek sandstone of Emery (1918); zone 2 includes sandstone locally known as Washington Irving.

M. C. Oakes, 1959, Oklahoma Geol. Survey Bull. 81, p. 34–36, pls. 1, 2. Oakes (1951) included Birch Creek limestone in his Barnsdall formation as basal member, in northern Oklahoma. Torpedo sandstone and shale above the Torpedo and beneath Birch Creek limestone crop out only in Washington County and eastern Osage County. This situation led Miser (1954, Geologic map of Oklahoma) to place top of Wann at base of Barnsdall formation throughout and to include Torpedo sandstone and shale above it in Wann formation. This amounts to minor change in definition of Wann, but it is significant for northern Oklahoma only. In this report [Creek County], Miser's definition is followed and term Wann formation is applied to rocks that crop out above Iola formation and below Barnsdall formation. Thickness 40 to 180 feet in Creek County.

P. B. Greig, 1959, Oklahoma Geol. Survey Bull. 83, p. 14–18, pls. 1, 2, 3, 4. Only upper part of formation crops out in Pawnee County. Thickness 142 feet at most complete section. Includes both Clem Creek and Washington Irving sandstones.

Named for Wann, Nowata County.

Wanrhodes Volcanics

Oligocene: Northern Utah.

Frank Neighbor, 1959, Intermountain Assoc. Petroleum Geologists Guidebook 10th Ann. Field Conf., p. 179. Series of water-laid tuffs. Light gray, medium to conglomeratic and fairly well bedded. Overlie Unita formation.

Crop out on northwest flank of Diamond Fork anticline, Utah County. Type locality and derivation of name not stated.

Wanship Formation

Upper Cretaceous and Paleocene: Northeastern Utah.

A. J. Eardley, 1952, Utah Geol. Soc Guidebook 8, p. 53–54. Unconformably overlies Frontier formation in Coalville anticline. In Wasatch hinterland may unconformably underlie Almy conglomerate. Name credited to N. C. Williams.

R. H. Peterson, D. J. Gauger, and R. R. Lankford, 1953, Utah Geol. and Mineralog. Survey Bull. 47, p. 13. Term first used in reference to 2,117 feet of strata outcropping in Cherry Canyon, east of Wanship. Composed of medium-bedded to massive ridge-forming sandstone beds separated by soft friable sandstone and siltstone and soft light- to dark-gray shale beds; intercalated lenticular seams of coal. Basal 170 feet consist of three thick beds of coarse conglomerate separated by two horizons of medium- to coarse-grained brown sandstone.

D. J. Jones, M. D. Picard, and J. C. Wyeth, 1954, Am. Assoc. Petroleum Geologists Bull., v. 38, no. 10, p. 2221 (table). Wanship formation shown on correlation table of Cenozoic formations of Utah and parts of adjacent states. Underlies Almy formation; overlies Henefer formation in north-central Wasatch Mountains. Upper Cretaceous.

N. C. Williams, 1955, Wyoming Geol. Assoc. Guidebook 10th Ann. Field Conf., p. 127–129. Sequence of sandstones and shales, largely marine but partly of brackish water and continental origin. Fossil evidence indicates deposition of Wanship continued without interruption from Montanan time into early Paleocene. Locally truncates Frontier and older formations; underlies Almy conglomerate, in some areas gradational, in others, unconformable.

N. C. Williams and J. H. Marsden, Jr., 1959, Intermountain Assoc. Petroleum Geologists Guidebook 10th Ann. Field Conf., p. 122–123. In Coalville area, Utah, formation is about 4,950 feet thick. Unconformably overlies Frontier formation; underlies Echo Canyon conglomerate (new). Unit has been considered part of Frontier formation which is herein restricted to exclude unit termed Wanship.

Named for occurrence near Wanship, Summit County.

**Wapanucka Limestone**[1]

Pennsylvanian: Central southern and southeastern Oklahoma.

Original reference: J. A. Taff, 1901, U.S. Geol. Survey Geol. Atlas, Folio 74.

B. H. Harlton, 1938, Am. Assoc. Petroleum Geologists Bull., v. 22, no. 7, p. 854 (fig. 1), 858, 902–908. Harlton (1934, Am. Assoc. Petroleum Geologists Bull., v. 18, no. 8) proposed to subdivide Wapanucka into basal, middle, and upper units. It is now proposed to apply names Primrose and Limestone Gap (new) formations to unit heretofore designated as basal Wapanucka. Name Wapanucka is restricted and applied to middle unit (or main lower massive limestone as Taff undoubtedly intended the usage); to upper unit, name Barnett Hill formation is applied. Wapanucka formation has been defined in various ways by different authors. Differences of opinion respecting age arose largely from the fact that Taff did not describe or designate a type locality. Hence it has been customary to accept exposures at town of Wapanucka as type. Section at this locality is not complete and units above Wapanucka have been included at other exposures. Original description by Taff appears to have included chiefly or entirely the lower limestone series, and same limits are observed in this paper. In extreme northwestrn Ouachitas, this formation, together with the Barnett Hill, as well as the Primrose, was erroneously designated by Taff (1902, U.S. Geol. Survey Geol. Atlas, Folio 79) as Chickachoc chert lentils. Recommended that Chickachoc be abandoned. Thickness of Wapanucka at Taff's possible type locality, 1 mile west of Wapanucka, about 220 feet. At Limestone Gap, near center of E½ sec. 31, T. 2 N., R. 13 E., thickness is 198 feet. Here Wapanucka overlies Limestone Gap shale and underlies Barnett Hill formation. Wapanucka is included in Morrow series of Bendian period.

H. D. Miser and others, 1944, Geologic map of Oklahoma (1:500,000): U.S. Geol. Survey. Mapped as Pennsylvanian. Chickachoc chert equals Wapanucka.

R. B. Laudon, 1958, Oklahoma Geol. Survey Circ. 46, p. 10 (fig. 3), 19–20. Chart shows Wapanucka underlies Atoka formation in McAlester Basin and Ouachita Front. Overlies Bloyd formation in McAlester Basin and Caney shale and Union Valley [sandstone] in Ouachita Front. Subsequent workers have not separated Harlton's (1938) Barnett Hill from the Atoka.

Named for Wapanucka, Johnston County.

Wapellan series[1]

Pleistocene (pre-Wisconsin): Iowa.

Original reference: C. R. Keyes, 1931, Pan-Am. Geologist, v. 56, p. 349.

†Wappinger Limestone[1] or Marble

†Wappinger Valley Limestone[1]

Lower Cambrian to Middle Ordovician: Southeastern New York.

Original reference: W. W. Mather, 1838, New York Geol. Survey 2d Rept., p. 168–169.

Robert Balk, 1936, Geol. Soc. America Bull., v. 47, no. 5, pl. 1. Wappinger limestone shown on geologic map of vicinity of Dutchess County; crystalline marble east of Poughquag.

P. H. Bird, 1941, New York Acad. Sci. Trans., 2d ser., v. 3, no. 5, p. 107, 108. Wappinger limestone (formation) of Cambro-Ordovician age conformably overlies Poughquag sandstone and underlies Hudson River formation. Thickness about 1,000 feet.

K. E. Lowe, 1947, Geol. Rev., v. 7, no. 1, p. 10. Wappinger limestone crops out near Tomkins Cove. Both Wappinger limestone and associated Annsville phyllite (new) trend southwest representing continuation of Cambro-Ordovician belt of sediments in Sprouts Brook (Peekskill) across Hudson River to northeast.

F. M. Swartz, 1948, Am. Assoc. Petroleum Geologists Bull., v. 32, no. 8, p. 1521–1522. *Olenellus* fauna of Lower Cambrian has been discovered in median to southern parts of Hudson River valley of New York in Poughquag quartzite and Wappinger limestone. Wappinger mass is a complex that is much deformed and poorly exposed. Discovery of *Olenellus* fauna in some layers of the Wappinger in Poughkeepsie quadrangle shows that these particular layers are Lower Cambrian in age, if it may be assumed that the specimens were not carried in by reworking; other parts of the Wappinger according to their faunas represent Potsdam, Beekmantown, and Trenton formations. Total thickness of Wappinger sequence about 1,000 feet.

Sidney Paige, 1956, Geol. Soc. America Bull., v. 67, no. 3, p. 391–394. Stratigraphic sequence, recognized and accepted as Paleozoic (Cambro-Ordovician) by workers in region, consists of three formations: Poughquag quartzite at base (about 200 feet), Wappinger limestone (about 2,000 feet), and Hudson River phyllite and shale (thickness unknown?) at top. These beds have been mapped both east and west of Hudson River (1) in northeast-trending strip about 1 mile north of Peekskill and east of the river, and (2) at Tomkins Cove, west of river. A second (shown on West Point quadrangle) stratigraphic sequence, "Inwood" limestone and "Manhattan" schist, has been mapped east of river, in city of Peekskill and to the southeast and southwest. Concluded that in Peekskill region stratigraphic units mapped as Cambro-Ordovician north of Peekskill and at Tomkins Cove, west of Hudson River, are identical with stratigraphic units in and south of Peekskill, mapped as "Inwood" limestone and "Manhattan" schist of "doubtful" age and referred to by Berkey and Rice (1921, New York State Mus. Bulls. 225–226) as of late Grenville age.

J. W. Clarke, 1958, Connecticut Geol. Nat. History Survey Quad. Rept. 7, p. 18. In this report [Danbury quadrangle], term Inwood marble is used in preference to term Wappinger marble (Balk, 1936) because unit is nearly physically continuous with Inwood of type locality (Inwood district of New York City).

S. Schaffel, 1958, New York Geol. Assoc. Guidebook 30th Ann. Mtg., p. 1–5. Conformably overlies Poughquag quartzite; conformably underlies Annsville phyllite (Hudson River pelite group). True thickness about 1,000 feet. Cambro-Ordovician. Discussion of controversies regarding age of stratigraphic units in area.

Named for Wappinger Creek, Dutchess County.

**Wapsipinicon Limestone**[1]

Middle Devonian: Eastern Iowa and southwestern Illinois.

Original reference: W. H. Norton, 1895, Iowa Geol. Survey, v. 4, p. 127, 155–166.

G. A. Cooper and others, 1942, Geol. Soc. America Bull., v. 53, no. 12, pt. 1, p. 1788. Referred to Taghanic stage (new).

M. A. Stainbrook, 1945, Am. Jour. Sci., v. 243, no. 2, p. 66. Formation comprises (ascending) Coggon, Otis, Kenwood, Spring Grove, and Davenport members. Studies indicate that, normally, Independence shale lies immediately below Cedar Valley limestone and above Wapsipinicon formation.

Named for Wapsipinicon River, between Troy Mills, Linn County, and Central City, Linn County, Iowa.

Waramaug Formation

Precambrian(?) or pre-Triassic: Northwestern Connecticut.

R. M. Gates *in* R. M. Gates and W. C. Bradley, 1952, Connecticut Geol. Nat. History Survey Misc. Ser. 5, p. 7, 8–14. Name proposed for those rocks previously termed Berkshire formation in this area. Includes two important rock types: coarse mica-quartz gneiss and gray mica quartzite with streaks of biotite. Weathering of gneiss member causes rough corrugated surface. Foliation locally significant. All rock types are injected and intruded by granites, pegmatites and granitic materials. Precambrian(?).

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

Typical occurrence around Lake Waramaug, Kent and New Preston quadrangles.

Ward Gypsum[1]

Permian: Central northern Texas.

Original reference: L. W. Storm, 1929, Geologic map of Stonewall County: Texas Bur. Econ. Geology.

Stonewall County.

Ward Limestone[1] Member (of Cannon Limestone)

Middle Ordovician: Central Tennessee.

Original reference: P. M. Jones, 1892, Geology of Nashville and immediate vicinity: Univ. Press, p. 36–38.

C. W. Wilson, Jr., 1948, Tennessee Div. Geology Bull. 53, p. 24, 27–29, geol. map. Averages 25 feet thick in Nashville area; consists of massively bedded very coarse-grained gray to bluish-gray limestone, locally extensively crossbedded or irregularly bedded. Overlain and underlain by units termed upper dove-colored member and lower dove-colored member.

Named for exposures in Mrs. Ward's quarry, near the Hudson place on Addison Ave., and Pearl St., Nashville, Davidson County.

Ward Cove Limestone

Ward Cove Limestone Member (of Cliffield Formation)

Middle Ordovician: Southwestern Virginia.

B. N. Cooper and C. E. Prouty, 1943, Geol. Soc. America Bull., v. 54, no. 6, p. 827–832, 863, 884 (fig. 3). In Tazewell County, strata embraced by Chazyan and Black River groups of Butts (1940, Virginia Geol. Survey Bull. 52, pt. 1) are subdivided into (ascending) 29 zones. Name Ward Cove limestone member of Cliffield formation is applied to first coarse-grained limestone (zone 6) and overlying *Nidulites* beds (zone 7). Thickness 225 feet. Underlies Lincolnshire member (new); overlies Peery limestone member (new). First coarse-graind limestone is Butts' Holston of some areas; *Nidulites* beds constitute a part of Butts' lower Ottosee.

B. N. Cooper, 1945, Virginia Geol. Survey Bull. 66. p. 46–49. Rank raised to formation.

C. E. Prouty, 1946, Am. Assoc. Petroleum Geologists Bull., v. 30, no. 7, p. 1152, 1157–1159. Restricted to *Nidulites* beds (zone 7); zone 6 is herein named Thompson Valley limestone. Thickens southwest from about 150 feet, near New Castle, to over 350 feet at Mechanicsburg, and over 550 feet near Sharon Springs.

Well exposed along State Highway 91 south of junction with County Road 604 and opposite Al Gillespie Farm. Takes its name from a breached plunging anticline in Tazewell County.

Wardell 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. 838–840, 873–875, 884 (fig. 3), pl. 5. In Tazewell County, strata embraced by Chazyan and Black River groups of Butts (1940, Virginia Geol. Survey Bull. 52, pt. 1) are subdivided into (ascending) 29 zones.

Name Wardell formation is applied to *Stromatocerium* beds (zone 16), *Receptaculites biconstrictus* beds (zone 17), third coarse-grained limestone (zone 18), and overlying buff shale (zone 19). Thickness more than 200 feet south of Wardell; thins gradually to the northeast and pinches out a short distance east of Tazewell; 35 feet at Marys Chapel, about 60 feet at North Tazewell, and 45 feet in west end of Burkes Garden. In type section and in southeastern end of Thompson Valley, overlies Burkes Garden member of Benbolt formation (both new); toward Tazewell from Russell-Tazewell County line, Gratton limestone (new) appears between the two formations and thickens at expense of the Wardell; in western part of the county, the Wardell is overlain by a sandstone that pinches out northeast of Russell-Tazewell County line; east of Liberty the sandstone that pinches out northeast of Russell-Tazewell County line; east of Liberty, the sandstone is absent and Wardell is overlain by red mudrock tongue of Bowen formation (new); in other words, the Wardell overlaps successively younger beds northeastward and is overlapped in the same direction by successively younger beds. Wardell includes beds which Butts considered characteristic limestone of Ottosee in Russell County.

C. E. Prouty, 1946, Am. Assoc. Petroleum Geologists Bull., v. 30, no. 7, p. 1166–1171. Northeast of Clinch Mountain, the Wardell occurs throughout entire Copper Creek belt from Pearisburg, Va., where it is only about 10 feet thick, to Knoxville region, where it is several hundred feet thick.

G. A. Cooper, 1957, Smithsonian Misc. Colln., v. 127, pt. 1, p. 96–97. Where Gratton limestone is not present, as at Rye Cove, it is difficult to separate the Wardell from the Benbolt, and the two combined are known as Dryden formation (new).

Type section: About 150 feet east of County Road 610 about 1 mile north of ford across Little River, Tazewell County, Va. Name derived from settlement near Tazewell-Russell County line.

Wardlaw Shale

Carboniferous(?): Northwestern Utah.

V. E. Peterson, 1942, Econ. Geology, v. 37, no. 6, p. 471 (table 1). Consists of black to gray thin to massive bedded pyritic shale, locally containing lenses of gray dolomitic limestone. Thickness 400 feet. Underlies newly named Phelan limestone and overlies newly named Vipont limestone.

In Ashbrook mining district on west side of Goose Creek Range.

War Eagle 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. 216.

H. R. Wanless, 1939, Geol. Soc. America Special Paper 17, p. 93. Massive sandstone in Kanawha group.

Named for association with War Eagle coal [Mingo County].

War Eagle Underclay (in Kanawha Group)

Pennsylvanian (Pottsville): Eastern West Virginia.

W. A. Tallon and R. G. Hunter, 1959, West Virginia Geol. and Econ. Survey Rept. Inv. 17, p. 18. Varies from light to dark gray, and from plastic to hard. Average thickness 7.2 feet. Occurs below War Eagle coal, and about 1,400 feet below top of Pottsville series.

Present in Nicholas and Webster Counties.

Ware Schist[1]

Carboniferous: Central Massachusetts.

Original reference: E. Callaghan, 1931, Geol. Soc. America Bull., v. 42, pt. 1, p. 230.

Occurs along Ware River near village of Coldbrook, Worcester County.

**Warley Hill Marl**[1]

Warley Hill Formation

†Warley Hill phase[1]

Eocene, middle: Western and central 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, 16.

C. W. Cooke and F. S. MacNeil, 1952, U.S. Geol. Survey Prof. Paper 243–B, p. 20 (fig. 2), 23. "Warley Hill phase," described by Sloan, was included in the McBean formation by Cooke (1936, U.S. Geol. Survey Bull. 867). Name Warley Hill marl is here revived in restricted sense to include dominantly glauconitic beds that intervene between Congaree formation (rank raised) and *Ostrea sellaeformis* zone, or restricted McBean. As restricted, the Warley Hill includes beds 9 and 10 of section described by Cooke (1936, p. 71); this is considered type locality and thickness here is 16 feet.

G. E. Siple, 1957, Carolina Geol. Soc. Guidebook Nov. 16–17, p. 11, 12. Referred to as Warley Hill formation.

Type locality: On abandoned road west of State Highway 267 and south of Warley Creek 3 miles north-northwest of Lone Star, Elloree quadrangle, Calhoun County. Phase and marl were named for exposures at Warley Hill, in eastern part of Orangeburg County.

Warm[1] (formation)

Lower Cretaceous: Montana.

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

Derivation of name not stated.

Warman Quartz Monzonite

Precambrian (late Algoman): Central Minnesota.

M. S. Woyski, 1949, Geol. Soc. America Bull., v. 60, no. 6, p. 1002, 1009, 1011, pl. 1. White to very light gray; may be weathered to pink, red, or yellow; medium granitoid with poikilitic orthoclase phenocrysts 1 to 3 centimeters long; massive except locally where there is slight primary foliation. Cut by basalt dikes; contains inclusions and roof pendants of Thomson formation. One of five major instrusives in late Algoman; these cannot be shown to be members of single magma series; age relations of named intrusives, St. Cloud gray granodiorite, Hillman tonalite, and the Warman are indeterminate as no contacts are exposed.

Exposed along the Snake River in T. 42 N., and T. 43 N., in vicinity of Ann River, and in quarries at Warman, Isle, and Pierz, in Pine, Kanabec, Mille Lacs, and Morrison Counties.

**Warm Creek Shale** (in Colorado Group)[1]

Upper Cretaceous: Central northern Montana.

Original reference: A. J. Collier and S. H. Cathcart, 1922, U.S. Geol. Survey Bull. 736–F, p. 172.

J. B. Reeside, Jr., 1944, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 10. As shown on correlation chart, Colorado group in central Montana, comprises Mowry shale below and Warm Creek shale, which underlies Telegraph Creek formation.

J. P. Gries, 1954, Am. Assoc. Petroleum Geologists Bull., v. 38, no. 4, p. 449. Colorado group, which formerly included all of Graneros formation around Black Hills, has been restricted to Upper Cretaceous (Cobban and Reeside, 1952, Geol. Soc. America Bull., v. 63, no. 10, chart 10–b) and includes Belle Fourche shale, together with overlying Greenhorn, Carlile, and Niobrara formations. Term Bell Fourche shale is now used in Williston basin wherever underlying Mowry can be differentiated, except in Little Rocky Mountains where name lower Warm Creek shale is applied.

Named for exposures along Big Warm and Little Warm Creeks, Little Rocky Mountain region.

Warmington Limestone Member (of Elephant Butte Formation)

Pennsylvanian (Des Moines Series) : Central New Mexico.

M. L. Thompson, 1942, New Mexico Bur. Mines Mineral Resources Bull. 17, p. 27 (table 2), 47, 49. Named proposed for basal 22 feet of Elephant Butte formation (new). Member consists of medium- to light-gray dense and cherty limestone. Overlies Cuchillo Negro formation (new).

Type locality: Western end of Whiskey Canyon, in northern part of Mud Springs Mountains, sec. 1, T. 13 S., R. 5 W., Sierra County.

Warm Spring Formation

Lower (?) Triassic: Southeastern California.

B. K. Johnson, 1957, California Univ. Pub. Geol. Sci., v. 30, no. 5, p. 384, 385–388, figs. 1, 3. Consists of two unnamed members, an upper, 10 to 100 feet thick, that is a limestone breccia or pépérite; and a lower, more than 4,000 feet thick, of andesite flows. Upper limit of formation is marked at some places by bodies of Jurassic(?) quartz monzonite that intruded the andesite and at other places by extrusive Tertiary rocks that conceal the andesites; thus, total thickness of the formation is unknown. Due to eastward overlap of Triassic rocks, the Warm Spring rests on Triassic Butte Valley formation (new) east of Striped Butte and on Permian Anvil Spring formation (new) near eastern edge of quadrangle.

Named for exposures at head of Warm Spring Canyon in eastern part of Manly Peak quadrangle, Inyo County.

Warm Springs Formation (in Colpitts Group)

Middle Jurassic: East-central Oregon.

R. L. Lupher, 1941, Geol. Soc. America Bull., v. 52, no. 2, p. 227 (table 1), 229–249. Sandstone, shale, and mudstone gradation in upper part of Colpitts group (new). Thickness 100 to 300 feet. Unconformably underlies Hyde formation (new); overlies Weberg formation (new) with contact not sharply defined.

W. R. Dickinson, 1960, Dissert. Abs., 20, no. 11, p. 4367 Weberg, Warm Springs, and Basey (new) formations are lateral equivalents of Snowshoe formation.

Type area: On east side of Warm Springs Creek valley in secs. 19, 20, 29, and 30, T. 18 S., R. 26 E. Named for Warm Springs Creek, Crook County.

Warner Basalt[1]

Pliocene, upper: Northeastern California.

Original reference: R. J. Russell, 1928, California Univ. Pub., Dept. Geol. Sci. Bull., v. 17, no. 11, p. 416–425, map.

R. S. LaMotte, 1936, Carnegie Inst. Washington Pub. 455, p. 65. Geologic section exposed at Rattlesnake Butte, Modoc County, shows Warner basalt overlying Alturas formation.

T. E. Gay, Jr., and Q. A. Aune, 1958, Geologic map of California (1:250000) Alturas Sheet: California Div. Mines. Mapped with Pliocene volcanic rocks. Warner basalt of Russell (1928) includes lithologically similar basalts ranging in age from post middle Miocene through Pleistocene; subdivided on this map sheet into Pleistocene, Pliocene, and Miocene units.

Cordell Durrell, 1959, California Univ. Pubs., Geol. Sci., v. 34, no. 3, p. 165 (fig. 1), 178–180. In Blairsden quadrangle, overlies Penman formation. Thickness 350 to 1,300 feet. The Warner was last formation to be deposited as sheet over area. Older than Mohawk lake beds. Upper Pliocene.

Named for exposures on sides of Warner Valley and for widespread distribution in Warner Lakes Range and Warner Range.

**Warner Sandstone Member** (of McAlester Formation)[1]

Warner Formation (in Cherokee Group or Krebs Group)

Warner Sandstone Member (of Krebs Formation)

Pennsylvanian (Des Moines Series): Eastern Oklahoma, southeastern Kansas, and southwestern Missouri.

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. 37–41. Member of McAlester formation. Generally consists of massive buff calcareous and hard sandstone 5 to 30 feet thick. In Tps. 12, 13, and 14 N., a thin-bedded sandstone as much as 10 feet thick occurs a few feet above scarp forming sandstone of Warner and a thin coal bed occurs in the intervening 5-foot shale. The two sandstones and intervening shale and coal were included by Wilson in the Warner. Term Warner is here restricted to the scarp-forming massive lower sandstone. Overlies McCurtain shale member; underlies unnamed shale below Lequire sandstone member. Reconnaissance mapping northward from Wagoner indicates that Warner sandstone is continuous with Little Cabin sandstone of northeastern Oklahoma. From Wagoner northward, Warner (Little Cabin) sandstone gradually converges with top of Mississippian rocks unitil it rests directly on Mississippian in southeastern Kansas.

M. C. Oakes and M. M. Knechtel, 1948, Oklahoma Geol. Survey Bull. 67, p. 32–35. Member of McAlester. Described in Haskell County. Type locality stated.

W. V. Searight and others, 1953, Am. Assoc. Petroleum Geologists Bull., v. 37, no. 12, p. 2748 (fig. 1). Warner formation in Krebs group. Overlies Riverton formation; underlies Rowe formation (new). Includes beds up to and including Neutral coal. A lower coal above Warner is present in Oklahoma and its horizon is identifiable in Kansas.

W. V. Searight, 1955, Missouri Geol. Survey and Water Resources Rept. Inv. 20, p. 9 (fig. 1), 11 (fig. 3), 18 (fig. 7), 19, 41. Formation, in Jasper County, Mo., is about 25 feet thick and consists of a sequence of shale and sandstone. Overlies Riverton formation. Thickness 31 feet in Vernon County. Name has priority over Little Cabin sandstone. Krebs group.

W. B. Howe, 1956, Kansas Geol. Survey Bull. 123, p. 22 (fig. 5), 32–35. Warner formation, in Krebs sub-group of Cherokee, includes beds above Riverton coal extending upward to top of Neutral coal bed. Succession includes prominent and wide-spread Warner (Little Cabin) sandstone from which it takes its name. Thickens southward in outcrop area in southeastern Kansas; generally less than 50 feet thick in Vernon and Barton Counties, Mo.; 50 to 100 feet in Cherokee County, Kans.

D. T. Russell, 1960, Oklahoma Geol. Survey Circ. 50, p. 14–17, pl. 1. Member of McAlester. Described in Latimer County where it is 77 feet thick; overlies McCurtain shale member, and underlies unnamed shale below Cameron sandstone member. Lequire sandstone member not recognized in area of this report.

Type locality (Oakes and Knechtel): About one-fourth mile east of NW cor. sec. 21, T. 12 N., R. 19 E., 1 mile north of Warner, Okla.

†Warren Beds (in Richmond Group)[1]

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

Original reference: J. M. Nickles, 1902, Cincinnati Soc. Nat. History Jour., v. 20, p. 86.

Named for Warren County, Ohio.

Warren Sandstone[1]

Mississippian: Northeastern Ohio.

Original reference: H. P. Cushing, 1888, Am. Assoc. Adv. Sci. Proc., v. 36, p. 214–215.

Named for Warren, Trumbull County.

†Warrendale Formation[1]

Oligocene or Miocene, lower: North-central Oregon.

Original references: W. D. Smith and E. L. Packard, 1919, Oregon Univ. Bull., v. 16, no. 7, p. 97–99; 1919, Jour. Geology, v. 27, p. 97–98.

T. P. Thayer, 1939, Oregon Dept. Geology and Mineral Industries Bull., v. 15, p. 7. Mehama volcanics are comparable in age to Warrendale or Eagle Creek formation in Columbia River Gorge. Oligocene.

E. T. Hodge, 1940, (abs.) Geol. Soc. America Bull., v. 51, no. 12, pt. 2, p. 2025. Referred to as lower Miocene pyroclastics.

Named for town of Warrendale, near Eagle Creek, Multnomah County.

**Warren Point Sandstone Member** (of Gizzard Formation)[1]

Warren Point Sandstone (in Gizzard Group)

Warren Point Sandstone (in Lee Formation)

Lower Pennsylvanian: Eastern Tennessee and Georgia.

Original reference: W. N. Nelson, 1925, Tennessee Div. Geology Bull. 33–a, p. 43, 44, 148–149, 184.

R. C. Moore and others, 1944, Geol. Soc. America Bull., v. 55, no. 6, chart 6 (column 18). Shown on correlation chart for northern Tennessee as sandstone in Lee formation.

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. 3, 4, 12–D. Rank raised to formation in Gizzard group (herein rank raised). Attains its maximum thickness—a little more than 200 feet—in vicinity of Signal and Lookout Mountains near Chattanooga, where it is conglomeratic. The Warren Point of this area may be composite sandstone, with true Warren Point sandstone resting unconformably on one or more sandstones of Raccoon Mountain formation (new); from Chattanooga northeastward to Sale Creek-Soddy mining district, the Warren Point thins gradually and splits into several nonconglomeratic sandstones; this change makes identification difficult; farther northeast, in Roddy quadrangle, it is again a single massive conglomeratic sandstone. Underlies Signal Point shale (new); overlies Raccoon Mountain formation. Pottsville series. Type locality stated.

Type locality: Warren Point, just north of Monteagle, Grundy County, Tenn.

Warren Ranch conglomerate facies (of Deese Group)

Pennsylvanian (Desmoinesian): Southern Oklahoma.

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), 33–35. Series of boulder conglomerates, totaling about 100 feet in aggregate thickness and distributed through about 1,000 feet of other sediments, chiefly gray and red shales. Lowest conglomerate lies about 900 feet above Rocky Point member; upper conglomerates lie within West Arm formation (new).

Occurs in an area of 2 or 3 square miles in sec. 14, S½ sec. 11, W½W½ sec. 23, E½E½ secs. 22 and 27, T. 3 S., R. 2 E., west of Ardmore Air Force Base, Carter County. Name taken from ranch which occupies much of outcrop area.

**Warrensburg Channel Sandstone**[1]

Warrensburg Sandstone (in Labette Shale)

Warrensburg Sandstone Member (of Nowata Formation)

Pennsylvanian: Central western Missouri.

Original reference: A. Winslow, 1892, Missouri Geol. Survey Sheet Rept. 1, (v. 9), p. 22, 45–54.

F. C. Greene and W. V. Searight, 1949, Missouri Geol. Survey and Water Resources Rept. Inv. 11, p. v (fig. 1), 8–9. Shown on stratigraphic section as Warrensburg sandstone member of Nowata formation. Name is retained in Missouri for sandstones occupying the Warrensburg and Moberly channels. Name has also been applied by Missouri geologists to sandstone now known to lie between the Altamont and Sni Mills limestones in Jackson County. Howe (unpub. thesis) restricted position of subsurface Warrensburg when he tentatively correlated a thin limestone overlying it with Norfleet limestone or lower Lenapah. These subsurface sandstones thus lie within the Nowata interval and occupy the approximate position of Walter Johnson sandstone of Kansas Geological Survey. Because of priority in usage, name Warrensburg will continue to be used in Missouri to include post-Altamont, pre-Lenapah sandstones of Marmaton age, and channels sands of the Warrensburg and Moberly channels.

R. C. Moore and others, 1951, Kansas Geol. Survey Bull. 89, p. 97. Englevale sandstone member is one of several bodies of sandstone collectively referred to as Warrensburg sandstone, lying in middle and lower parts of Labette shale.

Named for exposures at Warrensburg, Johnson County.

†Warrensburg Group[1]

Pennsylvanian: Central western Missouri.

Original reference: G. C. Broadhead, 1873, Missouri Geol. Survey Prelim. Rept. on Iron Ores, pt. 2, p. 169, 182.

Named for exposures at Warrensburg, Johnson County.

Warrens Ranch Latite

Tertiary: Southeastern Arizona.

W. H. Brown, 1939, Geol. Soc. America Bull., v. 50, no. 5, p. 742. Quartz-bearing latite porphyry. Constitutes a sill at extreme eastern end of Silver Lily dike system. Rests on narrow belt of Safford tuff (new) on the south and apparently in fault contact with Cat Mountain rhyolite (new) on the north.

Outcrops over an elliptical area 1½ miles by one-half mile in extent; approximately 1 mile north of Twin Hills, Tucson Mountains, Pima County.

Warrenton Agglomerate Member (of Catoctin Series)

Precambrian: Northeastern Virginia.

A. S. Furcron, 1939, Virginia Geol. Survey Bull. 54, p. 20–22, pl. 1. Composed of boulders, cobbles, and pebbles of greenstone imbedded in finer matrix of similar material. Largest boulders several feet in diameter. In some places, agglomerate composed almost entirely of greenstone fragments; in other places, greenstone fragments sparingly scattered through a fine matrix. Fragmental character best criterion for identification of rock in field. Most fragments of epidosite. Thickness variable; at Shiloh School and in Piney Mountain at least 1,500 to 2,000 feet; in southwestern corner of Warrenton quadrangle, it is thin. At or near base of greenstone making up series. Overlies Fauquier formation (new).

Widespread in Warrenton area, Warrenton quadrangle, Culpeper and Fauquier Counties.

**Warrior Limestone**[1]

Upper Cambrian: Central Pennsylvania.

Original reference: Charles Butts. 1918, Am. Jour. Sci., 4th v. 46, p. 528, 534, 537.

Charles Butts, 1939, Pennsylvania Geol. Survey, 4th ser., Topo. and Geol. Atlas 96, p. 9–10. Described in Tyrone quadrangle. Composed of interbedded limestone and dolomite, with thin layers of siliceous shale or shaly sandstone. Thickness about 1,200 feet. Overlies Pleasant Hill limestone; underlies Gatesburg dolomite.

J. L. Wilson, 1952, Geol. Soc. America Bull., v. 63, no. 3, p. 278–281, pl. 1. Described in Nittany Arch belt. Thickness at Williamsburg 1,340 feet. Overlies Pleasant Hill formation; underlies Stacy member of Gatesburg formation.

Named for exposures on Warrior Run, along river bluff 1 mile west of Williamsburg, Blair County, and on Warrior Creek, east of Warriorsmark in northern part of Huntingdon County.

**Warsaw Shale, Limestone, or Formation**

Warsaw Formation (in Osage Group)

Warsaw Shale or Limestone (in Meramec Group)[1]

Upper Mississippian (Meramec Series): Illinois, northern Alabama, Indiana, Iowa, Kentucky, northeastern Mississippi, eastern Missouri, and Tennessee.

Original references: J. Hall, 1857, Am. Assoc. Adv. Sci. Proc., v. 10, pt. 2, p. 54–56; 1858, Iowa Geol. Survey Rept., v. 1.

Charles Butts, 1922, Kentucky Geol. Survey, 6th ser. [Geol. Repts.], v. 7, p. 89–120, 121, 122, 123, 124. Formation in Meramec group. Warsaw succeeds rocks or Keokuk age. Lower limit in Jefferson County, Ky., is placed at top of Holtsclaw sandstone, whereas, in southern Kentucky. where Holtsclaw is absent, lower limit is determined by differences in lithology and fossils. In Kentucky, includes (ascending) Wildie sandstone, Somerset shale, and Garrett Mill sandstone members. Limestone of the Warsaw throughout Kentucky and Tennessee is practically identical in lithologic character with "Harrodsburg" limestone, of Warsaw age, at its type locality, Harrodsburg, Ind. Thicknesses; about 240 feet between Colesburg and Tunnel Hill, Hardin County; about 200 feet in Ohio River bluff in Indiana opposite West Point, Ky.; less than 100 feet at Edwardsville, Ind.; 80 to 100 feet in southern counties of central Kentucky and in northern middle Tennessee. In part of Kentucky and Tennessee, underlies St. Louis limestone. In south-central Indiana, particularly in Monroe, Lawrence, and Washington Counties, the limestone between the same upper and lower limits as the Warsaw of Kentucky, as herein interpreted, is divided into two formations, Warsaw ("Harrodsburg") limestone below and Spergen limestone above, the Spergen being called Salem limestone by Indiana geologists.

P. B. Stockdale, 1939, Geol. Soc. America Spec. Paper 22, p. 14, 15, 16, 17, 35, 41, 44, 49, 54, 57, 216, 222, 229. Discussion of Lower Mississippian of east-central interior. Lower Mississippian as used here includes Kinderhook and Osage divisions of standard Mississippian time scale. Warsaw is uppermost subdivision of the Osage and not the Meramec. Papers by Butts discussed, especially (1922). Some strata regarded by Butts (1922) as Warsaw are not so regarded in present study. Lower Harrodsburg (Keokuk age) is removed from Warsaw and placed at top of Muldraugh formation (new), uppermost formation of Borden group. Upper Harrodsburg (Harrodsburg, restricted) contains distinctive Warsaw fauna and consitutes definite bounding unit at top of lower Mississippian rocks studied in this report. Wildie sandstone member (Butts, 1922) is reallocated to Muldraugh formation; Somerset shale member (Butts, 1922) is interpreted as basal phase of Salem limestone at top of Harrodsburg (restricted). So-called Warsaw of Tennessee not studied for this report, but question arises as to correctness of classification and correlation of "Warsaw" in Tennessee. This involves "Garrett Mill" sandstone member of Warsaw (Butts, 1922).

J. M. Weller and A. H. Sutton, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 5, p. 766 (fig. 1), 802–805. Uppermost formation of Osage group, Iowa series. This classification follows Illinois Geological Survey. Name Warsaw was originally given to 18 feet of thin-bedded bluish-gray limestone with interbedded calcareous shale which crops out at Warsaw, Hancock County, Ill. Hall (1858) expanded the Warsaw to include about 50 feet of strata lying between the geode beds and St. Louis limestone.

Subsequently, 8 feet of crossbedded yellowish-weathering limestone grading locally into calcareous sandstone which occurs immediately below St. Louis limestone was removed from Warsaw at its type locality and assigned to Salem limestone (Weller, 1908, Illinois Geol. Survey Bull. 8), and the geode beds, which had formerly been included in the Keokuk, were transferred to Warsaw formation (Butts, 1915, Kentucky Geol. Survey, ser. 4, v. 3, pt. 2; Tuyl, 1925, Iowa Geol. Survey, v. 30). The Warsaw, as thus defined, was considered exact equivalent of Harrodsburg limestone of Indiana (Butts, 1915; Cumings, 1922, Indiana Dept. Conserv. Pub. 21), and latter name was abandoned because Warsaw had priority. Lower division of Warsaw, which at type locality is about 36 feet thick and has been termed "geode beds," consists of massive fine-grained earthy geode-bearing limestone below, thin bed of locally brownish dolomitic cherty limestone in middle, and bluish-gray slightly calcareuos geode-bearing shale above. Upper part of Warsaw has not been distinguished from overlying Salem everywhere in western Illinois and adjacent parts of Missouri. Upper division of Warsaw, at Warsaw, consists of about 40 feet of bluish-gray shale with thin interbedded layers of argillaceous limestone, a few thin beds of fine-grained bluish-gray sandstone, and several massive bluish-gray dense to finely crystalline limestone strata which locally are irregularly and incompletely dolomitized. It thins northward and disappears from section a little north of Keokuk. South of Warsaw this part of formation becomes increasingly calcareous and has probably been included in Salem or Spergen formation. In Ste. Genevieve County, Mo., and Monroe County, Ill., the upper Warsaw consists of about 60 feet of gray to buff fine-grained more or less earthy and locally dolomitic limestone. Warsaw and Salem limestones have not been separated in southern Illinois and western Kentucky where they attain maximum combined thickness of 200 to 250 feet. In northern Hardin County, Ky., the Warsaw, including the few feet of limestone above Somerset shale that may be equivalent to the Salem, is about 220 feet thick. Because Edwardsville formation of Borden group has commonly been included in Warsaw formation in Jefferson, Hardin, and adjoining counties, Kentucky, its reported thicknesses there may be too great by 50 feet or more. In Indiana, the Warsaw crops out continuously from Montgomery County to Ohio River with thickness of 60 to 90 feet. Divisible into two parts: upper, massive limestone 30 to 50 feet thick, and lower, divided into (ascending) Ramp Creek, Leesville, and Guthrie Creek. Conformably overlies Edwardsville formation in Indiana.

L. R. Laudon, 1948, Jour. Geology, v. 56, no. 3, p. 289–290. Discussion of Warsaw problem and Osage-Meramec contact. Warsaw formation has been classified with beds of Meramec age or with beds of Osage age. Type section of Warsaw restudied. At type section, slightly more than 118 feet of strata occur between last crystalline crinoidal beds of Keokuk formation and contact of St. Louis limestone. No beds of Salem age recognized in area. No evidence found at type section for separating some 10 feet of crossbedded calcareous sandstone, which lies immediately beneath St. Louis limestone in the area, from the Warsaw. This sandstone has been considered to represent Salem formation (Weller, 1908). No evidence of disconformity found between rocks of Keokuk age and Warsaw beds at type section or at several other sections studied in area. No evidence of physical break found within Warsaw. Contact with overlying St. Louis remarkably conformable. All previously published lists of faunas disregarded and new collections made. Thirty species of abundant Warsaw forms identified and 27 of them were found in Keokuk rocks. Comparison of Warsaw fauna with 20 abundant species from type area of Salem formation shows almost no affinities at all. This observation contrasts strongly with general opinion regarding relationships of Warsaw-Salem faunas (Weller and Sutton, 1940). The Warsaw resembles clastic facies of older Osage formations farther east but does not resemble typical Meramec rocks. In present report, Salem is considered as base of Meramec series in upper Mississippi Valley area. If Salem is calcareous facies development within Warsaw formation, as suggested by Weller and Sutton (1940), this classification will need serious revision.

J. M. Weller and others, 1948, Geol. Soc. America Bull., v. 59, no. 2, p. 99–100, chart 5. Shown on standard Mississippian section as basal formation in Meramecian series. Occurs below Salem limestone and above Keokuk limestone of Osagean series. Disagreement regarding boundary between Meramecian and Osagean series has been widespread and prolonged and has been concerned principally with proper placement of Warsaw formation. Current usage is not consistent.

H. R. Wanless, 1957, Illinois Geol. Survey Bull. 82, p. 45–47. Formation in Osage group, Valmeyer series. Oldest outcropping formation in area of this report [Beardstown, Glasford, Havana, and Vermont quadrangles]. Thickness 50 to 75 feet. Underlies Salem limestone.

J. W. Baxter, 1960, Illinois Geol. Survey Circ. 284, p. 2 (table 1), 4. Underlies Kidd member (new) of Salem limestone.

Typical exposure: Along creek known as Soap Factory Hollow, which joins the Mississippi from the east about one-half mile south of Lower Warsaw, Ill. Named from exposures at Warsaw, Hancock County, Ill.

**Wartburg Sandstone**[1]

Wartburg Sandstone (in Crooked Fork Group)

Pennsylvanian: Northeastern Tennessee.

Original reference: Arthur Keith, 1896, U.S. Geol. Survey Geol. Atlas, Folio 33.

C. W. Wilson, Jr., J. W. Jewell, and E. T. Luther, 1956, Pennsylvanian geology of the Cumberland Plateau, Tennessee: Tennessee Div. Geology [Folio], p. 5 (pl. 4), 6. Reallocated to Crooked Fork group (new). Overlies Glenmary shale (new); underlies Poplar Creek coal at top of group.

Named for Wartburg, Morgan County.

Wartburg Sandstone Member[1] (of Briceville Formation)

Pennsylvanian: Northeastern Tennessee.

Original reference: L. C. Glenn, 1925, Tennessee Geol. Survey Bull. 33B, p. 311.

Occurs in town of Wartburg, Morgan County.

Warwick Limestone[1]

Lower Ordovician: New York.

Original reference: W. W. Mather, 1843, Geology New York, v. 1, p. 367.

**Wasatch Formation**[1]

Wasatch Group[1]

Paleocene and Eocene: Utah, western Colorado, central southern and southeastern Montana, northwestern New Mexico, southwestern North Dakota, and western Wyoming.

Original reference: F. V. Hayden, 1869, U.S. Geol. Survey Terr. 3d Ann. Rept., p. 191 of 1873 ed.

Walter Granger, 1914, Am. Mus. Nat. History Bull., v. 33, p. 205–207. Estimated thickness of Wasatch beds in New Mexico is about 1,000 feet. Mammalian fossils occur throughout greater part of vertical range. Lower two-thirds of Wasatch, referred to as Almagre beds (new) and upper horizon, comprising remaining third, the Largo beds (new). Overlies Torrejon formation.

E. M. Spieker and J. B. Reeside, Jr., 1925, Geol. Soc. America Bull., v. 36, no. 3, p. 448–451. Formation, as recognized in Wasatch Plateau, consists of three members— lower member of sandstone, varicolored shale, conglomerate and small amounts of fresh-water limestone; middle member of fresh-water limestone, here called Flagstaff member; and an upper member of varicolored shale and sandstone. East of Wasatch Plateau, in Book Cliffs—Uinta Basin region—the three divisions lose their distinctness through wedging out, in many tongues, of the Flagstaff limestone.

W. T. Nightingale, 1930, Am. Assoc. Petroleum Geologists Bull., v. 14, no. 8, p. 1019–1040. Includes Hiawatha member (new).

H. E. Wood 2d and others, 1941, Geol. Soc. America Bull., v. 52, no. 1, p. 35–36, pl. 1. Term Wasatch is properly a group, though usually called a formation, in southwestern Wyoming, especially Uinta County. Early Eocene and (?) Paleocene. By unjustified extensions, term has come to include a wide variety of continental deposits of variegated colors in western North America, of uncertain age, presumed to be early Tertiary, as well as numerous actually dated deposits of Wasatchian age. In spite of its wide use in literature, it is an unfortunate term because the standard "Wasatch faunas" (those of the Bighorn and San Juan Basins) occur in formations which are merely called "Wasatch" and the Wasatch group proper is almost without fossil vertebrates. In the Wasatch proper, the La Barge local fauna is equivalent to that of the Lost Cabin, and the Knight fauna to that of the Lysite. Thus, the fossiliferous Wasatch is exactly equivalent, faunally, to the fossiliferous Wind River which, according to most text books and standard manuals, is supposed to overlie it. The exceedingly tentative determinations of the Fowkes as late Paleocene, the Almy as mid-Paleocene, and underlying Evanston as early Paleocene, do not rest on satisfactory evidence. When the "Wasatch fauna" is spoken of, it means in practice one of two things: (1) lower Eocene or Wasatchian of this report or (2) Gray Bull. The latter is difficult to justify because no fauna of Gray Bull age has been found in type Wasatch so that it is not certain that beds of that age are present. Term Canyon Largo group is here resurrected to replace term "San Juan Wasatch" (Holmes, 1877, U.S. Geol. and Geog. Survey Terr. 9th Ann. Rept. for 1875).

G. B. Richardson, 1941, U.S. Geol. Survey Bull. 923, p. 32–34, pls. 1, 8. Formation described in Randolph quadrangle, Utah-Wyoming, where it forms a belt across central part of the area, capping most of Bear River Plateau and extending westward over summit of part of Bear River Range. Composed of varicolored and varitextured continental deposits consisting principally of conglomerate and sandstone with subordinate amounts of sandy and clay shale, limestone, and tuff. Prevailing color red. Approximate thickness 1,000 feet. Not subdivided in this area. Overlies Bear River formation; near northern boundary of quadrangle, overlies tilted Twin Creek limestone. Eocene.

A. J. Eardley, 1944, (abs.) Utah Acad. Sci. Proc., v. 19, p. 19; 1944, Geol. Soc. America Bull., v. 55, no. 7, p. 824 (table 1). Group comprises (ascending) Almy conglomerate (with Pulpit and Saw Mill conglomerates, both new), Fowkes(?), and Knight(?) formations. Overlies Henefer formation (new); underlies Norwood tuff (new). Middle Paleocene(?), upper Paleocene(?), and lower Eocene.

P. T. Walton, 1944, Geol. Soc. America Bull., v. 55, no. 1, p. 114. In Uinta Basin, unconformably overlies Williams Fork formation.

H. E. Gregory, 1944, Am. Jour. Sci., v. 242, no. 11, p. 589–591, 601, 602. Formation, in upper Sevier River valley, Utah, underlies Brian Head formation (new). Thickness about 520 feet.

C. H. Dane, 1946, U.S. Geol. Survey Oil and Gas Inv. Prelim. Chart 24. Overlying the Nacimiento formation in southern part of San Juan Basin, and Animas formation in northern part, is series of gray, tan, and copper-colored conglomerates and sandstones and red and gray clays that, in San Juan Basin, for many years has been referred to Wasatch formation. For convenience this usage is continued in present report, with understanding that age limits of beds included in formation are not thereby implied to be same as those included in Wasatch at type locality. Formation occupies all of central part of basin. In part of T. 23 N., R. 1 W., about 1,000 feet stratigraphically above base of formation, is an escarpment capped by a higher horizon of sandstones and conglomerates. Between these higher resistant beds and basal sandstones the lower 1,000 feet of formation consists in large part of soft red and gray clays. Upper part of clays contains the lower faunule division of the Wasatch as recognized by Granger (1914), the Almagre beds. Thickness not less than 2,000 feet. Lower part of formation in northeastern part of basin contains beds of Paleocene age.

E. M. Spieker, 1946, U.S. Geol. Survey Prof. Paper 205–D, p. 121, 122 (fig. 15). Discussion of late Mesozoic and early Cenozoic history in central Utah. Discovery of dinosaur bones in strata of central Utah formerly assigned to Wasatch formation, together with other findings, notably recognition of thick section of conglomerates as Colorado in age, has made possible an outline of late Mesozoic and early Cretaceous history considerably different from scheme hitherto used. Important changes are recognition of orogenic epoch in eastern part of Great Basin early in Upper Cretaceous time and placing of main Laramide folding of central Utah between middle and late Montana time instead of end of Cretaceous. Present report presents data bearing on these conclusions, together with many other stratigraphic and structural determinations that bear on history and paleogeography of region, and discusses certain problems involved. Main points of revision of stratigraphic nomencalture involved are as follows: (1) abandonment of classification as Wasatch of the three units, Lower member. Flagstaff limestone member, and Upper member, formerly designated as members of that formation; (2) recognition of basal conglomerate of former lower member as equivalent to original Price River formation, and distinction of overlying part of lower member as North Horn formation; (3) establishment of Flagstaff limestone as independent formation; (4) adoption of name Colton for upper member of Wasatch formation as originally defined; (5) naming of unit beneath the Price River in western districts the Indianola group, subdivided where feasible and undifferentiated where not; and (6) assignment to Cretaceous of all beds up to and including highest dinosaur zone, and assignment to Paleocene of overlying part of North Horn formation. Wasatch problem discussed and history of usage of term reviewed. Believed name should not be abandoned without more thorough study of type area than has yet been done.

G. G. Simpson, 1948, Am. Jour. Sci., v. 246, no. 5, p. 257–282; no. 6, p. 363–385. Term San Jose formation proposed for "Wasatch" of authors in San Juan basin.

J. S. Williams, 1948, Geol. Soc. America Bull., v. 59, no. 11, p. 1130 (table), 1144–1147, pl. 1. Group, in Logan quadrangle, Utah, includes Cowley Canyon member (new) at base. Thickness 0 to 530 feet. Stratigraphically below Salt Lake group. Paleocene or lower Eocene.

M. D. Williams, 1950, Utah Geol. Soc. Guidebook 5, p. 102–106. Stratigraphic interval between Upper Cretaceous Mesaverde group and Green River formation in Uinta basin was originally referred to by early workers as Wasatch group but later came to be termed Wasatch formation. Spieker (1946) discusses Wasatch problem and in central Utah referred strata formerly assigned to Wasatch formation to North Horn, Flagstaff, and Colton formations. In a later publication, Spieker (1949, Utah Geol. Soc. Guidebook 4) does not use term Wasatch and apparently favors abandoning it, but without offering suitable substitute which can be used on regional basis. Top of Mesaverde group and base of Green River formation are usually readily recognizable horizons in regional mapping; intervening interval will here be designated as Wasatch group. Because lithologic boundaries and time limits do not always coincide, no definite age is assigned to the group other than "Cretaceous-Tertiary transition." As herein defined, Wasatch group may comprise North Horn, Flagstaff, and Colton formations; the 3,500 feet of strata containing the bituminous sandstone deposits at Sunnyside; the several thousand feet of strata assigned to the Wasatch in Piceance Creek basin and adjoining areas in western Colorado; the 780 feet of strata between the Mesaverde and Green River at Ravin Ridge; and Current Creek and Tuscher formations.

H. E. Gregory, 1950, U.S. Geol. Survey Prof. Paper 220, p. 51 (table), 111–112, pls. 2, 4, 5. Generalized section of formations, in Zion Park region, shows Wasatch formation, about 400 feet thick unconformable above Kaiparowits formation. In topography, formation makes up the Pink Cliffs.

J. D. Love and J. L. Weitz, 1951, U.S. Geol. Survey Oil and Gas Inv. Map OM–122. Formation, in Powder River basin, includes Kingsbury and Moncrief members. Overlies Fort Union formation; underlies White River formation. Base in some areas arbitrarily placed at top of Rowland coal. Eocene.

J. H. Donavan, 1950, Wyoming Geol. Assoc. Guidebook 5th Ann. Field Conf., p. 62, 64. As exposed in south-central Sublette County, the upper Wasatch is divided into two units, Knight member below and New Fork tongue (new). The Knight is stratigraphically succeeded by Green River formation, basal part of which is herein designated Fontenelle formation.

J. R. Donnell, W. B. Cashion, and J. R. Brown, Jr., 1953, U.S. Geol. Survey Oil and Gas Inv. Map OM–134. Formation crops out in relatively broad belt in west-central part of Cathedral Bluffs area. As defined in this area by Gale (1910, U.S. Geol. Survey Bull. 415), the formation was believed to include, in its lower part, beds equivalent to Fort Union formation which is of Paleocene age. Paleontological evidence collected by several workers since this early report has demonstrated that lowermost part of formation is of Eocene age. Boundary between Paleocene and Eocene beds is indefinite in Cathedral Bluffs area. Along Cathedral Creek, formation consists mostly of beds of buff sandstone and small amounts of interbedded varicolored shale and clay; to the north, formation consists predominantly of varicolored shale and small amounts of brown sandstone and limestone in lenticular beds. Thickness as much as 371 feet. Contact between Wasatch and overlying Green River (Douglas Creek member) drawn at top of uppermost bed of red shale; near head of Cathedral Creek, boundary drawn directly above uppermost sequence of interbedded thin beds of coal, shale, and redbeds. Overlies Mesaverde formation.

G. N. Pipiringos, 1955, Wyoming Geol. Assoc. Guidebook 10th Ann. Field Conf., p. 100–103. Formation, as mapped in this area [central part of Great Divide basin, Sweetwater County, Wyo.], is of early and middle Eocene age. Consists of rocks probably fluviatile and paludal in origin and intertongues throughout most of its vertical extent with rocks of Green River formation. Also intertongues with Battle Spring formation (new). Overlies Fort Union formation. Includes Red Desert and Niland tongues (both new) and Cathedral Bluffs tongue.

W. J. Morris, 1955, Dissert. Abs., v. 15, no. 3, p. 394. Use of term Wasatch for deposits in Washakie basin, Wyoming, is confusing. Name Knight extended from Bridger basin to include dominantly fluviatile Wasatchian deposits in Washakie basin. Knight formation includes Hiawatha member and Cathedral Bluffs tongue.

J. I. Tracey, Jr., and S. S. Oriel, 1959, Intermountain Assoc. Petroleum Geologists Guidebook 10th Ann. Field Conf., p. 128 (table 1), 129, 130. Formation, in Fossil Basin, Wyoming, overlies Evanston formation and underlies Green River formation. Confusion in original definition of Almy, Fowkes, and Knight formations as subdivisions of Wasatch group, and their areal distribution as mapped in much of Fossil Basin, had led to doubt as to validity of these names, especially Almy and Knight. These terms are not included in the Wasatch which is herein termed a formation.

W. J. Mapel, 1959, U.S. Geol. Survey Bull. 1078, p. 62–73. Formation described in Buffalo-Lake De Smet area, where it unconformably overlies Fort Union formation. Near Bighorn Mountains, comprises Kingsbury conglomerate and Moncrief members, which are separated by angular unconformity. Eastward, both members grade laterally into a conformable, nonconglomeratic sequence of sandstone, shale, and coal that makes up formation east of Buffalo and Lake De Smet. Eocene.

Type locality: Extends from Carter, Wyo., to the "Narrows on Weber," 7 miles below Echo City, Utah, and 10 to 15 miles east of crest of Wasatch Mountains. Name derived from Wasatch [Wahsatch] Station on Union Pacific Roalroad, Summit County, Utah.

†Wasatch Limestone[1]

Upper Ordovician, Silurian, Devonian, and Mississippian: Northeastern Utah.

Original reference: C. King, 1876, Am. Jour. Sci., 3d, v. 11, p. 477–479.

Northern Wasatch Mountains.

Wasatchian Age

Eocene: North America.

H. E. Wood 2d and others, 1941, Geol. Soc America Bull., v. 52, no. 1, p. 9, 10, pl. 1. Provincial time term, based on at least upper part of Wasatch group of southwestern Wyoming (modified to Wasatchian series by C. R. Keyes). Covers the time during which the faunas of the Sand Coulee, Gray Bull, Lysite, and Lost Cabin were deposited. As a functional term, the typical areas and faunas are those of the Bighorn and Wind River basins of Wyoming. Includes the interval between the Clarkforkian (Paleocene) and Bridgerian (Eocene) ages. Report defines 18 provincial time terms, based on mammal-bearing units, for the North American continental Tertiary. [For sequence see under Puercan].

†Washakie Formation[1]

Eocene: Southwestern Wyoming.

Original reference: F. V. Hayden, 1869, U.S. Geol. Survey Terr. 3d Ann. Rept., p. 190 of 1873 ed; (1869 ed. not available).

H. E. Wood 2d and others, 1941, Geol. Soc. America Bull., v. 52, no. 1, p. 36, pl. 1. Late Bridgerian and early Uintan.

W. J. Morris, 1955, Dissert. Abs., v. 15, no. 3, p. 394. Reinstated and applied to Bridgerian and Uintan strata lying above the Green River formation in Washakie Basin.

Named for exposures at Washaki Station between Creston and Bitter Creek on Union Pacific Railroad in Sweetwater Canyon, Wyo. (Washakie approved spelling).

Washburn Beds[1] (in Chequamegon Sandstone)

Precambrian (Keweenawan): Northeastern Wisconsin.

Original reference: F. T. Thwaites, 1912, Wisconsin Geol. Nat. History Survey Bull. 25, p. 34.

G. O. Raash, 1950, Illinois Acad. Sci. Trans., v. 43, p. 147. Discussion of Cambrian-Keweenawan boundary. Believed that Thwaites[1] Chequamegon brownstone formation is same as Port Wing brownstone member of Orienta formation repeated by faulting. Thwaites (1912) detailed description of the "Quarry" or "Brownstone beds" of the Chequamegon is essentially identical with that of the "Port Wing Brownstone" of the Orienta, whereas the upper or "Washburn beds" [upper part of Thwaites' Chequamegon] are described in much the same terms as his "upper member" of Orienta formation.

Named for exposures in shore cliffs south of Washburn, Bayfield County.

Washburn Sandstone[1]

Pennsylvanian: Western Arkansas and eastern Oklahoma.

Original reference: A. Winslow, 1896, New York Acad. Sci. Trans., v. 15, p. 51.

Probably named for Washburn, Sebastian County, Ark.

**Wash Creek Slate**[1]

Precambrian or Paleozoic: Central Alabama.

Charles Butts, 1940, U.S. Geol. Survey Geol. Atlas, Folio 226. Overlies Brewer phyllite; underlies Weisner formation. Thickness about 5,000 feet.

Named for exposures on Wash Creek, south of Sawyer Cove, Chilton County, in Columbiana quadrangle.

Washington cyclothem

Permian (Washington Series): Southeastern Ohio and western West Virginia.

A. T. Cross and M. P. Schemel, 1956, West Virginia Geol. Survey [Repts.], v. 22, pt. 1, p. 72 (fig. 1–61). Shown on geologic section below Winklers Mill cyclothem (new). Includes Washington coal at base and Washington "Rider B" No. 1 coal horizon at top.

M. T. Sturgeon and others, 1958, Ohio Geol. Survey Bull. 57, p. 203 (table 14), 213–215. Embraces interval from base of Washington sandstone to top of roof shale of Washington coal. Occurs above Little Washington cyclothem (new). Thickness about 53 feet. Includes (ascending) Washington shale and sandstone, redbed, Bristol limestone, Washington fire clay shale, Washington (No. 12) coal, and Washington roof shale members. Where Little Washington coal is missing, lower boundary of cyclothem is placed at base of Mannington sandstone, hence, thickness of cyclothem is variable due to boundary differences in that absence or presence of Little Washington coal is controlling factor. In area of this report, Washington series is discussed on a cyclothemic basis; four cyclothems are named. [For sequence see Elm Grove cyclothem.]

Present in Parkersburg quadrangle, West Virginia, and in Athens County, Ohio.

Washington Fire Clay (in Washington Formation)[1]

Washington fire clay shale member

Permian: Northern West Virginia and eastern Ohio.

Original reference: C. E. Krebs, 1911, West Virginia Geol. Survey Rept. Jackson, Mason, and Putnam Counties, p. 117.

M. T. Sturgeon and others, 1958, Ohio Geol. Survey Bull. 57, p. 203 (table 14), 215. Fire clay shale member of Washington cyclothem in report on Athens County. A yellowish-green, gray, or mottled maroon clay shale. Maximum thickness about 1 foot. Associated with Washington coal or at its horizon.

R. L. Nace and P. P. Bieber, 1958, West Virginia Geol. Survey Bull. 14, p. 18 (table 2). Washington fire-clay shale in Washington listed in summary of stratigraphic sections of Dunkard group in Harrison County.

Named for association with Washington coal.

**Washington Formation** (in Dunkard Group)[1]

Washington Group

Washington 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. 44–46.

W. A. Hickok 4th and F. T. Moyer, 1940, Pennsylvania Geol. Survey, 4th ser., Bull. C–26, p. 135–152. Washington group lies between Monongahela and Greene groups and, together with the latter, forms Dunkard series which was formerly called Upper Barren Coal Measures. Group consists of shale, sandstone, and limestone with several impure beds of coal. Base is taken at top of Waynesburg coal and at top of Upper Washington limestone. Named units listed.

R. E. Lamborn, 1951, Ohio Geol. Survey, 4th ser., Bull. 49, p. 39. Rank raised to series. In Ohio, comprises lower part of Permian extending from top of Waynesburg coal to top of Upper Washington limestone. Four coal beds and five limestone horizons are present; remainder of series consists of sandstone and shale. Limestones, which are fresh-water type, are (ascending) Elm Grove, Mount Morris, Lower Washington, Middle Washington, and Upper Washington. Average thickness about 220 feet.

D. L. Norling, 1958, Ohio Geol. Survey Bull. 56, p. 89, geol. map. In Morgan County, series includes only lower part of strata, that is, from Cassville shale to within lower Marietta sandstone.

H. L. Berryhill *in* C. O. Dunbar and others, 1960, Geol. Soc. America Bull., v. 71, no. 12, pt. 1, p. 1789–1790, chart 7 (column 80). Washington formation designated Pennsylvanian-Permian and Greene formation as Early Permian. There are neither lithologic nor faunal-floral bases for differentiating Washington and Greene formations anywhere in Dunkard Basin. Subdivision made by Stevenson (1876) has been handed down mainly through tradition. His Washington "group" is actually only a facies. Away from northern edge of basin, the Washington "group" has few of the lithologic characteristics of "type" area.

Carlyle Gray and others, 1960, Geologic map of Pennsylvania (1:250,000): Pennsylvania Geol. Survey, 4th ser. Formation mapped as Pennsylvanian and Permian. Consists of cyclic sequences of sandstone, shale, limestone, and coal; base at top of Waynesburg coal.

Named for exposures in highlands of Washington County, Pa.

**Washington Gneiss**[1]

Precambrian: Western Massachusetts and northern Connecticut.

Original references: B. K. Emerson, 1898, U.S. Geol. Survey Geol. Atlas, Folio 50; 1898, U.S. Geol. Survey Mon. 29, p. 18, 20, 31–32, pl. 24.

Named for occurrence at Washington and Washington Center, Berkshire County, Mass.

†Washington 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 Town Creek Valley at Washington, Hempstead County.

†Washington Limestone[1]

Ordovician: Northeastern Vermont.

Original reference: C. H. Richardson, 1898, Am. Assoc. Adv. Sci. Proc., v. 47, p. 295–296.

In Orange, Washington, Windsor, Orleans, Essex, and Caledonia Counties.

†Washington reds (in Conemaugh Formation)[1]

Pennsylvanian: Western Pennsylvania.

Original reference: J. J. Stevenson, 1906. Geol. Soc. America Bull., v. 17, p. 65–216.

Washington roof shale member

*See* Washington cyclothem.

**Washington Sandstone Member** (of Washington Formation)[1]

Washington shale and sandstone member

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

Original reference: J. J. Stevenson, 1876. Pennsylvania 2d Geol. Survey Rept. K.

M. T. Sturgeon and others, 1958, Ohio Geol. Survey Bull. 57, p. 203 (table 14), 213. Shale and sandstone member of Washington cyclothem in report on Athens County. Can probably be more correctly identified stratigraphically with Mannington sandstone. In areas where Little Washington coal is absent and Waynesburg "A"—Washington coal interval is occupied by massive sandstone, this sandstone would then be equivalent to Mannington sandstone, but timewise the upper part of this sandstone may be equivalent to Washington sandstone. In areas where Waynesburg, Mannington, and Washington sandstones are separate entities, they could merely be channel deposits in tributaries of main "Hockingport" trunk channel which were migrating upward through time. Therefore, upper part of "Hockingport" sandstone could be equivalent to Washington sandstone.

R. L. Nace and P. P. Bieber, 1958, West Virginia Geol. Survey Bull. 14, p. 18 (table 2). Washington sandstone member of Washington formation listed in summary of stratigraphic sections of Dunkard group in Harrison County. Thickness about 10 feet.

Named for Washington County, Pa.

†Washington Shale and Sandstone[1]

Pennsylvanian: Northwestern Arkansas and eastern Oklahoma.

Original reference: F. W. Simonds, 1891, Arkansas Geol. Survey Ann. Rept. 1888, v. 4, p. 26, 75–82.

Named for Washington Mountain, Washington County, Ark.

**Washington Hill Rhyolite**

Pliocene: Western Nevada.

G. A. Thompson, 1956, U.S. Geol. Survey Bull. 1042–C, p. 56–57, pl. 3. Light-gray highly flow-banded devitrified rhyolitic glass and perlite making up extrusive dome. Contains sparse phenocrysts of sodic plagioclase and biotite. Cuts through Kate Peak rocks and earlier beds of Truckee formation. Later beds of Truckee formation contains blocks of devitrified rhyolitic glass from the dome.

Name given to dome in and immediately southwest of Washington Hill, Virginia City quadrangle.

Washington Irving Sandstone (in Wann Formation)

Washington Irving Sandstone Member (of Wann Formation)

Pennsylvanian (Missouri Series): Northeastern Oklahoma.

M. C. Oakes, 1952, Oklahoma Geol. Survey Bull. 69, p. 86. Name applied locally to sandstone in lower part of Wann formation, Tulsa County. In some area, it is a massive sandstone formed by coalescence of several thin sandstones, and in some areas consists of two sandstones with intervening shale.

P. B. Greig, 1959, Oklahoma Geol. Survey Bull. 83, p. 14 (table 1), 15 (fig. 3), 16–17. Washington Irving and Clem Creek sandstones both occur in Pawnee County where Washington Irving is lowest recognizable member of Wann. In SE¼ sec. 25, T. 20 N., R. 9 E., it is overlain by 38 feet of silty maroon shale capped by eroded remnant of Clem Creek sandstone. To the northwest, shale pinches out and Washington Irving-Clem Creek section is represented by 90 feet of massive to crossbedded sandstone.

Named because outcrop rims Washington Irving glen in NW cor. sec. 29, T. 20, N., R. 10 E., Tulsa County.

Washingtonville Member (of Allegheny Formation)[1]

Washingtonville shale member

Pennsylvanian (Allegheny Series): Eastern Ohio, western Pennsylvania, and northern West Virginia.

Original reference: W. Stout and R. E. Lamborn, 1924, Ohio Geol. Survey, 4th ser., Bull. 28, p. 175–181.

N. K. Flint, 1951, Ohio Geol. Survey, 4th ser., Bull. 48, p. 49, table 1. Included in Middle Kittanning cyclothem, Allegheny series, Perry County.

M. T. Sturgeon and others, 1958, Ohio Geol. Survey Bull. 57, p. 76. Shale member of Middle Kittanning cyclothem not recognized in area of this report [Athens County]. Nearest known exposure is near Lexington in Perry County. Member varies from 1 to 6 feet in thickness and normally rests directly upon or is separated from Middle Kittanning coal by several feet of unfossiliferous shale.

Named for exposures at Washingtonville, Green Township, Mahoning County, Ohio.

**Washita Group**[1]

Lower and Upper Cretaceous (Comanche Series): Southern Oklahoma, southwestern Arkansas, northwestern Louisiana, and Texas.

Original reference: R. T. Hill, 1887, Am. Jour. Sci., 3d, v. 33, p. 298.

R. W. Imlay, 1944, U.S. Geol. Survey Oil and Gas Inv. Prelim. Chart 3. Washita group, Lower and Upper Cretaceous (upper Albian-lower Cenomanian). In north-central Texas includes (ascending) Duck Creek limestone, Fort Worth limestone, Denton clay, Weno limestone, Pawpaw formation, Main Street limestone, Grayson shale, and Buda limestone; other Texas areas include (ascending) Georgetown limestone, Grayson shale, and Buda limestone.

H. D. Miser and others, 1954, Geologic map of Oklahoma (1:500,000): U.S. Geol. Survey. As mapped, includes (ascending) Duck Creek formation, Fort Worth limestone, Denton clay, Weno clay, Pawpaw formation, Main Street limestone, and Grayson shale.

D. L. Frizzell, 1954, Texas Univ. Bur. Econ. Geology Rept. Inv. 22, p. 23–31. In this report [Cretaceous Foraminifera of Texas], group includes (ascending) Duck Creek, Fort Worth, Denton, Weno, Pawpaw, Main Street, and Grayson formations, Buda limestone, and Maness shale (subsurface only). Overlies Kiamichi formation of Fredericksburg group; underlies Cretaceous Woodbine group.

N. M. Curtis, Jr., 1959, Oklahoma Geology Notes, v. 19, no. 12, p. 257–264. In Bryan County, group includes (ascending) Kiamichi clay, Caddo limestone, Bokchito formation, Bennington limestone, and Grayson marl.

L. V. Davis, 1960, Oklahoma Geol. Survey Bull. 86, p. 16 (table 2), 35–39, pl. 1. In McCurtain County, group is undifferentiated. Overlies Fredericksburg group; underlies Woodbine formation. As mapped, includes Kiamichi formation of Fredericksburg group.

B. F. Perkins, 1960, Geol. Soc. America Mem. 83, p. 9 (fig. 3), 12 (fig. 4), 21–42, pls. 1, 2. Described in Fort Worth area where it comprises (ascending) Kiamichi formation, Duck Creek formation, Fort Worth limestone, Denison formation, and Buda limestone. Overlies Fredericksburg group; underlies Woodbine sandstone.

Named for old Fort Washita, T. 5 S., R. 7 E., about sec. 23, Bryan County, Okla.

†Washita Limestone[1]

Lower Cretaceous (Comanche Series): Southern Oklahoma and Texas.

**Original reference:** B. F. Shumard, 1860, St. Louis Acad. Sci. Trans., v. 1, p. 583, 586.

Named for old Fort Washita, T. 5 S., R. 7 E., about sec. 23, Bryan County, Okla .

**Wasson Formation** (in Little Butte Volcanic Series)

Oligocene, upper(?): Southwestern Oregon.

F. G. Wells, 1956, U.S. Geol. Survey Geol. Quad. Map GQ–89. Name applied to sequence of tuff beds and flow breccias that form upper part of Little Butte volcanic series (new). Most conspicuous layer of sequence is chalky white tuff about 200 feet thick; below this tuff and separated from it by about 300 feet of platy andesite flows is a 300-foot bed of dirty-yellow tuff consisting of angular fragments in basaltic tuff matrix. Overlies Roxy formation (new); capped by Heppsie andesites (new).

Well exposed in Wasson Canyon and in amphitheater north of Brest Mountain, T. 38 S., R. 2 E., Jackson County.

Wassonville Limestone (in Osage Group)[1]

Wassonville Limestone Member (of Hampton Formation)

Mississippian (Kinderhook Series): Southeastern Iowa.

Original reference: H. F. Bain, 1895, Am. Geologist, v. 15, p. 322.

J. M. Weller and others, 1948, Geol. Soc. America Bull., v. 59, no. 2, chart 5 (column 69). Shown on correlation chart as upper member of Hampton formation; overlies North Hill beds member. Included in Kinderhook series.

Named for outcrops at old Wassonville Mill, Washington County.

Wassuk Group

Miocene, upper, to Pliocene, middle: Western Nevada.

D. I. Axelrod, 1956, California Univ. Pubs. Geol. Sci., v. 33, p. 23, 61, 67–68, fig. 4. Made up of (ascending): Aldrich Station formation (new), thickness 4,050 feet; Coal Valley formation (new), thickness 3,325 feet; Morgan Ranch formation (new), thickness 700 feet. Aggregate thickness approximately 8,200 feet. Rests unconformably on biotite-hornblende andesite, or on granodiorite of Jurassic-Cretaceous(?) age. On page 67, age of Morgan Ranch formation is given as middle or upper Pliocene.

Exposed in Coal Valley-Mason Valley, Hawthorne quadrangle. Name derived from Wassuk Range.

Wassum Formation

Middle Ordovician (Mohawkian): Southwestern Virginia.

G. A. Cooper, 1956, Smithsonian Misc. Colln., v. 127, pt. 1, p. 97, chart 1 (facing p. 130). Calcarenites and buff crumbly shales. Composed principally of variegated marble or calcarenite in type locality. Total thickness 150 feet. Underlies Bays formation; overlies Chatham Hill formation (new). Name attributed to B. N. Cooper and G. A. Cooper.

Type locality: Four miles northwest of Marion, Marion quadrangle, Smyth County. Probably named for Wassum, Smyth County.

†Watauga Shale[1]

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

Original reference: A. Keith, 1903, U.S. Geol. Survey Geol. Atlas, Folio 90, p. 5.

Named for exposures in drainage area of Watauga River, Carter County, Tenn.

Watchman Flow, Andesite

Pleistocene: Southwestern Oregon.

Howel Williams, 1942, Carnegie Inst. Washington Pub. 540, p. 44–46. At least six of the Northern Arc of Vents on former Mount Mazama are visible on caldera walls of Crater Lake. In clockwise direction these are: vents of Watchman andesite, of the andesitic cone forming Hillman Peak, of Llao, Cleetwood, and Redcloud dacite flows, and Sentinel Rock andesite. Watchman flow is about 1¼ miles long with an average width of 2,000 feet. Average thickness between 400 and 500 feet. Watchman flow is one of youngest of pre-caldera andesites and probably coeval with andesite of Sentinel Rock. All but highest crags of Watchman flow have been overridden by ice. Watchman vent was active before the vents of the Llao, Cleetwood, and Redcloud dacite lavas. [Diller and Patton, 1902, U.S. Geol. Survey Prof. Paper 3, described Watchman andesite area.]

The Watchman is peak on western side of Crater Lake.

**Watchorn Formation** (in Meramec Group)

Upper Mississippian: Kansas (subsurface).

Wallace Lee, 1940, Kansas Geol. Survey Bull. 33, p. 84–89, pl. 2. Term applied in subsurface where subdivision of strata into Spergen, St. Louis, and possibly Ste. Genevieve limestones is impracticable. In Watchorn and Olson No. 1 Morrison, consists of three units: at base, a noncherty or sparsely cherty semigranular gray limestone 120 feet thick; in middle, a buff sucrose dolomite containing dull and semitranslucent gray chert, 25 feet thick; at top, semigranular gray and white limestone 545 feet thick. Overlies Warsaw limestone; unconformable below rocks of Batesville age.

First penetrated in Watchorn Oil and Gas Co. No. 2 Morrison well, in NE¼NW¼ sec. 20, T. 32 S., R. 21 W., Clark County. Thick sections occur in western Kansas; outliers of lower part present in eastern Kansas.

**Watchung Basalt**[1] or **Lava Flows** (in Newark Group)

Upper Triassic: Northern New Jersey and southeastern New York.

Original reference: N. H. Darton, 1889, Am. Jour. Sci., 3d, v. 38, p. 134–139; 1890, U.S. Geol. Survey Bull. 67.

Helgi Johnson *in* Erling Dorf, ed., 1957, Geol. Soc. America Guidebook Atlantic City Mtg., p. 112–113, 115. Termed basalts. Interbedded with sandstone and shales of upper Newark group. Only slight differences in composition of various sheets. Rocks generally fine granular to aphanitic except for vesicular zones which are glassy and filled with variety of secondary minerals. Visible phenocrysts in dense groundmass rarely found. Occasional beds of red-colored tuffs seen in drill cores. Geographically extended to New York.

E. D. McKee and others, 1959, U.S. Geol. Survey Misc. Geol. Inv. Map I-300. Listed as Watchung lava flows. Includes Hood Mountain flow.

Probably named for occurrence in Watchung Mountains of New Jersey.

**Waterboot Basalt**[1]

Miocene(?) or Pliocene(?): Southwestern Alaska.

W. M. Cady and others, 1955, U.S. Geol. Survey Prof. Paper 268, p. 21 (table), 55–56, pl. 1. Black porphyritic scoriaceous and vesicular olivine basalt. Groundmass predominantly ophitic, though locally trachitic. Cellular structure is recurrent feature that apparently marks tops of several successive and nearly horizontal lava flows, each a few feet thick. Total thickness probably not much more than 100 feet. Inferred that Waterboot basalt succeeds Holokuk basalt (new) in stratigraphic position. Gemuk group (new) probably forms footing of the basalt on eastern sides of mountain.

Type exposures: The nearly horizontal caprock of Flat Top Mountain, east of upper-middle course of Aniak River. Mountain lies between Atsaksovluk Creek, an easterly tributary of Aniak River, and Waterboot Creek (for which unit is named), which flows west at south foot of mountain, and then north into Atsaksovluk Creek; in central Kuskokwim region.

**Waterbury Gneiss**[1]

Precambrian(?): Central Connecticut.

Original reference: H. E. Gregory, 1906, Connecticut Geol. Nat. History Survey Bull. 6, p. 86, 100, map.

John Rodgers and others, 1956, Preliminary geological map of Connecticut (1:253,440): Connecticut Geol. Nat. History Survey. Complex of gneiss and schist of variable composition and texture. Schist mainly medium grained. Rusty-weathering gneiss typically strongly banded; quartz-feldspar bands alternate at inch or foot intervals with more micaceous bands that grade into schist. Small granitic and pegmatitic sills and dikes common in more contorted gneiss bodies. Mapped in Waterbury dome only. Pre-Triassic. Derivation of name stated.

Named for town of Waterbury, New Haven County.

**Water Canyon Formation**

Lower Devonian: Northern Utah and southeastern Idaho.

J. S. Williams, 1948, Geol. Soc. America Bull., v. 59, no. 11, p. 1138–1139, pl. 1. Consists of two unnamed members. Lower member essentially of compact thin-bedded silty and sandy dolomites that weather smoke gray (white) or buff. In upper member detrital content increases, and brown sandstone intraformational breccias and sandy shales are interbedded with dolomites, the only red beds in Paleozoic sequence in the quadrangle. Thickness of lower member estimated as much as 400 feet. Upper member 150 feet; missing northwest of Dry Lake. Disconformably underlies Hyrum member (new) of Jefferson formation; disconformably overlies Laketown dolomite.

H. W. Coulter, 1956, Idaho Bur. Mines and Geology Pamph. 107, p. 30–32, figs. 2, 3. Geographically extended to Preston quadrangle, Idaho.

Name taken from tributary of Green Canyon, Logan quadrangle, Utah, where, in sec. 4, T. 12 N., R. 3 E., it is well exposed.

**Waterford Slate**[1]

Ordovician(?): Northeastern Vermont.

Original reference: C. H. Richardson, 1906, Vermont State Geologist 5th Rept., p. 97.

In Waterford village or township, Caledonia County.

Watering Trough Shale

Upper Devonian (Conewango): Southwestern Pennsylvania.

W. M. Laird, 1941, Pennsylvania Topog. and Geol. Survey Progress Rept. 126, p. 11. Name will probably be used, following more definitive study of area, for unit here termed Shale C and described as gray thin-bedded shales with interbedded gray limy brown-weathering sandstones and some clay-gall conglomerates. Sandstones lenticular and very local; may be channel fillings. Thickness 181 feet at type locality; varies from 137 to about 406 feet. Conformably underlies Sandstone D (Jumonville sandstone); overlies Sandstone B (Youghiogheny sandstone) with gradational contact.

Type section: Along National Pike about 2¼ miles east of town of Hopwood, Fayette County. Section best exposed in cuts above and below Watering Trough Inn and Spring.

Water Island Formation

Age not stated: Virgin Islands.

T. W. Donnelly, 1960, Dissert, Abs., v. 20, no. 7, p. 2755–2756; 1960, Caribbean 2d Geol. Conf. Trans., Mayagüez, Puerto Rico, p. 153. Chiefly keratophyre flows and tuffs with minor spilite flows and rare radiolarites. Terrigenous sediments absent. Exposed thickness 15,000 feet. Underlies Virgin Island group (new) with slight angular unconformity. Age not stated. Only fossils are radiolaria, *Stomiosphaera* cf. *moluccana* Wanner, which ranges from Tithonian to Turonian.

Report discusses geology of St. Thomas and St. John Islands.

**Waterloo Quartzite**[1]

Precambrian (Middle Huronian): Central southern Wisconsin.

Original reference: T. C. Chamberlin, 1877, Geology Wisconsin, v. 2, p. 252–256.

Exposed at foot of ridge on border of marsh in town of Waterloo, Jefferson County.

Waterman Gneiss

Precambrian(?) or Upper Paleozoic(?): Southern California.

O. E. Bowen, Jr., 1954, California Div. Mines Bull. 165, p. 16 (fig. 2), 17–23, pls. 1, 2, 3. Black hornblende-plagioclase-quartz-mica gneiss and local diorite and pegmatite. At least 4,000 feet thick at type section. Believed to be younger than Oro Grande series and intrusive into it.

T. W. Dibblee, Jr., 1960, U.S. Geol. Survey Mineral Inv. Field Studies Map MF–233. Probably Precambrian, possibly Paleozoic. In vicinity of Hinckley Mound, was mapped by Bowen as Oro Grande series and gneissic hornblende diorite. Maximum exposed thickness about 10,000 feet.

Type section: In deeply eroded northeast-trending broad simple anticline south of Camp Irwin Road opposite Waterman silver mine, Barstow quadrangle, San Bernardino County. Unit covers about 3½ square miles in Barstow quadrangle and extends east into unmapped territory for undetermined distance.

Waterton Dolomite[1]

Waterton Member (of Altyn Formation)

Precambrian (Belt Series): Southern Alberta, Canada.

Original reference: R. A. Daly, 1913, Canada Dept. Int. Rept. Chief Ast. 1910, v. 2, p. 50, 178.

C. L. Fenton and M. A. Fenton, 1937, Geol. Soc. America Bull., v. 48, no. 12, p. 1882. Member of Altyn formation. Thickness about 280 feet, base not exposed. Grades upward in Hell Roaring member (new).

C. P. Ross, 1959, U.S. Geol. Survey Survey Prof. Paper 296, p. 19. Not known to crop out in United States.

Exposed in Waterton Lakes Park.

**Watertown Limestone** (in Black River Group)[1]

Watertown Member (of Chaumont Formation)

Middle Ordovician: Central New York.

Original reference: R. Ruedemann, 1910, New York State Mus. Bull. 138, p. 72.

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. 252, 253. Near Dexter, Jefferson County, Watertown member of Chaumont underlies Selby member (new) of Rockland formation. In earlier description of this section (Kay, 1931, Jour. Geology, v. 39, no. 4), the thin metabentonite that is 3 feet from base of Shelby member was mistakenly believed to separate Leray and Watertown members of Chaumont and to be same as persistent clay at that horizon in Glenburnie shale of Ontario. Type Hounsfield metabentonite is thus of Selby age. Hence, in revised section at Dexter, the Watertown underlies the Selby. Thickness at this section 5¾ feet.

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 at Watertown, Jefferson County.

Waterville Shale[1] or Slate

Silurian: South-central Maine.

Original reference: C. H. Hitchcock, 1861, Maine Bd. Agric. 6th Ann. Rept., p. 232.

Jacob Freedman, 1950, Geol. Soc. America Bull., v. 61, no. 5, p. 488. Middle Silurian.

Named for fine exposures at Waterville, Kennebec County.

Watson Limestone[1]

Lower Silurian: Northwestern Missouri.

Original reference: R. R. Rowley, 1916, Am. Jour. Sci., 4th, v. 41, p. 317–320.

Charles Schuchert, 1943, Stratigraphy of the eastern and central United States: New York, John Wiley and Sons, Inc., p. 671. Abandoned.

First described near Watson Station, Pike County.

†Watson Sandstone Member[1] (of Cattaraugus Formation)

Devonian or Carboniferous: Northwestern Pennsylvania.

Original reference: K. E. Caster, 1933, Geol. Soc. America Bull., v. 44, no. 1, p. 203.

Watson Ledge Quartz Syenite

Carboniferous(?): East-central New Hampshire.

Alonzo Quinn, 1937, Geol. Soc. America Bull., v. 48, no. 3, p. 377, 388, 400. Grayish quartz syenite. Porphyritic along contact with syenite which it intrudes. Porphyritic phase contains inclusions of syenite and fine-grained basic rock. Contains many small coarse streaks of amphibole and large grains of quartz clustered together. Belongs to White Mountain magma series.

Forms prominent bluffs known as Watson Ledge on Red Hill, Carroll County.

Watson Ranch Tongue (of Swan Peak Quartzite)

Middle Ordovician: Western Utah and eastern Nevada.

G. W. Webb, 1956, Utah Geol. and Mineralog. Survey Bull. 58, p. 12, 13 (fig. 3), 35, 42–43 (fig. 11), 44; 1956, Am. Assoc. Petroleum Geologists Bull., v. 42, no. 10, p. 2338. Thickness 243 feet at Smooth Canyon, near Ibex, Utah. Divided by numerous strongly developed bedding planes. In general, quartz arenite beds weather to an iron oxide-stained, reddish-brown-colored surface, although lower beds are light gray or yellow weathering. Underlies Crystal Peak dolomite (new).

Named for Jack Watson Ranch, Ibex, Millard County, Utah.

**Watts Creek Shale Member** (of Moran Formation)[1]

Permian: North-central Texas.

Original reference: N. F. Drake, 1893, Texas Geol. Survey 4th Ann. Rept., pt. 1, p. 387, 419.

R. C. Moore, 1948, *in* M. G. Cheney, 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. Underlies Gouldbusk limestone member (new); overlies Camp Colorado limestone member of Pueblo formation.

Named for Watts Creek, Coleman County.

**Waubakee Dolomite**[1]

Upper Silurian: Southeastern Wisconsin.

Original reference: W. C. Alden, 1906, U.S. Geol. Survey Geol. Atlas Folio 140.

C. K. Swartz and others, 1942, Geol. Soc. America Bull., v. 53, no. 4, chart 3. Correlation chart shows Waubakee limestone stratigraphically above Guelph dolomite.

First described near village of Waubakee, Ozaukee County.

Waucoba Lake Beds

Quaternary: Eastern California.

R. H. Hopper, 1947, Geol. Soc. America Bull., v. 58, no. 1, p. 418. Name applied to lake beds in vicinity of Waucoba Canyon. Younger than Coso formation. Correlated with Sherwin glacial stage.

Vicinity of Waucoba Mountain, Inyo Range, Inyo County. [Walcott (1897, Jour. Geology, v. 5, no. 4) described these beds and referred to them informally as the lake beds of the Waucobi embayment.]

**Waucoban Series**[1]

Waucoban Epoch[1]

Lower Cambrian: North America.

Original reference: C. D. Walcott, 1912, Smithsonian Misc. Colln., v. 57, no. 10, p. 305–306.

A. B. Shaw, 1954, Geol. Soc. America Bull., v. 65, no. 11, p. 1046. Suggested that term Waucoban series be abandoned and term Georgian series be reinstated.

Name derived from Waucoba Springs, northeastern side of Saline Valley, Inyo County, Calif. Lower Cambrian strata are well exposed in this area and east into Nevada.

Waucoma Limestone[1] (Alexandrian Group)

Silurian (Albion Series): Northwestern Illinois and northeastern Iowa.

Original reference: T. E. Savage, 1914, Am. Jour. Sci., 4th, v. 38, p. 35–36.

E. H. Scobey, 1938, Jour. Geology, v. 46, no. 2, p. 213–214. Beds found at type section of Waucoma are placed in the Edgewood formation on the basis of paleontology, lithology, and normal stratigraphic sequence; beds contain no chert and, where observed in Iowa, the Kankakee normally carries some chert bands.

C. K. Swartz and others, 1942, Geol. Soc. America Bull., v. 53, no. 4, chart 3. Shown on correlation chart as overlying Winston limestone; placed in Albion series.

Named for Waucoma, Fayette County, Iowa.

Waukesha Limestone[1] or Formation (in Coe Group)

Middle Silurian: Eastern Wisconsin, northeastern and northwestern Illinois, and northeastern Iowa.

Original reference: I. A. Lapman, 1851, Rept. of J. W. Foster and J. D. Whitney on geology of Lake Superior district, pt. 2, S. Ex. Doc. 4, U.S. 32d Cong., spec. sess., p. 168–171.

C. K. Swartz and others, 1942, Geol. Soc. America Bull., v. 53, no. 4, p. 536, 547, chart 3. Waukesha limestone has been defined as underlying Racine dolomite, but its lower limit has been placed at various horizons from the base of Cordell to base of Byron. The term hence lacks precision and in Wisconsin has been replaced by names used here, Cordell dolomite and Schoolcraft dolomite. Savage proposed name Bellwood dolomite for beds formerly called Waukesha dolomite in northeastern

Illinois, and also proposes name Cordova dolomite for beds formerly called Waukesha in northwestern Illinois and Iowa.

H. B. Williams, 1943, Illinois Geol. Survey Rept. Inv. 90, p. 29. Term Bellwood as used by Savage (1942) includes strata herein considered Waukesha and Racine.

H. A. Lowenstam, 1949, Illinois Geol. Survey Rept. Inv. 145, p. 18. Included in Coe group. (new).

First described in Waukesha County, Wis.

Waukon sandstone[1]

Upper Cambrian: Northeastern Iowa.

Original reference: C. R. Keyes, 1922, Pan-Am. Geologist, v. 38, p. 320–321, 326.

Named for exposures in vicinity of Waukon, Allamakee County.

Waupecan Sandstone[1]

Pennsylvanian: Northeastern Illinois.

Original reference: H. E. Culver, 1922, Illinois Geol. Survey, Extract from Bull. 43, 1923, p. 53–56.

Named for exposures along Waupecan Creek, Grundy County.

Wausau Granite[1]

Precambrian: Wisconsin.

Original reference: C. C. Wang, 1932, Geol. Soc. China Bull., v. 11, no. 4, p. 427.

Wausau Graywacke[1]

Precambrian (middle Huronian): Central northern Wisconsin.

Original reference: S. Weidman, 1907, Wisconsin Geol. Nat. History Survey Bull. 16, p. 55.

Occurs in isolated masses within a few miles northeast and northwest of Wausau, Marathon County.

**Wauseca Pyritic Member** (of Dunn Creek Slate)

Precambrian (Animikie Series): Northern Michigan.

H. L. James, 1958, U.S. Geol. Survey Prof. Paper 314–C, p. 30 (table 1), 38. Name applied to very fine-grained pyritic graphitic slate, typically containing 35 to 40 percent pyrite, that occurs in uppermost part of formation. Member is subdivided into two or three parts in detailed geologic mapping; one subunit is chaotic breccia that ranges from a foot or so to about 50 feet in thickness and is composed of small fragments of pyritic slate in matrix of same composition. True thickness probably 30 feet or less but commonly much greater or less due to squeezing and shearing.

Only exposure is roadcut south of Alpha, Iron County. Named for Wauseca mine at Iron River, in which unit is exposed in thousands of feet of mine workings.

Waushara Granite[1]

Precambrian (pre-Huronian?): Central southern Wisconsin.

Original reference: S. Weidman, 1898, Wisconsin Geol. Nat. History Survey Bull. 3, Sci. ser. 2, p. 47–64.

Crops out at several places in Marion and Warren Townships, Fox River district, southeastern part of Waushara County.

Wauswaugoning Quartzite[1]

Precambrian (Huronian): Northeastern Minnesota.

Original reference: N. H. Winchell, 1888, Minnesota Geol. Nat. History Survey 16th Ann. Rept.

At head of Wauswaugoning Bay.

†Wautubbee Marl (in Claiborne Group)[1]

Wautubbee Member (of Lisbon Formation)

Eocene, middle: Mississippi.

Original reference: E. N. Lowe, 1919, Mississippi Geol. Survey Bull. 14. p. 78.

U. B. Hughes and others, 1940, Mississippi Geol. Soc. [Guidebook] Field Trip, Feb. 10, 11, columnar section. Uppermost member of Lisbon. Overlies Kosciusko sand member. Thickness 60 feet.

E. P. Thomas, 1942, Mississippi Geol. Survey Bull. 48, p. 47–68, pls. Term Wautubbee used in this report essentially as applied by Lowe. Includes all of marine section above Kosciusko and below Cockfield in eastern and central Mississippi and its nonmarine equivalent, Shipps Creek shale, in western Mississippi. In eastern part of State, includes (ascending) Archusa marl, Potterchitto, and Gordon Creek shale members (all new). This subdivision impractical in central Newton County, and formation is mapped as undifferentiated as far northwest as Yockahockany River in northwestern Leake County. In western Holmes and Carroll Counties, tongue of carbonaceous shale lying at stratigraphic horizon of marine Wautubbee is here named Shipps Creek member. Thickness 45 to 75 feet.

Named for exposures near Wautubbee, Clarke County, on Northeastern Railroad, in cut beneath highway bridge on Highway 11, sec. 10, T. 3 N., R. 14 E.

Wauwatosa Formation

Silurian: Southeastern Wisconsin.

F. B. Phleger, Jr., 1937, Harvard Coll. Mus. Comp. Zoology Bull., v. 80, no. 11, p. 420. Incidental mention only.

Wauwatosa, Milwaukee County.

†Waverly Conglomerate[1]

Mississippian: Ohio.

Original reference: E. B. Andrews, 1871, Ohio Geol. Survey Rept. Prog. 1870.

Named for occurrence within Waverly group.

†Waverly Group[1] or Series

Mississippian (Kinderhookian-Osagean): South-central Ohio and northern Kentucky.

Original references: W. W. Mather, 1838, Am. Jour. Sci., 1st, v. 34, p. 363; C. Briggs, Jr., 1838, Ohio Geol. Survey 1st Ann. Rept., pl. 1, p. 79.

P. B. Stockdale, 1939, Geol. Soc. America Spec. Paper 22, p. 56. In Kentucky, includes (ascending) Bedford formation, Berea sandstone, and Sunbury shale.

J. M. Weller and others, 1948, Geol. Soc. America Bull., v. 59, no. 2, chart 5 (column 84). Age given on correlation chart as Kinderhookian and Osagean.

J. E. Hyde, 1953, Ohio Geol. Survey Bull. 51, p. 1–213. Name is applied to sandy and argillaceous series of rocks, 700 to 1,000 feet thick, which occupies interval between Ohio shale and the Coal Measures (excepting local Maxville limestone which intervenes between it and the Coal Measures). So delimited, series includes (ascending) Bedford shale, Berea grit, Sunbury shale, Cuyahoga shale, Black Hand formation, and Logan formation. Devonian-Mississippian contact and post-Waverlian disconformity in Ohio discussed.

Named for Waverly, Pike County, Ohio.

Waverlyan System[1]

Mississippian: North America.

Original references: E. O. Ulrich, 1905, U.S. Geol. Survey Prof. Paper 36, p. 24 (table); 1911, Geol. Soc. America Bull., v. 22, no. 3, p. 581–582.

R. C. Moore, 1948, Jour. Geology, v. 56, no. 4, p. 373. Lower Mississippian rocks of North America, comprising Kinderhookian and Osagean beds, which have been called "Waverlyan series," correspond to Tournaisian strata of Europe.

**Waxahatchee Slate**[1]

Precambrian or Paleozoic: Central Alabama.

Charles Butts, 1940, U.S. Geol. Survey Geol. Atlas, Folio 226, p. 3. Basal slate formation exposed in Montevalo-Columbiana quadrangles. Includes all slate below Brewer phyllite. Includes Sawyer limestone member near top. Thickness about 5,000 feet.

Named for exposures on Waxahatchee Creek, Shelby County, in Columbiana quadrangle.

**Wayan Formation**[1]

Lower(?) and Upper Cretaceous: Southeastern Idaho.

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

W. L. Stokes, 1953, Intermountain Assoc. Petroleum Geologists 4th Ann. Field Conf., p. 17–18. Continental sandstone, limestone, shale, and conglomerate, all showing rapid lateral facies changes. Passes eastward into Bear River and Aspen formations with complex facies relationships. Of Upper Cretaceous age.

J. D. Vine, 1959, U.S. Geol. Survey Bull. 1055–I, p. 259, 263–264, pl. 51. Mapped in Fall Creek area, Bonneville County, where it comprises about 3,000 to 4,000 feet of red and purple shale, and gray medium- to coarse-grained crossbedded friable sandstone. Overlies Bear River formation.

Named for settlement of Wayan, Bannock County, in northwestern part of Wayan quadrangle.

**Wayland Shale Member** (of Graham Formation)[1]

Wayland Shale (in Graham Group)

Upper Pennsylvanian: Central and central northern Texas.

Original references: F. B. Plummer and R. C. Moore, 1921, Texas Univ. Bull. 2132, p. 127–158; 1922, Jour. Geology, v. 30, p. 24, 31.

R. C. Moore and others, 1944, Geol. Soc. America Bull., v. 55, no. 6, p. 698, chart 6 (column 38). Shown on correlation chart as formation in Graham group, Cisco series.

D. H. Eargle, 1960, U.S. Geol. Survey Prof. Paper 315–D, p. 70. In Brown and Coleman Counties, Colorado River valley, Wayland shale member overlies Gunsight limestone member and underlies Ivan limestone member. Thickness about 100 feet along Colorado River. Plummer and Moore (1921) correlated their Wayland shale in Stephens County with Drake's (1893) Trickham bed in Coleman County. Most authors have followed Plummer and Moore in bringing term Wayland into Colorado River valley. Although term Trickham has priority, retention of name Wayland shale is recommended in Colorado River valley. Nickell (1938, Texas Univ. Bur. Econ. Geology Pub. 3801) extended term Avis sandstone into Colorado River valley and applied it to lenticular beds of sandstone at one or more positions below Ivan limestone member. Inasmuch as sandstone is present only locally and the sandstone lenses occupy several stratigraphic positions in the Wayland, name Avis member probably should not be brought into Colorado River valley.

Named for exposures at and near Wayland, Stephens County, Brazos River region.

**Wayne Formation**[1]

Wayne Group

Middle Silurian: Western Tennessee and northeastern Mississippi.

Original reference: N. F. Drake, 1914, Tennessee Geol. Survey Resources of Tennessee, v. 4, no. 3, p. 103.

C. W. Wilson, Jr., 1949, Tennessee Div. Geology Bull. 56, p. 244. Wayne group includes the following formations (ascending): Osgood limestone, Laurel limestone, Waldron clay, Lego limestone, and Dixon limestone.

Named for Wayne County, Tenn., where all units are well developed.

**Waynesboro Formation**[1]

Lower Cambrian: Central and southern Pennsylvania, western Maryland, northern Virginia, and northern West Virginia.

Original reference: G. W. Stose, 1906, Jour. Geology, v. 14, p. 209.

C. E. Resser, 1938, Geol. Soc. America Spec. Paper 15, p. 4, 7. Name considered invalid. Rome was called Waynesboro by Stose (1906).

H. P. Woodward, 1949, West Virginia Geol. Survey, v. 20, p. 142–155. Described in West Virginia where it consists of a miscellaneous assortment of red, purple, and green shale, thin slabby limestone, impure sandstone, and dolomite. Estimated thickness about 1,000 feet. Main outcrop is in Jefferson County. Underlies Elbrook limestone; occurs above Tomstown dolomite which is present only in Jefferson County.

Philip King, 1950, U.S. Geol. Survey Prof. Paper 230, p. 7 (table), 30–32, pl. 1. Described in Elkton area, Virginia, where it is about 1,700 feet thick, overlies Tomstown dolomite and underlies Elbrook dolomite. Consists of red and brown shale, calcareous shale and siltstone, and some limestone. Closely resembles Rome formation in character and stratigraphic position. Name Waynesboro is now used in Virginia as far south as Roanoke, beyond which name Rome is used for same unit.

Ernst Cloos, 1951, Maryland Dept. Geology, Mines and Water Resources Washington County [Rept. 14], p. 41–43. Overlies Tomstown dolomite; underlies Elbrook limestone. Many outcrops in Washington County, but complete sections are not known. Most complete section is east of Chewsville, where formation is about 875 feet thick.

Named for exposures in ridge just north of Waynesboro, Franklin County, Pa.

Waynesburg Clay[1] (in Monongahela Formation)

Waynesburg underclay member

Pennsylvanian (Monongahela Series) : Southwestern Pennsylvania, eastern Ohio, and northern West Virginia.

M. T. Sturgeon and others, 1958, Ohio Geol. Survey Bull. 57, p. 158 (table 13), 189. Underclay member of Waynesburg cyclothem in report on Athens County. Less than 1 foot thick. What is frequently termed Waynesburg "horizon" is an underclay with carbonaceous matter rather than coal or coaly shale. Monongahela series.

W. A. Tallon and R. G. Hunter, 1959, West Virginia Geol. and Econ. Survey Rept. Inv. 17, p. 10. Waynesburg underclay immediately underlies Waynesburg coal. Clay is light gray with iron-stained fractures. Average thickness of clay about 3½ feet.

Waynesburg cyclothem

Pennsylvanian (Monongahela Series) and Permian: Southeastern Ohio.

M. T. Sturgeon and others, 1958, Ohio Geol. Survey Bull. 57, p. 158 (table 13), 186–189. Youngest cyclothem in Pennsylvanian system in Appalachian region. Occurs above Little Waynesburg cyclothem (new). Includes (ascending) Gilboy sandstone, Waynesburg redbed, fresh water limestone, Waynesburg underclay, Waynesburg (No. 11) coal, and Cassville shale members. By drawing Pennsylvanian-Permian boundary at top of Waynesburg coal, Cassville shale becomes basal member of Permian system; hence, Waynesburg cyclothem transcends systemic boundary. Average thickness 20 feet; this interval is filled by Gilboy sandstone and the redbed member. Lateral continuity of the Waynesburg is broken wherever the Gilboy and Waynesburg sandstones are coalesced; also Little Waynesburg Rider cyclothem lies between the Little Waynesburg and Waynesburg coal beds. Although this cyclothem and identification of Waynesburg coal are critical to stratigrapher, they are not disctinctive in field, and a long measured section is necessary to determine intervals from other key horizons. In area of this report, Monongahela series is discussed on cyclothemic basis; 12 cyclothems are named. [For sequence see Pittsburg cyclothem.]

Confined to eastern third of Athens County, an area that includes eastern edge of Lodi Township; extensive parts of Bern, Carthage, and Rome Townships; and along Hocking River and its tributaries in Troy Township.

Waynesburg "A" cyclothem

Permian (Washington Series) : Southeastern Ohio.

M. T. Sturgeon and others, 1958, Ohio Geol. Survey Bull. 57, p. 203 (table 14), 204–210. Embraces interval between Elm Grove cyclothem (new) below and Little Washington cyclothem (new). Includes all strata from top of Cassville shale to base of Mannington sandstone. Thickness about 36½ feet. Includes (ascending) Waynesburg shale and sandstone, redbed, Mount Morris limestone, underclay, Waynesburg "A" (No. 11a) coal, and roof shale members. Variations in thickness and boundaries of cyclothem are due to lack of lateral persistence of Elm Grove and Lower Waynesburg "A" coal horizons or result of erosional downcutting and (or) coalescence of Waynesburg sandstone with the overlying and underlying sandstones. In area of this report, Washington series is discussed on cyclothemic basis; four cyclothems are named. [For sequence see Elm Grove cyclothem.]

Cyclothem, or parts of it, are present in Bern, Carthage, Lodi, Rome, and Troy Townships, Athens County.

Waynesburg Group[1]

Pennsylvanian: Pennsylvania.

Original reference: H. D. Rogers, 1858, Geology of Pennsylvania, v. 2, pt. 1, p. 474–477.

**Waynesburg Limestone Member** (of Monogahela Formation)[1]

Waynesburg Limestone (in Monongahela Group)

Waynesburg limestone and shale member

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

Original reference: J. J. Stevenson, 1877, Pennsylvania 2d Geol. Survey Rept. $K_2$.

W. O. Hickok 4th and F. T. Moyer, 1940, Pennsylvania Geol. Survey, 4th ser., Bull. C–26, p. 100, 124 (fig. 29), 125–126. Termed Waynesburg limestone in Monongahela group.

D. L. Norling, 1958, Ohio Geol. Survey Bull. 56, p. 10 (fig. 3), 84–85. In Ohio, Waynesburg limestone and shale member (Monongahela series) occurs between Uniontown sandstone and shale member and Little Waynesburg (No. 10–A) coal above. Average thickness about 10 feet. Poorly developed.

M. T. Sturgeon and others, 1958, Ohio Geol. Survey Bull. 57, p. 158 (table 13), 186. Waynesburg limestone member of Little Waynesburg cyclothem in report on Athens County. Member was named by Stevenson (1876, Geology Pennsylvania, Rept. K, p. 62) for its association with Waynesburg coal bed which it underlies in its type area by 20 to 40 feet. Later another coal bed directly overlying the Waynesburg limestone was reported and named by Stevenson the Little Waynesburg coal. Although this member is not directly related to the coal bed from which its name was derived, name Waynesburg has been retained and is firmly entrenched in geologic literature. Thickness of member 2⅓ feet.

Named for Waynesburg, Greene County, Pa.

Waynesburg Member (of Monongahela Formation)[1]

Pennsylvanian: Pennsylvania.

Original reference: M. E. Johnson, 1929, Pennsylvania Geol. Survey Topog. and Geol. Atlas 27, p. 31.

Waynesburg redbed member

Pennsylvanian (Monongahela Series): Eastern Ohio.

M. T. Sturgeon and others, 1958, Ohio Geol. Survey Bull. 57, p. 158 (table 13), 188. Member of Waynesburg cyclothem in report on Athens County. This member, together with underlying Gilboy sandstone member, accounts for virtually entire interval between Little Waynesburg and Waynesburg coal beds. Average thickness of member 9½ feet but, because of lateral gradation to sandstone, the range is from 3 to 20 feet. Monongahela series.

**Waynesburg Sandstone Member** (of Washington Formation)[1]

Waynesburg Sandstone (in Washington Group)

Waynesburg sandstone and shale member

Permian: Southwestern Pennsylvania, western Maryland, southeastern Ohio, and northern West Virginia.

Original reference: J. J. Stevenson, 1873, Am. Philos. Soc. Trans., v. 15, new ser., p. 16.

W. O. Hickok 4th and F. T. Moyer, 1940, Pennsylvania Geol. Survey, 4th ser., Bull. C–26, p. 135, 146. In Fayette County, Waynesburg sandstone occurs 16 to 25 feet above base of Washington group. Lies between Mount Morris limestone above and Cassville shale below locally separated from latter by Elm Grove limestone. Thickness 10 to 45 feet.

W. D. Martin, 1955, Dissert. Abs., v. 15, no. 8, p. 1371. True Waynesburg sandstone is geographically restricted to southwestern Pennsylvania and northern West Virginia. Relatively local sandstone, which occurs in Washington, Athens, and Meigs Counties, Ohio, and adjacent part of West Virginia, and has previously been considered a part of the Waynesburg sandstone, is here named Hockingport sandstone.

D. L. Norling, 1958, Ohio Geol. Survey Bull. 56, p. 10 (fig. 3), 91–92, geol. map. Waynesburg sandstone and shale member (Washington series) includes interval between Elm Grove limestone below and Waynesburg "A" (No. 11–A) coal. In Morgan County, general absence of these latter units makes basal and upper boundaries of member indefinite. In thicker bodies, sandstone is gray to tan, fine to medium grained with zones of coarser material, and thin to platy bedded; commonly contains beds of sandy shale, and in many areas is an alternation of sandstones and shales. Thickness 28 to 37 feet. Locally coalesces with Gilboy sandstone, which occurs below Waynesburg (No. 11) coal, thus transgressing systemic boundary; in some areas, merges with stratigraphically higher Mannington sandstone.

M. T. Sturgeon and others, 1958, Ohio Geol. Survey Bull. 57, p. 203 (table 14), 204–208. Waynesburg sandstone and shale member of Waynesburg "A" cyclothem in report on Athens County. Waynesburg sandstone is first major sandstone occurring in Washington series. Both top and bottom of this member have been used in the past as Pennsylvanian-Permian contact. Thickness 24½ feet.

Named for development on Tenmile Creek, east of Waynesburg, Greene County, Pa.

**Waynesville Shale[1] or Limestone** (in Richmond Group)

Waynesville Formation (in Richmond Group)

Upper Ordovician: Southwestern Ohio, southern Indiana, and north-central Kentucky.

Original reference: J. M. Nickles, 1903, Am. Geologist, v. 32, p. 205.

Wilber Stout, Karl Ver Steeg, and G. F. Lamb, 1943, Ohio Geol. Survey, 4th ser., Bull. 44, p. 110, chart facing p. 108. Shown on generalized section of Ohio as Waynesville formation. Thickness 95 feet. Includes (ascending) Fort Ancient, Clarksville, and Blanchester members. Underlies Liberty formation; overlies Arnheim formation.

W. H. Twenhofel and others, 1954, Geol. Soc. America Bull., v. 65, no. 3, chart 2 (columns 44, 45). Correlation chart shows Waynesville shale and limestone underlying Liberty shale and limestone and overlying Arnheim shale and limestone.

W. C. Sweet and others, 1959, Jour. Paleontology, v. 33, no. 6, p. 1030. Arnheim, Waynesville, Liberty, Whitewater, and Elkhorn formations define Richmond stage of Cincinnatian series.

Named for Waynesville, Warren County, Ohio.

Wayside Sandstone Member (of Caseyville Formation)

Wayside Sandstone and Shale Member (of Pottsville formation)[1]

Pennsylvanian: Southwestern Illinois.

Original reference: J. E. Lamar, 1925, Illinois Geol. Survey Bull. 48, p. 23, 84–85, map.

J. M. Weller, 1939, Illinois Geol. Survey Rept. Inv. 60, p. 11. Reallocated to member status in Caseyville formation. Basal member of formation; underlies Lick Creek sandstone member.

J. M. Weller, 1940, Illinois Geol. Survey Rept. Inv. 71, p. 36. Strata formerly termed Wayside now included in Lusk formation (new).

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 29, 30, 44 (table 1), pl. 1. Member of Caseyville formation (redefined). Occurs below Battery Rock sandstone member. Presentation of new rock-stratigraphic classification of Pennsylvanian strata in Illinois.

Type locality: N½ sec. 30, T. 11 S., R. 2 E., Jackson County. Named for village of Wayside, a few miles northwest of type exposures.

**Wea Shale[1] Member** (of Cherryvale Shale or Formation)

Wea Shale Member (of Sarpy Formation)

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, 91, 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), 95. Wea shale member of Cherryvale formation; underlies Westerville limestone member; overlies Block 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. 38. In Nebraska, reallocated to member status in Sarpy formation (new). Thickness in eastern Kansas 10 to 30 feet; northwestern Missouri, 15 to 25 feet; Sarpy County, Nebr., 3½ feet; south-central Iowa, 5 feet.

H. G. Hershey and others, 1960, Iowa Highway Research Board Bull. 15, p. 27, fig. 5. Consists of two dark-gray shale units that are separated by hard black fissile shale. Thickness about 3 feet. Uppermost member of Cherryvale shale; overlies Block limestone member; underlies Westerville limestone.

Type locality: SE cor. sec. 31, T. 16 S., R. 24 E., and at center of east side sec. 12, T. 18 S., R. 22 E., Miami County, Kans. Named for Wea Creek in northeastern part of county.

**Wearyman Dolomite Member** (of Minturn Formation)

Pennsylvanian: Central Colorado.

Ogden Tweto, 1949, Colorado Sci. Soc. Proc., v. 15, no. 4, p. 198–199. Prominent and persistent bed of light-gray to buff finely crystalline slightly siliceous reef dolomite that is pitted with small cavities elongated in plane of the bedding. Weathers to rounded forms but weathered surfaces rough and pitted. Dolomite probably largely of algal origin although at places it contains abundant remains of other fossils. Most organic structures almost obliterated by dolomitization and recrystallization. Thickness 15 to 75 feet. Underlies Hornsilver dolomite member (new).

Named for prominent exposures near Wearyman Creek, which lies in Minturn quadrangle just north of edge of Holy Cross quadrangle. Best exposed and thickest on ridge between Wearyman and Resolution Creeks, at northern edge of Holy Cross quadrangle.

Weatherby Canyon Ignimbrite

Tertiary: Southwestern New Mexico.

Elliot Gillerman, 1958, New Mexico Bur. Mines Mineral Resources Bull. 57, p. 70–75, table 1, pl. 1. Rhyolite and some trachyte ignimbrite and thin interbeds of nonwelded tuff. Most of the ignimbrite is light-gray to red hard compact aphanitic-porphyritic rhyolite with phenocrysts of quartz, sanidine, and orthoclase in devitrified matrix of shards and glass shreds. Thickness at least 3,000 feet on 1117 Peak and ridges to the west. Younger than Vanar Hills volcanic rocks.

Named from exposures in Weatherby Canyon, near southern boundary of the mapped area of central part of Peloncillo Mountains, Hidalgo County. Particularly well exposed on 1117 Peak, south of Weatherby Canyon. Forms surface rock of most of the Peloncillo Mountains between Cowboy Pass and south boundary of area mapped, and extends southward at least additional 5 miles.

**Weatherford Member** (of Cloud Chief Formation)

Weatherford Dolomite[1]

Permian: Central-western Oklahoma.

Original reference: R. L. Six and others, 1930, Oklahoma Geol. Survey Bull. 40–UU, map.

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

Present in Custer, Dewey, and Washita Counties. Probably named for Weatherford, Custer County.

**Weaver Rhyolite**[1] (in Koipato Group)

Permian(?) and Lower Triassic: Northwestern Nevada.

Original reference: A. Knopf, 1924, U.S. Geol. Survey Bull. 762.

R. E. Wallace and others, 1959, U.S. Geol. Survey Mineral Inv. Field Studies Map MF–220. Upper formation in Kiopato group. In Buffalo Mountain quadrangle, comprises three units: (1) porphyritic rhyolite with phenocrysts of quartz and feldspar, white or light greenish gray; generally homogeneous with rare, poorly defined bedding; thickness probably more than 1,000 feet in vicinity of Fisher Canyon but appears to pinch out west of Buffalo Mountain; (2) clastics, including pebble conglomerate, sandstone, and thinly laminated dark-gray or brown tuffaceous argillite in variable proportions; well stratified; in places an upper and lower unit; impressions of ammonites of probable Early Triassic age present in argillite; maximum thickness more than 700 feet; and (3) rhyolitic felsite flows; estimated thickness 1,000 feet in Fisher

Canyon. Overlies Rochester trachyte; underlies Prida formation with angular unconformity. Permian(?) and Triassic.

Exposed at head of Weaver Canyon, Rochester district.

Weaver Lake Quartz Monzonite

Jurassic-Cretaceous: Central California.

D. C. Ross, 1958, California Div. Mines Spec. Rept. 53, p. 13, pl. 1. Notably light gray; distinguishing features are fine grain size and low color index; texture is xenomorphic granular and grains average 1 to 2 mm; biotite sprinkled through rock; hornblende rare. Relation to other named plutonic rocks in area not determined.

Named from exposures around Weaver Lake in northeast part of area, Sequoia National Park. Largest mass crops out over about 12 square miles, seven smaller masses, probably satellitic to large mass, are exposed around periphery of main mass.

**Weaverville Formation**[1]

Oligocene(?): Northern California.

Original reference: N. E. A. Hinds, 1933, California Jour. Mines and Geology, v. 29, nos. 1, 2, p. 79, 115.

W. P. Irwin, 1960, Sacramento Geol. Soc. [Guidebook] Ann. Field Trip, June, 3, 4, 5, p. 22. Mentioned in road log. Oligocene(?).

Named for exposures near Weaverville, Trinity County.

†Webb Bluff[1] (formation)

Eocene: Southern Texas.

Original reference: E. T. Dumble, 1892, Geol. Soc. America Bull., v. 3, p. 224, 228, 230.

Named for Webb Bluff, Webb County, 3 miles below Maverick County line.

**Webbers Falls Sandstone Member** (of Atoka Formation)[1]

Pennsylvanian (Atoka Series): 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. 24–33. Thickness 10 to 15 feet in Muskogee-Porum district. Separated from underlying Dirty Creek sandstone member and overlying Blackjack School sandstone member by unnamed shales.

Named for exposures in secs. 10 and 15, T. 15 N., R. 20 E., about 2 miles west of Webbers Falls, Muskogee County.

†Webberville Beds[1]

Upper Cretaceous (Gulf Series): Central Texas.

Original reference: R. T. Hill, 1899, Texas Geol. Survey Bull. 4, p. xiii, xxx.

Well exposed at blue bluffs of Colorado River, and at and near Webberville, Travis County.

Weber Conglomerate[1]

Lower Cretaceous: Northeastern Nevada.

Original references: Arnold Hague, 1882, U.S. Geol. Survey 2d Ann. Rept., p. 28; 1883, U.S. Geol. Survey 3d Ann. Rept., p. 253; 1892, U.S. Geol. Survey Mon. 20, p. 30, 91, 92.

Lore David, 1941, Jour. Paleontology, v. 15, no. 3, p. 318–321. On basis of discovery of fish and plant fossils, so-called Weber conglomerate, originally mapped as Upper Carboniferous, is considered to be Lower Cretaceous in age.

T. B. Nolan, C. W. Merriam, and J. S. Williams, 1956, U.S. Geol. Survey Prof. Paper 276, p. 68. Name Newark Canyon proposed for beds of Lower Cretaceous age that include almost all strata mapped as Weber conglomerate by Hague (1883; 1892).

Occurs in Eureka and other districts of Nevada.

†Weber Grits[1]

Pennsylvanian: Central Colorado.

Original references: S. F. Emmons, 1882, U.S. Geol. Survey 2d Ann. Rept., p. 215–230; 1883, U.S. Geol. Survey.

Leadville and neighboring regions.

**Weber Quartzite[1] or Sandstone**

Weber Formation (in Durst Group)

Pennsylvanian and Permian: Northeastern Utah and western Colorado.

Original reference: C. King, 1876, Am. Jour. Sci., 3d, v. 11, p. 477–479.

K. G. Brill, Jr., 1942, Am. Assoc. Petroleum Geologists Bull., v. 26, no. 8, p. 1384–1385. Names Weber and Maroon abandoned in Gore area, Colorado; term Battle Mountain proposed for sequence of Pennsylvanian clastics. In earlier reports, sequence here assigned to Battle Mountain was divided into six formations (ascending): Weber (divided into Weber shale and Weber grit), Robinson limestone, White Quail limestone, Maroon, Jacque Mountain limestone, and Wyoming. Term Belden shale member of Battle Mountain is here proposed to replace Weber shale.

K. G. Brill, Jr., 1944, Geol. Soc. America Bull., v. 55, no. 5, p. 633–635. Term Weber quartzite restricted in west-central Colorado to white sandstone overlying Maroon formation; in some areas, overlies Morgan formation. Underlies State Bridge formation, Phosphoria, or Dinwoody (Moenkopi) formations. Thicknesses: 880 feet, Disappointment Creek; 70 feet, Miller Creek section; 79 feet, Glenwood Springs section. Term Belden member raised to formation rank and is equivalent to "Weber shale" throughout region.

A. J. Eardley, 1944, Geol. Soc. America Bull., v. 55, no. 7, p. 833–834. At type section, herein described for first time, Weber quartzite is about 3,000 feet thick; overlies Morgan sandstone and underlies Park City formation. Lower sandstones, 730 feet thick, are overlain by 355 feet of limestone; remainder of unit is quartzite.

M. L. Thompson, 1945, Kansas Geol. Survey Bull. 60, pt. 2, p. 34, 39. Term Weber restricted in Uinta Mountains to the thick crossbedded to massive buff sandstones above the limestone-bearing part of the section. As thus restricted, overlies Youghall formation (new) and underlies Park City formation. Thickness about 1,000 feet in vicinity of Vernal, Utah; about 850 feet on north side of Uinta Mountains at Sheep Mountain Canyon. No fossils; age not determined.

J. W. Huddle and F. T. McCann, 1947, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 75. In Duchesne River area, 1,500 to 1,600 feet thick and consists mainly of very fine grained gray and white sandstone that weathers buff. Overlies Morgan formation; underlies Park City formation, contact not everywhere distinct.

K. G. Brill, Jr., 1953, Geol. Soc. America Bull., v. 63, no. 8, p. 811 (fig. 1), 823. In vicinity of Glenwood Springs and McCoy, Colo., Weber sandstone includes Schoolhouse tongue at top.

J. W. Vanderwilt, 1953, *in* Rocky Mountain Assoc. Geologists Guidebook Field Conf., May 14–16, p. 15, fig. facing p. 12. Maroon formation, in Glenwood Springs area, contains Glenwood tongue (new) of Weber sandstone. Tongue is 200 feet thick.

Walter Sadlick, 1955, Wyoming Geol. Assoc. Guidebook 10th Ann. Field Conf., p. 58. Because of recent common usage, it is herein proposed that the Weber be henceforth known as Weber sandstone.

D. M. Kinney, 1955, U.S. Geol. Survey Bull. 1007, p. 45–48, pls. Originally defined as quartzite at type locality, the formation throughout Uinta Mountains and most of Wasatch Mountains is more correctly referred to as sandstone. Weber was defined as including strata that were later differentiated by Blackwelder (1910) as Morgan formation. In Uinta Mountains, geologists of Fortieth Parallel Survey mistakenly applied name to great thickness of Precambrian rocks, now known as Uinta Mountain group, instead of the less extensive sandstone of Pennsylvanian age. Powell (1876), in report on Uinta Mountains, named the massive sandstone of Pennsylvanian age the Yampa sandstone. Yampa sandstone was correlated by Schultz (1920, U.S. Geol. Survey Bull. 702) with more widely used Weber sandstone, and since that time Weber sandstone has been used in preference to Yampa. The Weber in Uinta River-Brush Creek area is uniform massive fine- to medium-grained light-gray slightly calcareous quartzose sandstone. Thickness 1,015 to 1,275 feet; thicker sections (in Ashley Creek and on Diamond Mountain) are adjacent and are located in area in which the upper 300 to 400 feet of Weber is particularly crossbedded. Overlies Morgan formation; underlies Phosphoria. No fossils; age open to question.

Walter Sadlick, 1957, Intermountain Assoc. Petroleum Geologists Guidebook 8th Ann. Field Conf., p. 70–71, 75–76. Weber formation included in Durst group (new).

H. J. Bissell and O. E. Childs, 1958, Rocky Mountain Assoc. Geologists Symposium on Pennsylvanian rocks of Colorado and adjacent areas, p. 27–30. Formation, as described in section that extends from type locality eastward to vicinity of Walcott, Colo., consists of western facies of orthoquartzites, shale, and limestone stringers that, in vicinity of Whiterock, Utah, interfingers with eolian and neritic sands. In western Colorado, includes Schoolhouse tongue at top and interfingers with Maroon formation. In vicinity of type locality, overlies Morgan and underlies Park City; eastward, underlies Phosphoria and between Meeker and Walcott, Colo., pinches out beneath State Bridge formation. Interpretation of fossil occurrences shows that Weber transcends Pennsylvanian-Permian time boundary, indicating that upper part of eolian Weber is Permian and that all of Schoolhouse tongue is Permian.

U.S. Geological Survey currently designates the age of the Weber Quartzite or Sandstone as Pennsylvanian and Permian on the basis of a study now in progress.

Type section: Upper Weber Canyon, east of Morgan, Morgan County, Utah.

†Weber Shales[1]

Pennsylvanian: 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.

Leadville and neighboring regions.

Weberg Formation (in Colpitts Group)

Middle Jurassic: East-central Oregon.

R. L. Lupher, 1941, Geol. Soc. America Bull., v. 52, no. 2, p. 227 (table 1), 229, 248. Consists mainly of gray granular limestone with calcareous sandstone, grit, and conglomerate; a thin basal conglomerate is present near Colpitts Ranch; elsewhere in type area, formation begins with limestone or coarse calcareous sandstone. Thickness 100 to 272 feet. Basal formation of group. Underlies Warm Springs formation (new); overlies Nicely shale (new).

W. R. Dickinson, 1960, Dissert. Abs., v. 20, no. 11, p. 4376. Weberg, Warm Springs, and Basey (new) formations are lateral equivalents of Snowshoe formation.

Type area: On east side of Warm Springs Creek valley in secs. 19, 20, 29, and 30, T. 18 S., R. 26 E. Named for Weberg Ranch, on lower Warm Springs Creek, in sec. 18, T. 18 S., R. 26 E., Crook County.

Webster Formation[1]

Ordovician: Oklahoma.

Original references: E. O. Ulrich, 1932, Unpublished chart exhibited at Geological Society of America meeting in December; F. C. Edson, 1935, Am. Assoc. Petroleum Geologists Bull., v. 19, no. 8, p. 1122–1130.

C. C. Branson, 1957, Oklahoma Geology Notes, v. 17, no. 11, p. 108. Abandoned by Oklahoma Geological Survey. An unpublished name for limestone now called Corbin Ranch.

Webster Group[1]

Devonian: Southwestern Missouri.

Original reference: E. M. Shepard, 1905, Drury Coll. Bradley Geol. Field Sta. Bull. 1, p. 57.

In Greene County. Derivation of name not stated.

Webster Springs Sandstone (in Bluefield Formation[1] or Group)

Mississippian: Southern West Virginia.

Original reference: D. B. Reger, 1920, West Virginia Geol. Survey Rept. Webster County, p. 214, 227–228.

P. H. Price and E. T. Heck, 1939, West Virginia Geol. Survey Greenbrier County, p. 255, 264. In Greenbrier County, consists of 10 to 50 feet of shaly grayish-brown sandstone. Overlies Glenray limestone; separated from overlying Reynolds limestone by shale which may be equivalent of Bickett shale of Reger (1926). Mauch Chunk series.

Exposed on north side of Elk River at southeast edge of town of Webster Springs, Webster County.

**Weches Greensand Member** (of Mount Selman Formation)[1]

Weches Formation (in Claiborne Group)

Eocene, middle: Eastern Texas, and northwestern Louisiana.

Original reference: A. C. Ellisor, 1929, Am. Assoc. Petroleum Geologists Bull., v. 13, p. 1339–1346.

H. B. Stenzel, 1939, Texas Univ. Bur. Econ. Geology Pub. 3818, p. 20 (table), 93–114. Rank raised to formation in Claiborne group. Thickness 25 to 45 feet. Subdivided into (ascending) Tyus, Viesca, and Therrill members (all new). Disconformably overlies Queen City sand; disconformably underlies Sparta formation (sand).

C. R. Smith, 1958, Am. Assoc. Petroleum Geologists Bull., v. 42, no. 10, p. 2520. In Caddo Parish, La., formation overlies Mytis sand member (new) of Queen City formation; underlies Pleistocene(?) terrace deposits. Thickness about 14 feet.

Well exposed on Crockett Road 1½ miles southwest of Weches, Houston County, Tex.

**Wedington Sandstone Member** (of Fayetteville Shale)[1]

Upper Mississippian: Northern Arkansas and northeastern Oklahoma.

Original reference: G. I. Adams, 1904, U.S. Geol. Survey Prof. Paper 24, p. 27.

J. M. Weller and others, 1948, Geol. Soc. America Bull., v. 59, no. 2, chart 5 (columns 65, 66). Shown on correlation chart about middle of Fayetteville shale.

Named for Wedington Mountain, Washington County, Ark.

**Wedowee Formation**[1]

Cambrian to Carboniferous: Eastern Alabama.

Original reference: G. I. Adams, 1926, Alabama Geol. Survey Spec. Rept. 14, p. 36, map.

G. W. Crickmay, 1936, Geol. Soc. America Bull., v. 47, no. 9, p. 1379. Here regarded as part of Carolina series, age of which is given as Precambrian.

Named for exposures at and around Wedowee, Randolph County.

Weed Patch Member[1] (of Edwardsville Formation)

Lower Mississippian: Southern Indiana.

Original reference: P. B. Stockdale, 1931, Indiana Dept. Conserv., Div. Geology Pub. 98, p. 76, 119, 189, 202, 280, 281.

P. B. Stockdale, 1939, Geol. Soc. America Spec. Paper 22, p. 74; J. M. Weller and others, 1948, Geol. Soc. America Bull., v. 59, no. 2, pl. 1. Included in Allens Creek facies of formation.

Name derived from Weed Patch Hill, 3 miles southeast of Nashville, Brown County.

**Weeks Limestone**[1]

Middle and Upper 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. 1126, 1141 (fig. 5), 1147, 1166. Weeks formation, originally assigned to Middle Cambrian, contains *Cedaria?* and numerous *Tricrepicephalus* throughout thickness of more than 1,000 feet of strata and is Upper Cambrian (Dresbach) in age. Total thickness 1,940 feet (Walcott gave 1,390); hence, Upper-Middle Cambrian boundary is moved down from horizon given by Walcott. Overlies Marjum limestone (emended).

H. E. Wheeler, 1948, Nevada Univ. Bull., Geology and Mining Ser., no. 47, p. 41, 42. Deiss (1938) placed Marjum-Weeks contact at estimated position of Middle-Upper Cambrian boundary. Therefore, as presently defined, these units are regarded invalid. Their present definition is comparable to the Cadiz formation of California and Comet shale in Nevada. Possible that part of lower Weeks may belong to Albertan series.

H. E. Wheeler and Grant Steele, 1951, Utah Geol. Soc. Guidebook 6, p. 30 (table 1), 32 (fig. 5), 34 (fig. 7), 36–37. Middle and Upper Cambrian. In this report, Weeks and Orr formations are described together because their similarity and intergradational character does not appear to justify distinction as separate formation. Total thickness 3,500 feet.

D. K. Powell, 1959, Brigham Young Univ. Research Studies, Geology Ser., v. 6, no. 1, p. 5 (chart), 12–15, geol. map. Weeks formation described and mapped in southern House Range (area of type locality for Weeks). Formation is 1,388-foot thick medium- to dark-gray fine-grained, thin- to thick-bedded argillaceous and arenaceous limestone; becomes more argillaceous toward top; color ranges from reddish brown to dark yellowish orange. Conformably overlies Marjum limestone; conformably underlies Orr formation. Complete section does not crop out in mapped area; much of unit has been intruded by Notch Peak intrusive and a large sill, or is metamorphosed. Albertan-Croxian.

U.S. Geological Survey currently designates the age of the Weeks as Middle and Upper Cambrian.

Type locality: North side Weeks Canyon, north of Orr Ridge, House Range, Millard County. Crops out on western slopes of Notch Peak, in Hansen Canyon, where it is terminated by fault, trends north to Notch Peak Canyon and continues to igneous intrusive.

Weeping Water Limestone Member (of Oread Limestone)[1]

Pennsylvanian (Virgil Series): Southeastern Nebraska, northeastern Kansas, and northwestern Missouri.

Original reference: C. S. Prosser, 1897, Jour. Geology, v. 5, p. 154–172.

G. E. Condra, 1949, Nebraska Geol. Survey Bull. 16, p. 26. Thickness 6 to 10 feet in Nebraska; thins to about 3 feet northwest of Leavenworth, Kans.; may be equivalent to part of Toronto limestone of southern Kansas. Nebraska Geological Survey uses name Weeping Water limestone, and Kansas Geological Survey uses name Toronto.

Type locality: West side North Branch Weeping Water Valley, about 1 mile northwest of Nehawka, Cass County, Nebr.

Weir Formation (in Cabaniss Group)

Weir Formation or cyclothem (in Cherokee Group)

Pennsylvanian (Des Moines Series): Southeastern Kansas, southwestern Missouri, and northwestern 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, 195. Cherokee group is divided into 15 cyclic formational units. The Weir, sixth in sequence (ascending), occurs below the Pilot and above the Knifeton. Thickness about 36 feet. Includes a 3-foot coal bed known as Weir-Pittsburg. [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 Weir formation in Cabaniss group. Underlies Tebo formation; overlies Seville formation of Krebs group.

C. C. Branson, 1954, Oklahoma Geol. Survey Guide Book 2, p. 6. Listed as coal cycle in Boggy formation, in Oklahoma.

W. B. Howe, 1956, Kansas Geol. Survey Bull. 123, p. 22 (fig. 5), 46–48. Formation in Cabaniss subgroup of Cherokee group. In Kansas, includes only Weir-Pittsburg coal and its underclay. Thickness averages about 12 feet in Cherokee and Crawford Counties.

Name derived from Weir-Pittsburg coal which is named for towns of Weir, Cherokee County, and Pittsburg, Crawford County, Kans.

Weisburg 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) is Weisburg, Saluda, and Oxford. Stratigraphic chart and page 114 shows Whitewater sequence (ascending) as Lower Whitewater, Saluda, and Upper Whitewater.

Type locality and derivation of name not given.

**Weisner Quartzite[1] or Formation[1]**

Lower Cambrian: Northern central and northeastern Alabama and northwestern Georgia.

Original reference: E. A. Smith, 1890, Alabama Geol. Survey Rept. Cahaba coal field, p. 149.

T. L. Kesler, U.S. Geol. Survey Prof. Paper 224, p. 8–10, 30–33, pl. 1. Described in Cartersville district in Georgia where it consists principally of finely micaceous quartzite and, less commonly, beds of metaconglomerate, metasiltstone, and crystalline carbonate rocks; beds do not occur in any uniform stratigraphic order and are exposed in a belt of parallel ridges that trend northward through middle of district. Base of section not exposed, but thickness is more than 1,000 feet, probably more than 2,000 feet. As mapped, includes Pinelog conglomerate. Conformably underlies Shady formation.

Named for fact it forms Weisner Mountain, Cherokee County, Ala.

Weissport Member (of Tully Formation)

Upper Devonian: East-central Pennsylvania.

R. E. Stevenson and W. S. Skinner, 1949, Pennsylvania Acad. Sci. Proc., v. 23, p. 30, 31, 32. Basal member of formation in Lehighton area. Consists of thin-bedded sandy shale. Thickness about 40 feet. Underlies Brodhead Creek member (new); overlies Moscow formation.

Type section: Roadcut 1.1 miles north of Weissport, Carbon County.

Weitchpec Schists[1]

Paleozoic or older: Northwestern California.

Original reference: O. H. Hershey, 1904, Am. Geologist, v. 33, p. 357.

O. P. Jenkins, 1943, California Div. Mines Bull. 118, pt. 4, p. 686. Age given as Paleozoic or older.

Probably named for exposures near Weitchpec, Humboldt County.

**Welch Formation** (in Pottsville Group)[1]

Lower Pennsylvanian: Southern West Virginia and southwestern Virginia.

Original reference: M. R. Campbell, 1897, U.S. Geol. Survey Geol. Atlas, Folio 44.

Named for exposures at Welch, McDowell County, W. Va.

Welch Sandstone (in New River Group)

Welch 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. 198.

P. H. Price and E. T. Heck, 1939, West Virginia Geol. Survey Greenbrier County, p. 216, 234. Commonly grayish white, medium to coarse grained, and lenticular. Thickness 20 to 45 feet. Occurs below unnamed shale; overlies unnamed shale above Welch coal. Apparently coalesces with Upper Raleigh sandstone. Included in New River group, Pottsville series.

Exposed at Welch, McDowell County.

Welcome Formation

Welcome Member (of Kreyenhagen Formation)

Eocene, upper: Central California.

Martin Van Couvering and H. B. Allen, 1943, California Div. Mines Bull. 118, pt. 3, p. 496–500. Siltstone and claystone 1,200 feet thick. Underlies Wagonwheel formation; overlies Point of Rocks formation.

H. P. Smith, 1956, California Univ. Pub. Geol. Sci., v. 32, no. 2, p. 67, 68 (fig. 2), geol. map. Rank reduced to member of Kreyenhagen formation. Map shows age as Eocene; stratigraphic column shows Eocene or Oligocene.

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.

**Welden Limestone**[1]

Mississippian: Central southern Oklahoma.

Original reference: C. L. Cooper, 1931, Oklahoma Geol. Survey Bull. 55, map.

C. L. Cooper, 1939, Jour. Paleontology, v. 13, no. 4, p. 381–382. Buff to blue-gray massive argillaceous limestone. Maximum thickness (type locality) 2 feet. Underlies Caney shale; overlies Bushberg-Hannibal strata. Lower Mississippian. Type locality designated.

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). In northern Arbuckles underlies Ahlosa member (new) of Caney shale.

Type locality: In railroad cut in sec. 27 , T. 3 N., R. 6 E., a few miles east of Ada, Pontotoc County. Name derived from Welden Creek which crosses outcrop in same section. Outcrops are some 20 miles in length.

Weldonian Stage

Late Cretaceous: California.

P. P. Goudkoff, 1945, Am. Assoc. Petroleum Geologists Bull., v. 29, no. 7, p. 960 (table 1), 989–991, 1006. 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). Surface equivalents are Joaquin Ridge sandstone in Alcalde Hills section. the Forbes, Guinda, and upper part of Funks formation in Putah Creek section, as classified by Kirby (1942). Includes interval between Tracian stage (new), above, and Cachenian stage (new).

Occurs in Great Valley in both surface and subsurface. Exposed along west side of San Joaquin Valley. Well represented in outcrops along Weldon Canyon.

**Welge Sandstone 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). Brown sandstone that grades upward into Morgan Creek limestone member; overlies Lion Mountain sandstone member of Cap Mountain formation. Contact sharp. 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, pls. 1, 2, 4 (fig. 5). Brown mostly nonglauconitic sandstone. Average thickness 18 feet; at type locality 27 feet; thicker sections are along northern and western sides of Llano uplift. Overlies Lion Mountain sandstone here considered member of Riley formation; contact abrupt.

P. E. Cloud, Jr., and V. E. Barnes, 1948, Texas Univ. Bur. Econ. Geology Pub. 4621, p. 155, 187, 225, 253, 310, [1946]. Local stratigraphy described.

Type section: Along Squaw Creek one-half mile north of Gillespie County line. Named from Welge land surveys between Threadgill and Squaw Creeks. Extends throughout Llano uplift.

**Wellborn Sandstone**[1] (in Jackson Group)

Eocene, upper: South-central Texas.

Original reference: W. Kennedy, 1893, Texas Geol. Survey 4th Ann. Rept., pt. 1, p. 39, 45.

D. H. Eargle, 1959, Am. Assoc. Petroleum Geologists Bull., v. 43, no. 11, p. 2624 (fig. 1), 2626 (table 1), 2627–2628. In south-central Texas, Wellborn sandstone is considered a formation undivided, and is persistent unit chiefly of sandstone. Overlies Caddell formation; underlies McElroy formation (redefined). Ellisor (1933, Am. Assoc. Petroleum Geologists Bull., v. 17, no. 11) applied name Wellborn sands to a member of McElroy formation, overlain by Manning beds and overlying, in east Texas, Wooleys Bluff clays, which she considered basal member of McElroy formation. West of Angelina County, she considered that the Wellborn overlaps Wooleys Bluff and lies directly on the Caddell. Renick (1936, Texas Univ. Bull. 3619) divided Wellborn into three members: Carlos sandstone at top; middle Wellborn, consisting of clay and soft lignitic sandstone; and Bedias sandstone at base. Exposures of Renick's members can be seen in vicinity of Wellborn. These exposures may be considered type locality.

Type locality (Eargle): In vicinity of Wellborn, about 7 miles south-southeast of College Station, Brazos County. On cuesta, one-fourth mile southeast of crossroads at Wellborn, contact of lower 4 feet of Carlos sandstone with brown clay of Renick's middle Wellborn is exposed in roadcuts in front of cemetery; 1¼ miles north of crossroad, cuts on road to College Station expose 5 feet of gray tuffaceous clayey siltstone of middle member grading down into 6 feet of gray silty very fine grained thin-bedded sandstone of Renick's Bedias sandstone; about 250 yards farther north basal 5 feet of Bedias sandstone, containing prints of pelecypods in lower 2 feet, lies on clay of Caddell formation.

Weller Sandstone[1] or horizon[1]

Miocene(?): Northwestern Colorado.

Original reference: O. A. Peterson, 1928, Carnegie Mus. Mem., v. 11, no. 2, p. 90–94.

Exposed at northern flanks of Douglas Mountain, on Weller Ranch, near Gray Stone post office, Moffat County.

Wellersburg Clay (in Conemaugh Formation)[1]

Pennsylvanian: Pennsylvania.

Original reference: C. K. Swartz, 1922, Maryland Geol. Survey, v. 11, p. 65, 114, pl. 6.

Named for association with Wellersburg coal, which was named for occurrence at Wellersburg, Somerset County.

Wellersburg Limestone (in Conemaugh Formation[1] or Group)

Pennsylvanian: Southern Pennsylvania and western Maryland.

Original reference: C. K. Swartz, 1922, Maryland Geol. Survey, v. 11, p. 65, 114, pl. 6.

R. R. Dutcher and others, 1959, Geol. Soc. America Guidebook Pittsburgh Mtg., p. 69 (fig. 4). Wellersburg limestone shown on generalized columnar section for Pennsylvanian of western Pennsylvania. Occurs above Barton (Elk Lick) coal and below Wellersburg coal. Conemaugh group.

Named for association with Wellersburg coal which was named for occurrence at Wellersburg, Somerset County, Pa.

**Wellesley Formation**[1]

Mississippian: Eastern Alaska.

Original reference: A. H. Brooks, 1900, U.S. Geol. Survey 20th Ann. Rept., pt. 7, p. 470–472, 479, 483.

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.

Composes Wellesley Mountain between Tanana and White Rivers.

**Wellington Formation** (in Sumner Group)[1]

Permian: Central and southern Kansas and northern Oklahoma.

Original reference: F. W. Cragin, 1885, Washburn Coll. Lab. Nat. History Bull., v. 1, no. 3, p. 85–86; Kansas City Review, 8, p. 678–682.

W. A. Ver Wiebe, 1937, Wichita Municipal Univ. Bull., v. 12, no. 5, p. 3–17. Subdivided to include (ascending) Pearl shale, Hollenberg limestone, Geuda Springs shale (new), Annelly gypsum (new), Chisholm Creek shale (new), Carlton limestone, Highland shale (new), Slate Creek limestone (new), and Afton limestone (new) members.

G. H. Norton, 1939, Am. Assoc. Petroleum Geologists Bull., v. 23, no. 12, p. 1755–1758, 1762–1763 (fig. 2), 1764–1765 (fig. 3). Includes Milan limestone member (new) at top. Underlies Ninnescah shale (new) ; Big Blue series.

G. O. Raasch, 1941, (abs.) Geol. Soc. America Bull., v. 52, no. 2, pt. 2, p. 1928. Wellington in Oklahoma is limited to north-central section of State; southward it passes into Stillwater redbed complex. Thickness 820 feet. Subdivided into basal sequence, 18 feet; anhydrite sequence, 190 feet; Otoe redbed member (new), 115 feet; Midco (lacustrine) member (new), 255 feet; Billings member (new), 52 feet; Antelope Flats member (new), 195 feet. Upper 372 feet is continuously exposed and includes many key beds. Overlies Herington limestone; underlies Garber redbed complex.

R. C. Moore and others, 1951, Kansas Geol. Survey Bull. 89, p. 40–41. Basal formation of Sumner group. Thickness about 700 feet. Includes Milan limestone member at top; Hutchinson salt member in middle part but not exposed; Carlton limestone member below Hutchinson; Hollenburg limestone member near base. Underlies Ninnescah shale; overlies Herington limestone member of Nolans limestone.

H. D. Miser and others, 1954, Geologic map of Oklahoma (1:500,000): U.S. Geol. Survey. As mapped, includes Fallis sandstone member in upper part.

Named for exposures at Wellington, Sumner County, Kans.

†Wells Chert[1]

Lower Ordovician (Beekmantown): North-central Tennessee.

Original reference: E. O. Ulrich, 1911, Geol. Soc. America Bull., v. 22, no. 3, p. 671, pl. 27.

E. O. Ulrich and G. A. Cooper, 1938, Geol. Soc. America Spec. Paper 13, p. 26. Upper Canadian (approximately Cotter).

In Wells Creek basin, Stewart and Houston Counties.

**Wells Formation[1]**

Pennsylvanian and Permian: Eastern Idaho, Montana, northeastern Utah, and southwestern Wyoming.

Original reference: R. W. Richards and G. R. Mansfield, 1912, Jour. Geology, v. 20, p. 683, 684, 689–693.

G. B. Richardson, 1941, U.S. Geol. Survey Bull. 923, p. 24–25, pl. 6. Described in Randolph quadrangle, Utah-Wyoming, where it is about 1,000 feet thick; overlies Brazer limestone and underlies Phosphoria formation. Pennsylvanian.

V. E. McKelvey and others, 1956, Am. Assoc. Petroleum Geologists Bull., v. 40, no. 12, p. 2842. In southeastern Idaho and western Wyoming, upper siliceous limestone of Wells formation as used by Mansfield (1927, U.S. Geol. Survey Prof. Paper 153) is designated as lower tongue of Park City formation; the name Wells is thus restricted to underlying sandstones, redbeds, and carbonate rocks of Pennsylvanian age.

E. R. Cressman, 1957, U.S. Geol. Survey Mineral Inv. Field Studies Map MF–118. Mapped in Snowdrift Mountain quadrangle, Caribou County, Idaho, where it overlies Brazer limestone and underlies Phosphoria formation. Consists of upper member, 1,000 to 1,300 feet thick, that contains 100-foot-thick cherty limestone tongue of Park City formation and lower member approximately 500 feet thick.

V. E. McKelvey and others, 1959, U.S. Geol. Survey Prof. Paper 313–A, p. 15, 36 (footnote). Name Wells formation is retained for rocks in western Wyoming, eastern Idaho, and northern Utah, but is restricted to carbonate rock sandstone, sandstone, and red beds that lie below upper carbonate rock beds that are reassigned to newly named Grandeur member of Park City formation. Pennsylvanian and Permian.

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 and that the Wells be dropped or retained as formation within group.

H. J. Bissell, 1960, Am. Assoc. Petroleum Geologists Bull., v. 44, no. 8, p. 1427 (chart). In Sublett Mountains, comprises (ascending) Calder Creek, Heglar Canyon, Sublett, and Indian Fork members (all new). Occurs above Milligen formation and below Grandeur member of Park City. Pennsylvanian-Permian (Springeran-Leonardian).

Name derived from Wells Canyon, in T. 10 S., R. 45 E., Bannock County, Idaho.

†Wells Limestone[1]

Middle Ordovician (Lowville): North-central Tennessee.

Original reference: A. F. Foerste, 1903, Jour. Geology, v. 11, p. 557, 705.

Named for Wells Creek Basin, Stewart and Houston Counties.

**Wellsburg Sandstone Member** (of Chemung Formation)[1]

Wellsburg Formation (in Chemung Group)

Upper Devonian: Central and west-central New York and northeastern Pennsylvania.

Original references: H. S. Williams, 1906, Science, new ser., v. 24, p. 365–372; 1907, Am. Assoc. Adv. Sci. Proc., v. 56, p. 265–267.

Bradford Willard, 1939, *in* Bradford Willard, F. M. Swartz, and A. B. Cleaves, Pennsylvania Geol. Survey, 4th ser., Bull. G–19, p. 15 (table 4), 247. Chemung group in south-central New York and adjacent Pennsylvania consists of Cayuta formation and Wellsburg formation. Wellsburg consists of thin-bedded sandstone and shale to flaggy sandstone and coquinite lenses. Fall Creek conglomerate locally at top.

Named for outcrop at Wellsburg, Chemung County, N.Y.

**Wells Creek Dolomite**

Wells Creek Limestone[1]

Lower Ordovician: Central Tennessee and southwestern Kentucky.

Original reference: R. G. Lusk, 1927, Am. Assoc. Petroleum Geologists Bull., v. 11, no. 9, p. 908.

Ray Bentall and J. B. Collins, 1945, Tennessee Div. Geology Oil and Gas Inv. Prelim. Chart 4, sheet 1. Wells Creek dolomite is here applied to 432 feet of tan to gray-green silty to sandy argillaceous fine-grained dolomite interbedded with dark-brown to tan dense limestone occurring below Murfreesboro limestone and above rocks of Beekmantown age in Ada Belle Oil Co., Hillman No. 2–A (21–E–18E), Trigg County, Ky. Dolomite thins toward the south and east, is erratic in occurrence in easternmost part of area, and in places is absent. Where 30 to 70 feet thick it is very argillaceous silty and sandy fine-grained dolomite interbedded with thin green shales. These rocks are here considered to be Chazy(?), in age. Name was originally used by Lusk to designate about 350 feet of rocks in this stratigraphic position and said by him to be exposed only in Wells Creek basin in southeastern Stewart County, Tenn.

First mentioned in Stewart and Houston Counties, Tenn.

Wellsville Formation (in Chadakoin Group)

Wellsville Formation (in Conneaut Group)

Wellsville Member (of Chadakoin Formation)

Upper Devonian: Southwestern New York.

J. G. Woodruff, 1942, New York State Mus. Bull. 326, p. 17 (fig. 4), 31–33. Consists of thin sandstones or siltstone, ½ to 3 inches thick, interbedded with shales, for the greater part argillaceous but sometimes arenaceous; commonly olive green and gray. Thickness about 200 feet. Basal formation of Conneaut group; underlies Hinsdale formation; overlies Cuba formation.

I. H. Tesmer, 1955, New York State Mus. Sci. Service Circ. 42, p. 10 (fig. 1), 18. Rank reduced to member status in Chadakoin formation. Underlies Hinsdale member; overlies Cuba member of Canadaway formation.

L. V. Rickard, 1957, New York State Geol. Assoc. [Guidebook] 29th Ann. Mtg., p. 17 (table 2), 19. A 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.

Well exposed near town of Wellsville but also present in nearly every locality of Wellsville quadrangle, Allegany County. [Tesmer and Rickard state that type locality is near Wellsville.]

Wemir Agglomerate

Miocene: Panamá Canal Zone.

[T. F. Thompson], 1943, Panama Canal Spec. Eng. Div., 3d Locks Proj., pt. 2, chap. 5, p. 37, figs. 5–54. Agglomerate is finer in texture than typical basaltic agglomerates in Pacific area; well bedded, with strata ranging from a few inches to several feet in thickness; commonly contains beds of soft shale of soapy fine-grained texture; contains water-sorted fragments and is believed to be phase of more massive land-laid deposits commonly present elsewhere. Age not stated.

W. P. Woodring, 1960, *in* R. Hoffstetter and others, Lexique Strat. Internat., v. 5, Amérique Latine, fasc. 2a, p. 349. Now included in Pedro Miguel agglomerate member of Panamá formation. Miocene.

Occurs in West Miraflores Hill area.

**Wenas Basalt[1] Member** (of Yakima Basalt)

Pliocene, lower: Central Washington.

Original reference: G. O. Smith, 1903, U.S. Geol. Survey Prof. Paper 19; 1903, U.S. Geol. Survey Geol. Atlas, Folio 86.

R. C. Treasher, 1937, Geol. Soc. Oregon Country News Letter, v. 3, no. 20, p. 218–220. Underlies Snipes conglomerates (new).

A. C. Waters, 1955, Geol. Soc. America Bull., v. 66, no. 6, p. 671, 673, pl. 1. Described in Yakima East quadrangle as basalt flow interstratified in Ellensburg formation. Basalt is about 100 feet thick where it enters quadrangle, but thins rapidly to the east and ends about halfway across the quadrangle. Where lower sediments of Ellensburg are cut out, the Wenas basalt rests directly on Yakima flows; stratigraphically below Selah Butte flow (new). Map shows basalt flows in the Ellensburg as Miocene and Pliocene.

Type locality: Valley of Wenas Creek, Ellensburg region.

**Wendell Grade 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.

H. T. Stearns, Lynn Crandall, and W. G. Steward, 1938, U.S. Geol. Survey Water-Supply Paper 774, p. 29 (table), 84, pl. 4. Overlies Malad basalt and Hagerman lake beds. Thickness about 25 feet.

U.S. Geological Survey currently designates the age of the Wendell Grade Basalt as Recent on the basis of a study now in progress.

Type locality: Wendell grade in road in Gooding County, from which it takes its name. Northwest of town of Wendell.

Wendover Group

Pennsylvanian: 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), 3, 5, 22 (fig. 7), 23–24, 28 (fig. 10), 30, 45. Consists of limestones interbedded with sandstones, mudstones, and shales. At the base is a sandstone which probably marks an unconformity. Comprises upper part of Division II of Hartville "formation" (Condra and Reed, 1935, Nebraska Geol. Survey Paper 9). Thickness 104 feet. Underlies Broom Creek beds (new); overlies Meek group (new).

Type locality: Platte River valley in vicinity of Wendover, Platte County, Wyo.

**Weno Clay or Limestone** (in Washita Group)

Weno Clay Member (of Denison Formation)[1]

Weno Limestone Member (of Georgetown Limestone)

Weno Marly Limestone Member (of Denison Formation)

Lower Cretaceous (Comanche Series): Northeastern and central Texas and central southern Oklahoma.

Original reference: R. T. Hill, 1901, U.S. Geol. Survey 21st Ann. Rept., pt. 7, p. 121, 247, 269–280.

R. W. Imlay, 1944, U.S. Geol. Survey Oil and Gas Inv. Prelim. Chart 3. Chart shows Weno limestone in Washita group. Occurs below Pawpaw formation and above Denton clay. [Denison formation abandoned.] Lower Cretaceous.

D. L. Frizzell, 1954, Texas Univ. Bur. Econ. Geology Rept. Inv. 22, p. 27–28, table 4. Foraminifera of Weno formation described.

W. J. Fox and O. N. Hopkins, Jr., 1960, Baylor Geol. Soc. Guidebook 5th Field Trip, p. 88, 92. In central Texas, considered member of Georgetown limestone. Overlies Denton shale member; underlies Pawpaw shale member. Thickness 40 feet in McLennan County.

B. F. Perkins, 1960, Geol. Soc. America Mem. 83, p. 9 (fig. 3), 12 (fig. 4), 31 (fig. 12), 32, 33 (fig. 13). Referred to as Weno marly limestone member of Denison formation. In Fort Worth area, consists largely of gray marl with several thick limestone beds in its uppermost and lowermost parts. Thickness about 50 feet. Overlies Denton marl member; underlies Pawpaw shale member.

Named for Weno, Grayson County, Tex.

†Weno Subgroup[1] (of Denison Beds)

Lower Cretaceous (Comanche Series): Northeastern Texas.

Original reference: R. T. Hill, 1901, U.S. Geol. Survey 21st Ann. Rept., pt. 7, p. 121, 247, 269–280.

Named for Weno, Grayson County.

**Wenonah Formation** (in Matawan Group)

Wenonah Member (of Matawan Formation)

Wenonah Sand (in Matawan Group)[1]

Upper Cretaceous: New Jersey and Delaware.

Original reference: G. N. Knapp, as reported by R. D. Salisbury, 1899, New Jersey Geol. Survey Ann. Rept. State Geologist, 1898, p. 35, 36.

W. B. Spangler and J. J. Peterson, 1950, Am. Assoc. Petroleum Geologists Bull., v. 34, no. 1, p. 32–36. Member of Matawan which is here reduced to formational rank. Conformably overlies Marshalltown member and underlies Mount Laurel member, both contacts conformable. Marine in origin and consists of fine micaceous sparingly glauconitic sand locally laminated with thin layers of clay. Thickness about 40 feet in Monmouth County, but thins to the south where it cannot be differentiated from overlying Mount Laurel. Can be followed in outcrop from Atlantic Highlands into Delaware where it is exposed in cuts of Chesapeake and Delaware Canal.

J. J. Groot, 1954, Delaware Geol. Survey Bull. 3, p. 25–26. Considered of formational rank in Matawan group. Where exposed in Chesapeake and Delaware Canal conformably overlies Merchantville and is gradational into it.

J. P. Minard and J. P. Owens, 1960, U.S. Geol. Survey Prof. Paper 400–B, p. B184, B185. Formation in Matawan group. Overlies Marshalltown formation; underlies Mount Laurel sand of Monmouth group. Average dip SE. 35 feet per mile.

Named for occurrence at Wenonah, Gloucester County, N.J.

**Wepo Formation** (in Mesaverde Group)

Upper Cretaceous: Northeastern Arizona.

G. A. Kiersch, 1955, Mineral Resources Navajo-Hopi Indian Reservations, Arizona-Utah, v. 2: Tuscon, Ariz., Univ. Arizona Press, p. 4 (fig. 1). Includes widespread coal beds. Subdivided into lower, middle, and upper members. Overlies Toreva formation (new); underlies Yale Point sandstone (new). Name credited to Repenning and Page.

C. A. Repenning and H. G. Page, 1956, Am. Assoc. Petroleum Geologists Bull., v. 40, no. 2, p. 271, 277–279. Comprises thick series of intercalated siltstone, mudstone, sandstone, and coal. Siltstone and mudstone units vary from dark olive gray through light olive brown to medium light gray. Carbonaceous in many places, and contains sandy zones and sandstone lenses throughout area. Commonly thin and flat bedded. Above Wepo Wash at type section are 142 feet of cliff-forming

Toreva formation and 656 feet of slope- and ledge-forming Wepo formation, including upper tongue of Toreva, which occupies interval from 67 to 134 feet above base of Wepo. Thins northeast across Black Mesa as result of tonguing in that direction into underlying Toreva formation and into overlying Yale Point sandstone. Thickness of entire formation observable only in northern half of area, where formation ranges in thickness from 743 feet east of Cow Springs to 318 feet near Rough Rock. Type section, therefore, represents nearly maximum thickness of formation, if thickness of upper tongue of Toreva formation is included.

Type section: Seven miles northeast of town of Pinon on west side of Wepo Wash where entire Mesaverde group of Black Mesa is exposed. Wepo Wash is an ephemeral stream that runs in southwesterly direction across central part of Black Mesa and joins Polacca Wash between First and Second Mesas in Hopi villages area.

**Werner Formation**

Jurassic(?): Subsurface in southern Arkansas, northern Louisiana, and eastern Texas.

R. T. Hazzard, W. C. Spooner, and B. W. Blanpied, [1947], Shreveport Geol. Soc. 1945 Ref. Rept., v. 2, p. 483, 484, 486–487. In type well, consists of an anhydrite member 57 feet thick overlying a red bed and conglomerate member 55 feet thick. Total thickness of red bed member is as much as 110 feet. In type well, the conglomerate is in contact with folded Paleozoic rocks. In some wells, the Werner is in contact with Morehouse formation; in other wells it is inferred that the Werner is in contact with the Eagle Mills. Appears to be conformable with overlying Louann salt. Term "Louann tongue," as formerly used, is synonymous with Werner formation of this report. Permian.

F. M. Swain, 1949, Am. Assoc. Petroleum Geologists Bull., v. 33, no. 7, p. 1207. Eagle Mills of this report includes (ascending) Werner formation, Louann salt, and Norphlet formation of Hazzard, Spooner, and Blanpied, who believe that type Eagle Mills is older than their Werner. Eagle Mills, including the salt, is assigned to Upper Jurassic; if the salt is Permian, an explanation of how it escaped extensive solution throughout Triassic time should be provided.

E. D. McKee and others, 1956, U.S. Geol. Survey Misc. Geol. Inv. Map I–175. Age shown as Jurassic. Position of lower boundary of Jurassic system is believed by some geologists to be above Louann and Werner formations, but by others to be beneath them, at top of Eagle Mills (restricted). Because Louann and Werner formations consist of unfossiliferous deposits of salt, anhydrite, and red beds, and because these formations have not been penetrated very far downdip, problem remains controversial. Base of Jurassic system is herein assumed to be at contact of Werner and Eagle Mills (restricted) formations.

Type well: Gulf Refining Co.'s No. 49 L Werner Saw Mill Co. well located in Louann district, Union County, Ark.

Weskan 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. 23. Consists of gray clayey shale; bentonite beds in lower part. Thickness 170 feet. Overlies Sharon Springs shale member; underlies Lake Creek shale member.

Type locality: Five miles north of town of Weskan, Wallace County.

**Weskeag Quartzite Member** (of Rockland Formation)[1]

Cambrian or Ordovician: South-central Maine.

Original reference: E. S. Bastin, 1908, U.S. Geol. Survey Geol. Atlas, Folio 158, p. 3–4.

H. W. Allen, 1951, Maine State Geologist Rept., 1949–1950, p. 79–80. Sequence of metamorphosed sedimentary rocks in Rockland quadrangle, Knox County, is (ascending) Isleboro formation, containing Coombs limestone member at top; Battie quartzite; Penobscot formation; and Rockland formation consisting of Weskeag quartzite member at base, siliceous limestone member above the quartzite, and Rockport limestone member at top.

Named for exposures on Weskeag River, Knox County.

Wesley Formation (in Jackfork Group)

Upper Mississippian: Southeastern Oklahoma.

B. H. Harlton, 1938, Am. Assoc. Petroleum Geologists Bull., v. 22, no. 7, p. 854 (fig. 1), 857, 886–889. Proposed for uppermost formation in group. Consists of massive siliceous shale 100 to 500 feet thick. Underlies Union Valley sandstone; overlies Markham Mill formation (new); along Choctaw fault zone, shale of Wesley age is in normal contact with Caney shale of Chester age. Wesley shale is a correlative of most of the shale heretofore called "Pennsylvanian Caney," which in Arbuckle Mountains occurs between Union Valley sandstone and Chester Caney shale, and in Ardmore basin occurs between Rod Club sandstone and Chester Caney shale. Since this shale attains great thickness in Ardmore basin and is important lithologic and paleontologic unit of widespread distribution in Midcontinent, the name Wesley shale is proposed for it. Pushmataha series.

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. Underlies Game Refuge formation (new); overlies Markham Mill formation.

L. M. Cline, 1960, Oklahoma Geol. Survey Bull. 85, p. 43 (table 3), 55–57, pls. Described in Ouachita Mountains. Late Mississippian.

Type locality: Southwest of village of Wesley in E½SE¼NW¼ sec. 20, T. 1 N., R. 13 E., Atoka County.

Wesson Tongue (of Dorcheat Member of Schuler Formation)

Upper Jurassic: Subsurface in southern Arkansas, northern Louisiana, and eastern Texas.

F. M. Swain, 1944, Am. Assoc. Petroleum Geologists Bull., v. 28, no. 5, p. 608–609. Dark-gray glauconitic fossiliferous shale near top of nearshore facies of Dorcheat member. Occurs between depths of 5,710 feet and 5,872 feet in type well.

Type well: Standard Oil Co. of Louisiana's D. A. Zimmerman No. 1, SE¼ SE¼ sec. 29, T. 18 S., R. 16 W., Union County, Ark.; Wildcat, Wesson area.

West Arm Formation (in Deese Group)

Pennsylvanian (Des Moines Series): Central southern Oklahoma.

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), 33. West Arm formation comprises upper part of Deese group. Includes Williams member at base and Natsy member near middle. Also includes upper members of Warren Ranch conglomerate facies (new). Name credited to B. H. Harlton (in preparation).

B. H. Harlton, 1960, Am. Assoc. Petroleum Geologists Bull., v. 44, no. 2, p. 213 (fig. 3), 220–221. Thickness approximately 900 feet. Includes Natsy member about 450 feet below top and Williams member at base. Underlies Confederate limestone of Hoxbar group. Type locality stated. Subsurface relationships discussed.

Type locality: West Arm of Lake Murray along west branch of Anadarche Creek, southeast of Ardmore, secs. 9, 16, 17, and 21, T. 5 S., R. 2 E., Carter County.

West Baden[1] Group

Mississippian, Chester Series): Indiana, Illinois, and Kentucky.

Original reference: E. R. Cumings, 1922, Indiana Dept. Conserv., Pub. 21, pt. 4, p. 514 (footnote).

H. H. Gray, R. D. Jenkins, and R. M. Weidman, 1960, Indiana Geol. Survey Bull. 20, p. 36 (table 5), 44–48, pl. 1. Cumings (1922) suggested West Baden as group name to include (ascending) formations now known as Paoli limestone, Bethel formation, Beaver Bend limestone, Sample formation, Reelsville limestone, Elwren formation, and Beech Creek limestone. Name had little usage. Proposed here to revive Cuming's name West Baden and redefine it as comprising (ascending) Bethel formation, Beaver Bend limestone, Sample formation, Reelsville limestone, and Elwren formation. Thickness 105 to 135 feet. Overlies Blue River group (new); underlies Stephensport group (redefined).

Named for town of West Baden, Orange County, Ind.

West Bath Slate[1]

Pre-Silurian: Northwest New Hampshire.

Original reference: M. Billings, 1933, Am. Jour. Sci., 5th, v. 25, no. 146, p. 149.

In Littleton and Moosilauke quadrangles, Ammonoosuc River region. Village of West Bath is in Woodsville quadrangle.

**Westboro Quartzite**[1] (in Blackstone Series)

Precambrian(?): Eastern Massachusetts and northern Rhode Island.

Original reference: B. K. Emerson and J. H. Perry, 1903, Geology of Worcester, 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. 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]. Described in Pawtucket quadrangle, Rhode Island-Massachusetts, as light-buff to white massive quartzite, locally with thin beds of quartz-mica schist. Also includes Albion schist member. Thickness 1,000 to 3,000 feet. Underlies Sneech Pond schist (new) with gradational contact; overlies Mussey

Brook schist (new). Assigned to Blackstone series of Precambrian(?) age.

Named for town of Westboro, Worcester County, Mass.

**West Branch Shale Member** (of Janesville Shale)

West Branch Shale[1] (in Admire Shale or Group)

Permian: Southeastern Nebraska and eastern Kansas.

Original reference: G. E. Condra, 1927, Nebraska Geol. Survey Bull. 1, 2d ser., p. 74, 82, 89, 111, 113.

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 Janesville shale (new). Underlies Five Point limestone member; overlies Falls City limestone. Wolfcamp series.

M. R. Mudge and H. R. Burton, 1959, U.S. Geol. Survey Bull. 1068, p. 14 (table 2), 48–49. Thickness about 27 feet in Wabaunsee County, Kans. Underlies Five Point limestone member; overlies Falls City limestone.

Named for exposures in West Branch Township, Pawnee County, Nebr.

**Westbrook Granite**[1]

Pre-Carboniferous(?): Southwestern Maine.

Original reference: F. J. Katz, 1917, U.S. Geol. Survey Prof. Paper, 108, p. 175.

Named for exposures in Westbrook Township, Cumberland County.

West Brook Member[1] (of Tully Formation)

Middle Devonian: Central New York.

Original reference: G. A. Cooper and J. S. Williams, 1935, Geol. Soc. America Bull., v. 46, p. 790–813.

G. A. Cooper and others, 1942, Geol. Soc. America Bull., v. 53. no. 12, pt. 1, p. 1787–1788, chart 4. Seems best to regard Tully as Middle Devonian, and to make a stage, the Taghanic, to include it and its correlates and overlying Geneseo.

R. E. Etevenson and W. S. Skinner, 1949, Pennsylvania Acad. Sci. Proc., v. 23, p. 29–33. Type Tully section consists of following members: Tinkers Falls, Apulia, and West Brook.

Type locality: On West Brook, 3 miles south of Sherburne, Chenango County.

West Canyon Limestone Member (of Oquirrh Formation)

Pennsylvanian: Northern Utah.

P. W. Nygreen, 1958, Utah Geol. and Mineralog. Survey Bull. 61, p. 13–14. Proposed for basal limestone part of formation. Chiefly bioclastic limestones with some interbedded sandstone or siltstone and lesser amounts of chert. Limestones are calcarenites and calcilutites, medium blue gray, thin to thick bedded, and blocky to slabby weathering. Many limestone units cherty or silicified. Some units reflect conditions of probably cyclic sedimentation. Sandstones are quartzose, very fine grained, silty, calcareous cement, and olive brown. Thickness 1,456 feet in type section; 510 feet in Sardine Canyon section, near Logan. Conformably(?) underlies "sandy" part of formation and conformably(?) overlies Manning Canyon formation.

Type section: On divide between Threemile Canyon and Fourmile Canyon, tributaries to drainage of West Canyon. in E½ sec. 23, W½ sec. 24, T. 5 S., R. 3 W., Utah County. Named for excellent exposures along northeast side of West Canyon 6 to 9 miles north of Cedar Fort, Utah, and northwest of town along base of ridge.

West Castleton Formation or Group.

Lower Cambrian: Eastern New York and west-central Vermont.

E-an Zen, 1959, New England Intercollegiate Geol. Conf. Guidebook 51st Ann. Mtg., p. 2. Consists largely of gray siltstone and black fissile slate, with rare beds of quartzite, pebble conglomerate, and rusty-weathering dolostone; near base of unit is black limestone, Beebe limestone, which is massive but discontinuous. Overlies Castleton member (new) of Bull formation; major unconformity probably separates West Castleton from Poultney River group (new). This conclusion is based on overlap relations as well as gaps in the stratigraphy. Thickness not determined; entire sequence has undergone intense deformation. Formation was called Hooker by Keith (1932), Schodack by Ruedemann (1914), Kaiser (1945) and Fowler (1950).

George Theokritoff, 1959, New England Intercollegiate Geol. Soc. Guidebook 51st Ann. Mtg., p. 53, 55. Described in Washington County, N.Y., where it overlies Mettawee slate member of Bull formation and locally Bomoseen grit member, and underlies Hatch Hill formation (new).

J. G. Elam, 1960, Dissert. Abs., v. 21, no. 6, p. 1523–1524. Discussion of Troy South and East Greenbush quadrangles, New York. Stratigraphic section subdivided into four groups and previously described dominant formational names have been elevated to group status. Groups are Bull (Lower Cambrian), West Castleton (upper Lower Cambrian-Upper Cambrian), Poultney (Lower Ordovician), and Normanskill (Middle Ordovician).

Westchester Gneisses and Granites[1]

Precambrian: Southeastern New York and northern New Jersey.

Original reference: F. J. H. Merrill, 1901, Geologic map of New York.

Probably named for Westchester County, N.Y.

**West Cove Member** (of Little Sitkin Dacite)

Quaternary: Southwestern Alaska.

G. L. Snyder, 1959, U.S. Geol. Survey Bull. 1028–H, p. 182–183, pl. 23. Consists of two aa flows (crater flow and cove flow). Rocks of both flows are black glassy dacite containing abundant small plagioclase phenocrysts and shown by analyses to be low in silica for dacite. Flows nearly contemporaneous and were extruded about 50 years ago. Cove flow overlies Williwaw Cove formation (new); crater flow overlies low-silica dacite of Little Sitkin dacite.

Type locality: Along coast on north side of West Cove, Little Sitkin Island, in Rat Island group of Aleutian Islands. Crater flow on south slope of Little Sitkin volcano; cove flow at West cove.

West Dummerston Granite[1]

Devonian: Southeastern Vermont.

Original reference: E. J. Foyles and C. H. Richardson, 1929, Vermont State Geologist 16th Rept., table opposite p. 288.

Quarried at village of West Dummerston, Dummerston Township, Brattleboro quadrangle, Windham County.

**West Elk Breccia**[1]

Miocene(?): Western central Colorado.

Original reference: W. Cross, 1894, U.S. Geol. Survey Geol. Atlas, Folio 9.

Forms West Elk Mountains and extends south to Gunnison River, in Anthracite-Crested Butte region.

**West End Rhyolite**[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.

Well exposed in Tonopah Extension and West End mines, Tonopah district.

**Westerly Granite**[1]

Pennsylvanian or younger: Southwestern Rhode Island and southeastern Connecticut.

Original reference: H. E. Gregory, 1906, Connecticut Geol. Nat. History Survey Bull. 6, p. 115, 136, 152, 154.

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

G. E. Moore, Jr., 1959, U.S. Geol. Survey Geol. Quad. Map GQ–117. Described and mapped in Carolina and Quonochontaug quadrangles. Intrudes Blackstone series, Hope Valley alaskite gneiss, and Narragansett Pier granite. Lead-alpha age determinations of zircon and monazite from Westerly are 243 and 220 million years. Map bracket shows Pennsylvanian or younger.

Quarried at Westerly, R.I.

Western Cascade series

Eocene to Miocene: 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 is divided into two parts, Western Cascades and High Cascades on basis of pronounced unconformity in stratigraphic sequence of lavas. Older series [Western Cascades] is divided into two groups on basis of dominant rock-type and associated structural features. One of these is characterized by black lavas with associated red agglomerates, tuffs, and rhyolites; the other of irregular flows of dominantly andesitic lavas with rhyolite and abundant andesitic and rhyolitic pyroclastic rocks in most places. The black lavas occur in two separate areas along western margin of range—one in southern Oregon in Rogue River valley area and the other along Willamette Valley. In southern Oregon, they rest upon an arkosic formation of Eocene age. Along Willamette Valley, they rest upon Oligocene. Gray andesitic series occupies remainder of Western Cascades from Rogue River north toward the Columbia. In vicinity of Rogue River, they appear to interfinger with the black lavas and farther north they are stratigraphically higher.

Howel Williams, 1949, California Div. Mines Bull. 151, p. 20–32, pls. 1, 2. Most of Macdoel quadrangle is occupied by volcanic materials. These belong to two series, first Western Cascade series, ranging in age from Eocene to Miocene, and second, High Cascade series of Pliocene, Pleistocene, and Recent age. Older series covers most of western half of quadrangle and consists mainly of andesitic lavas, with subordinate flows of basalt and dacite, beds of rhyolite tuff, and a few domical protrusions of rhyolitic lava. At close of the Miocene, this older series was gently tilted to east and northeast and was cut by faults that border long narrow horsts trending slightly west of north. At the same time, ancestral Cascade Range was formed by regional uplift. Subsequently, a north-trending chain of volcanoes was built along crest of range; their products form High Cascade series. Width of the belt of Western Cascade series in Oregon ranges generally from 30 to 40 miles. Southward the belt becomes narrower. Along California-Oregon line, width is about 24 miles; 18 miles in southern part of Macdoel quadrangle; 3 miles south of Weed. Belt comes to end owing to overlap by lavas discharged from Mount Shasta. In Oregon, Western Cascade series corresponds with Clarno, John Day, Columbia River basalt, Mascall, and Payette formations; in northeastern California, part of series is equivalent to Cedarville beds of Warner Range. Because of overlap by flows of High Cascade volcanoes, Western Cascade series is nowhere exposed in full thickness. About 12,000 to 15,000 feet along Oregon-California boundary; about 10,000 feet in latitude of Yreka.

**Westerville Limestone Member** (of Cherryvale Formation)

Pennsylvanian: Western Maryland, western Pennsylvania, and western West Virginia.

Original reference: I. C. White, 1882, The Virginias, v. 3, p. 141–143.

W. O. Hickok 4th and F. T. Moyer, 1940, Pennsylvania Geol. Survey, 4th ser., Bull. C–26, p. 73, fig. 21. In Fayette County, Westernport sandstone lies between Upper and Lower Kittanning coals; commonly divided into two parts by Johnstown limestone and Middle Kittanning coal; in vicinity of Normalville and Whites Bridge, the parts coalesce and cut out intervening limestone and coal. Thickness 30 to 60 feet. Included in Allegheny group.

Forms cliffs along Potomac west of Westernport, Allegany County, Md.

**Westerville Limestone Member** (of Cherryvale Formation)

Westerville Limestone (in Kansas City Group)

Westerville Limestone Member (of Kansas City Formation)[1]

Westerville Limestone Member (of Sarpy Formation)

Pennsylvanian (Missouri Series): Southwestern Iowa, northeastern Kansas, northwestern Missouri, and southeastern Nebraska.

Original reference: H. F. Bain, 1898, Am. Jour. Sci., 4th, v. 5. p. 437–439.

R. C. Moore, 1936, Kansas Geol. Survey Bull. 22, p. 45 (fig. 8), 100–101. Westerville limestone included in Kansas City group. Underlies Quivira shale; overlies Wea shale.

R. C. Moore, 1948, Am. Assoc. Petroleum Geologists Bull., v. 32, no. 11, p. 2030, 2031 (fig. 4). Rank reduced to member status in Cherryvale formation. Underlies Quivira shale member; overlies Wea shale member. This is classification agreed upon by State Geological Surveys of

Iowa, Kansas, Missouri, Nebraska, and Oklahoma, May 1947. Clair (1943, Missouri Geol. Survey and Water Resources, 3d ser., v. 27) included the Westerville in Cherryvale shale.

G. E. Condra, 1949, Nebraska Geol. Survey Bull. 16, p. 37–38. In Nebraska classified as uppermost member of Sarpy formation (new). Overlies Wea shale member.

T. L. Welp, L. A. Thomas, and H. R. Dixon, 1957, Iowa Acad. Sci. Proc., v. 64, p. 418 (fig. 1), 421. In section near Winterset, Iowa, Westerville member of Cherryvale is about 62 feet thick; underlies Quivira shale member; overlies Wea-Fontana shale members.

H. G. Hershey and others, 1960, Iowa Highway Research Board Bull. 15, p. 26, fig. 5. Formation in Kansas City group. Thickness about 2 feet in Madison County; 10 feet in Pottawattamie County. Underlies Quivira shale; overlies Cherryvale shale.

Named for exposures at Westerville, Decatur County, Iowa.

West Fairview Member (of Martinsburg Shale)

Ordovician: South-central Pennsylvania.

Bradford Willard and A. B. Cleaves, 1938, Pennsylvania Geol. Survey, 4th ser., Bull. G–8, p. 5, 6. Name proposed for principal body of massive usually weak sandstone with calcareous cement in Martinsburg shale in Harrisburg area.

Named for village of West Fairview, Cumberland County, near which unit forms prominent hill.

**West Falls Formation**

Upper Devonian: Western and west-central New York.

J. F. Pepper, Wallace de Witt, Jr., and G. W. Colton, 1956, U.S. Geol. Survey Oil and Gas Inv. Map OC–55. Includes all rocks between top of Cashaqua shale and base of Pipe Creek shale member of Hanover shale. Thickness 415 feet in western Erie County and at type exposure; thickens eastward; 925 feet in Letchworth Park along western boundary of Livingston County and 1,170 feet in eastern Steuben County. Comprises (ascending) Rhinestreet shale, Hatch shale, Grimes siltstone, Gardeau shale, West Hill, and Nunda sandstone members; all members not present in every area. In Naples-Hammondsport area, underlies Wiscoy sandstone. Rocks of formation comprise thin wedge of Upper Devonian deltaic deposits of black mud, gray mud, and silt.

Wallace de Witt, Jr., 1956, U.S. Geol. Survey Geol. Quad. Map GQ–97. Described in Eden quadrangle where it is about 415 feet thick and composed of two members: Rhinestreet shale below and Angola shale above. Overlies Cashaqua shale and underlies Pipe Creek member of Hanover shale.

Wallace de Witt, Jr., 1960, Am. Assoc. Petroleum Geologists Bull., v. 44, no. 12, p. 1933, 1935 (fig. 2). Underlies Pipe Creek shale reallocated to member status in Java formation (new).

Type exposure: Along Cazenovia Creek in vicinity of West Falls and East Aurora, central Erie County.

Westfield phase (of Otis Limestone)[1]

Middle Devonian: Central eastern Iowa.

Original reference: W. H. Norton, 1921, Iowa Geol. Survey, v. 27, p. 377.

Occurs at Westfield Bridge at Fayette, Fayette County and southeast of Waverly, Bremer County.

Westfield Serpentine[1]

Ordovician: Western Massachusetts.

Original reference: B. K. Emerson, 1898, U.S. Geol. Survey Mon. 29, p. 92.

Crops out in western edge of Westfield, Hampden County.

Westfield Shale[1] (in Canadaway Group)

Westfield Shale Member (of Canadaway Formation)

Upper Devonian: 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), 18. Member of Canadaway formation. Overlies Laona siltstone member; underlies Shumla siltstone member. Thickness 120 to 150 feet.

Probably named for exposures at or near Westfield, Chautauqua County.

Westford Schist

Precambrian: Northwestern Vermont.

E. C. Jacobs, [1937], Vermont State Geologist 20th Rept., p. 57, 117–118. Gray fine-grained thinly foliated schist. Interbedded with metamorphic rocks of Green Mountain series.

E. C. Jacobs, [1939], Vermont State Geologist 21st Rept., p. 33–35. Age designated. Derivation of name given; exposures described.

Named for occurrence in Westford Township, Chittenden County. Exposures include those in Lamoille River Gorge at Fairfax Falls and small gorge of Browns River in Jericho where eastern border of outcrop area is exposed.

**West Fork Formation**[1]

Upper Devonian or Mississippian: Northern Alaska.

Original reference: F. C. Schrader, 1900, U.S. Geol. Survey 21st Ann. Rept., pt. 2, p. 475.

Crosses Chandalar River valley in belt 15 miles wide from below Granite Creek to above West Fork of Chandalar River, in Wiseman-Chandalar region.

**West Franklin Limestone**[1]

West Franklin Limestone Member (of Modesto Formation)

Upper Pennsylvanian: Southwestern Indiana and southern Illinois.

Original references: Leo Lesquereux, 1862, *in* Rept. of Geol. Reconn. of Indiana, p. 294, 297; J. Collett, 1884, Indiana Dept. Geology and Nat. History 13th Ann. Rept., p. 61–62.

C. A. Malott, 1947, Indiana Acad. Sci. Proc., v. 57, p. 126 (fig. 1), 128. In Dicksburg Hills area, where only upper part of formation is exposed, underlies Ditney formation.

C. E. Wier, 1951, U.S. Geol. Survey Coal Inv. Map C–9. In Greene and Sullivan Counties, underlies Shelburn formation (restricted).

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 37, 49 (table 1). Member of Modesto formation (new) in southeastern

Illinois. Complex member which may include Piasa limestone, DeGraff, Pond Creek, and Lake Creek coal members in part of area. Type locality noted.

Type locality: South-central part sec. 24, T. 7 S.,R. 12 W., Posey County, Ind. Named for exposures at West Franklin.

West Gull jasper facies (of Ogishke 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), 1034, 1035. Characterized (at type locality) by closely spaced red jasper pebbles and cobbles. Thickness about 1,700 feet. Underlies Zeta Lake conglomerate or granite porphyry facies; overlies Peebles granite facies.

Type locality: On West Gull Lake, a few miles northeast of Ogishkemuncie Lake, in Vermilion district.

Westheimer Member (of Hoxbar Formation)[1]

Pennsylvanian: Central southern Oklahoma.

Original reference: C. W. Tomlinson, 1928, Oklahoma Geol. Survey Bull. 40Z, p. 15.

Well exposed on property of Westheimer & Daube, in NW¼SE¼ sec. 7, T. 6 S., R. 2 E, and about 200 yards east of asphalt prospect belonging to that firm, in Carter County.

**West Hill Member** (of West Falls Formation)

West Hill Formation[1]

Upper Devonian: West-central New York.

Original reference: J. M. Clarke, 1903, New York State Mus. Handb. 19, p. 23.

J. F. Pepper, Wallace de Witt, Jr., and G. W. Colton, 1956, U.S. Geol. Survey Oil and Gas Inv. Map OC–55. Name West Hill flags proposed by Clarke (1903) and applied by Clarke and Luther (1904 New York State Mus. Bull. 63) to sequence of siltstones and shales overlying the Grimes and underlying the Nunda in vicinity of West Hill. Measured sections for present report show that in Naples area rocks for 300 to 400 feet above Grimes member are similar in lithology to upper part of Gardeau member in Genesee Gorge. Therefore, these rocks in Naples area are herein included in Gardeau. West Hill member of West Falls formation (new) as used in this report applies only to those rocks higher in stratigraphic column that show noticeable increase in siltstone content. As used here, West Hill member consists of a series of rocks intermediate in lithology between Gardeau shale member and Nunda sandstone member. Consists mainly of gray siltstone and silty gray shale and at some places includes small amounts of petroliferous dark-gray shale and grayish-black slightly silty shale and a few layers of calcareous nodules; in southeastern part of mapped area, silty gray mudrock makes up much of member. Thickness 35 feet, northwestern Wyoming County; 240 feet northeastern Steuben County. Basal and upper contacts arbitrarily drawn. In western Wyoming County, West Hill intertongues with Gardeau member and uppermost siltstone bed is overlain by thin tongue of Gardeau.

Named for West Hill, Ontario County.

West Index Andesitic Series[1]

Eocene or Miocene: Central Washington.

Original reference: C. E. Weaver, 1912, Washington Geol. Survey Bull. 7, p. 34–50.

Named for Mount West Index, Snohomish County.

West Jefferson Sandstone[1]

Middle Devonian: Central Ohio.

Original reference: E. Orton, 1888, Ohio Geol. Survey, v. 6, p. 4, 21.

Named for West Jefferson, Madison County.

West Ledge Formation[1]

Precambrian: Southwestern South Dakota.

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

Occurs in Lead district, Lawrence County. Derivation of name not stated.

West Mead limestone member[1]

Mississippian: Northwestern Pennsylvania.

Original reference: K. E. Caster, 1934, Bulls. Am. Paleontology, v. 21, no. 71, p. 132, table facing p. 61.

Named for West Mead Township, Crawford County, where it is well developed.

**West Minesota 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, 24 p., map, Philadelphia, 1863; p. 21, map.

Named for occurrence on property of West Minesota Mining Co., in Ontonagon County.

**West Molokai Volcanic Series**

Pliocene(?): Molokai Island, Hawaii.

H. T. Stearns, 1946, Hawaii Div. Hydrography Bull. 8, p. 69 (table), 71; H. T. Stearns and G. A. Macdonald, 1947, Hawaii Div. Hydrography Bull. 11, p. 23–25, 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. 146. Thin-bedded aa and pahoehoe basalt flows, associated cinder cones; some intercalated vitric tuff. Thickness 1,381 feet; base not exposed. Separated from overlying East Molokai volcanic series (new) by erosional unconformity.

Type locality: West Molokai Mountain (Mouna Loa). Cover an area of 120 square miles, comprising most of mountain.

Westmore Formation (in Barre Group)

Silurian or Lower Devonian: Northeastern Vermont.

C. G. Doll, 1951, Vermont Geol. Survey Bull. 3, p. 15, 33–37. Chiefly light- to medium-gray phyllites interbedded with smaller amounts of light-gray to black schists and limestone and quartzites; all are generally fine to medium grained. Thickness about 4,300 feet. Overlies Barton River formation (new).

V. R. Murthy, 1958, Jour. Geology, v. 66, no. 3, p. 276–287. Formation crops out in southeastern corner of Barre quadrangle and northwestern corner of East Barre quadrangle in belt 1¾ to 2 miles wide. These rocks have been mapped as Waits River formation (Currier and Jahns, 1941) and as Gile Mountain(?) formation by White and Jahns (1950, Jour. Geology, v. 58, no. 3). Thickness 3,700 to 5,100 feet. Overlies Barton River formation; underlies Waits River (redefined). Included in Barre group (new).

Type locality: Section exposed in whetstone quarry 1¼ miles due north of Lake Willoughby in southeastern Brownington. Other exposures directly north and south of village of Margan; in pasture one-half mile west-southwest of Echo Pond; and in cuts along State highway leading from West Charleston to Island Pond. Named from village of Westmore on Lake Willoughby in southeastern corner of Memphremagog quadrangle.

Westmoreland Member (of Clinton Formation)

Middle Silurian: New York.

Tracy Gillette, 1947, New York State Mus. Bull. 341, p. 90, 93–94. Name Westmoreland (iron ore) is introduced as designation for oolitic iron ore of Smyth [1892, Am. Jour. Sci., 3d, v. 43] and Newland and Hartnagel (1908, New York State Mus. Bull. 123). Overlies Sauquoit beds; underlies Willowvale shale (new). Thickness about 18 inches at type locality.

Type locality: On tributary of Oriskany Creek about one-half mile east of hamlet of Lairdsville in town of Westmoreland, Oneida County.

Westmoreland Shale (in Chattanooga Shale)

Lower Mississippian: Central Tennessee.

Guy Campbell, 1946, Geol. Soc. America Bull., v. 57, no. 9, p. 885, pl. 1.

Hard fissile black shale, indistinguishable in lithology from the Gassaway (new); contains scattered nodules at Westmoreland. Thickness 6 to 12 inches. Distinguishable as distinct bed in the Chattanooga only by its position above the Eulie shale (new). Underlies New Providence shale. Eulie and Westmoreland shales are complementary in their stratigraphic relations; absence of either would make determination of the status of the other very difficult.

W. H. Hass, 1956, U.S. Geol. Survey Prof. Paper 286, p. 11. Westmoreland shale is grayish-black shale which locally contains phosphatic nodules. Name Westmoreland shale not used in present report [Chattanooga shale and Maury formation]; beds so named by Campbell are placed in Maury formation and not named.

Type section: Two Hundred yards north of Garritt's Creek Church, north of Westmoreland, Sumner County.

Weston Limestone[1]

Pennsylvanian: Northwestern Missouri.

Original reference: J. A. Gallaher, 1898, Missouri Bur. Geology and Mines Bienn. Rept., p. 52.

Named for exposures at Weston, Platte County.

Weston Sandstone (in Monongahela Formation)[1]

Pennsylvanian: Northern West Virginia.

Original reference: D. B. Reger, 1916, West Virginia Geol. Survey Rept. Lewis and Gilmer Counties, p. 124.

Occurs along Town Run, at southeast edge of village of Weston, Lewis County.

Weston Shale (in Monongahela Formation)[1]

Pennsylvanian: Northern West Virginia.

Original reference: D. B. Reger, 1916, West Virginia Geol. Survey Rept. Lewis and Gilmer Counties, p. 128.

Exposed in vicinity of Weston, Lewis County.

**Weston Shale** (in Pedee Group)

Weston Shale or Shale Member (in Douglas Formation or Group)[1]

Weston Shale (in Lansing Group)

Pennsylvanian (Missouri Series): Northwestern Missouri, southwestern Iowa, eastern Kansas, and northeastern Oklahoma.

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, v. 25, 2d ser., p. 28. Included in Pedee group in Missouri.

L. W. Wood, 1941, Iowa Geol. Survey, v. 37, p. 284 (table), 295. Weston and Iatan formations included in Lansing group. Term Pedee dropped from Iowa nomenclature.

R. C. Moore, 1948, Am. Assoc. Petroleum Geologists Bull., v. 32, no. 11, p. 2031 (fig. 4). Chart shows Weston shale in Ochelata group in Oklahoma.

G. E. Condra, 1949, Nebraska Geol. Survey Bull. 16, p. 31. Thickness in Missouri and Kansas about 80 feet and 88 feet in northern Oklahoma. Missing in Nebraska due to post-Missourian erosion which extended into top of Lansing group.

Named for Weston, Platte County, Mo.

**Westphalia Limestone[1] Member** (of Stranger Formation)

Pennsylvanian (Virgil Series): Eastern Kansas.

Original reference: R. C. Moore, 1936, Kansas Geol. Survey Bull. 22, p. 145, 146, 150.

R. C. Moore and others, 1951, Kansas Geol. Survey Bull. 89, p. 73. Characterized by abundant fusulines. Thickness ranges from featheredge to about 5 feet. Underlies Vinland shale member; overlies Tonganoxie sandstone member.

Named for village in western part of Anderson County. Typical outcrops are in roadside exposures along northern part of sec. 12, T. 21 S., R. 17 E., and at NE cor. sec. 20, T. 21 S., R. 18 E., not definitely recognized in outcrops north of T. 19 S.

West Point facies (of Muldraugh Formation)

Lower Mississippian: Northern Kentucky and southern Indiana.

P. B. Stockdale, 1939, Geol. Soc. America Spec. Paper 22, p. 75, 202–210. Northwesternmost facies of formation within Kentucky outcrop belt. It is an impure limestone phase most of which extends but a short distance in Indiana, as far as middle of T. 5 S., southeastern Harrison County, where it includes the two divisions which have been differentiated as Edwardsville and Lower Harrodsburg. Thickness as much as 95 feet. Thickness at type section 95 feet; here facies overlies Floyds Knob formation(?) and underlies Harrodsburg limestone.

Type section: At quarry, one-eighth mile southeast of Louisville and Henderson Railroad station at West Point, Hardin County, Ky.

†West Point Member[1] (of Warsaw Formation)

Mississippian: Western Kentucky.

Original reference: A. H. Sutton, 1931, Kentucky Geol. Survey, ser. 6, v. 37, p. 281.

J. M. Weller and A. H. Sutton, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 5, p. 801. Cherty Edwardsville limestone in Jefferson and adjacent counties, Kentucky, has generally been referred to Warsaw formation and name West Point member has been proposed for it, but it has not been distinguished as a separate unit of the section farther south. Although name West Point has priority, it is abandoned in favor of Edwardsville because of the much clearer stratigraphic relations of the latter in Indiana.

Derivation of name not stated, but there is a village called West Point in Hardin County.

West Prong Lentil (in Grayson Shale)

Lower Cretaceous: Southwestern Texas.

Robert Greenwood, 1956, Gulf Coast Assoc. Geol. Soc. Trans., v. 6, p. 168 (fig. 2), 169. Yellowish-brown poorly indurated argillaceous limestone with thin clay partings. Estimated thickness 50 feet. Overlies Georgetown limestone, apparent conformity.

Type locality: At intersection of West Prong Fork (a local name not shown on quadrangle map) with West Nueces River, Uvalde County.

West Prospect Basalt[1]

Cenozoic: Northern California.

Original reference: Howel Williams, 1932, California Univ. Pub., Dept. Geol. Sci. Bull., v. 21, no. 8, p. 214–376, geol. map.

O. P. Jenkins, 1943, California Div. Mines Bull. 118, p. 686. Cenozoic.

Occurs in Lassen National Park.

**West Range Limestone**[1]

Upper Devonian: Eastern Nevada.

Original references: L. G. Westgate and A. Knopf, 1927, Am. Inst. Mining Metall. Engineers Trans., no. 1647, p. 7; 1932, U.S. Geol. Survey Prof. Paper 171, p. 7, 16, map.

R. L. Langenheim, Jr., 1960, Illinois Acad. Sci. Trans., v. 53, nos. 3 and 4, p. 122–131. Discussion of Pilot shale, West Range limestone, and Devonian-Mississippian boundary in eastern Nevada. Thickness of West Range 296 feet at type section where it overlies Silverhorn dolomite and underlies 32 feet of calcareous siltstone or silty limestone assigned to lower Pilot shale.

Composes, together with underlying Silverhorn limestone, the whole of West Range, which lies west of Bristol Range, Pioche district.

West Ridge Group

Age unknown: Southern California.

K. J. Hsu, 1955, California Univ. Dept. Geol. Sci. Bull., v. 30, no. 4, p. 275–278, geol. map. Hypersthene amphibolites and almandine-diopside rocks. Occurs in narrow lenticular zone between Aurela Ridge granulites (new) and East Ridge mylonites (new); contact probably transitional. Separated from East Ridge rocks by north-dipping Marjo Canyon thrust.

Exposed in Cucamonga quadrangle, San Bernardino County.

**West River Shale Member** (of Genesee Formation)

West River Shale (in Genesee Group)[1]

Upper Devonian: Western and central New York.

Original reference: J. M. Clarke and D. D. Luther, 1904, New York State Mus. Bull. 63, p. 28.

W. L. Grossman, 1944, Geol. Soc. America Bull., v. 55, no. 1, p. 60–66. Formation (or shale) in Genesee group. Consists of interbedded blue-black, dark-gray, and black fissile shale with abundant spherical concretions. Proposed here to include *Styliolina* limestone facies (Genundewa limestone) in the base so that lower boundary of the West River will be lowest *Styliolina* layer. Term Genundewa abandoned. Uppermost boundary is marked by Middlesex shale. The West River continues as a clearly recognizable unit from its type area at Canadaigua Lake to Lake Erie. Interval between Geneseo shale and Middlesex shale in Keuka Lake Valley is thicker than at Canandaigua Lake. Tongue of Sherburne type rock in middle of the West River causes thickening of whole sequence to 250 feet. The West River is divided into the Penn Yan tongue (new) below and the Milo tongue (new) above by penetration of Starkey tongue (new) of Sherburne formation.

Wallace de Witt, Jr., and G. W. Colton, 1959, Am. Assoc. Petroleum Geologists Bull., v. 43, no. 12, p. 2814 (fig. 3), 2815, 2819, 2822. Name West River was proposed by Clarke and Luther (1904) for sequence of dark shaly rocks lying above their Genundewa limestone and below their Standish flags and shales. The West River is herein redefined as West River shale member of Genesee formation. Upper boundary is extended to include all rocks between base of Genundewa limestone member of the Genesee and base of Sonyea formation. Standish flags and shale of Luther and Clarke are included in the West River. At reference section, herein designated, member is about 132 feet thick, and composed largely of dark-gray shale and mudrock that contain several beds of black shale, very dark gray argillaceous limestone nodules, and a few layers of dark-gray or brown siltstone as much as 2 inches thick. In vicinity of Cayuga Lake, member is composed largely of medium-dark-gray shale and mudrock and contains many layers of siltstone ranging from laminae to beds as much as 2 feet thick near Ithaca and to beds 5 feet thick at Sheldrake Creek, 18 miles northwest of Ithaca. Thickness about 150 feet near Ithaca. Highly cross-laminated ripple-marked layer of siltstone 1 to 2 inches thick is present at base of upper third of member in most exposures between Lake Erie and Canandaigua Lake. This key bed, which is present in more than 500 square miles of 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 (1932, Am. Petroleum Inst. Div. Production Paper 826–4A), the same bed that was named Keuka flagstone by Fox (1932).

Reference section: Exposures in Seneca Point Gully on west side of Canandaigua Lake, 9 miles north on Naples, Ontario County. Named for exposures in West River valley, Yates County.

†West Roxbury Slate[1]

Devonian or Carboniferous: Eastern Massachusetts.

Original reference: W. W. Dodge, 1881–1882, Boston Soc. Nat. History Proc., v. 21, p. 208–210.

Occurs on each side of the tract near West Roxbury Station, Boston region.

**West Rutland Marble**[1]

Middle Ordovician: West-central Vermont.

Original reference: E. J. Foyles, 1929, Vermont State Geologist 16th Rept., p. 281–288.

Named for economic occurrences around West Rutland, Rutland County.

West Spring Formation (in Salt Lake Group)

Pliocene, lower and middle: Northeastern Utah.

Neal Smith, 1953, Intermountain Assoc. Petroleum Geologists [Guidebook] 4th Ann. Field Conf., p. 73, 75 (fig. 2). Chiefly soft earthy gray tuff and occasional pebble conglomerate; thin compact stromatolitic limestone in basal part. Thickness 1,200 feet. Overlies Collingston conglomerate (new); underlies Cache Valley formation; both contacts unconformable. Name credited to J. S. Williams (unpub. ms.).

R. D. Adamson, C. T. Hardy, and J. S. Williams, 1955, Utah Geol. Soc. Guidebook 10, p. 6. Considered to be part of Cache Valley formation.

Exposed on Hyrum Bench along southwest side of Cache Valley, about 12 miles south of Logan, Cache County.

**West Spring Creek Formation**[1] (in Arbuckle Group)

Lower Ordovician: Central southern Oklahoma.

Original reference: C. E. Decker, 1930, Am. Assoc. Petroleum Geologists Bull., v. 14, no. 12, p. 1495 (table 4).

C. E. Decker, 1933, Tulsa Geol. Soc. Digest, p. 55, 56. Uppermost formation in Arbuckle group. Overlies Alden limestone (new); underlies Joins formation of Simpson group. Upper Canadian.

C. E. Decker, 1939, Oklahoma Geol. Survey Circ. 22, p. 16 (table 1), 26–28; 1939, Geol. Soc. America Bull., v. 50, no. 8, p. 1320–1321, table 1. Characterized chiefly by many zones of thin shaly limestones separated by thick resistant limestone beds. Thickness 1,611 feet at type section in Arbuckles; 250 feet in Wichitas. Gradationally overlies Kindblade formation (new) which replaces preoccupied name Alden. Lower Ordovician.

W. E. Ham, 1954, Am. Assoc. Petroleum Geologists Bull., v. 38, no. 9, p. 2038–2039. Collings Ranch conglomerate (new) rests with marked angular unconformity on steeply dipping rocks of Arbuckle anticline. Exposed rocks beneath conglomerate are West Spring Creek formation of Arbuckle group, Joins, Oil Creek, McLish, Tulip Creek, and Bromide formations of Simpson group, and Viola limestone.

Type section: Along U.S. Highway 77 about 3 miles north of Springer, sec. 19, T. 2 S., R. 1. E., Carter County. Named for West Spring Creek at west end of Arbuckle Mountains (sec. 31, T. 2 S., R. 1 W.), where it flows across formation.

West Sutton Slate[1] or Formation

Precambrian(?) or Lower Cambrian: Southern Quebec, Canada, and northwestern Vermont.

Original reference: T. H. Clark, 1931, Geol. Soc. America Bull., v. 42, pt. 1, p. 225–226.

T. H. Clark, 1936, Royal Canadian Inst. Trans., v. 21, pt. 1, p. 137, 143–144. Fine mud rock varying from medium and dark gray to dark blue black. Hematite characteristically present either as discrete masses or disseminated. Contains gritty beds at type locality which is cited. Thickness generally 40 to 250 feet. Underlies Gilman quartzite; overlies White Brook dolomite.

V. H. Booth, 1950, Geol. Soc. America Bull., v. 61, no. 10, p. 1135, 1136, 1147, 1148. Extended to Vermont where it is known as West Sutton formation because of lithologic variations.

Phillip Fowler, 1950, Vermont Geol. Survey Bull. 2, pl. 1. Precambrian(?).

Type locality: One-half mile northwest of the West Sutton four corners, Sutton quadrangle, Quebec.

West Union Formation[1]

Silurian (Niagaran): Southwestern Ohio.

Original reference: E. Orton, 1871, Ohio Geol. Survey Rept. Prog. 1870, p. 271, 274, 301, fig. 1.

Alwyn Williams, 1953, Geol. Soc. America Mem. 56, p. 62. West Union formation mentioned in list of fossil localities.

Named for exposures at West Union, Adams County.

West Union Gravel

Pleistocene: Central Minnesota.

Kirk Bryan, Henry Retzek, and F. T. McCann, 1938, Texas Archeol. Paleont. Soc. Bull. 10, p. 125. Name applied to gravel in which skeleton of Sauk Valley man was discovered. Gravel is 5 to 6 feet thick and well stratified; coarse and rubbly at base and containing pebbles 2 to 4 inches in diameter; grades to finer material toward top. At south end of gravel pit, gravel rests on yellow clayey till which is more than 5 feet thick; till thins northward to featheredge and rests on slightly deformed gray gravel; the West Union rests unconformably on both of these materials. Underlies black loam about 1 foot thick.

Occurs in gravel pit on land of Daniel W. Fraser, Lot 1 of NE¼ sec. 11, T. 127 N., R. 35 W., West Union Township, Todd County.

Westville Shale[1]

Pennsylvanian: Southeastern Massachusetts.

Original reference: J. B. Woodworth, 1899, U.S. Geol. Survey Mon. 33, p. 134.

Westwater Gneisses and Schists[1]

Precambrian: Western Colorado.

Original reference: C. R. Keyes, 1924, Pan-Am. Geologist, v. 41, p. 39, 281.

Exposed in bed of Grand River at Utah-Colorado line. Derivation of name not stated.

Westwater Sandstone Member (of Morrison Formation)

*See* **Westwater Canyon Sandstone Member** (of Morrison Formation).

**Westwater Canyon Sandstone Member** (of Morrison Formation)[1]

Upper Jurassic: Southeastern Utah, northeastern Arizona, southwestern Colorado, and northwestern New Mexico.

Original reference: H. E. Gregory, 1938, U.S. Geol. Survey Prof. Paper 188, p. 59, pl. 15.

J. W. Harshbarger, C. A. Repenning, and R. L. Jackson, 1951, New Mexico Geol. Soc. Guidebook 2d Field Conf., p. 98. Geographically extended into Arizona and New Mexico. About 155 feet thick at Kayenta, Ariz.; decreases in thickness to the south and not present in Hopi Buttes area; pinchout due to pre-Dakota erosion.

L. C. Craig and others, 1955, U.S. Geol. Survey Bull. 1009–E, p. 153–155. Westwater Canyon constitutes lower unit of upper part of Morrison in southern part of region of this study [Colorado Plateau]. Unit was formed as large alluvial fan. To the north, Westwater Canyon intertongues with and grades into lower part of Brushy Basin member along a limit of recognition that passes just south of Monticello, Utah. In most of northwestern New Mexico and a small part of northeastern Arizona, upper part of Brushy Basin member overlies Westwater Canyon, but to the southwest, post-Morrison erosion has removed Brushy Basin, and the Westwater Canyon is only part of upper part of Morrison preserved. Arbitrarily divided into two facies: conglomeratic sandstone facies and sandstone facies. Maximum thickness 330 feet, 30 miles northeast of Gallup.

V. L. Freeman and L. S. Hilpert, 1956, U.S. Geol. Survey Bull. 1030–J, p. 309, 314, 315 (fig. 60), 324, 326, 330, 333. In Laguna area, New Mexico, Recapture, Westwater Canyon, and most of Brushy Basin members are present in stratigraphic interval previously considered as Recapture. Sandstone, previously considered as Westwater Canyon, is at top of Brushy Basin and is informally called Jackpile ore-bearing bed. Westwater Canyon in Gallup-Albuquerque area ranges from about 50 to 190 feet in thickness; locally absent near Laguna. In general, thickens from Laguna area westward toward Gallup and northward toward San Ysidro.

J. W. Harshbarger, C. A. Repenning, and J. H. Irwin, 1957, U.S. Geol. Survey Prof. Paper 291, p. 53–55, strat. sections. Gregory suggested that Westwater Canyon member might be correlative with Salt Wash member, but, in view of regional relationships presented by Stokes (1944 Geol. Soc. America Bull., v. 55, no. 8), the Salt Wash appears to be correlative with basal part of Gregory's Recapture. In this report [Navajo country], name Westwater Canyon is applied to cliff-forming sandstone of the Morrison lying below variegated shale of Brushy Basin member and above Recapture member. No positive evidence found to indicate that Westwater Canyon intertongues with Cow Springs sandstone as do underlying Recapture and Salt Wash; however, such a relationship between the Westwater Canyon and Cow Springs appears to exist in exposures between Todilto Park and Lupton. Where Brushy Basin has been removed by pre-Dakota erosion, Westwater Canyon unconformably underlies Dakota sandstone. Thicknesses: 155 feet south of Kayenta; 239 feet at Yale Point; 227 feet at Todilto Park; 127 feet at Thoreau, N. Mex.

R. T. Zitting and others, 1957, The Mines Magazine, v. 47, no. 3, p. 55, 57. In Ambrosia Lake area, McKinley County, N. Mex., includes Poison Canyon sandstone (new) at top.

Named for exposures in canyon of Westwater Creek near Blanding, San Juan County, Utah.

Wetmore conglomerate member[1] (of Knapp formational suite)

Devonian or Carboniferous: Southwestern New York and northwestern Pennsylvania.

Original reference: K. E. Caster, 1934, Bulls. Am. Paleontology, v. 21, no. 71, p. 61, 111–112, table facing p. 61.

Occurs only in McKean, northern Forest, northern Elk, and eastern Warren Counties, Pa., and in typical Knapp area, in vicinity of Knapp Creek, N.Y. Named for exposures along face of the hills between Wetmore and Ludlow, McKean County, Pa.

**Wetumka Shale**[1] (in Marmaton Group)

Pennsylvanian (Des Moines Series) : Central Oklahoma.

Original reference: J. A. Taff, 1901, U.S. Geol. Survey Geol. Atlas, Folio 74.

E. R. Ries, 1954, Oklahoma Geol. Survey Bull. 71, p. 30–32. Described in Okfuskee County where it is 120 to 148 feet thick. Conformably overlies Calvin sandstone; conformably underlies Wewoka formation. Marmaton group.

H. D. Miser and others, 1954, Geologic map of Oklahoma (1:500,000) : U.S. Geol. Survey. As mapped, extends northeastward from Pontotoc County through Hughes, Okfuskee, Okmulgee, and Tulsa Counties to near Arkansas River. Marmaton group.

Named for exposures at or near Wetumka, Hughes County.

**Weverton Quartzite** or **Formation** (in Chilhowee Group)

Weverton Sandstone[1]

Lower Cambrian(?) : Maryland, southeastern Pennsylvania, Virginia, 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. J. Stose and G. W. Stose, 1946, Maryland Dept. Geology, Mines and Water Resources Carroll and Frederick Counties [Rept. 12], p. 34–39. Weverton quartzite described in Carroll and Frederick Counties, where it is about 500 feet thick. Overlies Loudoun formation; underlies Harpers phyllite. Lower Cambrian.

P. B. King, 1950, U.S. Geol. Survey Prof. Paper 230, p. 15 (fig. 5), 17–19, pl. 1. Formation described in Elkton area, Virginia, where it is included in Chilhowee group. Divided into three members: lower, conglomerate and coarse-grained feldspathic quartzite; middle, persistent body of argillaceous shale; upper, contains numerous beds of quartzite, many of which are dark and ferruginous, between are layers of thin-bedded siltstone and fine-grained gray sandstone. Thickness 1,000 to 1,600 feet. In some areas, Loudoun formation pinches out and Weverton lies directly in injection complex. Conformably underlies Harpers formation. Lower Cambrian.

D. M. Scotford, 1951, Geol. Soc. America Bull., v. 62, no. 1, p. 48–49. Discussion of Sugarloaf Mountain area, Maryland. Quartzites on Sugarloaf Mountain were considered Lower Cambrian and therefore Weverton by early workers such as J. P. Lesley, G. H. Williamson, and C. R. Keyes. Jonas and Stose (1938, Geologic map of Frederick County) mapped these rocks as Sugarloaf Mountain quartzites and assigned them to probable Lower Cambrian age. Writer [Scotford] believes these rocks are equivalent to Lower Cambrian Weverton quartzite because Sugarloaf Mountain is an anticline rather than a syncline as reported by Stose and Stose (1946). Stratigraphic sequence is therefore reverse of that previously described and corresponds to known Cambrian sequence in South Mountain uplift. Underlies Harpers phyllite.

A. J. Stose and G. W. Stose, 1951, Geol. Soc. America Bull., v. 62, no. 6, p. 697–699. Discussion of article by Scotford (1951) in which he interpreted Sugarloaf Mountain area as anticlinal. Arguments are presented to uphold interpretation that area is synclinal.

J. C. Whitaker, 1955, Geol. Soc. America Bull., v. 66, no. 4, p. 442–445, pl. 1. Discussion of geology of Catoctin Mountain. Results of study indicate that area is not a syncline as previously interpreted, but a tightly folded eastward-dipping sequence which forms upper and eastern limb of South Mountain anticlinorium. Strata previously mapped as Loudon along eastern border of Catoctin Mountain constitute a zone including upper Weverton quartzite and basal Harpers phyllite. Weverton as herein interpreted forms complex unit of clastic which vary along strike over limited geographic area. Rock types are: banded quartzite, thin-bedded quartzite, laminated micaceous quartzite, interbedded quartzite and phyllite, ferruginous quartzite, crossbedded quartzite, ledge-maker quartzite, and ferruginous quartz conglomerate. Overlies Loudoun formation; underlies Harpers phyllite.

W. B. Brent, 1960, Virginia Div. Mineral Resources Bull. 76, p. 18. Formation, in Rockingham County, crops out on northwest slopes of Blue Ridge. Overlies Loudoun formation; underlies Hampton formation. Term Hampton used in preference to Harpers in this report.

Named for exposures at Weverton, Washington County, Md.

**Wewe Slate**[1]

Precambrian: Northwestern Michigan.

Original reference: C. R. Van Hise and W. S. Bayley, 1895, U.S. Geol. Survey 15th Ann. Rept., p. 530.

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, and Wewe. Palmer gneiss is not listed on this table.

Typical development on Wewe Hills, west of Goose Lake, Marquette district.

**Wewoka Formation**[1] (in Marmaton Group)

Pennsylvanian (Des Moines Series): Central Oklahoma.

Original reference: J. A. Taff, 1901, U.S. Geol. Survey Geol. Atlas, Folio 74.

E. R. Ries, 1954, Oklahoma Geol. Survey Bull. 71, p. 32–40. Described in Okfuskee County where it is a succession of thick shales containing interstratified friable sandstones and a few local limestones. Has composite thickness ranging from 780 feet in southern part of county to 730 feet along northern boundary. Conformably overlies Wetumka formation and conformably underlies Holdenville shale. Marmaton group.

H. D. Miser and others, 1954, Geologic map of Oklahoma (1:500,000): U.S. Geol. Survey. As mapped, extends northeastward from east-central part of Pontotoc County, through Hughes, Okfuskee, Okmulgee, and Tulsa Counties to Arkansas River. Marmaton group.

Named for Wewoka Creek, Seminole and Hughes Counties.

**Weybridge Member** (of Chipman Formation)

Weybridge Member (of Beldens Formation)

Lower Ordovician: West-central Vermont.

W. M. Cady, 1945, Geol. Soc. America Bull., v. 56, no. 5, p. 524, 550–552. Limestone with sandy streaks which weather into raised ridges and are more granular and darker than the intervening blue limestone. Sedimentary channels, some filled with fossil fragments, and crossbedding common. Current ripple marks present. Maximum thickness about 500 feet. Underlies and overlies undifferentiated parts of Beldens formation.

Marshall Kay, 1950, (abs.) Geol. Soc. America Bull., v. 61, no. 12, pt. 2, p. 1476. Quartz-silty facies of Beldens in Middlebury synclinorium. *Goniotelus* and *Syntrophia* support late Canadian age.

W. M. Cady and E-an Zen( 1960, Am. Jour. Sci., v. 258, no. 10, p. 728–739. A real distribution and structural and stratigraphic relations of the Beldens, Burchards, and Weybridge indicate that these members are lithofacies in Chipman formation. Sequence varies; in some areas, the Weybridge is at or near the bottom of formation; in other areas, either the Beldens or the Burchards is at the bottom and they are succeeded to west and upward stratigraphically by the Weybridge; in other areas, the Weybridge is succeeded by both the Burchards and the Beldens lithofacies. Lower Ordovician.

Typically exposed at "Weybridge Upper Falls," 1 mile east-northeast of Weybridge village, now locally known as Huntington Falls, Addison County.

**Weymouth Formation**[1]

Lower Cambrian: Eastern Massachusetts.

Original reference: Laurence LaForge, 1909, Science, new ser., v. 29, p. 945–946.

B. F. Howell and others, 1944, Geol. Soc. America Bull., v. 55, no. 8, chart 1. Shown on correlation chart above Hoppin formation.

Exposed north and east of Mill Cove at Weymouth, Norfolk County, and at Nahant, Essex County.

**Weyquosque Formation**[1]

Pleistocene: Southeastern Massachusetts and Rhode Island.

Original reference: J. B. Woodworth and Edwards Wigglesworth, 1934, Harvard Coll. Mus. Comp. Zoology Mem., v. 52.

C. W. Cooke, Julia Gardner, and W. P. Woodring, 1943, Geol. Soc. America Bull., v. 54, no. 11, p. 1715, chart 12. Pleistocene (Kansan).

Named for exposures at east end of Nashaquitsa Cliffs on south shore of Marthas Vineyard, Mass., at locality known as Weyquosque.

†Weyquosque Series[1]

Pleistocene: Southeastern Massachusetts.

Original reference: N. S. Shaler, 1888, U.S Geol. Survey 7th Ann. Rept., p. 303–363, maps.

Well exposed in western part of Chilmark or Weyquosque Cliffs, Marthas Vineyard.

Whaleback Basalts

Recent: Northern California.

Howel Williams, 1949, California Div. Mines Bull. 151, p. 42, pl. 3. Name appears on explanation of geologic sections. Text discusses basalt flows that make up cone of Whaleback volcano.

Whaleback volcano is largest of Recent volcanoes in Macdoel quadrangle.

**Whalen Group**[1]

Precambrian: Southeastern 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. 32 (fig. 11), 36. In section measured in vicinity of Lake Guernsey, the Precambrian (Whalen group) is exposed in banks and bed of Platte River. Composed of schists, granite, and dolomite. Underlies Deadwood sandstone.

Typical occurrence along walls of Whalen Canyon, Hartville uplift.

Wharncliffe Sandstone (in Pottsville Group)[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. 222.

Named for town in Mingo County.

Whately Bed[1]

Pre-Triassic: Massachusetts.

Original reference: B. K. Emerson, 1898, U.S. Geol. Survey Mon. 29, p. 190, 193.

Crops out beneath the sands of the valley in Whately, Old Hampshire County.

Wheatland Formation

Eocene, upper, or Oligocene, lower: Northern California.

B. L. Clark and C. A. Anderson, 1937, (abs.) Geol. Soc. America Proc. 1936, p. 326–327. Fossiliferous conglomerate, sandstone, and silty shales. Thickness about 300 feet. Upper Eocene.

B. L. Clark and C. A. Anderson, 1938, Geol. Soc. America Bull., v. 49, no. 6, p. 932–938, 942–945. Overlies greenstone of Sierra Nevada basement complex. Exact measurement of thickness impossible because of disconnected exposures and because dip varies both in amount and direction. Upper Eocene or lower Oligocene. Type section designated.

Type section: Six miles northeast of Wheatland at east margin of Sacramento Valley, Yuba County.

Wheatland Formation

Pleistocene, upper: Eastern New Mexico.

Sheldon Judson, 1950, Geol. Soc. America Bull., v. 61, no. 3, p. 263. Fine sand, gravel, and silt 5 to 15 feet thick. Base 1 to 5 feet above base of arroyos.

Sheldon Judson, 1953, Smithsonian Misc. Colln., v. 121, no. 1, p. 22–23, 24 (fig. 9), 30. Name proposed for terrace sediments at San Jon site. Each terrace remnant consists of fine basal gravel, mostly fragments of concretions from Ogallala sandstone, and of sand. Sand gravel layer is 1 to 3 feet thick and overlies irregular surface cut in older formations. Highest terrace has base 20 to 25 feet above grade of streams at point nearest head of canyon. Two lower terraces have bases at 8 to 10 feet and 1 to 5 feet above present grades. Each terrace records downcutting of streams through Sand Canyon and older formations with stabilization of grades and later slight alluviation. This episode was repeated three times before present stream grades were established. Highest terrace contains *Bison bison* bones.

Type locality: San Jon site approximately 10 miles south of town of San Jon, Quay County. Name derived from town of Wheatland, about 4½ miles south of site.

**Wheeler Formation**[1]

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. 1141 (fig. 5), 1146. Wheeler (emended) consists of dull-sooty-black, fine-grained, hard, platy, and rarely, fissile calcareous shale, which weathers pale gray and contains numerous intercalated argillaceous and finely arenaceous limestones which increase slightly in amount upward; about 85 feet below top is 2- to 4-foot zone of black thin-bedded fine-grained limestone which weathers bright orange tan. Fossiliferous. Thickness 350 feet. Overlies Swasey limestone (emended); underlies Marjum limestone (emended).

Type locality: Center of Wheeler Amphitheater, southeast of Antelope Springs, House Range, Millard County. Emended section measured south of Marjum Canyon, 10 miles southwest of Wheeler Amphitheater.

Wheeler Formation (in Cabaniss Group)

Pennsylvanian (Desmoinesian): Southwestern Missouri.

W. V. Searight *in* W. B. Howe and W. V. Searight, 1953, Missouri Geol. Survey and Water Resources Rept. Inv. 14, pl. 1. Name appears on generalized stratigraphic section. Underlies Bevier formation; overlies Verdigris formation. Contains Wheeler coal at top.

Exposed in northeastern Carroll and southeastern Livingston Counties.

Wheeler limestone

*See* **Pioche Shale.**

Wheeler Sandstone or Sandstone Member (of Juncal Formation)

Eocene, middle: Southern California.

T. L. Bailey, 1947, Am. Assoc. Petroleum Geologists Bull., v. 31, no. 11, p. 1920 (fig. 3). Wheeler sandstone shown on structure section as underlying middle Eocene Sisar black shale and overlying lower Eocene beds.

W. R. Merrill, 1952, *in* Am. Assoc. Petroleum Geologists, Soc. Econ. Paleontologists Mineralogists, Soc. Exploration Geophysicists, Joint Ann. Mtg. Guidebook, p. 77. Wheeler sandstone member of Juncal noted on road log from Ojai to Ozena.

Occurs in Ventura County.

Wheelerian Stage

Pliocene: Southern California.

Manley Natland, 1953, Pacific Petroleum Geologist, v. 7, no. 2, p. 2. One of four stages, based on foraminiferal assemblages, in the Pliocene and Pleistocene of southern California. Includes interval between Hallian stage above and Venturian stage. The Wheelerian includes the middle

Pico and part of the upper Pico. Division between Wheelerian and Hallian is within the upper Pico or "Mud Pit shale."

Wheeling Group[1]

Pennsylvanian: Appalachian Basin.

Original reference: J. J. Stevenson, 1907, Geol. Soc. America Bull., v. 18, p. 178.

Named for stream which flows through western parts of Greene and Washington Counties, Pa., and Marshall and Ohio Counties, W. Va.

Wheelock Marl Member (of Cook Mountain Formation)

Wheelock Marl Member (of Crockett Formation)

Eocene, middle: Eastern Texas.

H. B. Stenzel, 1938, Texas Univ. Bur. Econ. Geology Pub. 3818, p. 20 (table), 125–134 [1939]. Basal member of Crockett formation. Commonly light gray-green, bluish-gray, or slate-gray thin-bedded to laminated marl not rich in glauconite and fossils. Calculated thickness 70 feet. Interfingers with and transitional into overlying Landrum shale member; disconformably overlies Stone City beds.

H. B. Stenzel, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 9, p. 1664. Reallocated to Cook Mountain formation. Type locality stated.

Type locality: Wheelock Prairie in Brazos and Robertson Counties.

Whetstone Branch Shale[1]

Upper Devonian and Mississippian (Kinderhook): Northeastern Mississippi.

Original reference: W. C. Morse, 1928, Jour. Geology, v. 36, p. 31–43.

J. M. Weller and others, 1948, Geol. Soc. America Bull., v. 59, no. 2, p. 163, 166, chart 5 (column 89). Whetstone Branch formation is local designation for Chattanooga shale which contains interbedded sandstones in this area. Occurrence of *Tentaculites* seems to prove Devonian age of at least part of this formation, but middle New Albany conodonts have been recognized nearby in Tennessee, so the upper part may be younger. Shown on chart as Kinderhookian.

Type locality: In Tishomingo County in middle part of Whetstone Branch, which enters Tennessee River about 3½ miles above Tennessee State line and mouth of Yellow Creek.

**Whetstone Creek Shale Member** (of Breathitt Formation)

Middle Pennsylvanian: Southeastern Kentucky.

H. R. Wanless, 1946, Geol. Soc. America Mem. 13, p. 64, 65, 76, 153. Proposed for dark-gray shale that contains numerous fairly regular bands of ironstone. Thickness about 71 feet. Occurs in upper part of Breathitt formation below Bacon Creek or lower Blue Gem coal.

Exposed in north bluff of Cumberland River along Kentucky Highway 92 just west of Whetstone Creek, about 9 miles east of Williamsburg, Whitley County.

Whetstone Gulf Formation[1] (in Lorraine Group)

Upper Ordovician: Northern New York, and Southern Ontario, Canada.

Original reference: Rudolf Ruedemann, 1925, New York State Mus. Bull. 258.

W. H. Twenhofel and others, 1954, Geol. Soc. America Bull., v. 65, no. 3, chart 2, column 19. Shale is lower unit in Lorraine group.

Named for exposure in Whetstone Gulf near Martinsburg, Lewis County, N.Y.

Whetstone Hill Member (of Moretown Formation)

Age not stated: Vermont.

W. F. Brace, 1953, Vermont Geol. Survey Bull. 6, p. 51. Incidental mention of name. Refers to Thompson (unpub. thesis, 1950).

Whetstonian series

Paleozoic (Mid-Cambric): Arizona and New Mexico.

Charles Keyes, 1940, Pan-Am. Geologist, v. 74, no. 2, p. 107 (table), 120. Comprises (ascending) Dragoon and Carrasco terranes.

Whim Hill Breccia

Upper Cretaceous or younger: Southwestern New Mexico.

P. F. Kerr and others, 1950, Geol. Soc. America Bull., v. 61, no. 4, p. 289–291, fig. 3, pl. 1. Compact mass of angular blocks firmly cemented by matrix rich in magnetite. Fragments represent a number of rock types known to occur in the stratigraphic section. Broken pieces of biotite granodiorite porphyry predominate. Angular and rounded fragments of indurated shales and quartzites, which probably came from Beartooth and Colorado formations, included.

Two areas of exposure in northern part of Santa Rita stock; larger, comprises area of over 40,000 square feet and forms elongate mass in central part of North Pit; second body found on northern edge of Central Island between North and South Pits. In Santa Rita copper mine, in southeastern corner of Santa Rita quadrangle, about 12 miles east of Silver City, Grant County.

Whipple Marble

Ordovician: West central Vermont.

Phillip Fowler, 1950, Vermont Geol. Survey Bull. 2, p. 13, 32–34, pl. 1. Thin-bedded dark-blue-gray marble containing lenses of black slate and some buff-weathering dark-gray dolomite beds. Thickness from 50 to 250 feet. Underlies Hortonville slate though locally appears to be contemporaneous with it. Lenses of each occur in the other. Overlies Orwell limestone unconformably. Middle Ordovician (Trenton).

E-an Zen, 1956, (abs.) Geol. Soc. America Bull., v. 67, no. 12, pt. 2, p. 1830. Age of at least a part is Canadian [Lower Ordovician].

Best exposed in band about 2½ miles long extending northward along east side of West Rutland Valley from point about 2 miles north of West Rutland. Northern part of West Rutland Valley is labeled "Whipple Hollow" on Proctor 7½ minute topographic map. Other exposures also in and near Castleton quadrangle.

**Whirlpool Sandstone** (in Albion Group)

Whirlpool Sandstone (in Medina Group)

Whirlpool Sandstone Member (of Albion Sandstone)[1]

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

Original reference: A. W. Grabau, 1909, Jour. Geology, v. 17, p. 238.

C. K. Swartz and others, 1942, Geol. Soc. America Bull., v. 53, no. 4, chart 3. Shown on correlation chart in Albion group in New York and Cataract group in Ontario.

D. W. Fisher, 1954, Am. Assoc. Petroleum Geologists Bull., v. 38, no. 9, p. 1981 (fig. 2), 1982 (fig. 3), 1985–1987. Discussion of stratigraphy of Medinan group in Ontario and New York. Whirlpool sandstone is basal formation of group. Extends from Mitchells Mills, Ontario. along, or slightly north of, base of Niagara escarpment to its easternmost exposure at Medina, N.Y., a distance of about 150 miles. Maximum thickness 25 feet. Underlies Manitoulin dolomite in vicinity of Hamilton; underlies Fish Creek shale (new) from DeCew Falls to Lockport. Overlies Queenston shale.

D. W. Fisher, 1959, New York State Mus. Sci. Service Geol. Survey Map and Chart Ser. 1. Underlies Rumsey Ridge, herein raised to formational rank, and preoccupied term Fish Creek abandoned.

Named for occurrence at the Whirlpool of Niagara River.

Whirlwind Breccia Member (of Pruett Formation)

Tertiary: Western Texas.

C. G. Moon, 1953, Geol. Soc. America Bull., v. 64, no. 2, p. 179. Persistent light-colored sandstone marker bed that extends from northwest corner of area [Agua Fria quadrangle] southward to about latitude of Burnt House Camp may correspond to upper Whirlwind breccia member of Pruett formation. [Goldich and Elms (1949) refer to breccia-conglomerate at Whirlwind Spring.]

Sandstone bed dips gently west and is continuous along west bank of tributary which flows from north and empties into Crystal Creek.

Whirlwind Formation

Middle Cambrian: Western Utah and eastern Nevada.

R. A. Robison, 1960, Intermountain Assoc. Petroleum Geologists Guidebook 11th Ann. Field Conf., p. 47, 48 (fig. 3), 50 (fig. 4), 51. Name replaces Condor member of Swasey formation (Wheeler, 1948) and Condor formation (Cohenour, 1959). Series of paleolithofacies maps of Great Basin area illustrates gross shifts in lithofacies boundaries caused by alternately transgressive and regressive Lower and Middle Cambrian sea. Major Middle Cambrian regressive movements during *Glossoplura* and *Bathyuriscus-Elrathina* times caused noncalcareous detrital sediments to be swept westward over top of older carbonate sediments. Those two regressive tongues form recognizable stratigraphic marker units in much of eastern Great Basin. Name Chisholm formation is here extended to include all occurrences of older tongue. Rocks of younger tongue have had name Condor member of Swasey applied to them. Type section of Condor member is believed to be noncorrelative with type section of Swasey limestone; hence, younger regressive tongue has no valid name and term Whirlwind is proposed. In House and Wah Wah Ranges, underlies Swasey formation and overlies Dome formation; in Pioche district, overlies Burrows formation and underlies Highland Peak formation.

Type section: Along road in Marjum Canyon, House Range, Utah. Name derived from Whirlwind Valley to east of House Range.

Whiskey Canyon Limestone (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), 43–47, 50. Term proposed for massive bluish-gray to gray cherty limestones between top of Elephant Butte formation (new) below and base of Garcia formation (new) above. Thickness at type section about 163 feet.

J. A. Young, Jr., 1946, (abs.) Geol. Soc. America Bull., v. 57, no. 12, pt. 2, p. 1247. In Sangre de Cristo Mountains, overlies Cortado formation (new).

Type locality: Westernmost box canyon of Whiskey Canyon, in southwest part of sec. 1, T. 13 S., R. 5 W., Sierra County.

Whiskey Creek Pass Limestone Member (of Madera Formation)

Pennsylvanian (Desmoinesian) : South-central Colorado and north-central New Mexico.

K. G. Brill, Jr., 1952, Geol. Soc. America Bull., v. 63, no. 8, p. 818–819, pl. 1. Interbedded sandstone and light-gray sandy oolitic limestone, about 150 feet thick in vicinity of Whiskey Creek Pass. Persistent horizon marker in southern part of Permo-Pennsylvanian zeugogeosyncline of Colorado and New Mexico.

Typically developed at an elevation of about 13,000 feet above sea level on north side of north fork of Whiskey Creek, Las Animas County, Colo.

Whiskey Mountain Granodiorite

Mesozoic: Northeastern Washington.

A. C. Waters and Konrad Krauskopf, 1941, Geol. Soc. America Bull., v. 52, no. 9, p. 1370–1371, pl. 1. Porphyritic biotite granodiorite occurring in Whiskey Mountain stock which is considered roughly contemporaneous with Colville batholith.

Exposed over about 6 square miles on Whiskey Mountain, northern Okanogan County.

Whistle Creek Limestone

Middle Ordovician: Western Virginia.

B. N. Cooper and G. A. Cooper, 1946, Geol. Soc. America Bull., v. 57, no. 1, p. 74–75, 85 (fig. 7), 103. Name introduced for cherty limestones containing *Hesperorthis* fauna, which succeed New Market limestone (new) and underlie either coarse-grained "Holston" limestone of Lexington area or *Dinorthis atavoides* zone; at type section, underlies Lincolnshire limestone. Predominantly dark-bluish to brownish-gray cherty limestone, irregularly bedded. Thickness at type locality 82 feet. In many places, position of the Whistle Creek is indicated by blocks of fossiliferous. punky chert; where Whistle Creek is in direct contact with *Dinorthis atavoides* zone, the two can be distinguished only by fossils.

G. A. Cooper, 1956, Smithsonian Misc. Colln., v. 127, pt. 1, p. 80. Neuman named an 800-foot sequence of "Stones River" the Row Park formation. Cooper and Cooper had previously identified this sequence as Whistle Creek on basis of contained fossils. Below the New Market of Cooper and Cooper, Neuman discovered granular limestone containing abundance of *Rostricellula*. It is postulated here that both identifications of New Market are correct but that the Row Park is partial facies of the New Market and also the Whistle Creek.

Type section: Between U.S. Route 60 and Whistle Creek about 2 miles N. 40° W. of Lexington, Rockbridge County, Va.

Whistler Mountain Alaskite

Post-Mississippian: East-central Nevada.

C. W. Merriam, 1940, Geol. Soc. America Special Paper 25, p. 28, 29, 44, fig. 2. Consists of fine-grained alaskite intrusive body cutting certain shales and quartzitic deposits long regarded as entirely Diamond Peak Carboniferous but known to include beds of Ordovician age.

Constitutes central mass of Whistler Mountain, Roberts Mountain quadrangle.

**White Porphyry**[1]

Upper Cretaceous or early Tertiary: 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. 76; 1927, U.S. Geol. Survey Prof. Paper 148.

C. H. Behre, Jr., 1953, U.S. Geol. Survey Prof. Paper 235, p. 42–46, pl. 1. Since term White porphyry is well established in local mining parlance and in literature, it is retained here for the older of two white porphyries in area [west slope of Mosquito Range].

Term first used in Leadville district.

White Beach Sandrock[1]

Miocene, lower: Central Florida.

Original reference: W. H. Dall, 1892, U.S. Geol. Survey Bull. 84, p. 114, 337.

Named for exposures at a locality known in 1892 as "White Beach," at northern and western extreme of Little Sarasota Bay, south of Tampa Bay.

White Bluff Formation

White Bluff Marl[1]

Eocene (Jacksonian): Southeastern Arkansas.

Original reference: W. H. Dall, 1898, U.S. Geol. Survey 18th Ann. Rept., pt. 2, p. 343, table opposite p. 334.

L. J. Wilbert, Jr.. 1953, Arkansas Div. Geology Bull. 19, p. 27–80. Resurrected and emended; includes all marine Jacksonian deposits exposed in southeastern Arkansas. Includes three facies: Pastoria sand member (new) and Caney Point marl member, which are stratigraphically equivalent, and Rison clay member, which in places overlies the other members. Outcrops in northern Jefferson County lie near northern limit of Jacksonian outcrop area in this part of the embayment; formation thins northward and disappears; to the south, it dips beneath Redfield formation (new). Overlies beds of Claiborne group; where Caney Point marl member is present, contact is sharp and exhibits evidence of unconformity; where Pastoria sand member constitutes basal unit, contact is not so well expressed. Type locality designated.

Type locality: White Bluff, a prominent bluff on right bank of Arkansas River, 4 miles east of village of Redfield, in northern Jefferson County.

White Brook Dolomite[1]

Precambrian(?) or 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, 1936, Royal Canadian Inst. Trans., v. 21, pt. 1, p. 137, 143. Commonly white dolomite mottled with pink or purple patches, though very variable in color. Weathers to buff or brown shades. Contains much vein and nodular quartz. Stratification rare; where present, rock is a dolomitic sandstone. Thickness 20 to 75 feet. Underlies West Sutton slate; overlies Pinnacle graywacke. Type locality cited.

V. H. Booth, 1950, Geol. Soc. America Bull., v. 61, no. 10, p. 1135, 1136, 1145–1147. Extended into Vermont.

Phillip Fowler, 1950, Vermont Geol. Survey Bull. 2, pl. 1. Precambrian(?).

Type locality: Exposures around headwaters of White Brook, one-half mile northeast of four corners at West Sutton, Sutton quadrangle, Quebec.

**White Caps Limestone Member** (of Gold Hill Formation)[1]

Cambrian: Central Nevada.

Original reference: H. G. Ferguson, 1924, U.S. Geol. Survey Bull. 723.

At White Caps mine, Manhattan district.

†White Cliff Limestone[1]

Upper Jurassic: Southwestern to northeastern Utah and northwestern Colorado.

Original reference: J. W. Powell, 1876, Geology of eastern portion of Uinta Mountains, p. 41, 51, 152.

Caps the White Cliffs, Kane County, Utah; also occurs in vicinity of Flaming Gorge, northeast Utah.

†White Cliff Sandstone[1] or Group[1]

Jurassic(?): Southwestern to northeastern Utah and northwestern Colorado.

Original reference: J. W. Powell, 1876, Geology of eastern portion of Uinta Mountains, p. 41, 51, 52, 151.

Type locality: Escarpment known as White Cliffs, in Paria, Kanab, and Rio Virgen region, Kane County.

†White Cliffs Chalk[1]

Upper Cretaceous (Gulf Series): Southwestern Arkansas and northwestern Louisiana.

Original reference: R. T. Hill, 1888, Arkansas Geol. Survey Ann. Rept. 1888, v. 2, p. 72, 87–88, 188.

Named for exposures at White Cliffs of Little River, Little River County, Ark.

†White Cliffs subchalk[1]

Upper Cretaceous (Gulf Series): Southwestern Arkansas.

Original reference: R. T. Hill, 1888, Arkansas Geol. Survey Ann. Rept. 1888, v. 2, p. 7, 88–89, 188.

At White Cliffs of Little River, Little River County, Ark.

**White Cloud Shale Member** (of Scranton Shale)[1]

White Cloud Shale (in Wabaunsee Group)

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. 40, 41, 58.

R. C. Moore, 1936, Kansas Geol. Survey Bull. 22, p. 49 (fig. 11), 210–211. Rank raised to formation in Wabaunsee group. Term Scranton abandoned. Overlies Howard limestone; underlies Happy Hollow limestone. Thickness 30 to 80 feet.

G. E. Condra, 1949, Nebraska Geol. Survey Bull. 16, p. 19. Areal extent given.

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 as formation with stratigraphic span as assigned to it by Haworth and Bennett (1908). Underlies Happy Hollow limestone member; overlies Howard limestone [Utopia member].

H. G. Hershey and others, 1960, Iowa Highway Research Board Bull. 15, p. 14, fig. 5. Thickest formation of Wabaunsee group in area. Gray and green shale; upper half commonly contains many limestone nodules; massive sandstone present at base locally. Full thickness not exposed at surface. Measured at 100 feet in coal mines in Adams County. Overlies Howard limestone; underlies Happy Hollow limestone.

Named from exposures west of White Cloud, Doniphan County, Kans.

White Cone Member (of Bidahochi Formation)

White Cone Series[1]

Pliocene: Northeastern Arizona.

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

E. M. Shoemaker, F. S. Hensley, Jr., and R. W. Hallogen, 1957, U.S. Atomic Energy Comm. TEI Rept. 690, p. 392–394. An informal field designation for member of Bidahochi. Consists mainly of trachybasalt tuff and claystone. This member includes major part of section measured at White Cone by Gregory (1917, U.S. Geol. Survey Prof. Paper 83) which was designated White Cone series by Reagan (1932). It includes beds designated as "volcanic member" as well as beds included in lower part of "upper member" of Repenning and Irwin (1954).

Present in Hopi Volcanic Buttes field and along edge of Black Mesa west and northwest Hopi Volcanic Buttes. A typical section is at White Cone.

White Eagle Rhyolite

Tertiary: Southwestern New Mexico.

W. E. Elston, 1957, New Mexico Bur. Mines Mineral Resources Bull. 38, p. 36–37, pl. 1. Porphyritic rhyolite flows, sills and dikes. Rock is aphanitic, cream colored, flow banded, and flow folded. Many dikes in Precambrian granite as much as 1 mile long and 50 feet wide. Sills as thick as 56 feet in Bliss quartzite. Stratigraphic position unknown but possibly equivalent to Mimbres Peak rhyolite.

Named after White Eagle mine, in sec. 34, T. 19 S., R. 9 W. Confined to northern part of Cooks Range, Dwyer quadrangle.

White Earth Clay (in Golden Valley Formation)

Eocene: Western North Dakota.

1958, Great Northern Railway Company Mineral Research and Devel. Dept. Rept. 5, p. 2, 3, 12, 14, 15, map. Light-colored clay in lower part of Golden

Valley formation. Average thickness about 20 feet. South Ross, Lakeside, and East Tioga clays occur in same general area.

Occurs 9 miles north of town of White Earth and 7 miles southeast of Power Lake in secs. 20, 29, and 30, T. 158 N., R. 93 W., Mountrail County.

Whiteface Anorthosite[1]

Precambrian: Northern New York.

Original reference: J. F. Kemp, 1898, New York State Mus. 52d Ann. Rept., v. 1, p. 51–63.

A. F. Buddington, 1939, Geol. Soc. America Mem. 7, p. 19–21, table 3, pl. 5. Discussion of Adirondack igneous rocks and their metamorphism. Main massif of anorthositic rocks occupies about 1,200 square miles. Two facies of anorthositic rocks have been defined, named, and differentiated on geologic maps. One facies, the Whiteface, originally described by Kemp, is almost wholly restricted to borders of anorthosite masses or to bands closely involved with Grenville layers and inclusions, characterized by medium granular texture, more dark silicates than core of massif, a milky-white or nearly white feldspar, and usually a distinct foliation. Predominant rock is gabbroic anorthosite, but rocks mapped as Whiteface facies include true anorthosite, gabbroic anorthosite, and anorthositic gabbro. Miller (1918, Geol. Soc. America Bull., v. 29, no. 3) named rock characteristic of the core of the anorthosite massif the Marcy anorthosite. Thus, terms Whiteface and Marcy have been used in sense of formation names rather than of closely defined rock types, and it is with this significance that they are used in this report. Locally there are belts of anorthositic rocks which do not fit requirements for either Marcy or Whiteface facies, and term "transitional facies" is used to cover them. "Border facies," as shown in figure 3, includes both the Whiteface and "transitional" facies and in addition, as along exposed north border of St. Regis-Marcy anorthosite, a facies which has coarse Marcy texture but is commonly gabbroic anorthosite and contains garnet.

Forms summit and southern part of Mount Whiteface, Essex County.

**Whitefield Gneiss** (in Oliverian Plutonic Series)

Middle or Upper Devonian(?): Northwestern New Hampshire.

M. P. Billings, 1955, Geologic map of New Hampshire (1:250,000): U.S. Geol. Survey. Dark-gray medium-grained foliated biotite granodiorite gneiss. Included in Oliverian plutonic series.

M. P. Billings, 1956, Geology of New Hampshire, pt. 2, Bedrock geology: Concord, New Hampshire State Plan. Devel. Comm., p. 49–50, 52. Cut by pink quartz monzonite dikes of the Oliverian plutonic series. Derivation of name.

Named for town of Whitefield, Coos County, where well exposed. Lies in belt extending from Barrett to Riverton.

Whitefish Bay Limestone

Whitefish Bay member (of Alpena limestone stage)

Middle Devonian: Southern Michigan.

W. A. Kelly, 1940, Michigan Acad. Sci. Arts and Letters Sec. Geology and Mineralogy [Guidebook] 10th Ann. Field Excursion, [p. 13, columnar section]. Shown on columnar section as limestone underlying Alpena limestone and overlying Genshaw formation.

Charles Schuchert, [1943], Stratigraphy of the eastern and central United States: New York, John Wiley & Sons, p. 606 (chart 480, 613). Basal member of Alpena stage. Shown on chart as underlying Alpena limestone member and overlying Killians limestone member, Long Lake stage.

Present in Alpena area.

Whitehall Formation (in Beekmantown Group)

Lower Ordovician: New York and Vermont.

John Rodgers, 1937, Geol. Soc. America Bull., v. 48, no. 11, p. 1576–1577. Beds of Calciferous Division B (Brainerd and Seely, 1890, Am. Mus. Nat. History Bull., v. 3), together with upper 35 feet of their Division A, form a stratigraphic unit. They are separated from Division C above and from Little Falls formation below by unconformities. These beds are here named Whitehall formation. According to Brainerd and Seely, Division B consists of dove-colored limestone, intermingled with light-gray dolomite in massive beds; in lower beds and just above the middle, dolomite predominates; middle and upper beds are nearly pure limestone; thickness of unit 295 feet. Base of Whitehall is made up of 35 feet of alternating sandstone and dolomite. Underlies unnamed formation (Upper Calciferous).

R. H. Wheeler, 1942, Am. Jour. Sci., v. 240, no. 7, p. 518–524. Base of Whitehall is raised to coincide with contact of Little Falls dolomite and Hoyt limestone, and the latter redefined as lower member of Whitehall. Includes Skene member (new) at top. Underlies Tribes Hill formation. Thickness about 160 feet.

John Rodgers, 1952, Geol. Soc. America Guidebook for Field Trips in New England, Nov. 10–12, p. 35 (table 2), 53 (road log). Table of Upper Cambrian and Lower Ordovician formations shows Whitehall formation (Upper Cambrian) above Dewey Bridge dolomite (new) and below Lower Ordovician Baldwin Corner formation (new). Baldwin Corner formation formerly included in original Whitehall.

C. W. Welby, 1959, New England Intercollegiate Geol. Conf. Guidebook 51st Ann. Mtg., p. 22–23. In central Champlain Valley, formation (dolostone) is basal unit of Beekmantown group. Thickness about 300 feet. Underlies Cutting formation. As originally defined, Whitehall included beds that are now placed in underlying Ticonderoga formation (new).

Type section: On Skene Mountain, which rises out of village of Whitehall, Washington County, N.Y. Base of formation exposed not far below brow of mountain on steep west face; base of Division C is exposed in hillock to east just across first road east of mountain.

**Whitehead Granite**[1]

Precambrian: Southwestern Colorado.

Original reference: W. Cross and E. Howe, 1905, U.S. Geol. Survey Geol. Atlas, Folio 131.

Named for occurrence about mouth of Whitehead Gulch, Needle Mountain quadrangle.

**Whitehorse Sandstone[1] or Group**

Whitehorse Formation (in Custer Group)

Permian: Western and southern Oklahoma, central southern Kansas, and Texas.

Original reference: C. N. Gould, 1905, U.S. Geol. Survey Water-Supply Paper 148, p. 55.

N. H. Darton, L. W. Stephenson, and Julia Gardner, 1937, Geologic map of Texas (1:500,000): U.S. Geol. Survey. Whitehorse sandstone mapped in Double Mountain group in northwestern Texas.

Robert Roth, 1937, Am. Assoc. Petroleum Geologists Bull., v. 21, no. 4, p. 422–433. Report reviews history of problem of Whitehorse nomenclature and correlation. Term Whitehorse has been loosely applied to sediments of Custer age in Texas.

D. A. Green, 1937, Am. Assoc. Petroleum Geologists Bull., v. 21, no. 4, p. 1526 (fig. 3), 1528. Used as group term to include Marlow, Rush Springs, and Cloud Chief formations.

R. K. DeFord, 1938, (abs.) Am. Assoc. Petroleum Geologists Bull., v. 22, no. 12, p. 1706. The Whitehorse-Capitan [Eddy County, N. Mex.] is subdivided from top downward into Carlsbad, Yates, Seven Rivers, and Queen. This involves redefinition of the Carlsbad. Gradation of Whitehorse into Capitan disposes of theory that Whitehorse is Triassic.

G. H. Norton, 1939, Am. Assoc. Petroleum Geologists Bull., v. 23, no. 12, p. 1802–1811. In Kansas, Whitehorse sandstone can be divided into four members (ascending): Marlow, Relay Creek dolomite, an even-bedded sandstone member, and an upper shale member, the latter two representing Rush Springs-Cloud Chief members of Oklahoma section. Overlies Dog Creek shale; underlies Day Creek dolomite. Cimarron series.

R. I. Dickey, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 1, p. 44–49. Whitehorse is used as group term in Texas-New Mexico area to include (ascending) Grayburg, Queen, Seven Rivers, Yates, and Tansill formations.

M. G. Cheney, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 1, p. 66 (fig. 1). Chart of revised terminology shows Whitehorse group above El Reno (San Andres group).

Robert Roth, N. D. Newell, and B. H. Burma, 1941, Jour. Paleontology, v. 15, no. 3, p. 313. Table shows Custer group comprises (ascending) Whitehorse formation, Day Creek dolomite, and Quartermaster formation.

P. B. King, 1942, Am. Assoc. Petroleum Geologists Bull., v. 26, no. 4, pl. 2. Correlation chart shows Whitehorse group in central basin platform and Midland basin comprises (ascending) Grayburg formation, Queen sandstone, Seven Rivers formation, Yates sandstone, and Tansill formation; in eastern shelf area comprises (ascending) Childress dolomite member of Marlow formation, Eskota dolomite, and Claytonville dolomite; north-central Texas, near Red River (ascending) Marlow formation, Rush Springs formation, and Cloud Chief gypsum. Name Double Mountain group abandoned in this report.

R. C. Moore and others, 1951, Kansas Geol. Survey Bull. 81, p. 36 (fig. 15), 37–38. Whitehorse sandstone, in Quartermaster group, comprises (ascending) Marlow sandstone member, Relay Creek(?) dolomite and sandstone member, even-bedded sandstone and siltstone member, and upper shale member. Thickness about 270 feet. Underlies Day Creek dolomite; overlies Dog Creek shale of Nippewalla group.

L. V. Davis, 1955, Oklahoma Geol. Survey Bull. 73, p. 57–81. As used in this report, name Whitehorse is group name applied to all Permian strata above El Reno group and below Cloud Chief formation. Divided into two formations (ascending) Marlow and Rush Springs. Limited above and below by unconformities. Summary of literature.

J. M. Jewett, 1959, Graphic column and classification of rocks in Kansas: Kansas Geol. Survey. Formation comprises Marlow sandstone, Relay Creek dolostone, and unnamed member. Underlies Day Creek dolomite; overlies Dog Creek formation of Nippewalla group. Term Quartermaster group not used in this report.

Named for exposures in vicinity of Whitehorse Springs, Woods County, Okla.

†White Iron Granite[1]

Precambrian (Laurentian): Northeastern Minnesota.

Original reference: A. Winchell, 1888, Minnesota Geol. Nat. History Survey 16th Ann. Rept.

Occurs on shores of White Iron Lake, Vermilion district.

†White Mesa Sandstone[1]

Jurassic(?): Northeastern Arizona.

Original reference: H. F. Lunt, 1904, Am. Inst. Mining Engrs. Trans., v. 34, p. 989–990.

Occurs in White Mesa.

**White Mountain Plutonic-Volcanic Series**

White Mountain Magma Series[1]

Permian: New Hampshire and southeastern Vermont.

Original reference: M. P. Billings, 1934, Science, v. 79, no. 2038, p. 55–56.

David Modell, 1936, Geol. Soc. America Bull., v. 47, no. 12, p. 1894–1914, pl. 1. Chronology in Belknap Mountains, N.H., is (ascending) Moat volcanics, Gilford gabbro, Endicott diorite, Ames monzodiorite, Gilmanton monzodiorite, Belknap syenite, Sawyer quartz syenite, Lake quartz syenite, Albany quartz syenite, Conway granite, and Rowes vent-agglomerate. Also includes Pine Mountain complex; its age relative to other units in series unknown. Numerous leucocratic and melanocratic dikes cut the major intrusives.

Alonzo Quinn, 1937, Geol. Soc. America Bull., v. 48, no. 3, p. 379, 400. Subdivided in Red Hill area of central New Hampshire to include Garland Peak quartz syenite (new), Watson Ledge quartz syenite (new), and other syenites and a granite.

C. R. Williams and M. P. Billings, 1938, Geol. Soc. America Bull., v. 49, no. 7, p. 1025–1034, 1042. Further description of extrusive and intrusive phases in Franconia quadrangle, New Hampshire. Probably Mississippian.

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. Red Hill complex and Mount Tripyramid complex assigned to series in Mount Chocorua quadrangle.

C. J. Roy and Jacob Freedman, 1944, Geol. Soc. America Bull., v. 55, no. 7, p. 908. Represented by Pawtuckaway complex in Pawtuckaway Mountains of southeastern New Hampshire.

M. P. Billings, 1945, Am. Jour. Sci., v. 243–A, p. 43–47. Geographically extended to Vermont where unit includes rocks of Mount Ascutney area. Description of ring dikes in series.

M. P. Billings, 1956, Geology of New Hampshire, pt. 2, bedrock geology: Concord, New Hampshire State Plan. Devel. Comm., p. 35–37, 69–88, 105, 106–107, 129–135, 145–146, 182–183, 186. Summary discussion of plutonic-volcanic series. Rocks are massive and rarely show foliation and banding. Hypidiomorphic granular texture typical. Mineralogically characterized by amphiboles, pyroxenes, and olivines even in syenites and granitic rocks; muscovite absent. Pegmatites very rare. Mississippian(?). Derivation of name.

H. W. Jaffe, H. T. Evans, Jr., and R. W. Chapman, 1956, Am. Mineralogist, v. 41, nos. 5–6, p. 474, 485. Includes Devils Slide syenite (new) in Percy quadrangle, New Hampshire.

U.S. Geological Survey currently designates the age of the White Mountain Plutonic-Volcanic Series as Permian on the basis of a study now in progress.

Type area: North Conway quadrangle, New Hampshire. No one type locality can be designated. Named for extensive development in White Mountains of New Hampshire.

White Mountain Series[1]

Precambrian(?) and younger: Northern New Hampshire.

Original reference: C. H. Hitchcock, 1869, New Hampshire 1st Rept. on geology and mining.

White Mountain region.

White Oak Mountain Sandstone[1]

White Oak Mountain Sandstone (in Red Mountain Group)

Silurian (Albion Series): Southeastern Tennessee and northeastern Georgia.

Original reference: N. Sayler, 1866, Geologic map of Tennessee.

C. K. Swartz and others, 1942, Geol. Soc. America Bull., v. 53, no. 4, chart 3. Shown on correlation chart in Red Mountain group, Albion series. Underlies Clinton formation.

Named for White Oak Mountain, James and Bradley Counties, Tenn.

†White Pine Shale[1] or Group

Mississippian: Northeastern Nevada and eastern California.

Original reference: A. Hague, 1883, U.S. Geol. Survey 3d Ann. Rept., p. 253, 255–267.

C. W. Merriam, 1940, Geol. Soc. America Spec. Paper 25, p. 8 (table 1), 43–46. Term Diamond Peak series used to apply to post-Devils Gate sedimentary rocks in Roberts Mountains region; term is used in preference to extending Hagues' White Pine shale and Diamond Peak quartzite into area.

C. W. Merriam and C. A. Anderson, 1942, Geol. Soc. America Bull., v. 53, no. 12, pt. 1, p. 1690–1691. Because stratigraphic relations of true White Pine formation in White Pine district are not well understood, it appears undesirable to use this term for dark shale in Eureka and Roberts Mountains area. In this report, term Diamond Peak beds is used to include not only original Diamond Peak quartzite of Diamond Peak (Eureka district) but also underlying black shales and sandy interbed referred by Hague (1892, U.S. Geol. Survey Mon. 20) to White Pine shale.

W. H. Easton and others, 1953, Am. Assoc. Petroleum Geologists Bull., v. 37, no. 1, p. 147 (fig. 2), 149. In recommended revisions of stratigraphic units in Great Basin, it is proposed that White Pine shale be subdivided to include (ascending) Pilot shale, Joana limestone, and Chainman shale members. Term White Pine shale to be used in Roberts Mountains and Lone Mountain area, Eureka district, Ely district, and Pioche districts, Nevada, and Confusion and House Ranges, and Ibex area, Utah.

T. B. Nolan, C. W. Merriam, and J. S. Williams, 1956, U.S. Geol. Survey Prof. Paper 276, p. 56–57. Problems of nomenclature and correlation of White Pine shale and Diamond Peak quartzite reviewed. Usage of White Pine shale as proposed by Easton and others rejected; their proposal has advantage of retaining White Pine for dominant black-shale sequence but does not provide for satisfactory treatment of the thick gradational zone between the black shales and coarser clastics characteristic of Hague's Diamond Peak. Proposed to use Diamond Peak formation for coarse clastic part of upper Mississippian sequence where it can be separated from underlying black shales and to adopt Spencer's name of Chainman for lower unit, where it can be mapped separately.

R. L. Langenheim, Jr., and Herbert Tischler, 1960, California Univ. Pubs., Geol. Sci., v. 38, no. 2, p. 108 (fig. 5), 110. Discussion of Quartz Spring area, Inyo County, Calif. For purposes of expressing regional stratigraphic relationships, many already proposed stratigraphic names are redundant. Figure 5 presents condensed set of already proposed names, as restricted and applied to units of regional significance. These names, selected on basis of priority, have been utilized for rock bodies that most nearly approach original author's concept of the formation. Names Peers Spring formation and Chainman shale are retained for formational units within White Pine group, although these names have frequently been employed in synonymous sense. Name White Pine has been retained for group because it was first applied to entire detrital sequence (Hague, 1883).

Walter Sadlick, 1960, Intermountain Assoc. Petroleum Geologists Guidebook 11th Field Conf., p. 81–90. Discussion of aspects of Chainman stratigraphy. Chainman is recognized as valid stratigraphic unit. White Pine shale seems to be correlative with Pilot shale, Joana limestone, and Chainman formation; if so, term White Pine should be suppressed.

R. L. Langenheim, Jr., and others, 1960, Intermountain Assoc. Petroleum Geologists Guidebook 11th Ann. Field Conf., p. 149 (fig. 1), 151. White Pine shale, in Ely No. 3 quadrangle, is 950 feet thick and consists of 50 feet of calcareous siltstone assigned to Peers Spring member, succeeded by 900 feet of black fissile shale belonging to Chainman member. Overlies Joana limestone, disconformity; underlies Scotty Wash quartzite with contact gradational. Assigned to Late Mississippian because of goniatite occurrences in surrounding regions.

Named for exposures in White Pine mining district (now known as Hamilton), White Pine County, Nev.

**Whiteport Dolomite Member** (of Rondout Limestone)

Whiteport Waterlime

Lower Devonian: Southeastern New York.

D. W. Fisher, 1959, New York State Mus. Sci. Service Geol. Survey, Map and Chart Ser., No. 1. Recent studies by L. V. Rickard (in press) suggest that Manlius, upper Chrysler, and Whiteport (Upper Cement of the Rondout) are Devonian, pending precise placement of the Silurian-Devonian contact in Europe and more refined intercontinental correlations.

U.S. Geological Survey currently classifies the Whiteport as a member of the Rondout Limestone and designates its age as Lower Devonian on the basis of a study now in progress.

Town of Whiteport is in Ulster County.

**White Quail Limestone Member** (of Minturn Formation)

White Quail Limestone

Pennsylvanian and Permian(?) : Northwestern Colorado.

S. F. Emmons, 1898, U..S. Geol. Survey Geol. Atlas, Folio 48, p. 4. Commonly, a single limestone bed about 20 feet thick. Occurs above Robinson limestone and below Jacque Mountain limestone.

Ogden Tweto, 1949, Colorado Sci. Soc. Proc., v. 15, no. 4, p. 152 (table 1), 203–204, 208–211. Limestone which in Pando area lies 150 to 200 feet above Elk Ridge limestone member of Minturn, or about 5,000 feet above Belden shale, has been known as White Quail limestone in Kokomo district. It is here designated White Quail limestone member of Minturn. Consists of massive dark-gray oolitic limestone and small lenses of dolomite; locally black dolomite and fossiliferous dolomitic shale. Thickness 8 to 10 feet. Separated from overlying Jacque Mountain member by 950-foot interval of siltstone, grit, conglomerate, arkose, and shale. Age uncertain; more likely Pennsylvanian than Permian.

Well exposed on northeastern slope of Elk Ridge, near Kokomo, Summit County. Named derived from White Quail mines.

White Ranch Limestone (in Graham Formation)[1]

Pennsylvanian: Central Texas.

Original reference: F. M. Bullard and R. H. Cuyler, 1936, Texas Univ. Bull. 3501, p. 197, 222.

Typically exposed on White Ranch along west side of Bluff Creek, McCulloch County.

**White Raven Quartz Monzonite**[1]

Eocene: Central northern Colorado.

Original reference: P. G. Worcester, 1921, Colorado Geol. Survey Bull. 21, p. 33–34.

Named for White Raven mine, Boulder County.

White Ridge Limestone Member[1] (of Jefferson Limestone)

Upper Devonian: Northwestern Montana.

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

Charles Deiss, 1939, Geol. Soc. America Spec. Paper 18, p. 15, 49, 50. Basal Devonian.

G. A. Cooper and others, 1942, Geol. Soc. America Bull., v. 53, no. 12, pt. 1, chart 4 (facing p. 1788). Age shown as Upper Devonian on correlation chart.

Named for White Ridge. Forms lower part of slope above saddle on south side of peak forming west end of White Ridge, in S½ sec. 16, T. 22 N., R. 11 W.

White Ridge Quartzite or Formation

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. Older than Sevilleta rhyolite (new); younger than Blue Springs muscovite schist (new); intruded by Los Pinos granite (new).

J. T. Stark and E. C. Dapples, 1946, Geol. Soc. America Bull., v. 57, no. 12, pt. 1, p. 1133–1134. Near base, formation composed of massive quartzite beds 2 to 7 feet thick which vary from white to light pink, tan, and red. Impure shaly beds occur throughout formation and become prominent near top, where beds vary from light pink to red. Thin beds of gray quartzite 1 to 2 feet thick alternate with schistoze zones of gray and white sericitic schist near top. Thickness ranges from 3,000 to 3,700 feet in central part of belt. Near Sierra Montosa it thins to 900 feet.

Named after White Ridge, a prominent ridge on eastern side of Precambrian section of Los Pinos Mountains. Forms high eastern ridge crests in northern half of Los Pinos Range. Outcrop maintains width of 1 mile for 5 miles south of Highway 60, then narrows to less than one-half mile and continues southward another 5 miles.

**White Rim Sandstone Member** (of Cutler Formation)[1]

Permian: Southeastern Utah.

Original reference: A. A. Baker and J. B. Reeside, Jr., 1929, Am. Assoc. Petroleum Geologists Bull., v. 13, no. 11, p. 1423, 1425, 1436, 1444, 1445, 1446.

C. B. Hunt, Paul Averitt, and R. L. Miller, 1953, U.S. Geol. Survey Prof. Paper 228, p. 39 (table), 45, pl. 1. White Rim, as mapped in Henry Mountains, is restricted to white crossbedded sandstone at top of Cutler. Thickness as much as 250 feet. Conformably overlies Organ Rock tongue; in most places White Rim and Organ Rock are separated by sharp bedding plane, but at some places where color changes from red to white within a massive sandstone bed, boundary was mapped at next higher bedding plane. Unconformably underlies Moenkopi formation.

Exposed in escarpment between Green and Colorado Rivers, known as the White Rim.

**White River Group[1] or Formation[1]**

Oligocene: South Dakota, northeastern Colorado, eastern Montana, Nebraska, North Dakota, and Wyoming.

Original reference: F. B. Meek and F. V. Hayden, 1858, Philadelphia Acad. Sci. Proc. 1857, v. 9, p. 119, 133.

A. L. Lugn, 1938, Am. Jour. Sci., v. 36, 5th, no. 213, p. 227; 1939, Geol. Soc. America Bull., v. 50, no. 8, p. 1250–1251, 1264 (table 1). Group, in

Nebraska, attains or exceeds thickness of 700 feet. Comprises Chadron and Brule formations. Underlies Arikaree group; overlies Cretaceous shale formations, the Pierre, and others.

A. R. Edwards, 1941, Wyoming Geol. Survey Bull. 32, p. 10–13. As used in this report, term White River group includes Chadron, Brule, and Arikaree formations.

F. B. Van Houten, 1950, U.S. Geol. Survey Oil and Gas Inv. Map OM–113. White River formation of Granger (1910, Am. Mus. Nat. History Bull., v. 28) in Fremont County, Wyo., includes (ascending) unnamed channel deposit, Beaver Divide conglomerate member, and unnamed upper part. Upper part is divided into three units. Lower unit is massive, light-gray, tuffaceous siltstone and fine-grained sandstone with very little clay or coarse sand. Next is a thicker unit consisting of massive pale grayish-orange siltstone and fine-grained sandstone. Uppermost unit is massive, grayish-orange, locally cross-bedded arkosic conglomerate 60 to 80 feet thick, resting on erosional unconformity that has several feet of relief. Thickness 225 to 485 feet. Overlies middle and upper Eocene rocks. Underlies Miocene(?) rocks.

P. O. McGrew, 1953, Wyoming Geol. Assoc. Guidebook 8th Ann. Field Conf., p. 61–63. In Wyoming, it is customary to use term White River as formation name recognizing that to east the unit becomes a group divisible into two distinct formations.

E. C. Galbreath, 1953, Kansas Univ. Paleont. Contr. 13, Vertebrata, art. 4, p. 12–18, 27 (fig. 8). Formation in northeastern Colorado comprises (ascending) Horsetail Creek (of Chadron age), Cedar Creek (of Orellan age), and Vista (new) members. Underlies Pawnee Creek formation; overlies Cretaceous sandstones. Late lower Oligocene to early upper Oligocene, inclusive.

F. B. Van Houten, 1954, U.S. Geol. Survey Oil and Gas Inv. Map OM–140. Formation in Long Creek-Beaver Divide area, Fremont County, Wyo., includes (ascending) Sand Draw sandstone lentil (new), Beaver Divide conglomerate member, and unnamed upper part. Overlies middle and upper Eocene rocks and underlies Miocene(?) rocks.

R. K. Hose, 1955, U.S. Geol. Survey Bull. 1027–B, p. 70–71, pls. 6, 8. Formation restricted to two small outliers on subsummit uplands of Bighorn Mountains and consists mainly of marlstone, conglomerate, and soft brown bentonitic clay. Thickness 200 to 300 feet along North Fork of Crazy Woman Creek. Formation fills pre-Oligocene valleys of high relief. Stratigraphically above Wasatch formation.

John de la Montagne and W. C. Barnes, 1957, Guidebook to the geology of the North and Middle Parks Basin, Colorado: Rocky Mountain Assoc. Geologists, p. 55–60. White River formation of this report is equivalent of Chadron. Thickness about 400 feet. Underlies North Park formation; overlies Coalmont formation.

J. C. Harksen, 1960, Geology of the Sharps Corner quadrangle (1:62,500): South Dakota Geol. Survey. Group comprises (ascending) Brule formation and Sharps formation (new). Underlies Arikaree group.

T. A. Steven, 1960, U.S. Geol. Survey Bull. 1082–F, p. 350–353, pl. 12. Formation described in Northgate district, Colorado, where it consists of grayish to white tuffaceous silt and clay beds that partly fill old valleys cut in Precambrian rocks. Underlies North Park formation.

Named for occurrence near mouth of White River, S. Dak.

†White River Limestone[1]

Lower Ordovician: Southwestern Missouri.

Original reference: A. Winslow, 1894, Missouri Geol. Survey, v. 6, p. 331, 338–340.

Named for White River.

Whiterock Stage

Middle Ordovician (Mohawkian): North America.

G. A. Cooper, 1956, Smithsonian Misc. Colln., v. 127, pt. 1, p. 7–8, chart 1 (facing p. 130). Mohawkian series divided into five stages of which the Whiterock is lowermost. Brachiopod fauna taken from rocks deposited during this stage is characterized by numerous orthids, early strophomenids, plectambonitids, and decline of Syntrophiacea. Followed by Marmor stage (new). Discussion of unsuitability of older stage terms, such as Chazyan, Black River, Bolarian, Hatterian, and Hunterian.

Name is taken from Whiterock Canyon in Monitor Range, south center of Roberts Mountains quadrangle, Nevada. Rocks of interval well exposed in parts of Antelope, Monitor, and Toquima Ranges.

**Whiterock Bluff Shale Member** (of Santa Margarita Formation)[1]

Whiterock Bluff Shale Member (of Monterey Shale)

Miocene, upper: Southern California.

Original reference: W. A. English, 1916, U.S. Geol. Survey Bull. 621, p. 191–215.

M. L. Hill, S. A. Carlson, T. W. Dibblee, Jr., 1958, Am. Assoc. Petroleum Geologists Bull., v. 42, no. 12, p. 2874 (fig. 1), 2978 (fig. 3), 2990–2991. Reallocated to member status in Monterey shale. Conformably overlies Saltos shale member (new); conformably underlies Santa Margarita sand. Grades southeastward into upper part of Branch Canyon sandstone (new). Thickness in type area 1,200 feet.

Type area: Near Whiterock Bluff, sec. 25, T. 11 N., R. 28 W., north side Cuyama Valley, Caliente Mountain quadrangle. Well exposed on both flanks of Caliente Range. Traceable along northeast flank of La Panza Range into restricted Monterey shale as mapped by Bramlette and Daviess (1944, U.S. Geol. Survey Oil and Gas Inv. Prelim. May 24).

**White Sage Formation**[1]

Eocene(?): Western Utah.

Original reference: T. B. Nolan, 1935, U.S. Geol. Survey Prof. Paper 177.

Occurs only in northwest part of Gold Hill quadrangle. Named for White Sage Flat in Gold Hill district.

Whites Bend Limestone[1]

Silurian (Niagaran): Western Tennessee.

Original reference: A. F. Foerste, 1901, Geol. Soc. America Bull., v. 12, p. 397, 402.

Named for Whites Bend, Davidson County.

**Whitesburg Limestone Member** (of Blockhouse Shale)

Whitesburg Limestone (in Blount Group)[1]

Middle Ordovician: Northeastern Tennessee and western Virginia.

Original reference: E. O. Ulrich, 1924, Tennessee Dept. Ed., Div. Geology Bull. 28, p. 34; Bull. 31, p. 16.

R. B. Neuman, 1956, U.S. Geol. Survey Prof. Paper 274–F, p. 149. Rank reduced to member status in Blockhouse shale (new). Thickness at type locality of Blockhouse 5 to 20 feet. At base of formation. Overlies Lenoir limestone.

Type locality: Two miles southeast of Whitesburg, Hamblen County, and 1½ miles southwest of Bulls Gap, Tenn.

Whites Creek Beds Member (of Shoal River Formation)

Miocene, middle: Western Florida.

H. R. Smith, 1941, Am. Assoc. Petroleum Geologists Bull., v. 25, no. 2, p. 270 (fig. 2), 271 (table 1), 275. Proposed for member of Shoal River formation either older than, or in part equivalent to, typical Shoal River as exposed at Shell Bluff on Shoal River. At type section, about 12 feet thick; consists of blue shell marl, gray shell marl in places indurated to form hard lumps, brown and yellow sand; fossiliferous.

Type locality: In gulch about 200 feet south of road from Knoxhill to Eucheeana on east bank of Whites Creek, Walton County.

Whites Crossing Coquina Member (of Chappel Formation)

Mississippian: Central Texas.

F. B. Plummer, 1950, Texas Univ. Bur. Econ. Geology Pub. 4329, p. 28. Consists of several lenticular layers of massive limestone made up of crinoidal fragments and poorly preserved fossils; occurs in limestone sinks and depressions in the Ellenburger where it has escaped post-Chappel erosion; deposits range in thickness up to 60 feet or more depending upon the depth of the sink hole. Chappel comprises [ascending] King Creek marl (new), Ives conglomerate, Espey Creek limestone (new), 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 (footnote). Plummer's Whites Crossing coquina referred by him to Chappel formation is echinodermal limestone facies in lower part of Barnett formation.

Well exposed on east side of Llano River and on north side of road at White's Crossing, Mason County.

**Whiteside Granite**[1]

Ordovician to Devonian: Western North Carolina and northwestern South Carolina.

Original reference: A. Keith, 1907, U.S. Geol. Survey Geol. Atlas, Folio 147, p. 4.

W. R. Griffitts and W. C. Overstreet, 1952, Am. Jour. Sci., v. 250, no. 11, p. 787. Geographically restricted to area of its type locality where it is in part medium-grained biotite-muscovite-quartz-monzonite, having composition that is common in granitic rocks through much of southeast; also includes coarse-grained pegmatitic rock dissimilar to Toluca and Cherryville quartz monzonites (both new). Both Toluca and Cherryville were included in unit assigned to Whiteside granite by Keith and Sterrett (1931, U.S. Geol. Survey Bull. 660–D, p. 130–132).

J. L. Stuckey and S. G. Conrad, 1958, North Carolina Div. Mineral Resources Bull. 71, p. 24; J. L. Stuckey, 1958, Geologic map of North Carolina (1:500,000): North Carolina Div. Mineral Resources. As mapped, Whiteside granite is essentially Whiteside granite as originally named and described by Keith. Paleozoic.

Named for exposures in cliffs of Whiteside Mountain, Jackson County, N.C.

White Spot Sandstone[1]

Lower Cambrian: Southeastern Pennsylvania.

Original reference: J. P. Lesley, 1892, Pennsylvania 2d Geol. Survey Summ. Final Rept., v. 1, p. 165, 166.

At White Spot on mountain behind Reading, Berks County.

Whitesville Formation (in Chadakoin Group or Conneaut Group)

Whitesville Member (of Chadakoin Formation)

Upper Devonian: Southwestern New York.

J. G. Woodruff, 1942, New York State Mus. Bull. 326, p. 17 (fig. 4), 37–47. Whitesville formation is lower 300 feet of what has been called by Chadwick (1924) the Chadakoin formation. Overlies Hinsdale formation; underlies Germania formation (new). Beds are twofold in character: those of marine deposition and those of "Catskill" type of deposition. Nearly horizontal beds with marine fossils occur near Whitesville, but beds deposited at the same time 10 to 15 miles north are thinly laminated crossbedded green sandstone, bearing few or no marine fossils.

I. H. Tesmer, 1955, New York State Mus. Sci. Service Circ. 42, p. 10 (fig. 1), 18. Rank reduced to member status in Chadakoin formation. Underlies Germania member; overlies Hinsdale member.

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

Named for exposures near village of Whitesville, Wellsville quadrangle, Allegany County. [Tesmer and Rickard state type locality is near Whitesville.]

**Whitetail Conglomerate[1]**

Tertiary(?): Central Arizona.

Original reference: F. L. Ransome, 1903, U.S. Geol. Survey Prof. Paper 12.

P. A. Wood, 1959, Arizona Geol. Soc. Guidebook 2, p. 60. In Globe-Ray area, consists of conglomerate up to about 1,000 feet thick that rests unconformably on eroded surfaces of older rocks and is conformably overlain by dacite flow. Near Ray, dacite is overlain by 125 feet of conglomerate referred to by Ransome (1923, U.S. Geol. Survey Geol. Atlas, Folio 217) as Gila conglomerate. Tentatively considered younger than middle Tertiary.

T. F. Stipp and H. M. Beikman, 1959, U.S. Geol. Survey Oil and Gas Inv. Map OM–201. Shown on stratigraphic section as Tertiary(?).

D. W. Peterson, 1960. U.S. Geol. Survey Geol. Quad. Map GQ–128. Thickness 0 to 200 feet in Haunted Canyon quadrangle. Was deposited in low-lying areas on erosion surface of considerable relief and may overlie any of the older formations. Tertiary(?).

Named for exposures in Whitetail Gulch and Whitetail Spring, Globe quadrangle.

White Tank Monzonite

Jurassic(?): Southern California.

W. J. Miller, 1946, Geol. Soc. America Bull., v. 57, no. 5, p. 493. Megascopically monzonite, light gray to light pinkish gray, medium to moderately coarse-grained, contains several percent of mafic minerals; massive with faint primary foliation. Plainly and sharply cuts other rocks—Gold Park gabbro-diorite (new) and Pinto gneiss (new). Contains roof pendants of Palms granite (new). Late Mesozoic.

J. J. W. Rogers, 1958, Geol. Soc. America Bull., v. 69, no. 4, p. 449–464. Textural and spectrochemical study.

Named because of its typical occurrence in vicinity of White Tank, 10 miles south of Twentynine Palms, Riverside County.

†White Wall Sandstone[1]

Jurassic(?): Southeastern Utah.

Original reference: B. S. Butler, 1920, U.S. Geol. Survey Prof. Paper 111, p. 619.

In Abajo (Blue) Mountains, San Juan County.

**Whitewater Formation** (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. 208, 218.

Wilber Stout, Karl Ver Steeg, and G. F. Lamb, 1943, Ohio Geol. Survey, 4th ser., Bull. 44, p. 110. In Ohio, Whitewater formation is shown on page 110 as including (ascending) Weisburg, Saluda, and Oxford members. Stratigraphic chart and page 114 shows Whitewater sequence (ascending) Lower Whitewater, Saluda, and Upper Whitewater members. Calcareous shales with thin-bedded limestones. Thickness 60 to 100 feet. On chart, occurs above Liberty formation and below Silurian Elkhorn formation.

E. B. Branson, M. G. Mehl, and C. C. Branson, 1951, Jour. Paleontology, v. 25, no. 1, p. 2, fig. 1. Formation geographically extended into west-central Kentucky where it includes Saluda member. Overlies Liberty formation.

James Conklin, 1952, Kansas Acad. Sci. Trans., v. 55, p. 130. In Oldham County, Kentucky, Upper Richmond, which is similar to that of Ohio, is divided into Liberty formation, Lower Whitewater, Saluda, and Upper Whitewater members of Whitewater formation.

J. B. Patton, T. G. Perry, and W. J. Wayne, 1953, Indiana Geol. Survey Field Conf. Guidebook 6, p. 13–15, pl. 1. Thickness of formation in Indiana 4 to 35 feet. As described at stop 4 on itinerary, it is 14 feet thick and consists of dark-gray to black finely crystalline limestone in lower part and interbedded black limestone and shale in upper part; underlies Ordovician Brassfield limestone. North of Cross Plains, Brassfield is locally missing and Silurian Osgood formation rests on the Whitewater. Stratigraphic chart shows that Whitewater overlies Saluda formation and underlies Elkhorn where it is present.

W. C. Sweet and others, 1959, Jour. Paleontology, v. 33, no. 6, p. 1030. Arnheim, Waynesville, Liberty, Whitewater, and Elkhorn formations define Richmond stage of the Cincinnatian.

Named for Whitewater River, at Richmond, Wayne County, Ind.

**Whitewater Creek Rhyolite**[1]

Tertiary: New Mexico.

Original reference: H. G. Ferguson, 1927, U.S. Geol. Survey Bull. 787.

Named for exposures in steep canyons along lower reaches of Whitewater and Mineral Creeks, Mogollon district.

**Whitewood Limestone**[1] **or Dolomite**

Upper Ordovician: Western South Dakota and northeastern Wyoming.

Original reference: N. H. Darton, 1904, Geol. Soc. America Bull., v. 15, p. 383.

W. M. Furnish, E. J. Barragy, and A. K. Miller, 1936, Am. Assoc. Petroleum Geologists Bull., v. 20, no. 10, p. 1329–1341. In northern Black Hills, Middle(?) Ordovician fossils have been found to occur throughout approximately 70 feet of shale and siltstone beds immediately below typical Whitewood dolomite. Concluded that strata involved should be included tentatively with overlying Whitewood formation (Ordovician) rather than with underlying Deadwood formation (Cambrian) as has been done heretofore.

M. R. McCoy, 1952, Billings Geol. Soc. Guidebook 3d Ann. Field Conf., p. 44, 45, 46. Referred to as Whitewood dolomite. Thickness 50 to 60 feet. Underlies Englewood dolomite with angular unconformity; overlies Roughlock siltstone (new).

M. R. McCoy, 1958, Wyoming Geol. Assoc. Guidebook 13th Ann. Field Conf., p. 25–30. Thickness Whitewood dolomite about 50 feet at type section; underlies Englewood dolomitic shale; overlies Roughlock siltstone with gradational contact. Ordovician (Champlainian-Cincinnatian.)

Type section (McCoy): Sec. 13, T. 5 N., R. 3 E., Lawrence County, S. Dak. Named for exposures at Whitewood Canyon below Deadwood.

Whitingham Schist[1]

Upper Cambrian(?): Southeastern Vermont.

Original reference: G. D. Hubbard, 1924, Vermont State Geologist 14th Rept., p. 276–278, map.

Named for exposures in Whitingham Township, Windham County.

Whitmore Point Member (of Moenave Formation)

[Triassic]: Southwestern Utah.

R. A. Cadigan, 1957, U.S. Geol. Survey Trace Elements Inv. Rept. TEI-700, p. 126 (fig. 26), 127. Limy arkoses about 61 feet thick. Underlies Springdale sandstone member; overlies Dinosaur Canyon member.

Type locality and derivation of name not given. Report discusses area near St. George.

Whitmores Ferry Amphibolite[1]

Pre-Triassic: Massachusetts.

Original reference: B. K. Emerson, 1898, U.S. Geol. Survey Mon. 29, p. 190, 194.

Crops out at Whitmores Ferry, in North Sunderland, Old Hampshire County.

Whitney Member (of Brule Formation)

Oligocene, upper: Northwestern Nebraska, eastern Colorado, southwestern South Dakota, and eastern 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. Pub., p. 4 (table 1), 37, fig. 9. Proposed for massive clays of upper or *Leptauchenia* zone part of Brule formation. Thickness about 290 feet. Disconformably overlies Orella member (new).

A. L. Lugn and B. W. Brown, 1952, (abs.) Geol. Soc. America Bull., v. 63, pt. 2, p. 1384. Geographically extended into Bear Lodge Mountains, Wyo. Erosional unconformity separates Whitney from 11 to 16 feet of overlying Ogallala "mortar beds" of lower Ash Hollow formation.

C. B. Schultz and T. M. Stout, 1955, Nebraska Univ. State Mus. Bull., v. 4, no. 2, p. 42 (fig. 12), 44–46, figs. 3, 10, tables 1, 2. Three divisions of member recognized throughout much of outcrop belt in western Nebraska, eastern Wyoming, and in area southeast of Oelrichs, S. Dak. Recognition of these divisions is largely on the basis of separating beds of volcanic ash. Member consists chiefly of massive pinkish-buff silt and silty clay. Thickness in Crawford area, Nebraska, 278 feet; 460 feet in Scotts Bluff and Torrington areas, western Nebraska and eastern Wyoming. Bayard paleosol complex (new) locally caps member; elsewhere there is disconformity at contact; underlies Gering formation. Late Oligocene.

T. M. Stout, 1960, Nebraska Acad. Sci. Proc. 70th Ann. Mtg., p. 15. Proposed that classification of Oligocene sediments in Nebraska (Schultz and Stout, 1955) be extended into northeastern Colorado and eastern Wyoming. Exposures south and west of Peetz, Logan County, Colo., display the Lower ash and Upper ash beds of Whitney member of Brule. When these beds are traced westward, it is evident that the Upper ash is the "White marker bed" of Galbreath (1953, Kansas Univ. Paleont. Contr., Vertebrata, art. 4); thus basal part of Galbreath's "Vista" is equivalent to Upper Whitney (Whitney C) of Nebraska, and remainder of the "Vista" is probably Miocene (Gering and younger). Remaining Whitney as well as the Orella and Chadron units are like those in Nebraska.

Type locality: East of Toadstool Park along escarpment near Round Top, in secs. 16 and 21, T. 33 N., R. 53 W., about 16 miles west and 3 miles north of Whitney, Dawes County, Nebr.

Whitneyan 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 Whitney member of Brule formation, type locality, Whitney, northwestern Nebraska. Includes old term, "*Protoceras-Leptauchenia* beds," used in the most extended sense. Covers interval between the Orellan (Oligocene) and Arikareean (Miocene) ages. Report defines 18 provincial time terms, based on mammal-bearing units, for the North American continental Tertiary. [For sequence see under Puercan.]

**Whitsett Formation** (in Jackson Group)

†Whitsett Beds[1]

Eocene, upper: South-central Texas.

Original reference: E. T. Dumble, 1924, Am. Assoc. Petroleum Geologists Bull., v. 8, p. 424–436.

D. H. Eargle, 1959, Am. Assoc. Petroleum Geologists Bull., v. 43, no. 11, p. 2624 (fig. 1), 2626 (table 1), 2631–2634. Formation includes (ascending) Stones Switch sandstone, Dubose, Calliham sandstone, and Fashing clay members. Characterized chiefly by preponderance of sandstone near base and of carbonaceous tuffs and bentonitic clays near top. Overlies McElroy formation (redefined); overlain by Olmos sand of Ellisor (1933); this sand is apparently overlapped by the Catahoula. Additional information on type locality.

Type locality: Bluff 90 feet in height, on east bank of Atascosa River, near Whitsett's house in sec. 48, Reiffert and Forbese 109-acre tract of Juan Houligan Survey. Bluff is in Atascosa County, just northwest of Live Oak County line, and extends from 6½ to 7½ miles south of Campbellton, Atascosa County, and 1.7 miles N. 60°–70° W. of Whitsett, Live Oak County.

Whitsett Limestone Lentils (in Myrtle Formation)[1]

Upper Jurassic and Upper Cretaceous: Southwestern Oregon.

Original reference: J. S. Diller, 1898, U.S. Geol. Survey Geol. Atlas, Folio 49.

R. W. Imlay and others, 1959, Am. Assoc. Petroleum Geologists Bull., v. 43, no. 12, p. 2778–2780. Some of Diller's Whitsett limestone lentils are included in Riddle formation (new). Lentils are gray to white or locally pink, range from 15 to 60 feet or more in thickness, are thin- to thick-bedded, and may be dense, coarsely crystalline, locally oolitic, or fossiliferous. Most common megafossils are fragments of pelecypods and echinoids. In one lentil exposed in Roberts Creek in secs. 14 and 15, T. 28 S., R. 5 W., James Storr collected fossils that T. W. Stanton identified as *Opis californica* Stanton and *Hoplites* cf. *H. dilleri* Stanton (Diller, 1898). The ammonite appears to be an immature specimen of Portlandian genus *Durangites*. Its presence indicates that at least one of the limestone lentils is middle Portlandian in age. Probably, some clastic beds associated with the limestone lentils likewise belong in Riddle and Days Creek (new) formations. Age problem of Diller's Whitsett lentils is complicated by fact that some lentils contain microfossils of Cenomanian or Turonian age.

Occur near J. H. Whitsett's secs. 14 and 15, T. 28 S., R. 5 W., Roseburg quadrangle.

Whitt Group

Pennsylvanian (Canyon 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 are divided into lower Lone Camp group and upper Whitt group with common boundary at disconformity between Strawn and Canyon series. Includes (ascending) Salesville, Keechi Creek, and Palo Pinto formations. Group is nearly equivalent to Brownwood shale.

M. G. Cheney and D. H. Eargle, 1951, Geologic map of Brown County, Texas (1:62,500): Texas Univ. Bur. Econ. Geology. Includes Brownwood shale at base and Adams Branch limestone at top. Overlies Lone Camp group; underlies Graford formation.

R. J. Cordell and others, 1954, *in* Abilene Geol. Soc. Guidebook Nov. 19–20, fig. 2 (strat. chart). Revision suggested since Strawn-Canyon boundary has been placed at faunal break at top of Salesville shale and base of Turkey Creek sandstone and conglomerate member of Keechi Creek shale.

Named for village of Whitt in northwest Parker County near which included formations appear from beneath Comanche overlap.

**Whitwell Shale** (in Lee Group)[1]

**Whitwell Shale Member** (of Crab Orchard Mountains Formation)

Whitwell Member (of Lee Group)

Whitwell Shale (in Crab Orchard Mountains Group)

Lower Pennsylvanian: Eastern Tennessee and northern Georgia.

Original reference: Charles Butts and W. A. Nelson, 1925, Tennessee Div. Geology Bull. 33-D, p. 7, pl. 4.

H. R. Wanless, 1939, (abs.) Geol. Soc. America Bull., v. 50, no. 12, pt. 2, 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 6 to 50 feet thick. Underlies Bonair sandstone; overlies Sewanee member of Lookout sandstone.

C. W. Wilson, Jr., J. W. Jewell, and E. T. Luther, 1956, Pennsylvanian geology of the Cumberland Plateau: Tennessee Div. Geology [folio], p. 4, 19, pls. 2, 3, 4. Assigned to Crab Orchard Mountains group (new). Thickness 60 to more than 200 feet; 75 to 100 feet in type area. Includes Richland and Sewanee coal. Underlies Newton sandstone; grades conformably downward into Sewanee conglomerate. In northwestern part of Cumberland Plateau, forms part of Fentress formation. Pottsville series.

U.S. Geological Survey currently classifies the Whitwell Shale as a member of the Crab Orchard Mountains Formation on the basis of a study now in progress.

Named for exposures west of Whitwell, Marion County, Tenn.

†Wichita Conglomerate (in Clear Fork Formation)[1]

Permian: Central northern Texas.

Original reference: E. C. Case, 1907, Am. Mus. Nat. History Bull. 23, p. 662-664.

Named for Big Wichita River, near Seymour-Vernon Road, Baylor County.

**Wichita Group**[1] or **Formation**[1]

Lower Permian: Northern and central Texas and western Oklahoma.

Original reference: E. T. Dumble and W. F. Cummins, 1890, Texas Geol. Survey 1st Ann. Rept., p. lxix, 188, pl. 3.

R. I. Dickey, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 1, p. 42. Cheney proposes to abandon term Wichita. He places part of old Wichita group in Wolfcamp series and subdivides remaining part in Leonard series into three groups (ascending): Belle Plains, Clyde, and Lueders. These three groups are not distinguishable in subsurface of west Texas. Proposed here to continue term Wichita group (restricted) for beds of Leonard age between base of Clear Fork group and top of

Wolfcamp series. Wichita group (restricted) in Fisher County is about 800 feet thick from top of Lueders limestone to top of Fisk formation.

M. G. Cheney, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 1, p. 66 (fig. 1), 97. Term Wichita group discarded. Terms Pueblo, Moran, Putnam, Admiral, Belle Plains, Clyde, and Lueders raised to rank of group. Pennsylvanian-Permian boundary placed at base of Pueblo group. Wolfcamp-Leonard boundary placed at top of Fisk formation (new) in Admiral group.

R. C. Moore, 1949, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 80. Group comprises (ascending) Pueblo, Moran, Putnam, Admiral, Belle Plains, Clyde, and Lueders formations. Overlies Cisco group; underlies Clear Fork group. Permian.

G. W. Chase, 1954, Am. Assoc. Petroleum Geologists Bull., v. 38, no. 9, p. 2028–2035. In Wichita Mountains, Okla., formation includes Post Oak conglomerate member (new). Member is equivalent to Wellington formation and may be as old as upper part of Pontotoc group and as young as lowermost part of Garber sandstone.

P. T. Stafford, 1960, U.S. Geol. Survey Bull. 1081–G, p. 266–276, pl. 11. Group in north-central Texas includes rocks between base of Waldrip shale member of Pueblo formation and top of Lueders limestone. Comprises (ascending) Pueblo, Moran, Putnam, Admiral, Belle Plains, and Clyde formations, and Lueders limestone. Includes all rocks assigned to Wolfcamp series and about half of those assigned to Leonard series. Rocks of Pennsylvanian-Permian transition zone are included in lower part of Waldrip shale member of Pueblo. Overlies Pennsylvanian Cisco group; underlies Clear Fork group. Thickness ranges from about 1,650 feet in northern Callahan and northwestern Eastland Counties to 1,550 feet in central Shackelford and western Stevens Counties, and to 1,800 feet north of Clear Fork of Brazos River in Young and Throckmorton Counties. Channel deposits near base of group locally may increase thickness as much as 200 feet.

Named for Wichita River and Wichita County, Tex.

Wichitan series[1]

Carboniferous: Texas.

Original reference: C. R. Keyes, 1928, Pan-Am. Geologist, v. 49, p. 130, 133.

Wichman Formation

Pliocene, upper: Western Nevada.

D. I. Alexrod and W. S. Ting, 1960, California Univ. Pubs. Geol. Sci., v. 39, no. 1, p. 2–5. Consists of light-colored poorly indurated fluvio-lacustrine sediments and associated rhyolite ash; well-bedded pumiceous claystone, diatomaceous mudstone, sandstone, and conglomerate; rhyolitic tuff; rhyolitic breccia-agglomerate. Thickness not determined precisely; approximately 500 feet. Faults duplicate part of upper section. Lower part of section in fault contact with three formations: Excelsior, Kate Peak, and Coal Valley.

Type area: Four miles north of Wichman post office, Lyon County, and 1 mile northwest of entrance to East Walker Ranch headquarters. Exposed on east side of Pine Grove Mountains from vicinity of Wichman northward for over 15 miles; in southern part of area, crops out discontinuously under alluvial cover.

Wickcliff Sandstone (in Chester Group)[1]

Mississippian: Southern Indiana and western central Kentucky.

Original reference: C. A. Malott, 1925, Indiana Acad. Sci. Proc., v. 34, p. 108–132.

C. A. Malott, 1952, Stratigraphy of the Ste. Genevieve and Chester formations of southern Indiana: Ann Arbor, Mich., The Edwards Letter Shop, p. 7. Replaced by Waltersburg sandstone. Local Indiana names of upper Chester are dropped and formations given names of standard Chester column.

Named for exposures in ravines around Wickcliff, Crawford County, Ind.

†Wicker Formation[1]

Pliocene: Florida.

Original reference: H. F. Osborn, 1907, Am. Mus. Nat. History Bull., v. 23, pl. facing p. 249.

**Wicomico Formation** (in Columbia Group)[1]

Pleistocene: Atlantic Coastal Plain from Delaware to Florida.

Original reference: G. B. Shattuck, 1901, Johns Hopkins Univ. Circ., v. 20, no. 152, p. 73–75.

G. G. Parker and C. W. Cooke, 1944, Florida Geol. Survey Bull. 27, p. 75–77, pls. 2, 3. In southern Florida, the Talbot, Penholoway, and Wicomico formations comprise a conformable sequence of deposits whose differentiation is based mainly on location of their respective shore lines—42, 70, and 100 feet above present sea level. Presumably, the Penholoway everywhere merges downward into deposits of Wicomico age, and the Talbot into Penholoway and Wicomico successively. The sequence unconformably overlies Caloosahatchee marls and is likewise separated by a stratigraphic break from the Pamlico which fringes around it.

C. W. Cooke, 1952, Maryland Dept. Geology, Mines and Mineral Resources Bull. 10, p. 48–50. In Prince Georges County, Md., and District of Columbia, consists of coarse gravel bed at base and finer sand and silt above; color of silt ranges from yellow to drab to dirty white; local basal deposits of carbonaceous clay contain tree stumps and other woody debris. Thickness rarely more than 30 feet. In Potomac Valley, follows meandering course cut in crystalline bedrock and the Potomac group; along Patuxent River, lies on Cretaceous, Eocene, and Miocene beds; is sunk below base of Sunderland formation, and separated from it by a slope exposing older rocks. Deposition is believed to have begun during second (Kansan) glacial stage and completed during second (Yarmouth) interglacial stages.

Named for Wicomico River, St. Marys and Charles Counties, Md.

**Wiggins Formation**

Oligocene: Northwestern Wyoming.

J. D. Love, 1939, Geol. Soc. America Spec. Paper 20, p. 79–85, pl. 17. Proposed to replace preoccupied name Ramshorn volcanic series (Love, 1934). Consists of white and light-colored sequence of conglomerates, tuffs, sandstone, and shale. Thickness 1,700 feet on East Fork-South Fork of Owl Creek divide; 3,000 feet in vicinity of Brown Rock Canyon; 989 feet on east face of Steamboat Rock. Unconformably overlies Tepee Trail formation (new). Overlain by younger rocks only on Wiggins Peak.

Oligocene(?). Lithology varies from place to place; no standard section designated.

H. E. Wood 2d and others, 1941, Geol. Soc. America Bull., v. 52, no. 1, p. 37, pl. 1. Oligocene (Chadronian).

Name taken from Wiggins Fork River. Comprises high divides and ridges of southern and highest part of Absaroka Range.

Wigwam Formation[1]

Precambrian: Southern British Columbia, Canada, and northwestern Montana.

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

C. L. Fenton and M. A. Fenton, 1937, Geol. Soc. America Bull., v. 48, no. 12, pt. 1, p. 1892. Incidental mention in discussion of Belt series.

Named for Wigwam River, which essentially is in British Columbia.

Wilbarger 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, 384.

D. A. Zimmerman and G. D. Glover, 1956, Soc. Econ. Paleontologists and Mineralogists, Permian Basin Sec., [Guidebook] Spring Mtg., p. 78. Thickness 75 to 200 feet. Underlies Comanche Creek bed; overlies Buffalo 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.

Named for Wilbarger Creek, San Saba County.

**Wilberns Formation**[1]

Upper Cambrian: Central Texas.

Original reference: S. Paige, 1911, U.S. Geol. Survey Bull. 450, p. 23.

Frederick Romberg and V. E. Barnes, Geophysics, v. 9, no. 1, p. 88. Subdivided to include (ascending) Welge sandstone, Morgan Creek limestone, Point Peak shale, San Saba limestone, and Pedernales dolomite members.

P. E. Cloud, Jr., V. E. Barnes, and Josiah Bridge, 1946, Texas Univ. Bur. Econ. Geology Pub. 4301, p. 133, 149–151, 155–156 [1945]. Underlies Tanyard formation of Ellenburger group; overlies Riley formation (new). San Saba limestone and Pedernales dolomite are essentially equivalent facies, with limestone predominating to the west and dolomite to the east. Dolomites here termed Pedernales had formerly been considered part of Ellenburger limestone herein redefined as group and restricted to Lower Ordovician.

Josiah Bridge, V. E. Barnes, and P. E. Cloud, Jr., 1947, Geol. Soc. America Bull., v. 58, no. 1, p. 114–123, pls. 1, 2. Through most of Llano uplift thickness ranges from 540 to 610 feet; in southeastern part of region about 360 feet due to truncation and disconformity at top.

P. E. Cloud, Jr., and V. E. Barnes, 1948, Texas Univ. Bur. Econ. Geology Pub. 4621, p. 136, 155–157, 187–188, 192–194, 225, 253–255, 310–312, pls. [1946]. Local stratigraphy described in detail.

V. E. Barnes and W. C. Bell, 1954, San Angelo Geol. Soc. [Guidebook] March 19–20, p. 35, 36–37. Name Pedernales dropped. Formation includes four members: Welge sandstone, Morgan Creek limestone, Point Peak shale, and San Saba limestone.

Named for Wilberns Glen, Llano County.

†Wilbraham Gneiss[1]

Late Carboniferous or post-Carboniferous: Southern central Massachusetts.

Original reference: H. E. Gregory, 1906, Connecticut Geol. Nat. History Survey Bull. 6, p. 116.

**Wilbur Member** (of Rondout Limestone)

Wilbur Limestone Member (of Salina Formation)[1]

Upper Silurian: Eastern New York.

Original reference: J. M. Clarke, 1903, New York State Mus. Bull. 69, p. 855–867.

U.S. Geological Survey currently classifies the Wilbur as a member of the Rondout Limestone on the basis of a study now in progress.

Named for exposures at Wilbur, Ulster County.

Wilbur Tuff Lentils[1]

Eocene: Southwestern Oregon.

Original reference: J. S. Diller, 1898, U.S. Geol. Survey Geol. Atlas, Folio 49.

Has been traced from 2 miles west of Wilbur to Calapooya, Lynn County, a distance of 13 miles.

Wilburton Group[1]

Pennsylvanian: Oklahoma and Kansas.

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. 103. Abandoned by Oklahoma Geological Survey.

Named for town in Latimer County, Okla.

Wilcox Formation

Precambrian: West-central Vermont.

W. F. Brace, 1953, Vermont Geol. Survey Bull. 6, p. 19–20, 21–22, 29. Predominantly green, white, and black schist enclosing thin dolomite beds near base of schist. Schists are feldspathic and dolomitic, show fine banding, and contain thin buff and blue quartzite beds. Pegmatitic quartzose gneiss occurs near middle of the formation. Above the gneiss, dark schistose grits contrast with strictly argillaceous types below. Thickness about 3,000 feet. Underlies Mendon formation unconformably.

Exposed in western part of Mendon and Shrewsbury Towns, Rutland quadrangle. Best seen on slopes south of Cold River at Wilcox Hill and on northwest slopes of Mendon Peak.

**Wilcox Group[1] or Formation**

Eocene, lower: Gulf Coastal Plain from Georgia to southern Texas, inclusive, also southwestern Illinois, western Kentucky, southeastern Missouri, and western Tennessee.

Original reference: A. F. Crider and L. C. Johnson, 1906, U.S. Geol. Survey Water-Supply Paper 159, p. 5, 9.

Wythe Cooke, 1925, U.S. Geol. Survey Prof. Paper 140–E, p. 133, 134–135. Wilcox group in Alabama comprises (ascending) Nanafalia, Tuscahoma, Bashi, and Hatchetigbee formations. In Mississippi, comprises (ascending) Ackerman, Holly Springs sand, and Grenada formation. Overlies Midway group (Porters Creek clay in Mississippi and Naheola formation in Alabama). Underlies Tallahatta formation of Claiborne group.

H. V. Howe, 1933, Am. Assoc. Petroleum Geologists Bull., v. 17, no. 6, p. 617–621. Term Wilcox group should be abandoned in favor of Sabine. Sabine has priority and better type locality.

E. N. Lowe, 1933, Mississippi Geol. Survey Bull. 25, p. 32–119. Group subdivided into (ascending) Ackerman formation, Holly Springs sand, Bashi formation, Hatchetigbee formation, and Grenada formation. Although the same number of subdivisions is recognized in Mississippi as in Alabama, it is not possible to correlate them with corresponding subdivisions of Alabama Wilcox, except the Bashi and overlying Grenada beds which, in part, at least, correspond with Hatchetigbee of Alabama. Naheola is probably traceable in State in extensive sand outcrops immediately west of Porters Creek outcrop. Overlies Midway group; underlies Claiborne group.

F. B. Plummer, 1933, Texas Univ. Bull. 3232, p. 571–606. Group, in Texas, subdivided into (ascending) Seguin, Rockdale, and Sabinetown formations. Overlies Wills Point formation of Midway group; underlies Carrizo formation of Claiborne group.

H. V. Howe and J. B. Garrett, Jr., 1934, Louisiana Dept. Conserv., Geol. Bull. 4, p. 3–9. Sabine group divided into Mansfield and Wilcox subgroups. In Sabinetown outcrop, Mansfield subgroup is equivalent of "Rockdale formation" of Plummer in Texas. Wilcox subgroup is represented in Pendleton, Marthaville, and Fort Jessup outcrops and in Sabinetown outcrops. Alabama equivalents of Wilcox subgroup are Tuscahoma and Nanafalia formations and Bashi formation. Although name Wilcox is unfortunate because of its original usage, it has gained such wide acceptance that it is retained as subgroup name when it is distinctly understood that it applies only to upper one-third(?) of Sabine group or to marine beds overlying continental Mansfield subgroup. Such usage is fair because it is giving term "Wilcox" exactly same usage in Louisiana that it has at present in Alabama—its type section—and it is preferable to use of Sabinetown.

J. M. Weller and H. S. McQueen, 1939, Kansas Geol. Soc. Guidebook 13th Ann. Field Conf., p. 159. Group in southeastern Missouri includes Ackerman formation.

F. F. Mellen, 1939, Mississippi Geol. Survey Bull. 38, p. 29–46. Wilcox series in Winston County comprises (ascending) Fearn Springs (new), Ackerman, Holly Springs, and Hatchetigbee formations. Disconformably overlies Betheden formation (new) of Midway series; disconformably underlies Meridian formation of Claiborne series.

L. D. Toulmin, Jr., 1940, Alabama Geol. Survey Bull. 46, p. 25–36. Under heading of Wilcox group, report discusses (ascending) Ackerman formation, Nanfalia formation, Salt Mountain limestone, Tuscahoma formation, Bashi formation, and Hatchetigbee formation.

R. J. LeBlanc and J. O. Barry, 1941, Am. Assoc. Petroleum Geologists Bull., v. 25, no. 4, p. 734–737. Basal Wilcox of Louisiana, as of Alabama, is characterized by beds containing *Ostrea thirsae* (Gabb). In Louisiana, this fossil, which characterizes Nanafalia formation, of Alabama, has been reported in abundance only from beds of Marthaville, Natchitoches Parish. Collections have been made recently from 18 additional *Ostrea thirsae* localities between Red River and Sabine River flood plains. These localities comprise zone traceable from 8 miles east of Marthaville to 5 miles east of Zwolle, Sabine Parish. Establishment of this zone affords firmer basis for correlation proposed by Veatch (1905, Louisiana Geol. Survey Bull. 5) and Howe and Garrett (1934), of beds at Marthaville with Nanafalia. Basal Wilcox of Texas is also equivalent of *Ostrea thirsae* zone of Louisiana. Writers have collected from three localities in this zone specimens of another oyster, *Ostrea multilirata* Conrad (*tasex Gardner*), a species which, according to Plummer, occurs in Caldwell Knob member of Seguin formation, the basal Wilcox formation of Texas. Extension of *Ostrea multilirata* zone into Louisiana as part of *Ostrea thirsae* zone forms connecting link between lower Wilcox of Alabama and of Texas.

J. O. Barry, 1941 (abs.) Am. Assoc. Petroleum Geologists Bull., v. 25, no. 5, p. 941. Discovery of 40 new fossil localities permits better definition of the three faunal units of Louisiana Sabine (Wilcox): Sabinetown (youngest), Pendleton, and Marthaville beds (oldest). Study of these fossils substantiates long-standing correlation of Louisiana section with marine Wilcox of Alabama. Presence of *Ostrea multilirata* Conrad, a guide fossil of basal Wilcox Seguin formation of Texas, associated with *Ostrea thirsae* (Gabb) in Marthaville beds is of importance because it establishes connecting link between basal Wilcox faunas of Alabama and Texas.

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 thirsac* zone have surface thickness of about 800 feet in Sabine uplift region of northwestern Louisiana. Upper 300 feet of sediments contain limited fauna. Lower 500 feet carry 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 results of study of over 90 species from 15 previously undescribed localities in Sabine, Natchitoches, and De Soto Parishes, La.

D. P. Meagher and L. C. Aycock, 1942, Louisiana Geol. Pamph. 3, p. 12. Group in Louisiana, includes Marthaville, Pendleton, and Sabinetown units.

C. W. Cooke, 1943, U.S. Geol. Survey Bull. 941, p. 48–53. Deposits of Wilcox age in Georgia have not been subdivided and are called Wilcox formation, though equivalents of Nanafalia, Tuscahoma, and Bashi formations are known to be represented. Thickness 150 to 200 feet. Unconformably overlies Clayton formation; unconformably underlies McBean formation or Flint River formation, both of which overlap it.

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., Sept. 1944, Alabama Acad. Sci. Jour., v. 16, p. 41–42. Discussion of Midway-Wilcox contact in Alabama. Contact is easily located in exposures on Chattahoochee River at Fort Gaines, Ga., where fossiliferous Wilcox (Nanafalia) beds lie on irregular surface of Midway limestone. 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. Wilcox group comprises (ascending) Nanafalia formation consisting of (ascending) "Basal sand," "Nanafalia Landing (*Ostrea thirsae*) marl," and "Gullette Bluff beds," Tuscahoma formation (including beds below Bashi marl formerly assigned to Bashi formation), Bashi marl (restricted), and Hatchetigbee formation. Disconformity separates "Basal sand" of Nanafalia formation from "Coal Bluff beds" of Naheola formation of Midway group.

F. S. MacNeil, 1944, Southeastern Geol. Soc. [Guidebook] 2d Field Trip, p. 23–28. Wilcox formations were treated together as undifferentiated Wilcox formation in Georgia by Cooke (1943). Wilcox is here treated to show same units recognized in Alabama section—Nanafalia formation, Tuscahoma sand, and Hatchetigbee formation with Bashi marl member. Wilcox formations are progressively overlapped in Georgia by Claiborne and Jackson groups. Not certain that Jackson anywhere rests directly on Wilcox in present exposures. It is probable that at least a thin wedge of Claiborne overlies Wilcox as far as vicinity of Montezuma where both Midway and Wilcox pass under cover of younger beds, Claiborne and Jackson. Basal beds of Claiborne, definitely equivalent to Tallahatta formation, rest directly on upper shales and sands of Hatchetigbee formation near Fort Gaines and down Chattahoochee River to near mouth of Abbie Creek, on Alabama side about 13 miles south of Fort Gaines. Near Andersonville, in northern Sumter County, sands of either Claiborne or Jackson rest directly on Nanafalia.

W. E. Belt and others, 1945, Geologic map of Mississippi (1:500,000): Mississippi Geol. Survey. Formation, as mapped in Mississippi, includes Fearn Springs sand member at base, Bashi marl member, and fossiliferous marl bed which, in Alabama, occurs near middle of Nanafalia formation.

G. E. Murray, Jr., and E. P. Thomas, 1945, Am. Assoc. Petroleum Geologists Bull., v. 29, no. 1, p. 45–70. Sabine uplift of northwestern Louisiana and northeastern Texas is reflected as subregional doming by presence of inlier of Midway, Wilcox, and lower Claiborne sediments. Midway and Wilcox beds are largely deltaic and barren of fossils, but lentils bearing marine faunas are found around southern flank of uplift. Wilcox age of upper part of section was established by Harris and Veatch (1899, Louisiana State Expt. Sta., Geol. Rept., pt. 5, section 2), and entire section was considered Wilcox in age by subsequent writers until recent investigations by Louisiana Geological Survey revealed presence of faunas of Midway age in lower part. Three Midway and four Wilcox formations are recognized within section exposed on Sabine uplift, and these are correlated with type formational units of Alabama section. Group, in southern half of Sabine uplift, comprises (ascending) Marthaville, Pendleton (with Bayou Lenann, Slaughter Creek, and High Bluff members), Sabinetown, and Carrizo formations. In northern half of uplift, comprises (ascending) Marthaville(?) shale, undifferentiated Wilcox, and Carrizo formation. Overlies Hall Summit formation of Midway group. Eocene. Carrizo formation considered basal Claiborne by many geologists.

F. S. MacNeil, 1946, U.S. Geol. Survey Strategic Minerals Inv. Prelim. Rept. 3–195, p. 17–22, correlation chart. Discussion of beds of Wilcox age-Wilcox formation and Wilcox group. Name Wilcox is not based on a type exposure, an objection commonly voiced against employing it at all. Name was derived from either Wilcox County or now abandoned Wilcox post office in Alabama. In Alabama, Wilcox group consists of Nanafalia formation with Fearn Springs sand member at base, Tuscahoma sand, and Hatchetigbee formation with Bashi marl member at base. In Mississippi, the Wilcox is treated as a formation equivalent to whole Wilcox group in Alabama. Two members of formation are recognized: Fearn Springs sand member at base and Bashi marl member in upper part. Formation is more than 800 feet thick in southeastern Neshoba County, Miss.; thins northward along strike, largely as result of overlap by Claiborne group to less than 100 feet at Tennessee line. Recent work has revealed that type Holly Springs formation of northern Mississippi, formerly included in the 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 Mississippi. Removal of beds designated as Holy Springs from Wilcox group left Ackerman formation as only unit formerly recognized by U.S. Geological Survey in Wilcox of Mississippi. Although usually correlated with Nanafalia formation of Alabama, Ackerman at its type locality in Mississippi was found to be correlated with beds well up in Tuscahoma sand of Alabama. Rather than attempt to redefine the Ackerman, it was decided to adopt Wilcox formation for all beds of Wilcox age in Mississippi.

G. E. Murray, 1948, Louisiana Dept. Conserv., Geol. Bull. 25, p. 135–140. Barry and Le Blanc have presented evidence for drawing base of Wilcox group in Louisiana at base of *Ostrea thirsae-Ostrea multilirata* zone. In present report, base of Wilcox group is drawn at base of lithologic sequence (Marthaville formation) that contains the *Ostrea thirsae-Ostrea multilirata* zone.

H. B. Stenzel, 1950, Texas Univ. Bur. Econ. Geology Pub. 5019, p. 12–18. Wilcox group described in Troup district. Only upper part exposed. Includes Henrys Chapel ball clay (new).

G. E. Murray, 1953, Mississippi Geol. Soc. [Guidebook] 10th Ann. Field Trip, p. 48–60. 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 permits retention of Midway as time and time-rock term for all time and rocks deposited during fluctuations of Paleocene sea in Coastal Plain province. This usage also permits application of Sabine as a time and time-rock term for all time and rocks deposited during fluctuations of early Eocene sea in Coast Plain province. Wilcox group is considered to be the mass of complexly interbedded continental to deltaic deposits of Midway and Sabine ages. It is a three-dimensional lithologic unit, limits of which are determined by discernible extent of typical Wilcox lithology. Group contains delineatable and mappable litholigic units, some of Midway age and some of Sabine age. Exposures in Wilcox County, Ala., are typical of the group.

G. E. Murray, 1955, Am. Assoc. Petroleum Geologists Bull., v. 39, no. 5, p. 671–696. Discussion of history and development of Paleocene-lower Eocene nomenclature of central Gulf Coast region. Midway group, Wilcox group, and Sabine group, the modern geographic class nouns most commonly applied to these deposits, are used dually as major divisions (groups) of rocks and as provincial subdivisions (stages) of the Paleocene and Eocene. Initially established as names of lithologic units, stated or implied modern usage of Midway, Wilcox, and Sabine is predominantly in a time-rock sense. Dual usage of Wilcox as a rock-unit name is increasingly common. Use of (1) Midway and Sabine stages and their companion units, Midway and Sabine ages, as provincial time-rock and time units of early Tertiary of Coastal Plain, based on major fluctuations of strand line; and (2) Wilcox group for mass of lignitic, prominently arenaceous deposits of both Midway and Sabine ages can clarify nomenclatural confusion and permit conformity to standard usage of time and time-rock units elsewhere in world. Exposures of Naheola, Nanafalia, Tuscahoma, and Hatchetigbee formations in Wilcox County, Ala., are typical of Wilcox group. Exposures of Naborton, Hall Summit, Logansport, Marthaville, Pendleton, and Sabinetown formations in De Soto, Red River, Natchitoches, Sabine Parishes, La., and in Panola, Shelby, and Sabine Counties, Tex., are cited as reference sections. Wilcox group is discriminated lithologically on first occurrence of clays or silts, commonly lignitic or carbonaceous, and (or) dirty sands, below marine greensands of Claiborne stage and above dark shales or glauconitic strata of Porters Creek formation.

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 and comparison of Alabama and Louisiana sequences. Problem of determining boundary in Louisiana involves same difficulties as in Alabama but with added necessity of correlating cross-country with Alabama section. In both Louisiana and Alabama, lower beds of deltaic (Wilcox) lithology contain fauna of Midway aspect. Sequence in Alabama embraces Naheola as now restricted and in Louisiana the Mansfield subgroup of Howe and Garrett (1934) later subdivided by Murray (1941). Surface evidence in Mississippi-Alabama area indicates that Naheola is missing inland so that these problematical and somewhat transition beds only occur in thicker gulfward sections. By analogy, the same is true in Louisiana although documentation is incomplete. Evidence does not prove exact contemporaneity for base of Wilcox in Louisiana and Alabama but certainly does not indicate any great variation in time of deposition. In both Alabama and Louisiana, a wedge of gulfward thickening deltaic sediments is present. This wedge, absent inland, contains typical Wilcox lithology but fossils considered by most workers to be Midway in affinity. Various Louisiana workers have dealt differently with nomenclature problem of this wedge. The many interpretations reflect difficulty of using same names in lithologic, faunal, and time sense when geologic facts do not lend themselves to such combined usage. It is doubtful if Murray's (1955) proposal of labeling the same sequence both Midway and Wilcox will be adopted generally. Several recent papers by both paleontologists and stratigraphers have used Midway and Paleocene as well as Wilcox and lower Eocene in synonymous sense (Cushman, 1944, Cushman Lab. Foram. Research Contr., v. 20, pt. 2; Munsey, 1953, Jour. Paleontology, v. 27, no. 1; Loeblich and Tappan, 1957, Jour. Paleontology, v. 31, no. 6; Toulmin and others, 1951, Alabama Geol. Survey Spec. Rept. 21; LaMoreaux and Toulmin, 1953, Mississippi Geol. Soc. Guidebook 10th Field Trip). This usage of Midway and Wilcox is based on faunal rather than lithologic considerations reinforced perhaps in some instances by position of disconformable contact between the Naheola and Nanafalia of Alabama. In stratigraphic summary, Toulmin (1955, Am. Assoc. Petroleum Geologists Bull., v. 39, no. 2) eliminated all reference to terms Midway and Wilcox using Paleocene and lower Eocene exclusively instead. This frees terms Midway and Wilcox to be used in their other lithologic sense. As first used, Wilcox was called a formation, and that usage persists in Mississippi. Inland where Wilcox is thin, of variable rapid facies changes, and mappable subdivisions cannot be made, this is permissible. Gulfward in thicker Alabama and west-central Louisiana sequences, individual formations as well as members have been delineated and mapped. In this area, Wilcox must be considered a group. In northernmost Louisiana, the Wilcox has the same characteristics that led it to be called formation in Mississippi. But, inasmuch as it is subdivided into formations only a short distance southward, it is preferable to refer to it as "undifferentiated Wilcox group" in that area. In present report, the term "Mansfield subgroup," as used by Howe and Garrett (1934), is used informally for the lower Wilcox although it embraces subdivisions of Murray (1941, 1948) that is, Naborton, Logansport, and Hall Summit formations with their members. "Mansfield" thus comprises the thicker Louisiana counterpart of Naheola formation of Alabama. Use of the several formational names of Murray is avoided because recent work in Sabine, Red River, and Caddo Parishes has indicated need for their revision. In Alabama and Louisiana, the Paleocene character of the fauna persisted during deposition of older part of deltaic sequence, the Naheola of Alabama and Mansfield of Louisiana. Thus, Paleocene-Eocene contact falls within deltaic mass. Inland, a disconformity rests on Midway clay. Lack of fossils prevents positive proof, but this hiatus probably occurred while Naheola and Mansfield were being deposited to the south during late Paleocene. Hence, Midway and Wilcox cannot be used in both lithologic sense and as time-stratigraphic terms equivalent to Paleocene and lower Eocene, but Midway and Wilcox are available for use as lithologic terms. Without this usage, no terms exist to describe the underlying lime and clay sequence of Paleocene age nor overlying deltaic sequence of late Paleocene and early Eocene age.

A lithologic boundary is drawn between Midway and Wilcox groups in Louisiana. Updip in Caddo Parish, this contact is disconformable; to the south, it is transitional. Lower deltaic Wilcox comprises partially fossiliferous sequence containing Paleocene fossils beneath beds containing *Ostrea thirsae*. This sequence is probably completely absent inland, thickens rapidly gulfward, and is divisible into formational units, locally. Upper Wilcox group of lower Eocene age includes *O. thirsae* beds (Marthaville), as well as overlying Pendleton and Sabinetown formations on south flank of Sabine uplift, but is undifferentiated in thinner nonfossiliferous sequence on north flank. This is practical nomenclature for both surface and subsurface Midway-Wilcox sequence wherever studied in Louisiana, as well as entire Gulf Coast area.

Mackenzie Gordon, Jr., J. I. Tracey, Jr., and W. W. Ellis, 1958, U.S. Geol. Survey Prof. Paper 299, p. 11 (fig. 4), 38–58. Group described in Arkansas bauxite region. Divided into (ascending) Berger formation, Saline formation, and Detonti sand (all new). Thickness as much as 1,209 feet. Unconformably overlies Wills Point formation of Midway group. Overlain by variegated clay and sand and thin lignite beds similar to those assigned to Claiborne group in other parts of Arkansas; whether this represents true contact of Wilcox and Claiborne must be decided by later studies. It is possible that Wilcox in Arkansas bauxite region, on lithologic basis, probably should be restricted to Berger formation, but current Arkansas usage is being followed in this report. Lower Eocene.

H. V. Andersen, 1960, Louisiana Dept. Conserv., Geol. Bull. 34, p. 48–85, maps. Wilcox group (rock group) in Sabine Parish comprises (ascending) Converse (new), Lime Hill, and "Hall Summit" formations (all Paleocene) and Marthaville, Pendleton, Sabinetown (with lower Pierson glauconite member), and Carrizo formations (all Eocene). Naborton, Dolet Hills, and Cow Bayou formations recognized in subsurface.

C. C. Mason, 1960, Texas Board Water Engineers Bull. 6003, p. 15–25. Group, In Dimmit County, contains Indio formation. Overlies Kincaid formation of Midway group; underlies Carrizo sand of Claiborne group. Eocene.

Named for extensive development in Wilcox County, Ala.

†Wild Cat Coquinite[1]

Upper Devonian or Mississippian: Northwestern Pennsylvania.

Original reference: K. E. Caster, 1933, Geol. Soc. America Bull., v. 44, no. 1, p. 203.

Well exposed on Wild Cat Creek at Ludlow, McKean County.

Wildcat Group

Wildcat Series[1]

Miocene, upper, to Pleistocene, lower: Northern California.

Original reference: A. C. Lawson, 1894, California Univ. Pub., Dept. Geol. Bull., v. 1, p. 255–263.

B. A. Ogle, 1953, California Div. Mines Bull. 164, p. 13 (fig. 3), 24–26, 102, pls. 1, 2. Wildcat series (Lawson 1894) has become established in literature as loose term for Tertiary sediments (in Humboldt County) of suspected Pliocene age. Term Wildcat group is used here for sediments ranging from upper Miocene to lower Pleistocene. Composed principally of slightly indurated mudstone, siltstone, claystone, sandstone, and conglomerate; minor amounts of limestone, tuff, and lignite. Thickness more than 12,000 feet. In Ferndale Hills, on south side of Cenozoic basin, subdivided into (ascending) Pullen, Eel River, Rio Dell, Scotia Bluffs, and Carlotta formations (all new). Northeast of Foruna, group is undifferentiated. Strong angular unconformity separates group from Yager formation (new) and Franciscan; Hookton formation (new) deposited on eroded surface of Wildcat group.

G. C. Gester, 1951, Am. Assoc. Petroleum Geologists Bull., v. 35, no. 2, p. 205. Generalized stratigraphic section across Tertiary formations of Eel River basin near Scotia shows that Pliocene Wildcat series, 11,000 feet thick, overlies upper Miocene Bear River formation.

Type locality for group: Along Eel River from west of Scotia, Humboldt County, north to Van Duzen River. Region occupied by terrace is commonly known to people of Humboldt County as "Wild-cat Country."

Wildcat Marble

Precambrian: Northern New Jersey.

J. M. Hague and others, 1956, Geol. Soc. America Bull., v. 67, no. 4, p. 440, 468, 469, fig. 18. Throughout most of outcrop length horizon represented by single band of marble, but in area north of Sparta it gradually changes into series of tightly folded bands of impure marble and calcareous hornblende and pyroxene gneisses. Commonly contains blocks and discontinuous bands of gneiss and pegmatite. Thickness at Franklin, 300 feet. Underlies Pochuck Mountain gneiss series (new); overlies Cork Hill gneiss (new).

Named for small creek which flows through its outcrop southwest of Franklin. Also found north, west, and southwest of Sparta.

**Wildcat Creek Shale Member** (of Admiral Formation)

Permian: North-central Texas.

R. C. Moore, 1947, *in* A. K. Miller and Walter Youngquist, Kansas Univ. Paleont. Contr. 2, Mollusca, art. 1, p. 1 (footnote). Name introduced for shale overlying Hords Creek limestone and underlying Overall limestone (new).

R. C. Moore, 1949, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 80, sheet 2. Drake (1893) applied name Indian Creek bed to predominantly shaly strata occurring between Hords Creek limestone below and "Bed No. 5" (here named Overall limestone) above. Drake also used Indian Creek for beds in his Strawn division of Pennsylvanian age; Sellards (1933, Texas Univ. Bull. 3232) restricted application of name to the Strawn without renaming the Permian Indian Creek. This shale member is named Wildcat Creek shale. Thickness near Colorado River about 60 feet. Wildcat Creek shale makes up lower main part of Cheney's Fisk formation.

Named for exposures on Wildcat Creek which joins Home Creek at a point about 0.9 mile north of south line, and 1 mile east of west line of J. H. Barkey Survey No. 700, 6 miles S. 15° W. from courthouse at Coleman, Coleman County.

Wild Cat Mountain Conglomerate[1]

Pennsylvanian: Southeastern Kentucky.

Original reference: C. J. Norwood, 1877, Kentucky Geol. Survey, 2d ser., v. 2, pt. 6, p. 201, 243.

Forms top of Wild Cat Mountain and extends to hills around London, Laurel County, which it covers.

Wildcat Peak Formation

Carboniferous: Central Nevada.

Marshall Kay, 1960, Internat. Geol. Cong., 21st, Copenhagen, pt. 12, p. 98 (fig. 4). Named on structure section in report on Paleozoic continental margin in central Nevada. Overlies Pinecone formation (new).

Toquima Range, Nye County.

**Wilder Formation**

Late Tertiary(?) or Pleistocene(?): West-central Arizona.

C. A. Anderson, E. A. Scholz, and J. D. Strobell, Jr., 1955, U.S. Geol. Survey Prof. Paper 278, p. 1, 26–27, pl. 3. Consists of porphyritic olivine basalt flows, intrusive plug of olivine basalt, coarse pyroclastic basaltic deposits formed as cinder cones or interbeds of pyroclastics in flows, and horizontically bedded basaltic tuffaceous sediments. Aggregate thickness generally ranges from 200 to 300 feet, but west of Contreras Wash 400 feet is exposed. In Wilder and upper Boulder Canyons, intercalated throughout the Gila(?) conglomerate; on west bank of Wilder Canyon, intercalated with and underlies Sanders basalt (new).

Exposed along walls of Wilder Canyon, for which it is named. Also crops out to east of Wilder Creek, along north wall of Boulder Canyon; to the south, along west wall of Boulder Canyon, and along eastern margin of Bozarth Mesa, Bagdad area, Yavapai County.

Wilderness Stage

Middle Ordovician (Mohawkian): North America.

G. A. Cooper, 1956, Smithsonian Misc. Colln., v. 127, pt. 1, p. 8–9, chart 1 (facing p. 130). Mohawkian series divided into five stages (ascending): Whiterock, Marmor, Ashby, Porterfield, and Wilderness. Wilderness stage includes old Black River stage plus the Rockland and their equivalents. Older than Trenton stage. Name credited to G. A. Cooper and B. N. Cooper.

Marshall Kay, 1958, Am. Jour. Sci., v. 256, no. 2, p. 94. Pre-Trentonian part constitutes upper part of type Bolarian series.

Named from Wilderness Trail (U.S. Highway 58) that parallels Cumberland Front in western Virginia. Rocks deposited during this stage well exposed for several miles east of Cumberland Gap and are revealed in their entirety along the railroad at the switch near Hagan, Rose Hill quadrangle, Virginia.

Wildhorse Dolomite Member or Bed (in Barnsdall Formation)

Wildhorse Limestone (in Nelagoney Formation)[1]

Pennsylvanian (Missouri Series): Central northern Oklahoma.

Original reference: F. C. Greene, 1918, Am. Assoc. Petroleum Geologists Bull., v. 2, p. 121–122.

M. C. Oakes, 1951, Tulsa Geol. Soc. Digest, v. 19, p. 120. Rank reduced to bed in unnamed shale member of Barnsdall formation (new).

P. B. Greig, 1959, Oklahoma Geol. Survey Bull. 83, p. 19. Wildhorse dolomite member, which occurs near top of Barnsdall in southern Osage County, is not found south of Arkansas River.

First described in Osage County.

Wildhorse Formation[1]

Pleistocene: Southeastern Oregon.

Original reference: W. D. Smith, 1926, Oregon Univ. Commonwealth Rev., v. 8, p. 207–214.

Typically exposed in Kieger and Wildhorse Canyons, Harney County.

Wildhorse Member (of Muldoon Formation)

[Upper Mississippian or Pennsylvanian]: Central and eastern Idaho.

M. R. Thomasson, 1959, Dissert. Abs., v. 20, no. 3, p. 999. Overlies Iron Mine member (new); underlies Wood River formation.

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

Wildhorse Sandstone[1]

Permian: Central southern Oklahoma.

Original reference: E. R. Brockway and H. J. Owens, 1923, Oklahoma Univ. Bull., new ser., no. 271, p. 95–96.

C. C. Branson, 1957, Oklahoma Geology Notes, v. 17, no. 11, p. 108. Abandoned by Oklahoma Geological Survey. Name preoccupied.

Exposed along Wildhorse Creek, Garvin and Carter Counties.

Wildhorse Canyon Series

Precambrian: Southwestern Utah.

K. C. Condie, 1959, The Compass, v. 36, no. 3, p. 184, 185, 186, 187. Comprised of ptygmatically folded gneisses and schists. Enclosed within Mineral Range pluton. Early Precambrian in age.

Crops out on west side of Mineral Range from Ranch Canyon on the south to contact of the pluton on the north; in Beaver and Millard Counties.

Wildhorse Mountain Formation (in Jackfork Group)

Upper Mississippian: Southeastern Oklahoma.

B. H. Harlton, 1938, Am. Assoc. Petroleum Geologists Bull., v. 22, no. 7, p. 854 (fig. 1), 856–857, 878–880. Proposed for lowermost formation of group. Consists of massive basal sandstone, which is commonly succeeded by thin-bedded sandstones and intercalated shales, and massive sandstone about 60 feet thick at top. Thickness varies from east to west; approximately 3,600 feet at type locality (in Tuskahoma syncline); about 1,000 feet in Round Prairie syncline in Tps. 1 and 2 S., R. 12 E. Underlies Prairie Mountain formation (new); overlies Chickasaw Creek siliceous shale (new) of Stanley group. Pushmataha series.

L. M. Cline, 1956, Tulsa Geol. Soc. Digest, v. 24, p. 101, 102. Restudy of type sections of Jackfork formation 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 type Prairie Mountain includes type locality of Prairie Hollow maroon shale member but it has been found that the Prairie Hollow also occurs in midst of Wildhorse Mountain type section; stratigraphic overlap amounts to about 3,600 feet.

L. M. Cline, 1960, Oklahoma Geol. Survey Bull. 85, p. 47–51. Redefined to include Prairie Hollow shale member.

Type locality: Wildhorse Mountain, north of town of Moyers, in T. 2 S., R. 16 E., Pushmataha County.

**Wildie Sandstone Member** (of Warsaw Formation)[1]

Upper Mississippian: Southeastern Kentucky.

Original reference: Charles Butts, 1922, Kentucky Geol. Survey, ser. 6, v. 7, p. 89, 102.

P. B. Stockdale, 1939, Geol. Soc. America Spec. Paper 22, p. 215, 229. Unit termed Wildie sandstone member of Warsaw formation is here included in Wildie siltstone member (new) of Muldraugh formation (new).

Well exposed in vicinity of Wildie, Rockcastle County.

Wildie Siltstone Member (of Muldraugh Formation)

Lower Mississippian: Southeastern Kentucky.

P. B. Stockdale, 1939, Geol. Soc. America Spec. Paper 22, p. 215–216, pls. 6, 15. Name applied to rock unit bounded by two well-marked glauconitic silt horizons, irrespective of number or thickness of individual siltstone beds or relative proportions of interval filled by siltstone or silty shale. Thickness 20 to 30 feet; at type locality about 27 feet. In vicinity of type locality, consists mostly of bedded fairly resistant siltstone, with subordinate amount of shale. Included in Hummel facies (new) at base of formation; underlies unnamed silty yellow limestone; overlies Floyds Knob formation. As defined, includes unit termed Wildie sandstone member of Warsaw formation by Butts (1922).

Type locality: Sec. 36, at quarry of A. G. Carter Stone Works, Hummel post office, east of south end of abandoned tunnel of Louisville and Nashville Railroad, 1¾ miles south-southeast of Wildie, Rockcastle County. This is abandoned quarry of old Kentucky Freestone Co.

Wildrose Formation[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 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 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.

Wildwood Limestone[1]

Permian: Northern California.

Original reference: J. P. Smith, 1910, Jour. Geology, v. 18, p. 218, chart facing p. 217.

Named for Wildwood (Landis' Ranch), on Hay Fork, Trinity County.

**Wiles Limestone Member** (of Graford Formation)[1]

Wiles Limestone (in Whitt Group)

Wiles Limestone Member (of Palo Pinto Formation)

Upper Pennsylvanian: Central northern Texas.

Original reference: C. E. Dobbin, 1922, U.S. Geol. Survey Bull. 736-C, p. 60.

M. G. Cheney, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 1, p. 66 (fig. 1). Reallocated to member status in Palo Pinto formation (redefined). Overlies Wynn limestone member (new); underlies Adams Branch formation.

C. E. Davis, 1956, *in* North Texas Geol. Soc. Guidebook, May 25–26, p. [6]. Shown on columnar section as uppermost formation in Whitt group. Stratigraphically above Palo Pinto limestone and below Wolf Mountain shales in Graford group.

Named for exposures near Wiles, Stephen County.

Wiley 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), 62, pl. 1. Assigned member status in Spoon formation (new). Occurs below Greenbush coal member and above Seahorne limestone member. Thickness 10 inches in type section of formation. Coal named by Wanless (1931, Illinois Geol. Survey Bull. 60). Presentation of new rock-stratigraphic classification of Pennsylvanian strata in Illinois.

Type locality: SW¼NW¼ sec. 16, T. 7 N., R. 2 E., Fulton County. Near Wiley School.

Wiley cyclothem (in Spoon Formation)

Wiley cyclothem[1] (in Tradewater Group)

Pennsylvanian: Western Illinois and eastern Iowa.

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. Geographically extended into Iowa.

H. R. Wanless, 1957, Illinois Geol. Survey Bull. 82, p. 50 (fig. 22), 63, 79–81. Normally thinnest cyclothem in area—about 4 inches to 4½ feet thick. Underlies Greenbush cyclothem; overlies Seahorne cyclothem. Gives type exposure.

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 53 (table 2), 56 (table 3), pl. 1. In Spoon formation (new). Above Seahorne cyclothem and below Greenbush cyclothem. Presentation of new rock-stratigraphic classification of Pennsylvanian in Illinois; cyclical classification is independent of rock-stratigraphic classification.

Type exposure south bank of ravine, near westline of SW¼SW¼ sec. 16, T. 7 N., R. 2 E., Avon quadrangle, Fulton County, Ill.

Wiley dolomite[1]

Carboniferous: Texas.

Original reference: C. R. Keyes, 1933, Pan-Am. Geologist, v. 59, no. 2, p. 136.

Wiley Mountains east of Van Horn, Culberson County.

†Wileys Landing Bed[1]

Miocene, lower: Southwestern Georgia and northern Florida.

Original reference: A. F. Foerste, 1894, Am. Jour. Sci., 3d v. 48, p. 50–51.

Named for exposures at Wiley's Landing, on Flint River, in Decatur County, Ga.

Wilgus Clay[1] (in Conemaugh Formation)

Wilgus underclay member

Pennsylvanian (Conemaugh Series): Southeastern Ohio.

[Original reference:] Wilber Stout and R. E. Lamborn, 1924, Ohio Geol. Survey, 4th ser., Bull. 28, p. 334–335.

N. K. Flint, 1951, Ohio Geol. Survey, 4th ser., Bull. 48, p. 65. Included in Wilgus cyclothem, Conemaugh series. Clay not present in area of this report, Perry County.

M. T. Sturgeon and others, 1958, Ohio Geol. Survey Bull. 57, p. 95 (table 11), 116. Wilgus underclay member noted in discussion of Wilgus cyclothem in Athens County. Thickness about 1¾ feet.

Named for its association with Wilgus coal which is well developed near Wilgus, Lawrence County. Wilgus coal named by D. D. Condit (1912, Ohio Geol. Survey, 4th ser., Bull. 17).

Wilgus 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. 65–66, table 1, geol. map. Includes (ascending) Buffalo shale, 33 feet; Wilgus clay and Wilgus coal (both absent in Perry County); and Cambridge limestone. Occurs below Anderson cyclothem and above Brush Creek cyclothem. In area of this report, Conemaugh series is described on 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), 113–118. In Athens County, includes (ascending) Buffalo shale and (or) sandstone, Meyersdale redbed, Wilgus underclay and coal, and Cambridge limestone members. Overlies Upper Brush Creek cyclothem; underlies Anderson cyclothem. Conemaugh series.

Wilgus coal was named by Condit (1912, Ohio Geol. Survey, 4th ser., Bull. 17) for occurrence near Wilgus, Lawrence County.

**Wilhite Formation** (in Walden Creek Group)

Wilhite Slate[1]

Precambrian (Ocoee Series): Eastern Tennessee, northwestern Georgia, and western North Carolina.

Original reference: C. D. Walcott, 1894, Geol. Soc. America Bull., v. 5, p. 196–198.

A. S. Furcron, K. H. Teague, and J. L. Calver, 1947, Georgia Geol. Survey Bull. 53, p. 21–22, pl. 1. Wilhite slate mapped in Chatsworth talc district, Murray County. Wilhite of this area does not seem to correspond entirely to description of Wilhite to north; thus its age is open to question. Mapped separately from Ocoee rocks as it does not appear to belong to that series lithologically.

John Rodgers, 1953, Tennessee Div. Geology Bull. 58, pt. 2, p. 29. Wilhite slate, as used by Keith (1895, U.S. Geol. Survey Geol. Atlas, Folio 16) is considered synonym of Sandsuck shale.

P. B. King and others, 1958, Geol. Soc. America Bull., v. 69, no. 8, p. 955 (table 1), 962, 963. Redefined as formation in Walden Creek group (new). Near type locality, divisible into two members (ascending) Dixon Mountain and Yellow Breeches (both new). Combined thickness of members at type locality about 3,500 feet. Overlies Shields formation (new); underlies Sandsuck formation.

Type locality: Wilhite Creek, Sevier County, Tenn.

**Wilkes Formation**

Miocene, 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. Older than Logan Hill formation. Name credited to A. E. Roberts (in press).

A. E. Roberts, 1958, U.S. Geol. Survey Bull. 1062, p. 12 (chart), 34-37, pl. 1. Name designates sequence of fluvial, lacustrine, and brackish-water deposits consisting of more than 760 feet of semiconsolidated claystone, siltstone, sandstone, and conglomerate. Contains fossil wood. Unconformably underlies Logan Hill formation; overlies middle(?) Miocene volcanic sequence and in some areas unconformably overlies Toutle formation.

Type area: Section measured from new roadcuts along State Highway 1-Q in secs. 20 and 29, T. 11 N., R. 1 E., and secs. 3 and 10, T. 10 N., R. 1 E., in Wilkes Hills, Toledo-Castle Rock district.

Wilkeson [coal] series[1]

Eocene: Western central Washington.

Original reference: B. Willis, 1886, U.S. 10th Census, v. 15, pls. 81, 84.

Puget Sound region.

**Wilkeson Formation** (in Puget Group)[1]

Eocene: Western Washington.

Original reference: Bailey Willis, 1898, U.S. Geol. Survey 18th Ann. Rept., pt. 3, p. 400-436.

C. E. Weaver, 1937, Washington [State] Univ. Pubs. in Geology, v. 4, p. 55, 63, 65. Middle formation of group in Carbon River area. Lies stratigraphically below Burnett formation on South Prairie Creek and is approximately 1,000 feet thick. Overlies Carbonado formation. Formations in Carbon Canyon have been folded into anticlines and synclines with general northwesterly trend.

Typical occurrence upon the eastern dip, either in quarries along South Prairie Creek, east of Burnett or in bluffs a quarter mile east of Wilkeson, Pierce County, on north side of valley.

**Wilkins Peak Member** (of Green River Formation)

Eocene, lower and middle: Southwestern Wyoming.

W. H. Bradley, 1959, Am. Assoc. Petroleum Geologists Bull., v. 43, no. 5, p. 1073-1074. Name applied to beds in Bridger basin formerly thought to be Laney shale member of Schultz (1920). Thickness about 900 feet at type locality. Overlies Tipton shale member along eastern side of Bridger basin; does not crop out on west side of basin. Everywhere underlies Laney shale member.

Type locality: Wilkins Peak, T. 18 N., R. 106 W., Sweetwater County.

Wilkinson Creek Member (of Fleming Formation)

Probably lapsus for Williamson Creek Member (of Fleming Formation).

Willamette Group[1]

Miocene: Northwestern Oregon.

Original reference: T. Condon, 1902, The Two Islands: Portland, Oreg., The J. K. Gill Co.

Named for Willamette region.

**Willamette Silt**

Pleistocene: Western Oregon.

R. C. Treasher, 1942, Geologic map of Portland area, Oregon (1:96,000): Oregon Dept. Geology and Mineral Resources. Referred to as Willamette terrace deposits occurring along Willamette River at elevations from 100 to 250 feet. Thickness probably as much as 150 feet.

I. S. Allison, 1953, Oregon Dept. Geology and Mineral Industries Bull. 37, p. 12–13. Name Willamette silts proposed for parallel to bedded sheets of silt and associated materials that cover the greater part of Willamette Valley lowland. At type section, silts are 9 to 13 feet thick and overlie deposits of Linn stage [Linn gravels].

E. M. Baldwin and others, 1955, U.S. Geol. Survey Oil and Gas Inv. Map OM–155. In McMinnville quadrangle, Willamette silt is approximately 75 feet thick and uniform in texture; bedding is not distinct but is shown by faint color changes. Top of silt deposits reaches altitude of 160 feet throughout Willamette Valley and thinner coverings along hill slopes reach altitude of 200 feet or more; above 200 feet silt is difficult to distinguish from weathered Tertiary formations and soil.

Type locality: On right bank of Willamette River at Irish bend in southwestern Linn County.

Willamettian 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. 836, 841 (table 1). Third of five glacial epochs in area. Occurs in interval between Bull Run epoch and Jeffersonian.

Willapa Clays

Pleistocene: Southwestern Washington.

S. L. Glover, 1941, Washington Div. Mines and Geology Bull. 24, p. 52–53. Term adopted to designate surficial materials that occur throughout much of southwestern Washington and which are abundant in Willapa Hills region. As used, term includes vast amounts of clays, clayey sand, and decomposed gravel that masks bedrock throughout large part of nonglaciated western Washington. Commonly clays are alluvial; lacustrine and marine beds occur near coast.

Name derived from Willapa, Pacific County.

**Willard Shale** (in Wabaunsee Group)[1]

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

Original reference: J. W. Beede, 1898, Kansas Acad. Sci. Trans., v. 15, p. 31.

R. C. Moore and M. R. Mudge, 1956, Am. Assoc. Petroleum Geologists Bull. 40, no. 9, 2274 (fig. 1), 2276. Underlies Zeandale formation (new); overlies Emporia limestone.

H. G. Hershey and others, 1960, Iowa Highway Research Board Bull. 15, p. 12, fig. 5. Shale, gray at top, maroon near center, and black at base. Thin argillaceous limestone present about 3 feet below top. Thickness 9½ feet. Underlies Tarkio limestone; overlies Elmont limestone. Wabaunsee group.

Named for exposures south of Willard, Shawnee County, Kans.

William Henry Bay Marble

Lower Paleozoic: Southeastern Alaska.

E. C. Robertson, 1955, Geol. Soc. America Bull., v. 66, no. 10, p. 1309. White medium-grained rock. Age tentatively set as early Paleozoic.

In small inlet of same name, off Lynn Canal and about 20 miles south of Haines.

**Williams 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 520 feet. Comprises two sandstone members (ascending) Schulz and Pleasants. Unconformably underlies Eocene Martinez(?); unconformably overlies Ladd formation (new).

W. P. Popenoe, 1942, Am. Assoc. Petroleum Geologists Bull., v. 26, no. 2, p. 166, 168 (fig. 2), 173. Type locality and derivation of name given.

W. P. Woodring and W. P. Popenoe, 1945, U.S. Geol. Survey Oil and Gas Inv. Prelim. Chart 12. In this report, name Schulz member has been altered to Schulz Ranch sandstone member of Williams formation. Underlies Silverado formation (new).

Type locality: Along Williams Canyon near its mouth. Formation forms summit of Cretaceous section of Santa Ana Mountains, Orange County.

Williams Member (of Deese Formation or Group)

Pennsylvanian (Des Moines Series): Central Oklahoma.

C. W. Tomlinson, 1937, Ardmore Geol. Soc. [Guidebook] Field Trip, Mar. 13, p. 1, geol. map. At type locality, includes 2 feet of impure silty fossiliferous limestone capping some 30 feet of more or less calcareous sandstones. At base of formation; underlies Natsy member (new). Name credited to Guthrey and Milner (unpub. map).

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), 35. Williams member, about 900 feet from top of Deese group, southeast of Ardmore includes 2 feet of impure silty limestone which caps some 30 feet of more or less calcareous sandstones and underlies 3 or 4 feet of calcareous shale. This is basal member of Harlton's West Arm formation, which extends upward to top of Deese group. Stratigraphically above Camp Ground member. About 300 feet below Natsy member.

Type locality: On former Williams Farm, now part of Lake Murray State Park, 100 yards north of CSL SE¼ sec. 17, T. 5 S., R. 2 E., Carter County.

Williams Brook Shale (in Ithaca Shale)

Williams Brook coquinite member[1] (of Ithaca facies subgroup)

Upper Devonian: South-central New York.

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

G. A. Cooper and others, 1942, Geol. Soc. America Bull., v. 53, no. 12, pt. 1, p. 1768, chart 4. Termed shale and included in Ithaca shale.

Wallace de Witt, Jr., and G. W. Colton, 1959, Am. Assoc. Petroleum Geologists Bull., v. 43, no. 12, p. 2824, 2827. At Williams Brook, about 1½ miles northwest of Ithaca, Williams Brook coquinite (Caster, 1933) is apparently at horizon of Crosby sandstone of Torrey (1932)—the horizon of Genundewa member of Genesee formation.

Occurs in Ithaca region.

**Williamsburg Granodiorite[1]**

Carboniferous(?): Central Massachusetts and north-central Connecticut.

Original references: B. K. Emerson, 1898, U.S. Geol. Survey Geol. Atlas, Folio 50; 1898, U.S. Geol. Survey Mon. 29, pl. 34.

M. E. Willard, 1951, Bedrock geology of the Mount Toby quadrangle, Massachusetts: U.S. Geol. Survey Geol. Quad. Map [GQ–8]. Restricted. Gneissic rocks which occur extensively north of town of Amherst, Mass., and which Emerson (1917, U.S. Geol. Survey Bull. 597) mapped as Williamsburg are here included in Amherst schist and Joshua schist (new).

M. E. Willard, 1956, U.S. Geol. Survey Geol. Quad. Map GQ–85. In Williamsburg quadrangle, only body which fits Emerson's (1917) description is that exposed east and north of Haydenville. Dikes and sills of equigranular medium-grained biotite-muscovite granodiorite are associated with pegmatite and pegmatitic alterations of country rock. All other exposures, including those in village of Williamstown, are of mixed type. Carboniferous(?).

Named for exposures at Williamsburg, Mass.

†Williamsburg Marl[1] or Pseudobuhr[1]

Eocene, lower: Eastern South Carolina.

Original reference: E. Sloan, 1908, South Carolina Geol. Survey, ser. 4, Bull. 2, p. 449, 451, 452.

Named for exposures in Williamsburg County, near Rhems, but more extensively as mantle covering ridge between Black River and Santee River, notably on scarp of swamp southwest of Gourdin Station and on crest of ridge, 3 miles north of Salters.

**Williams Canyon Limestone[1]**

Mississippian: Eastern Colorado.

Original reference: A. E. Brainerd, H. L. Baldwin, Jr., and I. A. Keyte, 1933, Am. Assoc. Petroleum Geologists Bull., v. 17, no. 4, p. 381–396.

J. C. Maher, 1950, U.S. Geol. Survey Oil and Gas Prelim. Chart 39; 1951, World Oil, v. 133 (Oct.), 89–91. Sequence of dolomite and limestone beds overlying Ordovician rocks and underlying Pennsylvanian rocks along Front Range has been divided in earlier reports into Williams Canyon limestone, considered Devonian in age, and Madison (or Leadville) limestone considered lower Mississippian. In this report, these beds are considered Mississippian (Meramec?). Commonly, a thin-bedded sequence of lavender- to purple-mottled, gray to buff, finely granular to finely crystalline limestone, dolomitic limestone, dolomite, and sandy dolomite with a few thin layers of pink to lavendar fine- to medium-grained sandstone; thin beds of tan limy to sandy shale and gray platy limy shale present near middle of formation at several places; very thin bed of maroon fine sandy shale containing dolomite pebbles present at base in Priest Canyon; pinkish-white chert nodules present locally. Thickness 16 to 53 feet. Underlies Hardscrabble limestone (new); overlies Fremont limestone; both contacts unconformable.

Typically exposed near Cave of Winds in Williams Canyon at Manitou, El Paso County.

**Williams Fork Formation** (in Mesaverde Group)[1]

Upper Cretaceous: Northwestern Colorado and northeastern Utah.

Original references: Named by E. T. Hancock, but publication of his report was delayed, so name first appeared in U.S. Geol. Survey Press Memo. 16037, Oct. 1, 1923, on map of Hamilton and Seeping Gulch domes and vicinity, Moffat County, Colo; also used by J. D. Sears but credited to Hancock, in U.S. Geol. Survey Bull. 751, 1924, p. 290.

E. T. Hancock and J. B. Eby, 1929, U.S. Geol. Survey Bull. 812–D, p. 203–208. In Meeker quadrangle, Colorado, includes Fairfield coal group, Goff coal group, Lion Canyon sandstone member, and Lion Canyon coal group. Overlies Iles formation; unconformably underlies Wasatch formation.

P. T. Walton, 1944, Geol. Soc. America Bull., v. 55, no. 1, p. 99 (table 2), 114–117. Geographically extended into Uinta Basin, Utah. Consists of buff, brown, and white sandstone, gray, pink, and brown shale, and coal beds. Includes more than type Williams Fork. Thickness as much as 2,614 feet. Overlies Rim Rock sandstone (new). Beginning at Asphalt Ridge and proceeding eastward, formation is successively overlain unconformably by Duchesne River, Green River, and Wasatch formations.

N. W. Bass, J. B. Eby, and M. R. Campbell, 1955, U.S. Geol. Survey Bull. 1027–D, p. 157–159, pl. 19. Includes all beds between top of Trout Creek limestone member of Iles formation and base of Lewis shale. Thickness 1,100 to about 2,000 feet. Includes lower unit about 1,000 feet thick, consisting chiefly of shale, thin sandstone beds, sandy shale, and several coal beds; Twentymile sandstone member, 100 to 200 feet thick; upper unit of interbedded sandstone, sandy shale, shale, sandstone, and coal beds.

Exposed on Williams Fork Mountain and along Williams Fork near its junction with Yampa River, Moffat County, Colo.

Williamson 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. 84, 165.

H. R. Wanless, 1939, Geol. Soc. America Spec. Paper 17, p. 108. Massive sandstone in Kanawha group.

Exposed on Williamson Creek at Williamson, Mingo County.

**Williamson Shale** (in Clinton Group)

Williamson Shale Member (of Clinton Formation)[1]

Middle Silurian: Central and western New York.

Original reference: J. M. Clarke, 1906, New York State Mus. 2d Rept. Dir. Sci. Div., 1905, p. 12.

Tracy Gillette, 1940, New York State Mus. Bull. 320, p. 16 (table 1), 71–79. Formation in Clinton group. Williamson shale described in Clyde and Sodus Bay quadrangles where it is lowest member of Upper Clinton group. Directly overlies Wolcott Furnace iron ore. Lower Sodus and Williamson are in contact at Rochester, but in area of this report the two are separated by upper Sodus shale, Wolcott limestone, and Wolcott Furnace iron ore. Underlies Irondequoit limestone. In Genesee Gorge, Hartnagel used term Williamson to include both the Williamson and Lower Sodus as used in this report.

Tracy Gillette, 1947, New York State Mus. Bull. 341, p. 13 (fig. 2), 15 (table 2), 79–84. Williamson shale enters Clinton section between Oak Orchard Creek in Orleans County and Genesee Gorge. In the gorge, formation is about 6 feet thick and is dark-green to black calcareous to slightly calcareous fissile graptolite-bearing shale. Upper part, which is predominantly dark green, contains a few limestones. The limestones are particularly evident near contact with Irondequoit. Unconformity at base of Williamson is of considerable magnitude; at Lakeport, the Williamson rests on the Sauquoit; overlaps westward progressively older formations, Wolcott Furnace iron ore, Wolcott limestone, and Lower Sodus shale. Williamson is westward equivalent of lower part of Willowvale shale of Oneida and Madison Counties.

Named for exposures at Williamson, Wayne County.

Williamson Creek Member (of Fleming Formation)

Miocene: Central Louisiana.

H. N. Fisk, 1940, Louisiana Dept. Conserv. Geol. Bull. 18, p. 118 (fig. 26), 161–164, geol. map. Consists of thick group of non-marine silts and silty clays, with incorporated sand lentils and local brackish-water clay tongues. Total thickness approximately 500 feet. Overlies Dough Hills member (new), and contact arbitrarily is placed in clayey-silt sequence where sand lentils begin to appear in abundance; underlies Castor Creek member (new), and contact is placed where sand lentils are replaced by silty clay sequence grading upward into calcareous clays.

Typically exposed in uplands within drainage area of Williamson Creek headwaters south of Dough Hills, Rapides Parish.

Williamsport Sandstone[1]

Upper Silurian (Cayugan): Northern West Virginia, western Maryland, and western Virginia.

Original reference: D. B. Reger, 1924, West Virginia Geol. Survey Rept. Mineral and Grant Counties, p. 395–398.

H. P. Woodward, 1941, West Virginia Geol. Survey, v. 14, p. 149–153. Term Williamsport sandstone, applied by Reger (1924) to this sandstone when it was considered to be subdivision of Bloomsburg shale, is herein redefined as formational name. As thus interpreted, Williamsport sandstone is basal member of Cayugan group. Its identity in eastern Silurian outcrops is obliterated by, or absorbed in, red nonmarine Bloomsburg facies. Near Cumberland, Md., includes near middle, Cedar Cliff limestone member (reallocated). Abruptly overlies calcareous shales of McKenzie formation; transition unto overlying Wills Creek limestone is normally sharp. At some localities in Virginia, contacts are gradational and the formation is more a zone of sandstones than a distinct siliceous body. Geographically extended into Maryland and Virginia.

Named for exposure on a short branch of Patterson Creek, 0.6 mile east of Williamsport, Grant County, W. Va., at point where private road turns northeast from main Williamsport-Moorefield Highway.

†Williamsport Sandstone[1]

Mississippian: Central western Indiana.

Original references: A. Winchell, 1870, Am. Philos. Soc. Proc., v. 11, p. 414–415; S. S. Gorby, 1886, Indiana Dept. Geology and Nat. History 15th Ann. Rept., p. 86.

Probably named for Williamsport, Warren County.

Williamstown Granite[1]

Devonian: Northeastern Vermont.

Original reference: E. J. Foyles and C. H. Richardson, 1929, Vermont State Geologist 16th Rept., table facing p. 288.

Probably named for Williamstown Township, or village within the township, northwestern part of Orange County.

Williamsville Dolomite Member (of Bertie Formation)

Williamsville Waterlime (in Bertie Group)

Williamsville Waterlime and Shale[1]

Upper Silurian: Western and central New York.

Original reference: G. H. Chadwick, 1919, *in* M. Y. Williams, Canada Geol. Survey Mem. 111, p. 85, 93.

D. W. Fisher and L. V. Rickard, 1953, New York State Mus. Circ. 36, p. 9, fig. 1. Rank reduced to member status at top of Bertie formation. Overlies unnamed middle member; underlies Cobleskill.

L. V. Rickard, 1955, New York State Geol. Assoc. Guidebook 27th Ann. Mtg., p. 7, 9. In central New York, considered upper member of Bertie formation. Overlies Forge Hollow member (new); underlies Cobleskill formation. Thickness 4 to 10 feet. Believed to be continuous with same unit in western New York. Cayugan series.

D. W. Fisher, 1959, New York State Mus. Sci. Service Geol. Survey Map and Chart Ser. 1. Williamsville waterlime is uppermost formation in Bertie group. Overlies Scajaquada shale or waterlime; underlies Akron dolomite. Fieldwork has not demonstrated lateral continuity of Williamsville and Oxbow dolomite (new) as shown on present chart. Thick glacial deposits conceal units in area where they may merge. For the present, distinct names are retained for western and central New York.

Probably named for exposures at Williamsville, Erie County.

**Williana Formation**

Williana member

Pleistocene: Central and southwestern Louisiana.

H. N. Fisk, 1938, Louisiana Dept. Conserv. Geol. Bull. 10, p. 78 (fig. 6), 155–157. 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. Williana member consists of three transitional phases: coarse phase with lenticular masses of sands and gravels, predominantly sandy phase with local lenses of gravels, and upper silty clay phase with local sand lenses. Thickness 50 to 95 feet. Unconformably overlies Vicksburg sediments.

H. N. Fisk, 1940, Louisiana Dept. Conserv. Geol. Bull. 18, p. 176–177, pl. 1. Rank raised to formation. Described in Rapides and Avoyelles Parishes where it overlies undifferentiated Fleming formation.

P. H. Jones *in* P. H. Jones, A. N. Turcan, Jr., and H. E. Skibitzke, 1954, Louisiana Dept. Conserv. Geol. Bull. 30, p. 57, 63–65. In southwestern Louisiana, overlies Pliocene Foley formation (new).

Well exposed along U.S. Highway 167 between Mosley Hill, 2 miles north of Williana and Bentley, Grant County.

**Willimantic Gneiss**[1]

Pre-Pennsylvanian: Eastern Connecticut.

Original reference: H. E. Gregory, 1906, Connecticut Geol. Nat. History Survey Bull. 6, p. 115, 140, 141, 142.

W. G. Foye, 1949, Connecticut Geol. Nat. History Survey Bull. 74, p. 51. Restricted; igneous part of Willimantic included in Monson gneiss.

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

U.S. Geological Survey currently designates the age of the Willimantic Gneiss as pre-Pennsylvanian on the basis of a study now in progress.

Crops out in and around Willimantic, Windham County.

Willis Coal Member (of Abbott Formation)

Pennsylvanian: Southern Illinois.

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 31, 44 (table 1), 62, pl. 1. Assigned to member status in Abbott formation (new). Occurs above Grindstaff sandstone member and below Finnie sandstone member. Thickness 2 to 4 inches at type section of Abbott. Coal named by Charles Butts (1925, Illinois Geol. Survey Bull. 47). Presentation of new rock-stratigraphic classification of Pennsylvanian strata in Illinois.

Type locality: SE¼SW¼ sec. 30, T. 10 S., R. 9 E., Gallatin County.

Willis Phyllite

Precambrian: Southwestern Virginia.

R. V. Dietrich, 1959, Virginia Polytech. Inst. Bull., Engineering Expt. Sta. Ser. 134, p. 74, 75, pl. 1. A highly crenulated garnet-bearing phyllite. Top of unit grades into Lynchburg formation through many hundred feet of alternating layers of phyllite like the Willis proper and layers of mica schist-gneiss indistinguishable from Lynchburg mica schist. (Lynchburg as used here may not be correlative of type locality Lynchburg). Base of Willis not recognized in Floyd County; phyllite unit may be wholly beneath the Lynchburg and may even represent a facies of Little River gneiss (new), or it may be wholly within the Lynchburg and therefore be a member of that formation. May be of same general age as some of rocks in Blue Ridge complex.

Named for the fact that it underlies Willis Ridge, Floyd County. It also is bedrock of two belts that trend east-northeast with their geographical centers on either side of Route 221 near Kings store.

**Willis Sand**[1]

Pliocene(?) : Southeastern Texas and southern Louisiana.

Original reference: J. Doering, 1935, Am. Assoc. Petroleum Geologists Bull., v. 19, no. 5, p. 644, 656, 660.

A. W. Weeks, 1945, Am. Assoc. Petroleum Geologists Bull., v. 29, no. 12, p. 1695 (fig. 1), 1702–1703. Discussed with Quaternary deposits of Texas Coastal Plain. Unconformably overlies sandstone and clay beds of Pliocene and upper Miocene age. Underlies terrace deposit herein named Gay Hill. Age of Willis not determined from fossil evidence but is here considered to be Pleistocene.

J. A. Doering, 1956, Am. Assoc. Petroleum Geologists Bull., v. 40, no. 8, p. 1822. Citronelle formation of south Mississippi and Alabama, which was considered to be, in part, a residual formation is now recognized to be equivalent of Willis formation of Texas and Louisiana. Name Citronelle has priority and is here used for combined Citronelle-Willis in newly proposed classification of Gulf Coast. Pleistocene.

Named for town of Willis, 10 miles north of Conroe, Montgomery County, Tex.

Williston Formation (in Ocala Group)

Williston Member (of Moodys Branch Formation)

Eocene: Western Florida.

R. O. Vernon, 1951, Florida Geol. Survey Bull. 33, p. 141–152. Upper member of formation. Overlies Inglis member (new). Two types of marine limestone predominate: cream-colored coquina of camerinids and miliolids loosely held in calcite paste, and cream to tan-colored detrital limestone composed of quantities of small foraminifers with minor percentages of echinoids, large foraminifers, Comatulid brachials, and mollusks loosely held by secondary calcite and calcite paste. Thickness 27 to 32 feet. Underlies Ocala limestone restricted.

H. S. Puri, 1953, (abs.) Jour. Sed. Petrology, v. 23, no. 2, p. 130; 1957, Florida Geol. Survey Bull. 38, p. 29–30. Rank raised to formation in Ocala group. Overlies Inglis formation; underlies Crystal River formation (new).

Type locality: Pit in SE¼NE¼ sec. 27, T. 12 S., R. 18 E., Levy County.

**Williston Limestone**[1]

Upper Cambrian: Northwestern Vermont.

Original reference: Arthur Keith, 1923, Am. Jour. Sci., 5th ser., v. 5, p. 117+.

Charles Schuchert, 1937, Geol. Soc. America Bull., v. 48, no. 7, p. 1078. Age designated Beekmantown, Upper Canadian series [Lower Ordovician].

Named for exposures in western part of Williston Township about 5 miles southeast of Burlington.

**Williwaw Cove Formation**

Tertiary or Quaternary: Southwestern Alaska.

G. L. Snyder, 1959, U.S. Geol. Survey Bull. 1028–H, p. 173–175, pl. 23. Thick sequence of andesite and bandaite flows with minor amounts of basalt and dacite flows and major amounts of pyrocalstic material. Dikes of andesite and basalt in some areas. Pyroclastic deposits occur in beds, 1 to 40 feet thick, interbedded with the flows. Vertical sea cliff exposures, as much as 550 feet high appear to represent a single flow. Forms base upon which all later volcanic deposits accumulated. Contact with younger rocks very irregular; locally has relief of several thousand feet. Probably late Tertiary or early Quaternary. Andesite adjacent to West Cove member (new) of Little Sitkin dacite (new) has been highly altered by fumarolic activity.

Named from exposures in sea cliffs on west side of Williwaw Cove, Little Sitkin Island, in Rat Islands group of Aleutian Islands.

**Willoughby Limestone**

Upper Silurian: Southeastern Alaska.

J. F. Seitz, 1959, U.S. Geol. Survey Bull. 1058–C, p. 71–72, pl. 6. Discussion of Geikie Inlet area, Glacier Bay. Limestone of Willoughby formation forms one isolated outcrop within area; relationship to other bedded rock in area not determined. In adjacent areas, Willoughby forms large conspicuous outcrops that reveal stratigraphic thickness of more than 5,000 feet.

Type locality and derivation of name not given.

Willow limestone[1]

Lower Ordovician: Eastern Nevada.

Original reference: C. R. Keyes, 1923, Pan-Am. Geologist, v. 40, p. 53; 1924, Pan-Am. Geologist, v. 41, p. 78.

Named for exposures on east flank of Egan Range along Willow Creek, Ely region.

†Willow Creek Beds[1]

Upper Cretaceous: Eastern Colorado.

Original reference: G. T. Eldridge, 1888, Colorado Sci. Soc. Proc., v. 3, pt. 1, p. 86–112.

Named for Willow Creek, in southern part of field, 1 to 3 miles southeast of mouth of Platte Canyon, where it is well exposed.

Willow Creek facies (of Flagstaff Formation)

Paleocene, upper: Central Utah.

W. N. Gilliland, 1951, Nebraska Univ. Studies, new ser., no. 8, p. 29–30, pl. 5 (fig. B). Consists of light-gray to white very dense limestone and gray conglomerate with limestone and quartzite pebbles. Minor amounts of red shale and siltstone also included. Thickness nearly 750 feet. Three units generally recognized (ascending): conglomerate, limestone, and conglomerate. Overlies Twist Gulch formation.

In prominent hogback located just south of Willow Creek, northeast of Redmond, Gunniston quadrangle.

**Willow Creek Formation[1]**

Upper Cretaceous and Paleocene: Southwestern Alberta, Canada, and northwestern Montana.

Original reference: G. M. Dawson, 1883, Canada Geol. Survey Rept. 1880–1882, p. 3B–6B.

R. W. Brown, 1949, Map showing Paleocene deposits of the Rocky Mountains and Plains (1:1,000,000): U.S. Geol. Survey. Paleocene.

W. A. Cobban, 1955, Billings Geol. Soc. Guidebook 6th Ann. Field Conf. p. 108 (fig. 1), 118. Discussion of Cretaceous rocks of northwestern

Montana. Willow Creek formation overlies St. Mary River formation. Present on northwest flank of Sweetgrass arch. Little is known concerning fossil record of formation in Montana. In Alberta, according to Tozer (1953, Alberta Soc. Petroleum Geologists Guidebook 3d Ann. Field Conf.), Cretaceous-Paleocene boundary falls within Willow Creek formation.

Type section: Willow Creek, west of Granum, Alberta, Canada.

**Willow Creek Rhyolite** (in Alboroto Group)

Willow Creek Rhyolite (in Potosi Volcanic Series)[1]

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.

Well exposed above Creede in canyons of Willow Creek.

Willow Lake Basalts[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. 686. Cenozoic.

Occur in Lassen National Park.

Willow Lake Norite

Lower Cretaceous(?): Northeastern Oregon.

W. H. Taubeneck, 1957, Geol. Soc. America Bull., v. 68, no. 2, p. 191–193, 235. Medium-grained rock with banding characterized by plagioclase and mafic minerals in alternating layers in which the direction of elongation of individual crystals is essentially at right angles to the banding. Intrudes Elkhorn Ridge argillite.

Well exposed along cirque walls east of Willow Lake, in Elkhorn Mountains [Grant County]. Forms part of Bald Mountain batholith.

Willow Point Limestone (in Palo Pinto Formation)[1]

Pennsylvanian: Central northern Texas.

Original reference: J. M. Armstrong, 1929, Texas Bur. Econ. Geology, geol. map.

Named for Willow Point in southwestern part of Wise County.

†Willow River Limestone[1]

Willow River Member (of Prairie du Chien Formation)

Lower Ordovician: Central western Wisconsin.

Original reference: L. C. Wooster, 1882, Geology of Wisconsin, v. 4, p. 106, 123–129.

L. A. Thomas and C. A. Balster, 1949, Iowa Acad. Sci. Proc., v. 56, p. 236 (table 1). In discussion of micropaleontological zones in Iowa, Willow River is shown as uppermost member of Prairie du Chien. Occurs above Root Valley member and below the St. Peter.

Named for exposures on Willow River, St. Croix County.

**Willow Spring Granodiorite**

Willow Spring Granite[1]

Upper Cretaceous or lower Tertiary: Central Arizona.

Original reference: F. L. Ransome, 1903, U.S. Geol. Survey Prof. Paper 12.

E. D. Wilson, 1952, Arizona Geol. Soc. Guidebook for field trip excursions in southern Arizona, p. 8 (table 3). Name appears on table as Willow Springs granodiorite. Age given as Laramide (Late Cretaceous to early Tertiary).

N. P. Peterson, 1952, Arizona Geol. Soc. Guidebook for field trip excursions in southern Arizona, p. 122 (fig. 43), 124. Age of granite given as Late Cretaceous or early Tertiary.

Exposed in Willow Spring Gulch, Globe quadrangle.

Willow Spring Member (of Cove Mountain Formation)

Tertiary: Southwestern Utah.

E. F. Cook, 1960, Utah Geol. and Mineralog. Survey Bull. 70, p. 18 (fig. 1). Volcanic sediments. Thickness 0 to 50 feet. Basal member of formation. Underlies Racer Canyon tuff member (new).

Occurs in Washington County.

**Willow Tank Formation**

Upper Cretaceous: Southeastern Nevada.

C. R. Longwell, 1949, Geol. Soc. America Bull., v. 60, no. 5, p. 929 (table 1), 931–932, figs. 2, 3, pl. 5. Coarse conglomerate at base ranging in thickness from few feet to maximum of 30 feet. Conglomerate succeeded rather abruptly by about 300 feet of fine-grained deposits, largely gray and buff clays interspersed with layers of tuffaceous sandstone. Clays distinctly bentonitic at several horizons. Underlies Baseline sandstone (new); overlies Aztec sandstone with slight angular unconformity. Previously part of Overton fanglomerate.

Section described was measured near Willow Tank, in Muddy Mountains, about 5 miles southwest of Overton, Clark County.

Willowvale Shale (in Clinton Group)

Middle Silurian: New York.

Tracy Gillette, 1940, New York State Mus. Bull. 320, p. 22 (fig. 6). Shown on cross section below Herkimer sandstone and above Sanquoit beds.

Tracy Gillette, 1947, New York State Mus. Bull. 341, p. 94–96, 99. Name introduced for those rocks which occupy position between Westmoreland (oolitic iron ore) and the Kirkland (red flux iron ore). At type locality, unit is about 22 feet thick and consists of uniform dark-gray to purple thin-bedded shale which is highly fossiliferous. In vicinity of Clinton, underlies Dawes sandstone (new). Between Clinton and Lakeport, the Willowvale merges with Irondequoit and Williamson formations.

Type locality: On small tributary flowing eastward into Sauquoit Creek at village of Willowvale, Oneida County.

**Wills Creek Shale (in Cayuga Group)**[1]

Wills Creek Limestone or Formation

Upper Silurian: Western Maryland, central Pennsylvania, western Virginia, and West Virginia.

Original reference: P. R. Uhler, 1905, Maryland Acad. Sci. Trans., v. 2, p. 20–25.

H. P. Woodward, 1941, West Virginia Geol. Survey, v. 14, p. 8, 175–207, measured sections. Wills Creek limestone described in West Virginia, where it is 54 to 458 feet thick. Underlies Tonoloway limestone. Overlies Williamsport sandstone—Bloomsburg facies. Cayugan series, Upper Silurian. This is "Rondout limestone" of earlier reports.

H. H. Arndt and others, 1959, Geol. Soc. America Guidebook Pittsburgh Mtg., p. 5, 20, 22. Thickness of formation in central Pennsylvania 400 to 650 feet. Underlies Tonoloway formation; overlies Bloomsburg formation. Silurian.

Named for exposures on Wills Creek at Cumberland, Md.

**Wills Point Formation** (in Midway Group)[1]

Paleocene: Eastern Texas and southern Arkansas.

Original reference: R. A. F. Penrose, Jr., 1890, Texas Geol. Survey 1st Ann. Rept., p. xliii, 17, 19.

C. W. Cooke and others, 1943, Geol. Soc. America Bull., v. 54, no. 11, chart 12. Shown on correlation chart as overlying Kincaid formation. Paleocene.

Mackenzie Gordon, Jr., J. I. Tracey, Jr., and M. W. Ellis, 1958, U.S. Geol. Survey Prof. Paper 299, p. 11 (fig. 2), 25–38, pls. "Basal or Wills Point clays" was name given by Penrose (1890) to lower Tertiary clay beds exposed in vicinity of Wills Point, Tex. Under this designation, Penrose included all beds above unconformity at top of Upper Cretaceous and below base of partly continental Sabine River strata (Wilcox). Harris (1896, Bulls. Am. Paleontology, v. 1, no. 4) noted that laminated blue and yellow clay beds exposed west of Wills Point are equivalent only to upper part of section that in Alabama was designed Midway series by Smith and Johnson (1887, U.S. Geol. Survey Bull. 43). Name Wills Point was dropped for sometime because it was considered synonymous with earlier name Midway. In 1930's name Wills Point was revived and redefined to apply only to upper part of Midway group that lies above top of Tehuacana member of Kincaid formation or its lateral equivalents in south-central to northeast Texas. In this part of Texas, the Kincaid is subdivided into (ascending) Mexia member and Kerens member containing Wortham aragonite lentil. Geographically extending into bauxite region, Arkansas [this report]. Formation is undifferentiated and consists of dark-bluish-gray to black silty clay with sideritic layers; a dark-gray calcareous mudstone containing marine microfossils at base. Thickness as much as 450 feet. Overlies Kincaid formation; underlies Berger formation (new). Paleocene.

Named for Wills Point, Van Zandt County, Tex.

**Willwood Formation**

Eocene, lower: Northern Wyoming.

H. E. Wood 2d and others, 1941, Geol. Soc. America Bull., v. 52, no. 1, p. 15, 37. Name to be proposed by Van Houten for the "Bighorn Wasatch".

F. B. Van Houten, 1944, Geol. Soc. America Bull., v. 55, no. 2, p. 178–191. Proposed for variegated shales and hornblende-bearing sandstones conformably overlying Polecat Bench formation near center of Big Horn basin, and truncating folds along western margin of area. Thickness about 2,500 feet. Oldest Willwood deposits yield mammals of Clark Fork fauna, and the youngest, Lost Cabin mammals. Underlies Tatman formation. Late Paleocene and early Eocene.

R. L. Hay, 1956, Am. Assoc. Petroleum Geologists Bull., v. 40, no. 8, p. 1871 (fig. 5), 1875 (fig. 8), 1878 (fig. 9), 1886–1888. Underlies Pitchfork formation (new). Lower Eocene.

Name derived from Willwood division of Shoshone Reclamation project in Park County, located between Shoshone River and northeastern slope of McCulloch Peaks.

†Wilmington Beds[1]

Eocene, upper, and Miocene, lower: Southeastern North Carolina.

Original reference: W. H. Dall, 1898, U.S. Geol. Survey 18th Ann. Rept., pt. 2, p. 344, chart facing p. 334.

Probably named for exposures at Wilmington, New Hanover County.

Wilmington Complex

Age not stated: Delaware, Maryland, and Pennsylvania.

R. F. Ward, 1959, Geol. Soc. America Bull., v. 70, no. 11, p. 1425–1458, pl. 1. Consists of banded gneiss comprising mafic bands of calcic plagioclase, hypersthene, augite, and commonly hornblende and thick felsic bands of quartz and andesine with minor pyroxene; in central part, gneiss has been invaded by granite [Arden] consisting of orthoclase, oligoclase-andesine, biotite, and pyroxene; to the southwest, banded gneiss grades into amphibolites. Veins of granite, apparently related to Port Deposit granodiorite, intrude southwestern part of complex; coarse-grained undeformed gabbro stock intrudes gneiss north of Wilmington; similar body of gabbro occurs as group of low hills surrounded by Coastal Plain sediments. Complex is bordered by Wissahickon formation (lower Paleozoic?) and Port Deposit granite; southern edge of complex is covered by Coastal Plain sediments.

Occupies about 100 square miles in Delaware and adjacent Pennsylvania and Maryland.

Wilmington Group[1]

Pleistocene, late: Southern California.

Original reference: R. T. Hill, 1929, Science, new ser., v. 69, p. 379–380.

Derivation of name not stated.

Wilmington Limestone[1]

Upper Ordovician (Richmond): Northeastern Illinois.

Original reference: J. R. C. Evans, 1926, Chicago Univ. Abs. Theses, Sci. ser., v. 2, p. 199–200.

Type locality not stated.

†Wilmore Limestone[1]

Middle Ordovician (Trenton): Central Kentucky.

Original reference: J. M. Nickles, 1905, Kentucky Geol. Survey Bull. 5, p. 15.

Named for exposures at Wilmore, Jessamine County.

**Wilmore Sandstone Member** (of Conemaugh Formation)[1]

Upper Pennsylvanian: Western Pennsylvania.

Original reference: C. Butts, 1905, U.S. Geol. Survey Geol. Atlas, Folio 133.

Exposed at top of first railroad cut west of Wilmore, on hillside west of Wilmore, about 3 miles southwest of Wilmore, Cambria County, and at other places.

Wilson Diorite or Quartz Diorite

*See* Mount Wilson Quartz Diorite.

†Wilson Formation[1]

Pennsylvanian: Southeastern Kansas and northeastern Oklahoma.

Original reference: F. C. Schrader and E. Haworth, 1905, U.S. Geol. Survey Bull. 260, p. 447.

U.S. Geological Survey has abandoned the term Wilson formation by the acceptance of its members or their successors as formations. Northward from Wilson County, they are included in Lansing group and upper part of Kansas City group.

Named for Wilson County, Kans.

Wilson Creek Member (of Wood River Formation)

Permian (Wolfcampian): Central and eastern Idaho.

M. R. Thomasson, 1959, Dissert, Abs., v. 20, no. 3, p. 999. Youngest member of formation. Overlies Lake Creek member (new).

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

Wilson Ranch Beds[1]

Pliocene: Western California.

Original reference: V. C. Osmont, 1904, California Univ. Pub., Dept. Geol. Bull., v. 4, p. 74.

Probably named for exposures on a ranch in Sonoma County.

†Wilton Formation[1]

Precambrian(?): Southwestern Connecticut.

Original reference: J. G. Percival, 1842, Connecticut Geol. Survey Repts., p. 51–53, 63, map.

Covers large part of Wilton, Fairfield County.

Wimer Beds[1]

Miocene, upper: Northwestern California.

Original reference: J. S. Diller, 1902, U.S. Geol. Survey Bull. 196, p. 32–35, 47.

F. W. Cater, Jr., and F. G. Wells, 1953, U.S. Geol. Survey Bull. 995–C, p. 104. Described in Gasquet quadrangle as marine beds consisting of friable yellow shale and siltstone that weather red. Exposed at an altitude of 2,000 feet along Big Flat-Bear Basin Road just north of French Flat and at an altitude of 2,200 feet on Lower Coon Mountain.

Well exposed along old Wymer (Wimer) stage road, in sec. 20, about 13 miles northeast of Crescent City, Del Norte County.

Wimer School Limestone Member (of Labette Shale)

Pennsylvanian (Des Moines): Northeastern Oklahoma.

C. M. Cade 3d, 1953, Tulsa Geol. Soc. Digest, v. 21, p. 132 (fig. 2), 138–139. Persistent limestone in upper part of Labette. Compact massive lithographic limestone, very fossiliferous; dark gray to yellow brown, weathering to light yellow. Thickness 2 feet. Overlies greenish-yellow calcareous shale; separated from overlying Anna shale by shale interval of varying thickness.

Type locality: On north side of Oklahoma Highway 10, one-quarter mile west of SW cor. sec. 19, T. 28 N., R. 18 E., [Craig County]. This locality is three-quarters mile west of Wimer School.

Wimsattville Formation

Tertiary, lower: 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. Basin-filling gravel and sand. Thickness about 1,000 feet. Unconformably underlies Rubio Peak formation (new); unconformably overlies unnamed andesite breccia.

Restricted to Wimsattville basin, Santa Rita quadrangle.

**Winchell Limestone** (in Canyon Group)

Winchell Formation (in Graford Group)

Winchell Member (of Graford Formation)[1]

Upper Pennsylvanian: Central northern Texas.

C. O. Nickell, 1938, Texas Univ. Bur. Econ. Geology Pub. 3801, p. 97, 104–107. Name Winchell member of Graford formation is applied to group of thin limestones separated by thick shale beds and thin sandstones in Winchell area, Brown County, which to the west develop into conspicuous limestone bed, as recorded by well logs in central Coleman County. This group of limestones includes Clear Creek limestone of Drake (1893) and of Plummer and Moore (1921, Texas Univ Bull. 2132), plus some higher beds heretofore included in Placid shale member of Plummer and Moore (1921). Thickness 50 to 72 feet. Overlies Cedarton shale member.

M. G. Cheney, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 1, p. 66 (fig. 1), 88. Rank raised to formation in Graford group. Overlies Cedarton shale; underlies Placid shale of Brad group.

D. H. Eargle, 1958, San Angelo Geol. Soc. Guidebook Apr. 17–19, p. 51; 1960, U.S. Geol. Survey Prof. Paper 315–D, p. 65–66. Shown on composite stratigraphic section of Brown and Coleman Counties as Winchell limestone in Canyon group. Underlies Placid shale member of Brad formation; overlies Cedarton shale member of Graford formation. Consists of lower unnamed limestone, light olive gray to dark yellowish brown, containing brachiopods; shale, olive gray to greenish gray to yellowish-brown and grayish-red, that contains beds of fine sand and conglomerate-filled channels which have removed lower limestone locally; upper unnamed limestone, upper part of which is light gray, thick bedded, and contains brachiopods and crinoids, lower part of olive gray, thick bedded, fine grained, and separated from upper part by shale traceable across Brown County. Thickness about 100 feet.

Named for occurrence near Winchell, Brown County.

**Winchester Limestone**[1]

Middle and Upper Ordovician: Central Kentucky.

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

Named for Winchester, Clark County.

**Windfall Formation**

Upper Cambrian: Central Nevada.

T. B. Nolan, C. W. Merriam, and J. S. Williams, 1956, U.S. Geol. Survey Prof. Paper 276, p. 19–20, pl. 2. Proposed for rocks of Cambrian age at Eureka between Dunderberg shale below and Pogonip group, as restricted above. Formation in Windfall Canyon is close to 650 feet thick, and this figure appears to be approximately correct for whole area of outcrop. At Eureka, divided into two limestone members (ascending) Catlin and Bullwhacker (both new).

J. C. Young, 1960, Intermountain Assoc. Petroleum Geologists Guidebook 11th Ann. Field Conf., p. 161. In Ely district, includes Barton Canyon member (new).

Type locality: Windfall Canyon, just north of old Windfall mine, Eureka mining district, Eureka County.

**Windham Sand**

Pleistocene (Wisconsin): Northeastern Ohio.

G. W. White, 1960, U.S. Geol. Survey Bull. 1121–A, p. 2 (table 1), 3 (fig. 1), 7–8. Medium-grained outwash sand. Commonly 4 to 6 feet thick; in depression on pre-Windham surface, it is 30 feet or more thick as shown by well records. Unconformably overlies Kent till; underlies Hiram till. Associated with buried Lavery till.

Type section: Sand pit of Miller-Dutter Sand and Gravel Co., 2 miles northeast of village of Windham, 1 mile east of east line of Windham Township and 1½ miles south of north line of township, one-quarter mile south of Erie Railroad and 100 yards south of Garrettsville-Warren Road, Windham Township, Portage County.

Windom 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.

Named for extensive occurrence northeast of village of Windom, McPherson County.

**Windom Member** (of Moscow Shale)

Windom Shale[1]

Middle Devonian: Western New York and eastern Pennsylvania.

Original reference: A. W. Grabau, 1917, Geol. Soc. America Bull., v. 28, p. 946.

Bradford Willard, 1937, Am. Jour. Sci., 5th, v. 33, no. 196, p. 276. Table of Hamilton correlations in Maryland, Pennsylvania, and New York shows Windom member present in eastern Pennsylvania.

R. G. Sutton, 1951, Rochester Acad. Sci. Proc., nos. 5–6, p. 337–379, pl. 1. In Batavia quadrangle, underlies Leicester marcasite member (new). Overlies Kashong shale member.

Wallace de Witt, Jr., 1956, U.S. Geol. Survey Geol. Quad. Map GQ–96. Member described in Eden quadrangle where it is 11½ to 15½ feet thick. Overlies Tichenor limestone member of Ludlowville shale; underlies Genundewa limestone lentil of Geneseo shale.

Named for exposures near village of Windom, Erie County, N.Y.

Windous Butte Tuff

Tertiary: Eastern Nevada.

E. F. Cook, 1960, Intermountain Assoc. Petroleum Geologists Guidebook 11th Ann. Field Conf., p. 139, 140 (fig. 4). Consists of lower member, 200 to 350 feet thick, of highly welded vitric-crystal ignimbrite, dark purplish gray and red brown with black glass zone near base, and upper member, 165 to 860 feet thick, of moderately welded crystal-vitric ignimbrite, pale purple to mottled pink and gray, prominent angular quartz. Occurs above Currant tuff and below Needles Range formation. Has K-A age of 34 million years.

Present in Grant Range.

**Wind River Formation**[1]

Eocene, lower: Western Wyoming.

Original reference: F. T. Hayden, 1862, Am. Philos. Soc. Trans., new ser., v. 12, p. 125–127.

J. D. Love, 1939, Geol. Soc. America Spec. Paper 20, p. 63–66, pl. 17. Meek and Hayden (1862, Philadelphia Acad. Nat. Sci. Proc. 1861) were not sure of relationships of Wind River strata to others in region so they provisionally placed formation between Fort Union and White River groups. Granger (1910, Am. Mus. Nat. History Bull., v. 28, art. 21) described rocks of Bridger(?) and Uinta ages, between top of Wind River sequence and base of White River group on Beaver Divide, thus restricting usage of term Wind River to lower Eocene rocks. Wood (1934) gave name Green Cove formation to Bridger(?) beds described by Granger in Beaver Divide section. Sinclair and Granger (1911) divided lower Eocene strata of Wind River basin into Lysite and Lost Cabin "formations" on faunal basis. In present report [southern margin of Absaroka Range], Indian Mountain formation (new) is separated from lower part of original part of Wind River on the basis of both faunal and structural breaks, thus limiting usage of term Wind River to beds of upper lower Eocene age, between Indian Meadows formation and Green Cove or other middle Eocene formations in Wind River basin. As thus defined, the Wind River is a formation including only Lysite and Lost Cabin members or faunal zones. No definite structural break noticeable between two members and they are both lithologically and paleontologically so similar that they are not mappable units.

H. E. Wood 2d and others, 1941, Geol. Soc. America Bull., v. 52, no. 1, p. 24, 25, pl. 1. Includes Lysite and Lost Cabin members.

W. R. Keefer, 1956, Wyoming Geol. Assoc. Guidebook 11th Ann. Field Conf., p. 110 (fig. 1), 111–114. Described in northwestern part of Wind River basin where it is most widespread lithologic unit. Five sequences recognized: lower variegated sequence, greenish-gray and drab tuffaceous sequence, middle variegated sequence, conglomerate sequence, and upper variagated sequence. Lower three units are most widespread and are best exposed along east side of Bench Creek where they have composite thickness of 1,618 feet. Two upper units of Wind River as herein defined may be lateral equivalents of some parts of Aycross formation. Underlies Tepee Trail formation; overlies Indian Meadows formation.

H. A. Tourtelot, 1957, Smithsonian Misc. Colln., v. 134, pt. 1, no. 4, p. 4–5. Described in northeastern Wind River basin where it is divided into Lysite and Lost Cabin members, each of which consists of two facies. Underlies Tepee Trail formation.

Named for exposures in Wind River basin.

Windrock Sandstone[1]

Pennsylvanian: Northeastern Tennessee.

Original reference: L. C. Glenn, 1925, Tennessee Geol. Survey Bull. 33B, p. 327–328.

Exposed in cross-country sections from Windrock to American Knob, Morgan County.

**Windrow Formation**[1]

Cretaceous or Tertiary: Southwestern Wisconsin, northeastern Iowa, and southeastern Minnesota.

Original references: F. T. Thwaites and W. H. Twenhofel, 1920, Geol. Soc. America Bull., v. 31, p. 133; 1921, v. 32, p. 293–311.

C. R. Stauffer and G. A. Thiel, 1931, Minnesota Geol. Survey Bull. 29, p. 103–104. Name Windrow abandoned in southeastern Minnesota and sediments named Ostrander member of Dakota formation.

G. W. Andrews, 1958, Jour. Geology, v. 66, no. 6, p. 597–624. Here defined to include known deposits of upper Mississippi Valley which are in lithologic and mineralogic conformity with type section as described by Thwaites and Twenhofel (1921) and as described in this paper. Comprises Iron Hill member below and East Bluff member (both new). Underlain by rocks as old as Precambrian and as young as Devonian. Overlain by deposits as old as Nebraskan drift and as young as recent soil. Available evidence strongly suggests Cretaceous age.

Named for exposure on top of Window Bluff, near Tomah, Monroe County, Wis. Area of occurrence includes Driftless Area of Wisconsin, north of Wisconsin River and extends northward into older glaciated region of west-central Wisconsin; a part of glaciated region of southeastern Minnesota and northeastern Iowa.

**Windy Gap Limestone Member** (of Greene Formation)[1]

Permian: Southwestern Pennsylvania and northern West Virginia.

Original reference: I. C. White, 1891, U.S. Geol. Survey Bull. 65, p. 24, 30.

R. L. Nace and P. P. Bieber, 1958, West Virginia Geol. Survey Bull. 14, p. 17 (table 2). Listed in summary of stratigraphic sections of Dunkard group in Harrison County. Thickness 5 feet near top of Greene formation.

Thomas Arkle, Jr., 1959, Geol. Soc. America Guidebook Pittsburgh Mtg., p. 118 (table 2). Listed with members of Greene series. Occurs below Lower Proctor sandstone and above Windy Gap coal.

Named for Windy Gap, a divide separating Laurel Run branch of Fish Creek from waters of Wheeling Creek, in Springfield Township, Greene County, Pa.

**Windy Gulch Rhyolite Breccia** (in Potosi Volcanic Series)[1]

Miocene: Southwestern Colorado.

Original reference: W. H. Emmons and E. S. Larsen, 1923, U.S. Geol. Survey Bull. 718.

In drainage basin of Windy Gulch and to west in Creede district.

**Windy Point Granite**[1]

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, p. 43. Summit of Pikes Peak marks position of nearly vertical stock of coarsely porphyritic quartz monzonite of mineral belt associated with Laramide revolution. South of peak a linear series of outcrops of this granite, known as Windy Point granite, shows almost horizontal contacts with underlying and earlier Pikes Peak granite.

Forms summit of Pikes Peak, El Paso County.

Wineglass Welded Tuff

Wineglass Dacite Flow

Pleistocene to Recent: Southwestern Oregon.

J. S. Diller and A. B. Patton, 1902, U.S. Geol. Survey Prof. Paper 3, p. 37–38. Wineglass dacite flow lies in gap of Crater Lake rim southeast of Round Top. It is about 1 mile long, about 50 feet wide, and about 20 feet thick. Might be considered tuff were it not for stringers of black glass intermingled with reddish groundmass containing fragments of other material and imparting a decided fluidal structure to the mass. A small sheet of this tuffaceous dacite, 10 feet thick, occurs along western edge of Cloud Cap flow ( new) and closely resembles tuffaceous material of Redcloud Cliff. At the Wineglass slide it is immediately associated with pumiceous tuff. Hard rock of the rim is andesite, overlain by 15 feet of pumiceous tuff with 10 feet of red tuffaceous dacite. This is overlain by 30 feet of conglomerate and capped by fine layer of pumice 25 feet thick. Evident from this section that the fragmental dacite does not represent final eruption, for that finds expression in top layer of pumice. Gap west of Round Top contains small sheet of tuffaceous dacite like that on other side, but thicker. It is 50 feet thick in middle and tapers to thin edge on west. On east of Round Top it extends up slope a short distance, and is seen above glacial striae and is undoubtedly a post-Glacial flow. Mapped as tuffaceous dacite. Near Rugged Crest, overlaps Rugged Crest flow (new). [See Sun Creek Dacite Flow.]

Howel Williams, 1942, Carnegie Inst. Washington Pub. 540, p. 60–63, pl. 15 (fig. 1). Diller's Wineglass dacite flow or "tuffaceous dacite" named Wineglass welded tuff. At time Diller wrote, manner of deposition of such material was not known. Wineglass welded tuff is regarded as product of glowing avalanche. As the tuff and underlying lump pumice, in sections northwest of the Wineglass, are traced uphill toward Roundtop, the pumice thins to about 50 feet and the tuff to 10 feet, at the same time losing its welded character and merging into yellow, orange, or brown friable pumiceous lapilli tuff. If the tuff was once continuous over entire top of Roundtop lava (new), it has since been stripped away and is exposed only in the saddle-shaped depression over the center, where it is about 8 feet thick and is overlain by bouldery drift. In descent from Roundtop to shallow depression separating it from Palisades flow (new), the tuffaceous dacite thickens and becomes compact again and within short distance it shows same firmly welded appearance as displayed in brim of the Wineglass. In center of valley, it forms 30-foot cliff underlain by about 50 feet of incoherent white lump pumice. The two layers then continue westward over top of Palisades flow.

Beyond Palisade Point, on rise toward Rugged Crest, both pumice and welded tuff rest on margin of Cleetwood dacite. They are not present over center of Cleetwood lava. They are exposed along Rim Road, and here the tuff rests directly on crest of Cleetwood lava. South from the Wineglass, the dacite tuff extends to top of Skell Head, a distance of 2 miles, where it comes to an end. Deposit varies in thickness between 4 and 6 feet, reaching maximum of 12 feet at head of the "Champagne Glass," just before it comes to an end. Talus obscures relations at north edge of Redcloud lava (new). Presumably, the steep margin or Redcloud flow prevented tuff from spreading farther.

Type section: Forms brim of the Wineglass and the brick-red layer near top of the long slide above Grotto Cove near Crater Lake. Throughout most of its length of 4 miles, tuff makes a conspicuous cliff as much as 50 feet in height.

†Winfield dolomite[1]

Lower Ordovician: Central eastern Missouri and southwestern Illinois.

Original reference: C. R. Keyes, 1898, Iowa Acad. Sci. Proc., v. 5, p. 59, 60.

Named for Winfield County, Mo.

**Winfield Limestone** (in Chase Group)[1]

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

Original reference: C. S. Prosser, 1897, Kansas Univ. Geol. Survey, v. 2, p. 64–66.

J. M. Jewett, 1941, Kansas Geol. Survey Bull. 39, p. 82–88. Although name Winfield was applied because of exposures near Winfield in Cowley County, Prosser's original type exposure near Marion, in Marion County, should still be regarded as typical for formation. When formation was first named and when name was changed to Winfield, the formation included three members (ascending): Stovall limestone, Grant shale, and Cresswell limestone. Kansas Geological Survey now includes a fourth member, the Luta, above the Cresswell, Overlies Doyle shale; underlies Odell shale.

R. C. Moore and others, 1951, Kansas Geol. Survey Bull. 89, p. 41–44. Winfield comprises (ascending) Stovall limestone, Grant shale, and Cresswell limestone members. "Luta" limestone included in Cresswell. Thickness about 25 feet. Individual members not identified in southern Kansas.

P. B. Greig, 1959, Oklahoma Geol. Survey Bull. 83, p. 116–119. Winfield limestone is uppermost Permian unit exposed in Pawnee County. In the western part of county, red sandstones and shales of the Doyle are capped by about 7 feet of thin-bedded sandstone, which contains thin lenticular beds of light-colored nonfossiliferous calcareous sandstone and sandy limestone. This section has been correlated with and mapped as Winfield limestone. Possibility exists that Pawnee correlative of the Winfield is the brown fossiliferous limestone in upper part of Doyle. Southern extent of formation not known. Wolfcamp series.

Named for exposures around Winfield, Cowley County, Kans.

Wing Conglomerate[1]

Lower Ordovician (Beekmanstown): Northwestern Vermont.

Original reference: H. M. Seely, 1906, Vermont State Geologist 5th Rept., p. 174–187.

Champlain Valley.

**Wingate Sandstone** (in Glen Canyon Group)[1]

Upper Triassic: Western New Mexico, northeastern Arizona, southwestern and western Colorado, and southeastern Utah.

Original reference: C. E. Dutton, 1885, U.S. Geol. Survey 6th Ann. Rept., p. 136, pl. 16.

A. A. Baker, C. H. Dane, and J. B. Reeside, Jr., 1936, U.S. Geol. Survey Prof. Paper 183, p. 4–5, pls. Summary of results of fieldwork in eastern Utah and adjacent parts of Arizona, New Mexico, and Colorado and revision of interpretations and correlations of Jurassic formations in area. Wingate is basal unit of Glen Canyon group which is classified as Jurassic(?). The Wingate occurs in full development in southeastern Utah, northeastern Arizona, northwestern New Mexico, and apparently across north-central New Mexico. Extends eastward into Colorado but reaches mountains only in attenuated form. Northern boundary not known; probably not represented in Nugget sandstone of Wasatch Mountains. As much as 470 feet thick but in most of extent is about 300 feet. Underlies Kayenta formation; overlies Chinle formation.

R. L. Heaton, 1937, Am. Assoc. Petroleum Geologists Bull., v. 23, no. 8, p. 1153–1177. Results of study show that basal "Jurassic" of northern Colorado is probably part Entrada and partly Upper Triassic; that latter grades into redbeds southward and the former continues into New Mexico where it is identical with so-called Wingate. True Wingate of Zuni Mountains grades marginally into red beds and may be of Upper Triassic age.

A. A. Baker, C. H. Dane, and J. B. Reeside, Jr., 1947, Am. Assoc. Petroleum Geologists Bull., v. 31, no. 9, p. 1665, 1667–1668. Discussion of revised correlation of Jurassic formations in parts of Utah, Arizona, New Mexico, and Colorado and problems of stratigraphic nomenclature involved. Study indicates that Entrada sandstone extends into northeastern New Mexico, where it is the Jurassic sandstone that was designated by writers of present report and others as Wingate sandstone. Strict application of rules of priority would require that name Wingate sandstone be applied to unit heretofore called Entrada and that new name be applied to Wingate sandstone of Utah and adjacent regions. However, these names are well entrenched in literature and abandonment through principle of priority would be confusing. Therefore, name Entrada is extended to include sandstone at type locality of Wingate sandstone, and name Wingate is retained for sandstone forming lower part of Glen Canyon group, with understanding that original type locality of Wingate has been abandoned.

H. E. Gregory, 1950, U.S. Geol. Survey Prof. Paper 220, p. 49 (fig. 25), 51 (table), 76–79, pl. 2. Described in Zion Park region where it is best exposed in walls of Johnson, Hog, Kanab, Cottonwood, and Sand Canyons and in mesas and towers along southern edge of Wygaret Terrace. Forms band of massive crossbedded sandstone, gray, red, or tan, which lies between bedded red sandstones of Chinle below and Kayenta above. Thickness as much as 400 feet. Jurassic(?).

Paul Averitt and others, 1955, Am. Assoc. Petroleum Geologists Bull., v. 39, no. 12, p. 2521, 2523. Name Lamb Point tongue (new) of Navajo sandstone is applied to rocks in Kanab area formerly classified as Wingate by Gregory (1950). Unit mapped as Wingate sandstone by Wanek and Stephens (1953, U.S. Geol. Survey Oil and Gas Inv. Map OM–145) is here considered Springdale sandstone member of Moenave formation. Hence, name Wingate sandstone is eliminated in Kanab, Utah, area. Triassic age assigned to Wingate.

J. W. Harshbarger, C. A. Repenning, and J. H. Irwin, 1957, U.S. Geol. Survey Prof. Paper 291, p. 3 (fig. 2), 8–12, pl. 2. Dutton described Wingate from exposures in cliffs north of Fort Wingate, N. Mex. In his description he refers to limestone unit in the Chinle, since referred to as Chinle "B" by Gregory (1917, U.S. Geol. Survey Prof. Paper 93). Units Chinle "B" and Wingate stand out clearly in sketch included in Dutton's report. At point shown in sketch, unit described as Wingate is 658 feet thick. Of this thickness, basal 355 feet is composed of sedimentary rocks now considered to be Wingate sandstone, as recognized throughout northeastern Arizona, southeastern Utah, and Parts of western Colorado. Upper 303 feet of Dutton's type Wingate is now recognized as Entrada sandstone of San Rafael group (Baker, Dane, and Reeside, 1947). Wingate sandstone is here restricted to lower half of Dutton's type section. In Navajo country, Wingate comprises two mappable units herein named (ascending) Lukachukai and Rock Point members. At type locality underlies Entrada sandstone; in Arizona underlies Kayenta formation or Moenave formation. Upper Triassic.

Type locality: Cliffs north of Fort Wingate, N. Mex.

Winifrede Limestone (in Kanawha Formation[1] or Group)

Pennsylvanian: Southern West Virginia.

Original reference: R. V. Hennen, 1941, West Virginia Geol. Survey Rept. Kanawha County, p. xxvi, 641.

H. R. Wanless, 1939, Geol. Soc. America Spec. Paper 17, p. 108. Limestone in Kanawha group.

Exposed on South Hollow Branch of Fields Creek, south of Winifrede, Kanawha County.

Winifrede Sandstones (in Kanawha Formation[1] or Group)

Pennsylvanian: Southern West Virginia.

Original reference: I. C. White, 1908, West Virginia Geol. Survey, v. 2A, p. 271, 430.

H. R. Wanless, 1939, Geol. Soc. America Spec. Paper 17, p. 93, 106. Lower and Upper Winifrede sandstones included in Kanawha group.

Probably named for occurrence at Winifrede, Kanawha County.

Winifrede Underclay

Pennsylvanian (Pottsville Series): Southwestern West Virginia.

W. A. Tallon and R. G. Hunter, 1959, West Virginia Geol. and Econ. Survey Rept. Inv. 17, p. 17–18. Immediately underlies Winifrede coal. Where sampled in Kanawha County, clay is about 2 feet thick and is silty with small iron nodules.

Type locality and derivation of name not given.

Winkler Ford 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. 1581.

Crops out 0.1 mile south of northwest corner Elizabeth Aurand survey No. 1861, on road 1.2 mile southeast of that crossing on Concho River, Concho County.

Winklers Mill cyclothem

Permian: Western West Virginia.

A. T. Cross and M. P. Schemel, 1956, West Virginia Geol. Survey [Repts.], v. 22, pt. 1, p. 72 (fig. 1–61). Shown on geologic section above Washington cyclothem (new) and below unnamed cyclothem.

Present in Parkersburg quadrangle.

Winnebago Drift

Pleistocene (Wisconsinan): Northern Illinois.

J. C. Frye and H. B. Willman, 1960, Illinois Geol. Survey Circ. 285, p. 2 (fig. 1), 5. Named applied to rock-stratigraphic unit described by Shaffer (1956, Illinois Geol. Survey Rept. Inv. 198, p. 18–19) and assigned to Farmdale substage. Consists of till and outwash; occurs stratigraphically below loess below Shelbyville till and is younger than Sangamon soil. Assigned to Altonian substage (new).

Named for exposures in Winnebago County.

Winnebago Shale[1]

Winnebago Shale Member (of Burlingame Formation)

Pennsylvanian (Virgil Series): Southeastern Nebraska, southwestern Iowa, and northeastern Kansas.

Original reference: G. E. Condra, 1935, Nebraska Geol. Survey Paper 8, p. 5.

E. H. Wenberg, 1942, Iowa Acad. Sci. Proc., v. 49, p. 343 (fig. 6). Listed as Winnebago shale in insoluble residue correlations of Missouri and Virgil strata in Iowa.

G. E. Condra and E. C. Reed, 1943, Nebraska Geol. Survey Bull. 14, p. 45–46. In Nebraska, Burlingame limestone includes (ascending) Taylor Branch limestone, Winnebago shale, and South Fork limestone members.

Type locality: In Missouri River bluffs south of mouth of Winnebago Creek, north of Rulo, Richardson County, Nebr.

**Winnemucca 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]. Consists of shales and sandstones interbedded with dolomites and limestones. In Sonoma Range, lower part is shale or slate with numerous limestones and dolomite beds; sandstone prominent near top. In East Range, slate and quartzite, some limestone in upper part. Basal contact drawn at lowest prominent clastic bed. Thickness at type locality about 2,000 feet. In East Range, about 3,000 feet thick. Overlies Dun Glen formation (new) with local unconformity.

R. R. Compton, 1960, Geol. Soc. America Bull., v. 71, no. 9, p. 1387, pl. 1. In Santa Rosa Range, overlies Grass Valley formation and conformably underlies O'Neill formation (new). Thickness 600 to 1,500 feet. No persistent unit as calcareous as the Dun Glen formation occurs in Santa Rosa Range, but local thick lenses of limestone and dolomite indicate that the Winnemucca formation of Santa Rosa Range may connect laterally with both Winnemucca and Dun Glen formations of Winnemucca quadrangle.

Type locality: Mullen Canyon, west side of Sonoma Range, 8 miles south of Winnemucca, Winnemucca quadrangle.

Winneshiek limestone[1]

Lower Ordovician: Iowa.

Original reference: C. R. Keyes, 1934, Pan-Am. Geologist, v. 61, no. 3, p. 240.

†Winnfield Limestone[1]

Upper Cretaceous(?): Northwestern Louisiana.

Original reference: G. D. Harris and A. C. Veatch, 1899, Louisiana Geol. Survey Rept. 1899, pt. 5, p. 56–59.

Named for Winnfield, Winn County.

**Winnipeg Formation**

Winnipeg Sandstone[1]

Middle Ordovician: Surface and subsurface in Manitoba, and subsurface in Saskatchewan, Canada; and subsurface in Montana, North Dakota, and South Dakota.

Original references: D. B. Dowling, 1896, Ottawa Field Nat. Club Trans. 1895–1896, v. 11, p. 67–68; 1901, Canada Geol. Survey Ann. Rept. 11, p. 39F–46F.

H. D. Erickson, 1954, South Dakota Geol. Survey Rept. Inv. 74, p. 43–44. Name Winnipeg formation has only recently been introduced into South Dakota by oil geologists to correlate with wells drilled north of South Dakota. Name St. Peter sandstone had been used for the Winnipeg.

Georgia Macauley, 1955, Alberta Soc. Petroleum Geologists Jour., v. 5, no. 4, p. 49–52, 59. Winnipeg formation is herein defined as the shale and sandstone section which underlies the limestone of Red River formation and which rests upon Precambrian basement complex in Manitoba. In Saskatchewan and the Dakotas, formation is underlain by Cambrian sediments. No type outcrop section can be established because nowhere are both upper and lower contacts exposed in any one outcrop. , Section between 5,220 and 5,359 feet in California Standard No. 15–8 well, in Lsd. 15, sec. 18, T. 10, R. 27, West 1st Mer., could be designated as type well section, although Union Aanstad Stratigraphic Test No. 1, in sec. 29, T. 158 N., R. 62 W., North Dakota, was cored through much of the shale and sandstone, and if this core is available, may be a better type well section.

R. J. Ross, Jr., 1957, U.S. Geol. Survey Bull. 1021–M, p. 446 (fig. 68), 448–449, pl. 44. Discussion of Ordovician fossils from wells in Williston basin, eastern Montana. In subsurface, Winnipeg formation overlies Deadwood formation and underlies Red River formation of Bighorn group.

Named for exposures on islands and shores of south part of Lake Winnipeg, Manitoba, Canada.

**Winnipegosis Formation** (in Elk Point Group)

Winnipegosan Formation[1]

Middle Devonian: Surface and subsurface in Manitoba, Canada, and subsurface in northeastern Montana, western North Dakota, and northwestern South Dakota.

Original reference (Winnipegosan): J. B. Tyrrell, 1893, Canada Geol. Survey, new ser., v. 5, pt. 1, p. 144E–199E.

A. D. Baillie, 1953, Am. Assoc. Petroleum Geologists Bull., v. 37, no. 2, p. 444–447; 1953, Manitoba Dept. Mines and Nat. Resources Mines Br. Pub. 52–5, p. 19, 20–21, 22 (fig. 4), 24. Formation originally called Winnipegosan by Tyrrell (1892) [1893] but, because adjectival suffix has time connotation, term Winnipegosis is used in this paper to conform with usage recommended by Geological Survey of Canada and American Commission on Stratigraphic Nomenclature. In outcrop, overlies Elm Point formation and underlies Dawson Bay formation (new). Redefined in subsurface to include Elm Point limestone. Elk Point group.

C. A. Sandberg and C. R. Hammond, 1958, Am. Assoc. Petroleum Geologists Bull., v. 42, no. 10, p. 2299 (fig. 2), 2303 (fig. 4), 2304–2306. Report deals with Devonian system of United States part of Williston basin and adjacent parts of central Montana and northern Wyoming between which deposition was continuous. In area of this report, the Winnipegosis is redefined to include deposits previously assigned to Ashern formation of Baillie (1951, Manitoba Dept. Mines and Nat. Resources Mines Br. Pub. 49–2). In the United States, the Winnipegosis is restricted to Williston basin and northeastern Montana. Ranges in thickness from fraction of a foot to about 300 feet. Lower formation of Elk Point group. Underlies Prairie formation. In Birdbear well, Dunn County, N. Dak., lies between depths of 11,438 and 11,698 feet and rests unconformably on Silurian rocks. Middle Devonian. Subsurface nomenclature of this report is for Williston basin and Montana east of 111° meridian.

Well exposed in outcrop area along shores of Lake Manitoba and Lake Winnipegosis, Manitoba, Canada.

**Winnipesaukee Quartz Diorite** (in New Hampshire Plutonic Series)

Winnipesaukee Gneiss[1]

Upper Devonian(?): East-central New Hampshire.

Original reference: C. H. Hitchcock, 1874, Geology New Hampshire, pt. 1, p. 508–545.

Alonzo Quinn, 1937, Geol. Soc. America Bull., v. 48, no. 3, p. 377, 378, 400. Name revived and unit redescribed as light- to medium-gray medium-grained quartz diorite. Characterized by faint foliation. Streaky in places and cut by many small pegmatite veins and aplite dikes. Locally porphyritic with plagioclase phenocrysts. Assigned to New Hampshire magma series of probable Upper Devonian age. Subdivision of Chatham granite of Billings (1928).

Alonzo Quinn, David Modell, and Louise Kingsley, 1940, Geologic map and structure sections of the Winnipesaukee quadrangle, New Hampshire (1:62,500): New Hampshire State Highway Dept. Mapped extensively in Lake Winnipesaukee area. Includes granite, granodiorite, and diorite.

Named for Lake Winnipesaukee, Belknap and Carroll Counties.

**Winoka Gravel**[1]

Pliocene: Southwestern Missouri.

Original reference: E. J. Park, Mabel Hays, and E. M. Shepard, 1904, Bradley Geol. Field Sta. Drury Coll. Bull. 1, pt. 1, p. 14, 19, 41.

Named for exposures at Winoka, Greene or Christian County.

**Winona Amygdaloid**[1] (in Central Mine Group)

Precambrian (Keweenawan): Northern Michigan.

Original reference: B. S. Butler and W. S. Burbank, 1929, U.S. Geol. Survery Prof. Paper 144 (chart compiled by M. G. Wilmarth).

Named for occurrence in Winona mine, Houghton County.

**Winona Conglomerate**[1] (in Bohemia Range Group)

Precambrian (Keweenawan): Northern Michigan.

Original reference: A. C. Lane, 1911, Michigan Geol. and Biol. Survey Pub. 6, geol. ser. 4, p. 547, 563, 566, 576, 982, fig. 42.

Named for occurrence in Winona mine, Houghton County.

**Winona 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 Winona mine, Houghton County.

**Winona Sand** or **Formation** (in Claiborne Group)

Winona Sand Member (of Lisbon Formation)[1]

Eocene, middle: Mississippi.

Original reference: E. N. Lowe, 1919, Mississippi Geol. Survey Bull. 14, p. 73.

E. P. Thomas, 1942, Mississippi Geol. Survey Bull. 48, p. 28–33. Most authors have considered Winona greensand to be a member of either the Tallahatta or Lisbon formation. It is herein raised to formational rank. Overlies Neshoba sand member (new) of Tallahatta formation; underlies Zilpha shale. Thickness commonly 25 feet in general vicinity of type locality.

F. S. MacNeil, 1947, U.S. Geol. Survey Oil and Gas Inv. Prelim, Chart 29. Correlation chart shows Winona formation in Claiborne group. Underlies Zilpha clay; overlies Tallahatta formation, either Holly Springs sand member, Basic City shale member, or Neshoba sand member.

Named for development at Winona, Montgomery County.

**Winooski Marble**[1] or **Dolomite**

Lower Cambrian: Northwestern Vermont.

Original reference: Edward Hitchcock, 1861, Rept. Geol. Vermont, v. 1, p. 329.

W. M. Cady, 1945, Geol. Soc. America Bull., v. 56, no. 5, p. 525, 532, 534. Winooski dolomite restricted to dolomitic beds in Winooski Falls or Winooski village in Colchester Township. Localities near Malletts Bay, in vicinity of Ethan Allen Park in Burlington, and along lower Winooski River are in a distinctly lower stratigraphic zone. Thickness difficult to determine because faunal zone that must exist between top of formation and beds of Upper Cambrian age is not accompanied by recognized lithologic break. Top of Winooski has never been identified. For mapping purposes, top of formation is placed beneath lowest beds of typical Upper Cambrian Danby quartzite. Lower limit of formation also indistinct. Lower contact (with Monkton quartzite) is mapped through points where, passing down section, quartzite beds over 1 foot thick and separated by less than 25 feet begin to appear. Thickness: 100 to 150 feet on east slope Snake Mountain; about 600 feet at Brandon; at least

800 feet at Pittsford; about 350 feet on north slope of Snake Mountain on Buck Mountain.

A. B. Shaw, 1958, Geol. Soc. America Bull., v. 69, no. 5, p. 536. Discussion of St. Albans area, northwestern Vermont. Name Winooski abandoned in area. Rocks that are here assigned to Dunham dolomite have been known in this area as Winooski marble. Cady (1945) has shown that name Winooski has been applied to two distinct units and has restricted name to the younger of the two, which is above Monkton quartzite, a formation in west-central Vermont. The Winooski, as thus restricted, is not present in St. Albans area but is represented by its equivalent, Rugg Brook dolomite.

Named for exposures along Winooski River in Burlington, Chittenden County, where the marble was first quarried.

†Winslow Formation[1]

Pennsylvanian: Northwestern Arkansas and northeastern Oklahoma.

Original reference: G. I. Adams, 1904, U.S. Geol. Survey Prof. Paper 24, p. 29.

C. W. Wilson, Jr., 1935, Am. Assoc. Petroleum Geologists Bull., v. 78, no. 4, p. 511. Rocks mapped in Muskogee County, Okla., as Winslow formation on State geological map have been subdivided into units herein designated as Atoka, Hartshorne, McAlester, and Savannah formations, and lower part of true Boggy shale.

Named for exposures in and around Winslow, Ark.

Winslow Member (of Moenkopi Formation)

Lower Triassic: Northeastern Arizona.

E. D. McKee, 1951, New Mexico Geol. Soc. Guidebook 2d Field Conf., p. 86, 87 (fig. 1). Composed largely of light-colored (gray) siltstones and mudstones with considerable bedded gypsum. Contrasts strongly with red-colored overlying Holbrook member and underlying Wupatki member (new) and in slope-forming tendencies. Thickness over 50 feet.

In Winslow-Holbrook area.

Winslow shale[1]

Lower Triassic: Northern Arizona.

Original reference: C. R. Keyes, 1922, Pan-Am. Geologist, v. 38, p. 250, 339.

Exposed in Rio Chiquito Colorado Valley, at mouth of Rio Puerco, Navajo and Coconino Counties. Derivation of name not stated.

**Winsor Formation**

Winsor Formation (in San Rafael Group)

Upper Jurassic: Central Southern Utah.

H. E. Gregory, 1948, Geol. Soc. America Bull., v. 59, no. 3, p. 235; 1950, U.S. Geol. Survey Prof. Paper 220, p. 49 (fig. 25), 51 (table), 96–98, pl. 5. Consists of sandstone and very subordinate conglomerate. Bulk is unbroken series of horizontal white or yellow-white beds characterized by regularity of stratification and consistency of texture and composition. Few beds are more than 2 feet thick—most of them measured in inches—except in uppermost 50 feet where continuity is broken by inclusion of lenses of extraneous material. Thickness 180 to 300 feet in Zion Park region; 450 to 800 feet in Paria Valley. Unconformably underlies

Dakota(?) sandstone; unconformably overlies Curtis formation of San Rafael group. No fossils found. Provisionally classed as Jurassic.

C. T. Snyder, 1952, Utah Geol. Soc. Guidebook 7, p. 12. Included in San Rafael group.

R. R. Kennedy, 1960, Brigham Young Univ. Research Studies, Geology Ser., v. 7, no. 4, p. 24, 25, 26, geol. map. Unconformably underlies Tushar conglomerate (new) in Tushar Range, Piute County.

Name derived from Winsor, the original settlement at Mount Carmel, Kane County. Present in upper Virgin Valley, Orderville Gulch, Muddy Creek, Flume Canyon, and eastward along Gray Cliffs to Paria Valley at Cannonville.

Winston Dolomite[1]

Silurian (Albion Series): Northwestern Illinois and northeastern Iowa.

Original reference: T. E. Savage, 1914, Am. Jour. Sci., 4th, v. 38, p. 34–37.

C. K. Swartz and others, 1942, Geol. Soc. America Bull., v. 53, no. 4, chart 3. Shown on chart as underlying Waucoma limestone; placed in Albion series.

Named for Winston, Jo Daviess County, Ill.

Winterport (type) Granite

Age not stated: South-central Maine.

J. M. Trefethen, 1941, (abs.) Geol. Soc. America Bull., v. 52, no. 12, pt. 2, p. 2020. Described as foliated granites. Biotite streaking on foliation planes occurs locally. Older than Waldo granite.

Crops out in small masses in Bucksport quadrangle.

Winters Clay (in Allegheny Formation)[1]

Winters underclay member

Pennsylvanian (Allegheny Series): Southeastern Ohio.

[Original reference:] Wilber Stout, 1927, Ohio Geol. Survey, 4th ser., Bull. 31, p. 186–187.

N. K. Flint, 1951, Ohio Geol. Survey, 4th ser., Bull. 48, p. 42. Considered part of Winters 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 11), 56. Winters underclay member of Winters cyclothm in report on Athens County. Thickness about 1½ feet.

First described in Vinton County.

Winters cyclothem

Pennsylvanian (Allegheny Series): Ohio.

N. K. Flint, 1951, Ohio Geol. Survey, 4th ser., Bull. 48, p. 40, 42. Winters clay and coal are only representatives of Winters cyclothem in area studied. Occurs above Ogan cyclothem and below Clarion cyclothem.

M. T. Sturgeon and others, 1958, Ohio Geol. Survey Bull. 57, p. 49 (table 7), 56. Incomplete in Athens County [this report]. Includes Winters shale (or) sandstone members and Winters coal and underclay members. Occurs above Ogan cyclothem and below Clarion cyclothem. Allegheny series.

Named for Winters coal. Orton (1884, Ohio Geol. Survey, v. 5, Econ. geology) first used name Winters for coal in vicinity of McArthur, Vinton County.

Winters shale and (or) sandstone member

Pennsylvanian: Eastern Ohio.

M. T. Sturgeon and others, 1958, Ohio Geol. Survey Bull. 57, p. 49 (table 11), 56. Member of Winters cyclothem in report on Athens County. Thickness less than 2 feet. Allegheny series.

**Winterset Limestone Member** (of Dennis Limestone)

Winterset Limestone (in Kansas City Group)[1]

Winterset Limestone Member (of Hogshooter Limestone)

Winterset Limestone Member (of Kansas City Formation)

Upper Pennsylvanian (Missouri Series): Western Iowa, eastern Kansas, northern Missouri, southeastern Nebraska, and northeastern Oklahoma.

Original reference: J. L. Tilton, 1897, Iowa Acad. Sci. Proc., v. 4, p. 48–54.

M. C. Oakes, 1940, Oklahoma Geol. Survey Bull. 62, p. 44–47; 1952, Oklahoma Geol. Survey Bull. 69, p. 59–64. Uppermost member of Hogshooter formation in Oklahoma. Normally overlies Stark shale member but locally overlies Lost City member. Except where Canville, Stark, or Lost City members are present, Winterset lies on Coffeyville strata; underlies Nellie Bly formation.

R. C. Moore, 1948, Am. Assoc. Petroleum Geologists Bull., v. 32, no. 11, p. 2031 (fig. 4). Uppermost member of Dennis formation. Overlies Stark shale member; underlies Fontana shale member of Cherryvale formation. In Oklahoma, member of Hogshooter limestone. 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. 27, fig. 5. Winterset, at type section, is composed of massive upper unit commonly containing brown chert nodules changing to thin-bedded basal section. Shalley zone 4 feet from top has abundance of fusulinid *Triticites irregularis*. Thickness about 12 feet. Overlies Stark shale member; underlies Fontana shale member of Cherryvale formation.

Named for exposures at Winterset, Madison County, Iowa.

Winthrop Phyllite

Silurian: Southwestern Maine.

L. W. Fisher, 1941, Geol. Soc. America Bull., v. 52, no. 1, p. 130, pl. 1, table 1 (facing p. 112). Described as quartz-biotite phyllite. Chloritoid and garnet-staurolite facies are recognized. In middle-grade metamorphic zone. Overlies Androscoggin formation.

Type locality: A quarter mile northwest of village of Winthrop, Kennebec County. Other outcrops located along railroad on west side of Lake Marancook half mile north of village.

Winthrop Sandstone[1]

Upper Cretaceous: Central northern Washington.

Original reference: I. C. Russell, 1900, U.S. Geol. Survey 20th Ann. Rept., pt. 2, p. 100–137.

J. D. Barksdale, 1948, Northwest Sci., v. 22, no. 4, p. 165, 167–169. Described in Methow quadrangle. Conformably overlies Virginian Ridge formation (new); conformably underlies Midnight Peak formation (new). Upper Cretaceous.

Well exposed on north border of Methow Valley about 5 miles northwest of Winthrop, Okanogan County.

**Winzeler Shale[1] Member** (of Howard Limestone)

Pennsylvanian (Virgil Series): Southwestern Iowa, eastern Kansas, and southeastern Nebraska.

Original reference: R. C. Moore, 1932, Kansas Geol. Soc. Guidebook 6th Ann. Field Conf., p. 20, 94, 96.

R. C. Moore, 1949, Kansas Geol. Survey Bull. 83, p. 170 (fig. 34), 174. Bluish-gray or yellowish and clayey to calcareous shale. About 3 to 8 feet thick. Underlies Utopia limestone member; overlies Church limestone member. Recognizable from Nebraska and Iowa southward to Oklahoma, but locally, where Utopia limestone disappears, the Winzeler cannot be differentiated from White Cloud shale.

G. E. Condra, 1949, Nebraska Geol. Survey Bull. 16, p. 19. Occurrence, southeastern Nebraska, southwestern Iowa, and northwestern Missouri, and southward into Kansas.

Type locality: Winzeler Farm, sec. 4, T. 26 S., R. 11 E., Greenwood County, Kans.

**Wiota Gravels**

Pleistocene: Northwestern Montana.

R. B. Colton, 1955, U.S. Geol. Survey Geol. Quad. Map GQ–67. Name applied by Jensen (1951, U.S. Geol. Survey Open-File Rept.) to preglacial gravels deposited later than Flaxville gravel. Consist of well-rounded fragments of very fine- to medium-grained quartzite. Large part of unit is sand; lenses of silt and clay are present locally. Vary laterally from deposits that consist entirely of sand to those that contain coarse gravel. Commonly reddish brown. Thickness 1 to 30 feet; commonly 10 to 15 feet; at Wolf Point 26 feet. Overlie rocks ranging in age from Upper Cretaceous to Miocene or Pliocene. In vicinity of Wolf Point, overlie Bearpaw shale, Fox Hills, Hell Creek, and Fort Union formations, and Flaxville gravel. Capped by till as much as 20 feet thick.

Area of this report is Wolf Point quadrangle. Jensen used name in area 25 miles to west. Town of Wiota is in Valley County.

**Wisconsin Glaciation, Drift, Till**

Wisconsinan Stage

Wisconsin stage of glaciation[1]

Pleistocene: North America.

Original reference: T. C. Chamberlain, 1894, *in* James Geikie, The Great Ice Age, 3d ed.: London, Edward Stanford, p. 754–775.

J. C. Frye and A. B. Leonard, 1952, Kansas Geol. Survey Bull. 99, p. 123–140. Five substages (subages) of Wisconsinan recognized in Kansas: Iowan, Tazewellian, Bradyan, Caryan, and Mankatoan. Four of these substages are characterized by glacial advance and retreat and are based on type localities in Mississippi Valley region. The Bradyan is interglacial interval. Wisconsinan follows Sangamonian stage and is followed by Recent stage.

J. C. Frye and A. B. Leonard, 1955, Am. Jour. Sci., v. 253, no. 6, p. 358–364. Bradyan interglacial interval is most significant break in sedimentation in Midcontinent region during post-Sangamonian time. Correlation of deposits in this interval with those of Upper Mississippi Valley Wisconsin is still tenuous and debatable. Provincial classification of post-Sangamonian time into Scandian, Bradyan, and Almenan sub-ages is proposed for use in Midcontinent region.

T. N. V. Karlstrom, 1956, U.S. Geol. Survey Bull. 1021–J, p. 304–330. Proposed that the Cochrane be considered a Wisconsin event of substage rank.

H. R. Wanless, 1957, Illinois Geol. Survey Bull. 82, p. 174–177. Wisconsin glaciation consisted of five successive glacial advances: Farmdale (oldest), Iowan, Tazewell, Cary, and Mankato. None of the glaciers reached area of this report although the Tazewell came within less than 2 miles of Glasford quadrangle. First and second glaciations are recorded by widespread loesses and the next three by glacio-fluvial, alluvial, or lacustrine deposits in Illinois Valley and its tributaries. Pleistocene epoch.

M. M. Leighton, 1957, Jour. Geology, v. 65, no. 1, p. 108–109. Discussion of Cary-Mankato-Valders problem. Wisconsin stage classified as follows (ascending): Farmdale, Iowan, Tazewell, Cary, Mankato, and Valders substages. Cochran[e] excluded from classification because it is considered that it represents a minor incident in final climactic adjustment to present interglacial stage, the Recent.

V. C. Shepps and others, 1959, Pennsylvania Geol. Survey, 4th ser., Bull. G–32, p. 22–46. Ice advanced into northwestern Pennsylvania five times during Wisconsin age. Advances occurred at least once during Tazewell substage and four times during Cary substage.

J. C. Frye and H. B. Willman, 1960, Illinois Geol. Survey Circ. 285, p. 1–16. Revised time-stratigraphic classification of Wisconsinan stage of Lake Michigan lobe as used by Illinois Geological Survey consists of following substages (descending): Valderan, Twocreekan, Woodfordian (new), Farmdalian, and Altonian (new). Extrapolation from presently available radiocarbon dates suggests that Wisconsinan time started 50,000 to 70,000 radiocarbon years ago and terminated about 5,000 radiocarbon years ago. More than half this time falls within Altonian substage. New rock-stratigraphic names introduced are Roxana silt, Morton loess, and Richland loess. In terms of stratigraphic sequence, stage includes all deposits above Sangamon soil and below Recent alluvium. Although this expands definition of stage to include deposits now known to be older than type Farmdale loess, these deposits had previously been included in the Wisconsinan. Former classification of stage as used by Illinois Geological Survey was (descending) Mankato, Cary, Tazewell, Iowan, and Farmdale.

M. M. Leighton, 1960, Jour. Geology, v. 68, no. 5, p. 529–552. Wisconsin stage is classified on basis of stratigraphy into six glacial substages (ascending): Farmdale, Iowan, Tazewell, Cary, Mankato, and Valders. In this paper, names are proposed for the interglacial substages not previously designated, completing sequence as follows (ascending): Farmdale (glacial), Farm Creek (new), Iowan (glacial), Gardena (new), Tazewell (glacial), St. Charles (new), Cary (glacial), Bowmanville (new), Mankato (glacial), Two Creeks, and Valders (glacial). Paper also gives consideration to other classifications, including one proposed by Frye and Willman (1960). Author [Leighton] does not agree with Frye and Willman.

†Wisconsin Valley Slates[1]

Precambrian (Huronian) : Central northern Wisconsin.

Original references: C. R. Van Hise, 1892, U.S. Geol. Survey Bull. 86, pl. 3, map; 1892, U.S. Geol. Survey Mon. 19, pl. 1, map.

Upper part of Wisconsin River.

**Wiscoy Sandstone Member** (of Java Formation)

Wiscoy Member (of Chemung Formation)

Wiscoy Shale or Sandstone[1]

Upper Devonian: Western and west-central New York.

Original references: J. M. Clarke, 1897, Ann. Rept. State Engineer and Surveyor, p. 737; 1899, New York State Mus. 16th Ann. Rept., p. 31–41.

J. F. Pepper and Wallace de Witt, Jr., 1950, U.S. Geol. Survey Oil and Gas Prelim. Inv. Chart 37. Referred to as Wiscoy sandstone. At type locality, composed largely of massive greenish-gray silty mudstones and some argillaceous limestones. East of type locality, in vicinity of Arkport, Wiscoy is mainly greenish-gray siltstones and some medium-bedded sandstones. Intertongues with Hanover shale.

J. F. Pepper and Wallace de Witt, Jr., 1951, U.S. Geol. Survey Oil and Gas Inv. Chart OC–45. From Franklin Gulf eastward, an expanding wedge of Wiscoy sediments underlies Perrysburg formation (new).

I. H. Tesmer, 1955, New York State Mus. Sci. Service Circ. 42, p. 10 (fig. 1). Considered member of Chemung formation.

Wallace de Witt, Jr., 1960, Am. Assoc. Petroleum Geologists Bull., v. 44, no. 12, p. 1935–1936. Wiscoy sandstone redefined as member of Java formation (new). In type section of the Java, the Wiscoy is represented by several beds of medium-gray to medium-greenish-gray argillaceous siltstone and silty mudrock in upper 15 feet of Hanover shale member. Wiscoy thickens to east as gray shale and mudrock of Hanover shale member intertongue at successively older stratigraphic horizons with medium-gray and medium-greenish-gray silty mudrock, siltstone, and very fine grained sandstone. East of central Wyoming County, upper contact of Wiscoy is clearly marked at most places by black or brownish-black shale of Dunkirk member of Perrysburg formation.

Typically exposed in valley of Wiscoy Creek at Wiscoy, Hume Township, Allegany County.

**Wise Formation**

Wise Formation (in Pottsville Group)[a]

Middle Pennsylvanian: Southwestern Virginia and southeastern Kentucky.

Original reference: M. R. Campbell, 1893, U.S. Geol. Survey Bull. 111, p. 28, 34.

H. R. Wanless, 1946, Geol. Soc. America Mem. 13, p. 72–75. In Wise County, formation includes coals from High Splint (above) at top to Dorchester; underlies Harlan sandstone; overlies Gladeville sandstone. Addington sandstone occupies interval between Clinton and Addington coals.

Named for Wise County, Va.

Wise Lake Formation (in Galena Group)

Middle Ordovician: Northern Illinois.

J. S. Templeton and H. B. Willman, 1952, Tri-State Geol. Soc. Guidebook 16th Ann. Field Conf., p. 6, figs. 3, 15B. Massively bedded dolomite, pure in upper part, slightly argillaceous in lower part. Thickness about 90 feet. Comprises (ascending) Stewartville and Sinsinawa members. Shown on columnar section as underlying Dubuque formation and overlying Dunleith formation (new).

Occurs in Dixon-Oregon area.

Wisenor Formation

Lower Cretaceous: West-central California.

L. I. Briggs, Jr., 1953, California Div. Mines Bull. 167, p. 12 (fig. 2), 20–22, pls. 1, 2, 3, 4. Dark shale and thin hard carbonaceous sandstone. Thickness about 1,800 feet. Lies between Franciscan rocks of Ortigalita thrust and basal conglomerate of Panoche formation. Angular discordance exists between the Wisenor where strikes of the two formations differ, but everywhere the angle of dip of the formations is steep and approximately the same. Beds were originally included in Panoche formation by Anderson and Pack (1915). Taliaferro (1943, Am. Assoc. Petroleum Geologists Bull., v. 27, no. 2) placed them in Shasta group on basis of lithology and stratigraphic position.

Named for exposures in Wisenor Hills. Area of report is Ortigalita Peak quadrangle, which is in the Coast Ranges bordering the San Joaquin Valley, about 5 miles south of Los Banos.

Wise Ridge Coal Member (of Spoon Formation)

Pennsylvanian: Southeastern Illinois.

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 33. 46 (table 1), 64, pl. 1. Proposed for coal formerly called Stonefort in order to restrict that name to Stonefort limestone. Thickness about 1 foot. Stratigraphically above Mount Rorah coal member (new) and below Stonefort limestone member. Presentation of new rock-stratigraphic classification of Pennsylvanian of Illinois. Cyclical classification retained but is entirely independent of rock-stratigraphic classification.

Type locality: NE¼SE¼ sec. 25, T. 10 S., R. 4 E., Williamson County. Named for Wise Ridge, about 3 miles west of town of Stonefort.

**Wishbone Formation**

Eocene: South-central Alaska.

T. G. Payne, 1955, U.S. Geol. Survey Misc. Geol. Inv. Map I–84. Name appears only on correlation chart. Paleocene(?). Nonmarine formation in Matanuska Valley.

F. F. Barnes and T. G. Payne, 1956, U.S. Geol. Survey Bull. 1016, p. 13, 18–19, pls. 1, 2. Predominantly conglomerate composed of pebbles, cobbles, and a few boulders in sandy matrix. Includes numerous lenticular beds of sandstone, generally crossbedded and ranging in thickness from a few inches to 40 feet, and a few small lenses of silty claystone. Maximum thickness at least 1,850 feet. Overlies Chickaloon formation with gradational contact; unconformably underlies Tsadaka formation (new). Represents lower conglomeratic beds in Wishbone Hill district, mapped as Eska conglomerate by Martin and Katz (1912). Probably Paleocene, or possibly early Eocene in age.

U.S. Geological Survey currently designates the age of the Wishbone as Eocene on the basis of a study now in progress.

Named for exposures on Wishbone Hill, Wishbone Hill district, Matanuska coal field.

Wiskanian series

Cretaceous (Cretacic): Northwestern Kansas and eastern Colorado.

C. R. Keyes, 1941, Pan-Am. Geologist, v. 75, no. 5, p. 369–371. Term proposed for great section of dark shales usually called vaguely and erroneously the Pierre formation. Thickness about 1,000 feet. Covers large but indefinite part of median portion of Assiniboine centrum shales, which itself is not really a stratigraphic unit of any rank, but a term applied to great central filling of Cordillera geosyncline.

Name derived from a way-station in Wallace County, Kans.

**Wissahickon Schist**[1] or **Formation**[1]

Wissahickon Gneiss

Lower Paleozoic(?) (Glenarm Series): Southeastern Pennsylvania, Delaware, northern Maryland, and Virginia.

Original reference: F. Bascom, 1902, Maryland Geol. Survey Cecil County Rept., p. 104–108.

R. O. Bloomer, 1939, Virginia Geol. Survey Bull. 51–F, p. 141–145. In Hanover County, Wissahickon granitized gneiss is intruded by Petersburg granite. Wissahickon underlies Triassic sediments.

A. W. Postel, 1940, (abs.) Geol. Soc. America Bull., v. 52, no. 12, pt. 2, p. 2004–2005. Igneous rocks in Wissahickon schist in Philadelphia region owe their origin to two types of magmatic activity: definite magmatic intrusions into Wissahickon schist, and hydrothermal replacement of Wissahickon by potash and soda-rich intrusions. The metagabbro, the Springfield aplitic granodiorite (new), and Ridley Park granodiorite (new) are products of magmatic intrusion. Age of Wissahickon is in doubt.

A. J. Stose and G. W. Stose, 1944, U.S. Geol. Survey Prof. Paper 204, p. 39–42, 52, 54, pl. 1. Formation described in Martic overthrust block in Hanover-York district, Pennsylvania, where it is an oligoclase-biotite-muscovite schist. This schist lies on southeast side of Peters Creek quartzite. On northwest side of this quartzite, there is belt of albite-chlorite-muscovite schist regarded as different metamorphic facies of Wissahickon formation. This albite-chlorite schist occupies most of southeastern part of district. The Wissahickon lies southeast of Marburg schist and contains infolds of metabasalt. Precambrian(?) Glenarm series. Precambrian age of Glenarm series not proved.

Judith Weiss, 1949, Geol. Soc. America Bull., v. 60, no. 10, p. 1689–1726. Report deals with structure, petrology, and metamorphism of Wissahickon schist in and near Philadelphia. Area under consideration is 35 miles long and 8 miles wide, and extends from Morrisville, Pa., on Delaware River, west to Darby Creek in Delaware County. Paleozoic rocks and Baltimore gneiss form northern boundary and Delaware River southern boundary. Formation is called Wissahickon schist in order to avoid cumbersome phrase "schist and gneiss," and because prevalent structure is schistose. Name applies to those recrystallized dominantly pelitic rocks that are south of Cream Valley-Huntingdon Valley fault and Rosemont fault and that extend southwest into Delaware and Chester Counties. Deposits of unconsolidated clays, sand, and gravels of Cretaceous, Tertiary, and Quaternary age overlap Wissahickon schist to the southeast of area studied. Overlap extends west of Delaware River. Schist is exposed along major streams and at altitudes above 100 feet; small isolated patches of gravel cover schist up to altitudes as high as 400 feet. On the north and northwest, Cream Valley-Huntingdon Valley and Rosemont faults separate schist from Precambrian Baltimore gneiss and Paleozoic sediments. These sediments are Cambro-Ordovician limestone that underlies Huntingdon Valley, Wissahickon, and Cambrian Chickies quartzite that crops out between Somerton and Edge Hill. Baltimore gneiss is older than Wissahickon schist. However, since in this region a high-angle thrust fault separates schist from northern bordering rocks, stratigraphic relation between schist and Paleozoic sediments is not clear. Age not certain.

R. O. Bloomer, 1950, Am. Jour. Sci., v. 248, no. 11, p. 753–783. In places, there appears to be complete section between Catoctin in the Blue Ridge and Wissahickon in the Piedmont of central Virginia. No continuous faults, including Martic overthrust, have been identified. Catoctin is not everywhere separated from Wissahickon or Lynchburg from Wissahickon by faults. Wissahickon is herein interpreted as Paleozoic in age and at least partly equivalent to Lower Cambrian Chilhowee group of Appalachian geosyncline.

J. W. Frondel, 1951, (abs.) Geol. Soc. America Bull., v. 62, no. 12, pt. 2, p. 1550. Recent work suggests that Wissahickon schist at Philadelphia is higher grade metamorphic equivalent of phyllitic rocks lying to northwest. The phyllite, in normal stratigraphic sequence with other Paleozoic rocks, is Cambro-Ordovician or possibly Cambrian. Assignment of Wissahickon schist to Paleozoic does not seem valid.

W. C. Rasmussen and others, 1957, Delaware Geol. Survey Bull. 6, v. 1, p. 102–104, pl. 3. Mapped in northern Delaware. Glenarm series. Precambrian(?).

A. W. Postel and H. W. Jaffe, 1957, Pennsylvania Acad. Sci. Proc., v. 31, p. 120–123. Study indicates that lead-alpha ages of zircon of Wissahickon schist are older than those of Swarthmore granodiorite (new) and related rocks, and that all ages are younger than Precambrian. Swarthmore replaces preoccupied name Springfield granodiorite.

P. W. Choquette, 1960, Geol. Soc. America Bull., v. 71, no. 7, p. 1029 (table 1). In Cockeysville area, Maryland, Wissahickon formation overlies Cockeysville formation with contact gradational. Glenarm series. Pre-Silurian.

Carlyle Gray and others, 1960, Geologic map of Pennsylvania (1:250,000): Pennsylvania Geol. Survey, 4th ser. Wissahickon formation mapped as probably Lower Paleozoic.

Named from Wissahickon Creek, in Philadelphia, Pa.

**Witnet Formation**[1]

Miocene, pre-middle: Southern California.

Original reference: J. P. Buwalda, 1934, Pan-Am. Geologist, v. 61, no. 4, p. 310.

J. P. Buwalda and G. E. Lewis, 1955, U.S. Geol. Survey Prof. Paper 264–G, p. 147. Consists mainly of alternate beds of coarse gray arkose, locally bouldery, and dark sandy shale; probably of continental origin. Thickness not more than 4,000 feet. Strata steeply tilted and partly overturned. Neither top nor base exposed; at lower contact, granitic basement rocks are thrust over formation, and youngest beds are covered by gently dipping Miocene strata that overlies upper part of Witnet with strong angular unconformity. Type section designated; derivation of name given.

Type section: Lower Oil Canyon about 1 mile above its junction with Cache Creek; NW¼ sec. 13, T. 32 S., R. 34 E., Mojave quadrangle; Tehachapi quadrangle, Kern County. Named from Witnet Ridge north of lower Oil Canyon.

Witt Coal Member (of Bond Formation)

Pennsylvanian: Central and southwestern Illinois.

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 39, 50 (table 1), 71, pl. 1. Name applied to coal member stratigraphically above Flat Creek coal member (new) and below Coffeen limestone member (new). Mainly gray limestone with some gray shale. Thickness about 1 foot. Name credited to H. J. Gluskoter. Presentation of new rock-stratigraphic classification of Pennsylvanian of Illinois. Cyclical classification retained but is entirely independent of rock-stratigraphic classification.

Type locality: NE¼NW¼SE¼ sec. 7, T. 8 N., R. 2 W., Montgomery County. Exposed about 6½ miles due south of town of Witt.

Witt cyclothem (in Bond Formation)

Pennsylvanian: Southwestern Illinois.

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 43, 53 (table 2), 70, pl. 1. Uppermost cyclothem in formation in area. Occurs above Flat Creek cyclothem. Name credited to H. J. Gluskoter (unpub. ms.). Presentation of new rock-stratigraphic classification of Pennsylvanian strata in Illinois; cyclical classification is independent of rock-stratigraphic classification.

Type locality: East bank of East Fork, Shoal Creek, NE¼NW¼SE¼ sec. 7, T. 8 N., R. 2 W., Montgomery County. Named from village of Witt, 6 miles north of type outcrop.

**Witten 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. 841–843, 877–879, 884 (fig. 3), pl. 5. In Tazewell County, strata embraced by Chazyan and Black River groups of Butts (1940, Virginia Geol. Survey Bull. 52, pt. 1) are subdivided into (ascending) 29 zones. Name Witten limestone is proposed for zones 22 through 25, or upper laminated limestone, fourth calcilutite, *Cryptophragmus* beds, and *Camarocladia* beds. Average thickness 100 feet. Intertongues with underlying Bowen formation (new); northeast of Five Oaks, Marys Chapel, and Thompson, lies disconformably on Wardell or Gratton limestone (both new). Underlies Moccasin formation. Corresponds to part, and locally to all, of Lowville limestone or Lowville limestone facies of Lowville-Moccasin formation as defined by Butts (1941, Virginia Geol. Survey Bull. 52, pt. 2).

C. E. Prouty, 1946, Am. Assoc. Petroleum Geologists Bull., v. 30, no. 7, p. 1172–1176. Geographically extended into northeastern Tennessee. Locally, in Cumberland Plateau, calcilutite zone attains thickness of more than 500 feet.

Type section: Along State Highway 16 about one-fourth mile north of County Road 604, Tazewell County, Va. Name derived from Witten Valley Church.

Wittenberg Conglomerate[1]

Wittenberg Conglomerate Member (of Katsberg Redbeds)

Upper Devonian: Southeastern New York.

Original reference: G. H. Chadwick, 1935, Am. Jour. Sci. 5th ser., v. 29, no. 170, p. 140.

G. H. Chadwick, 1944, New York State Mus. Bull. 336, p. 135. Termed member of Katsberg redbeds. Described as white-looking and pebbly beds consisting of gray to "white" sandstones or flagstones with small amounts of red shale and red or reddish sandstones. Quartz pebbles common especially in "white" layers. Thickness about 1,250 feet on Hunter Mountain. Overlies Stony Clove sandstone member; underlies Slide Mountain conglomerate. Unit occurs about 800 feet stratigraphically below top of Katsberg as exposed on Slide Mountain. Beds are in Pocono facies and have been called "Pocono", but are older than Pocono beds of Pocono Mountains in northeastern Pennsylvania.

Best exposed on summit of Wittenberg in Catskill Mountains.

Wittenberg shale[1]

Middle Devonian: Southeastern Missouri.

Original reference: C. Keyes, 1915, Iowa Acad. Sci. Proc., v. 22, p. 253.

Probably named for Wittenberg, Perry County.

Wizard Wells Limestone (in Graford Formation)[1]

Pennsylvanian: Central northern Texas.

Original reference: J. M. Armstrong and G. Scott, 1930, Texas Bur. Econ. Geology map of Wise County.

In Wise County.

**Woburn Formation**[1]

Precambrian: Eastern Massachusetts.

Original reference: L. LaForge, 1932, U.S. Geol. Survey Bull. 839.

Named for good exposures in southwestern part of Woburn, Middlesex County.

**Wolcott Limestone** (in Clinton Group)

Wolcott 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.

Tracy Gillette, 1940, New York State Mus. Bull. 320, p. 63–68. Formation in Clinton group. In Clyde and Sodus Bay quadrangles, overlies Sodus shale; underlies Wolcott Furnace iron ore. Consists of limestones and interbedded shales. Thickness about 20 feet. Base taken as lowest *Pentamerus*-bearing beds.

R. E. Griswold, 1950, New York State Water Power and Control Comm. Bull. GW–29, p. 13. Referred to as member of Clinton formation. In

Wayne County 15 feet thick; overlies Sodus shale member and underlies Williamson shale member.

Named for Wolcott, Wayne County, N.Y.

Wolcott Furnace iron ore[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, 1947, New York State Mus. Bull. 341, p. 13, 70–72, 93. Name used for all dominantly hematitic formations at top of lower Clinton group to avoid multiplicity of names. Includes Verona iron ore of Chadwick (1918). Dominantly fossiliferous at type locality. Has high calcareous content which varies noticeably between layers. At top is a thin dark-gray sandy layer with abundant phosphatic nodules. Total thickness about 1 foot. Traced westward from type locality to Second Creek where consists of 18 inches of hematitic limestone and shale. At center is a highly calcareous layer with relatively high concentration of iron; remainder of unit contains only scattered oolites of hematite. Upper limit sharp and well defined. In Wayne County, thin conglomeratic sandstone separates unit from Williamson shale above; contact with underlying Wolcott limestone everywhere gradational. Type locality described.

Type locality: In bed of Wolcott Creek at old Wolcott Furnace, 1 mile north of Wolcott village, Wayne County.

Wolf formation[1]

Precambrian: Southern British Columbia, Canada, and northeastern Washington.

Original reference: R. A. Daly, 1912, Canada Geol. Survey, Dept. Mines Mem. 38, map.

Exposed from Mount Ripple north to headwaters of Wolf Creek, in Selkirk Mountains, British Columbia.

**Wolf Porphyry**[1]

Post-Cretaceous: Central northern Montana.

Original reference: W. H. Weed, 1899, U.S. Geol. Survey Geol. Atlas, Folio 55.

F. C. Armstrong, 1957, Econ. Geology, v. 52, no. 3, p. 221. In Little Belt Mountains, both Neihart and Flathead quartzites unconformably overlie Archean rocks, and locally the Flathead has been intruded by post-Cretaceous Wolf and Barker porphyries.

Forms intrusive mass of Wolf Butte, the peak south of it, and Mixes Baldy, east of Barker, Fort Benton quadrangle.

**Wolfcamp Formation**[1] **or Series**

Lower Permian: Western Texas and New Mexico.

Original reference: J. A. Udden, 1917, Texas Univ. Bull. 1753, p. 41, pl. 3.

P. B. King, 1937, U.S. Geol. Survey Prof. Paper 187, p. 94–97. Wolfcamp is oldest formation of Glass Mountains section and crops out in scattered exposures in southern foothills of the mountains. In western part of mountains, it rests with strong unconformity on older Paleozoic rocks of Marathon basin. To the east, this unconformity is no longer evident, and formation rests with no marked difference in dip or strike upon higher members of the Pennsylvanian. Top of formation is everywhere well-marked plane of unconformity, by which it is separated from succeeding Leonard formation. Udden (1917) separated the Wolfcamp from uppermost Pennsylvanian (Gaptank) formation on the basis of fossils of Permian aspect collected at type locality. Section at Wolf Camp, as shown by Udden, includes at base shales and limestones of Pennsylvanian age, succeeded by 100 feet of shale containing ammonoids described by Böse as *Uddenites* fauna. These in turn are succeeded by a thick-bedded limestone which is here considered to be basal bed of Wolfcamp formation. Above this are several hundred feet of shales and thin limestones, which extend up to basal conglomerate of overlying Leonard formation. Since original work in the area, the Wolfcamp formation and its fossils have been studied by many geologists. Upper part of formation has been generally considered to be of Permian age, but shale containing *Uddenites* fauna has been interpreted by some paleontologists as uppermost Pennsylvanian and by others as lowermost Permian. It is here included in Gaptank formation and considered to be Pennsylvanian. Wolfcamp formation north of Wolf Camp is 583 feet thick and consists of lower gray limestone member, 49 feet thick, and upper shale member, 534 feet thick. Fossils listed at type section.

J. E. Adams and others, 1939. Am. Assoc. Petroleum Geologists Bull., v. 23, no. 11, p. 1674–1675, 1677. Permian system divided into four divisions of series rank. Wolfcamp is first and lowest of these divisions. Comprises beds that have been referred to as Wolfcamp formation (restricted), which is thus raised to series rank. In Glass Mountain, series consists of about 600 feet of limestone, limestone conglomerates, and shales. In West Texas, Wolfcamp rests with angular unconformity on rocks ranging in age from Precambrian to upper Pennsylvanian and is unconformably overlain by Leonard series. Characterized by fusulind genera *Schwagerina* s. s., *Pseudoschwagerina*, and *Paraschwagerina*. Wolfcamp equivalents include Hueco formation (restricted) of Diablo Plateau and Abo formation of New Mexico. Series in northern Oklahoma, Kansas, and Nebraska includes beds from disconformity above Brownville limestone up to horizon near top of Herington limestone. Recommended that in Oklahoma term Wanette be dropped in favor of Wolfcamp series.

P. B. King, 1942, Am. Assoc. Petroleum Geologists Bull., v. 26, no. 4, p. 556–566, 646–650. Series is not exposed in Guadalupe Mountains but comes to surface in Sierra Diablo; here it is represented by Hueco limestone. Local representative of series is Wolfcamp formation, which is about 600 feet thick and consists of alternating thick beds of shale and thin beds of limestone. Base of formation is defined as bottom of gray limestone member about 45 feet thick, which lies directly on *Uddenites*-bearing shale member at top of Gaptank formation. At type locality and elsewhere in Glass Mountains, Wolfcamp formation is unconformably overlain by Leonard formation of Leonard series.

R. C. Moore and others, 1951, Kansas Geol. Survey Bull. 89, p. 41. Wolfcampian series, formerly called Big Blue series, contains older Permian rocks of Kansas. Outcrop thickness in Kansas about 785 feet.

C. A. Ross, 1959, Washington Acad. Sci. Jour., v. 49, no. 9, p. 299–311. Wolfcamp series in Glass Mountains, Tex., is represented by sequence of diverse lithologies and includes regional unconformity. Detailed study reveals that two formations can be recognized in field and that both units are within "zone of *Pseudoschwagerina.*" Each formation has characteristic fusulinid fauna. Nealranch formation (new) embraces upper part of beds originally called Wolfcamp by Udden (1917) in Wolf Camp Hills and is renamed to retain this widely used name for time-stratigraphic unit, Wolfcamp series. Lenoxhills formation (new) unconformably overlies Nealranch formation and is upper formation of Wolfcamp series in Glass Mountains. It was in part included in Wolfcamp formation of King (1931, Texas Univ. Bull. 3080) where it crops out in western Glass Mountains and is now known to be present across southern escarpment of eastern Glass Mountains, and is lower 200 to 300 feet of Hess formation of Udden (1917). Exact placement of top of Pennsylvanian system in Glass Mountains has long been major controversy. Fusulinid faunas of Cisco (Virgil) age are known from strata as high as "grey limestone" of King (1931 and 1937). In Wolf Camp Hills, the Nealranch (300 to 470 feet thick unconformably) overlies the "grey 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. The "grey limestone" of King (1931) contains youngest Pennsylvanian fauna in Wolf Camp Hills and includes *Triticites comptus* n. sp., *T. ventricosis* (Moller), *T. pinguis* Dunbar and Skinner, and *T. koschmanni* Skinner.

G. V. Cohee, 1960, Am. Assoc. Petroleum Geologist Bull., v. 44, no. 9, p. 1578–1579. U.S. Geological Survey recognizes two-fold subdivision of Permian system and period. The divisions (Lower and Upper series and Early and Late Epochs) 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 of United States is Permian outcrops of 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. Boundary falls between Word and Capitan formations as recognized in Glass Mountains area. West Texas provincial series, Wolfcamp, Leonard, Guadalupe, and Ochoa, are retained according to current usage.

C. C. Branson, 1960, Oklahoma Geology Notes, v. 20, no. 9, p. 229–235. Name Lyon series (Lyonian epoch) proposed for American standard early Permian(?) rocks. 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.

Named for Wolfcamp, site of an old dwelling place, just south of the two buttes, located 6½ miles east and 2 miles north of east of Leonard Mountain. Wolf Camp Hills are at base of south face of Glass Mountains, 12 to 14 miles northeast of Marathon, Brewster County, Tex.

Wolfcampian Series or Stage

*See* **Wolfcamp Formation or Series.**

**Wolf Creek Conglomerate Lentil** (in Cattaraugus Formation)[1]

Wolf Creek Conglomerate (in Conewango Group)

Devonian: Southwestern New York.

Original reference: C. S. Prosser, 1892, Rochester Acad. Sci. Proc., v. 2, p. 54–57, 64, 93–95.

J. G. Woodruff, 1942, New York State Mus. Bull. 326, p. 54–63. In Wellsville quadrangle, conglomerate which is lowest bed carrying Conewangan fauna is tentatively called Wolf Creek conglomerate member of Cattaraugus. Underlies Salamanca conglomerate member; overlies Germania formation.

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.

I. H. Tesmer, 1955, New York State Mus. Sci. Service Circ. 42, p. 19. Panama and Wolf Creek conglomerates and sandstones are contiguous. Panama has priority; name Wolf Creek is abandoned.

L. V. Rickard, 1957, New York Geol. Assoc. Guidebook 29th Ann. Mtg., p. 17 (table 2), 19. Referred to as Wolf Creek conglomerate in Conewango group. In Genesee Valley, overlies Germania formation and underlies Cattaraugus shales. Average thickness about 30 feet. Upper Devonian; Chautauquan series.

Named for occurrence on Wolf Creek, west of West Clarksville, Allegany County.

Wolf Creek Dolomite[1] (in Arbuckle Group)

Ordovician: Southern Oklahoma.

Original reference: C. E. Decker, 1933, Tulsa Geol. Soc. Digest, p. 55–57.

C. E. Decker, 1939, Geol. Soc. America Bull., v. 50, no. 9, p. 1313. Preoccupied name Wolf Creek dolomite replaced by Strange formation.

C. C. Branson, 1957, Oklahoma Geology Notes, v. 17, no. 11, p. 108. Abandoned by Oklahoma Geological Survey. Name preoccupied. Unit named Wolf Creek by Decker is probably Butterly dolomite.

Occurs in Arbuckle and Wichita Mountains.

**Wolfe City Sand Member** (of Taylor Marl)[1]

Wolfe City Sand or Formation (in Taylor Group)

Upper Cretaceous: Northeastern Texas.

Original reference: L. W. Stephenson, 1918, U.S. Geol. Survey Prof. Paper 102–H, p. 155.

H. B. Stenzel, 1938, Texas Univ. Bur. Econ. Geology Pub. 3818, p. 38, 39 (fig. 4), 41–42 [1939]. Rank raised to formation in Taylor group. Gray fine calcareous argillaceous partly glauconitic sand or sandy marl. Thickness near Wolfe City 75 to 100 feet. Underlies Pecan Gap chalk; overlies unit referred to as lower Taylor marl.

J. T. Rouse, 1944, Am. Assoc. Petroleum Geologists Bull., v. 29, no. 4, p. 524. Wolfe City sand (formation) described along belt of outcrop from Collin County eastward into Red River County. Name sand is confusing because in many localities formation is arenaceous clay, marl, or sandy chalk rather than sand; sandy facies is best developed in vicinity of Wolfe City. Thickness 200 to 300 feet. Underlies Pecan Gap chalk; correlated with Annona chalk.

H. R. Blank, N. L. Stoltenberg, and H. H. Emmerich, 1952, Texas Bur. Econ. Geology Rept. Inv. 12, p. 5, 10 (table 1), 11–12. Member described in Blacklands experimental watershed, near Waco. Consists of basal sandy marl about 100 feet thick and upper silty marl about 40 feet. Unconformably underlies Pecan Gap member. Lowest strata outcropping in area.

Named for exposures at Wolfe City, Hunt County.

Wolf Hollow Limestone Member (of Tribes Hill Formation)

Lower Ordovician (Lower Canadian): East-central New York.

D. W. Fisher, 1954, Geol. Soc. America Bull., v. 65, no. 1, p. 76 (fig. 2), 87–88. Name proposed for typically very massive thick-bedded white-weathering blue-black dolomitic calcilutite in upper part of formation. Spatterings of dolomite form buff-weathering raised reticulate markings; these have erroneously been called siliceous matter. A stratum of dolomite a few feet above base contains pockets of white, yellow, and pink calcite. Thickness 28 feet at type section; fairly uniform from one section to another. Underlies Fonda member (new) of formation in Mohawk Valley.

Type section: Abandoned quarry and field exposure 2 miles north of Greens Corners in Amsterdam quadrangle. Named for narrow north-south-trending trenchlike valley 3 miles southeast of type locality.

Wolf Lake Granite[1]

Precambrian (upper Huronian): Northwestern Michigan.

Original reference: R. C. Allen and L. P. Barrett, 1915, Michigan Geol. and Biol. Survey Pub. 18, geol. ser. 15, p. 131–139.

Named for occurrence in vicinity of Wolf Lake, Gogebic County.

Wolf Lake Schist[1]

Precambrian (upper Huronian): Northwestern Michigan.

Original reference: R. C. Allen and L. P. Barrett, 1915, Michigan Geol. and Biol. Survey Pub. 18, geol. ser. 15, p. 131–139.

Occurs in Wolf Lake area, Gogebic County.

Wolf Mountain Granite

[Precambrian]: Central Texas.

R. E. McAdams, 1936, Am. Mineralogist, v. 21, p. 128–135. Name used in discussion of accessory minerals of Wolf Mountain granite mass or intrusive. Apparently same age as Lone Grove granite and probably older than Bear Mountain granite (new).

Wolf Mountain intrusive, approximately 30 square miles in area, is north and west of Llano, Llano County.

Wolf Mountain Shale Member (of Graford Formation)[1]

Pennsylvanian: Central northern Texas.

Original reference: F. B. Plummer and J. Hornberger, Jr., 1936, Texas Univ. Bull. 3534, p. 48–55, map.

M. G. Cheney, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 1, p. 66 (fig. 1). Correlation chart shows Graford group comprises (ascending) Adams Branch, Cedarton shale, and Ranger limestone. Wolf Mountain shale shown equivalent to Adams Branch and Cedarton.

Typically exposed below capping Merriman limestone in slopes of Wolf Mountain, 4 miles west-northwest of Palo Pinto, Palo Pinto County.

**Wolfpen Tonalite**[1]

Devonian(?): Eastern Massachusetts.

Original reference: B. K. Emerson, 1917, U.S. Geol. Survey Bull. 597, p. 170, 171, map.

W. R. Hansen, 1956, U.S. Geol. Survey Bull. 1038, p. 12. In type locality of Marlboro formation, oldest unit in contact with Marlboro is Wolfpen tonalite of Devonian(?) age.

Well exposed in Wolfpen Hill in Southboro, Worcester County.

**Wolf Ridge Sandstone Member** (of Pottsville Formation)[1]

Pennsylvanian: North-central Alabama.

Original reference: C. Butts, 1927, U.S. Geol. Survey Geol. Atlas, Folio 221.

Named for fact that it forms Wolf Ridge.

Wolf River Limestone[1] Member (of Topeka Formation)

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

Original reference: G. E. Condra and E. C. Reed, 1937, Nebraska Geol. Survey Bull. 11, 2d ser., p. 7, 12, 16, 20, 24, 26, 30, 33, 51–52, figs. 1, 2.

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 the Topeka in northeastern Kansas, southeastern Nebraska, northwestern Missouri, and southwestern Iowa so proposed name Wolf River for basal member of the 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: Missouri River bluffs just east of mouth of Wolf River north of Sparks, Doniphan County, Kans.

**Wolfskill Formation**

Pliocene: Northwestern California.

C. E. Weaver, 1949, Geol. Soc. America Mem. 35, p. 16 (table 3), 94–97, pls. 7, 8, 12. Consists of conglomerates, sandstones, and interbedded deposits of andesitic tuffs, all continental; poorly consolidated. Approximately 500 feet thick. Unconformably overlies San Pablo group, Lawlor tuff, and Neroly sandstone; east of Putah Creek overlaps on the Markley sandstone. Unconformably underlies Montezuma formation (new).

N. L. Taliaferro, 1951, California Div. Mines Bull. 154, p. 147. Suggests that name Wolfskill be abandoned in favor of Tehama since Wolfskill, as mapped and defined, is continuous with the Tehama and name Tehama has priority.

Named from Wolfskill Station between Vacaville and Winters in northwest Vacaville quadrangle. Formation mapped on western slope of Vacaville Hills, Potrero Hills, western border of Montezuma Hills, and north slope of Los Medanos Hills. Type section not designated, but unit typically exposed in extreme northeast corner of Mount Vaca quadrangle and northwest corner of Vacaville quadrangle along highway which follows south side of Putah Creek.

**Wolsey Shale**[1] **or Formation**

Wolsey Shale (in Gros Ventre Group)

Wolsey Shale Member (of Gros Ventre Formation)

Middle Cambrian: Western Montana and northwestern Wyoming.

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, 1328–1330, strat. sections. Weed's original definition emended; new type section designated as exposure referred to by Weed, near dam on Sheep Creek, is now covered. Conformably overlies Flathead sandstone (emended) wherever these formations are exposed in Montana and Yellowstone National Park; underlies Meagher limestone (emended). Deposit clearly transitional between subjacent and superjacent formations. Lower part of Wolsey is dominantly dull-green to greenish-gray shale, interbedded with thin lenses of sandstone; worm trails, *Cruziana*, and borings common. Middle part of formation is nearly pure micaceous paper-thin shale and occasional thin platy intercalated beds of rusty-weathering sandstone, which in upper part is often slightly calcareous and usually contains worm borings; several zones of chocolate-brown fissile shales interbedded with the characteristically green shales; intercalated limestone lenses. Upper third consists of fissile shales, dominantly chocolate- to maroon-brown in upper part; intercalated thin beds of gray crystalline limestone, which contain iron and glauconite; fossils present in the limestone lenses and in fissile maroon and green shales, and are largely concentrated into two zones. In type section, upper of these two zones occurs 10 to 24 feet below top of Wolsey, and lower occurs 25 to 50 feet below upper zone. Thickness at type section 174 feet; maximum thickness 363 feet, Beaver Creek. Type section of emended Wolsey is on south end of South Hill in Belt Park; best exposure is on Crowfoot Ridge, Yellowstone National Park. [See Flathead Quartzite.]

Charles Deiss, 1938, Geol. Soc. America Bull., v. 49, no. 7, p. 1089. Deiss (1933, Montana Bur. Mines and Geology Mem. 6) divided Cambrian rocks of northwestern Montana into 11 formations. Second in sequence was Wolsey shale. This sequence is herein revised, and Walcott's name Gordon is used instead of Wolsey for shale which lies upon Flathead sandstone and underlies Damnation limestone (redefined).

A. B. Shaw and P. O. McGrew, 1954, Wyoming Geol. Assoc. Guidebook 9th Ann. Field Conf., Chart 2. Gros Ventre group in western Wyoming includes three mappable formations (ascending): Wolsey shale, Death Canyon limestone, and Park shale.

H. R. Wanless, R. L. Belknap, and Helen Foster, 1955, Geol. Soc. America Mem. 63, p. 12–13. In this report, the Wolsey is considered basal member of Gros Ventre formation. Underlies Meagher limestone member; overlies Flathead sandstone. Thicknesses: 86 feet, Gros Ventre Range; 134 feet, Teton Range; 607 feet, Snake River Range.

M. R. Klepper, R. A. Weeks, and E. T. Ruppel, 1957, U.S. Geol. Survey Prof. Paper 292, p. 8, 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. Wolsey shale is 368 feet thick; underlies Meagher limestone, and overlies Flathead quartzite. Upper half of unit is interbedded gray argillaceous limestone and greenish- and yellowish-gray calcareous mudstone and shale; lower half is greenish-gray and drab shale with some interbeds of sandstone and limestone; many beds micaceous, some glauconitic.

Type section (emended): South end of South Hill Belt Park. Little Belt Mountains. Keegan Butte is in central part of sec. 15, T. 14 N., R. 7 E., and isolated hill immediately to south, called South Hill (Deiss, 1936), is in central part of sec. 15, in same township and range. Keegan Butte is near southern edge of Fort Benton quadrangle. and south Hill is near northern edge of Little Belt Mountains quadrangle. Both are from 4 to 6 miles west of Belt Creek section. Field evidence indicates Weed meant South Hill to be type locality of Wolsey, but that he took name Wolsey from post office of that name at a ranch on Sheep Creek. Post office no longer in existence. Named for exposures at dam on Sheep Creek near Wolsey, Meagher County, Mont.

**Wolverine Sandstone**[1] (in Portage Lake Lava Series)

Precambrian (Keweenawan): Northern Michigan.

Original reference: L. L. Hubbard, 1898, Michigan Geol. Survey, v. 6, pt. 2, p. 77, 81, 93.

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 outcrops near Wolverine mine, Houghton County.

**Wolverine Canyon Limestone Member** (of Preuss Sandstone)

Upper Jurassic: Southeastern Idaho.

R. W. Imlay, 1952, Am. Assoc. Petroleum Geologists Bull., v. 36, no. 9, p. 1741–1743. Consists mainly of yellowish gray sandy thin- to medium-bedded limestone but including some yellowish thin-bedded sandstone and containing, a little above the middle, one prominent unit of cliff-forming oolite 14 feet or more in thickness. Upper part of oolite crumbly and less massive then lower part and bears corals and algal-like markings or, locally, numerous gastropods and pelecypods. Member is 193 feet thick at type section, where it is bounded above and below by sandstones of the Preuss.

Type section: North slope of Wolverine Canyon is west-central part of sec. 27, T. 1 S., R. 39 E., Bingham County. Main area of outcrop is in Ammon quadrangle from Wolverine Canyon northward 5 miles to headwaters of Henry Creek. Excellent exposures occur along ridges at head of Dry Fork of Henry Creek.

Womac Coal Member (of Modesto Formation)

Pennsylvanian: Southwestern Illinois.

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 37, 38, 49 (table 1), 68, pl. 1. Proposed for coal formerly called Macoupin coal. Name Macoupin restricted to Macoupin limestone. Thickness 8 inches. Stratigraphically above Burroughs limestone member and below Macoupin limestone member. Presentation of new rock-stratigraphic classification of Pennsylvanian of Illinois. Cyclical classification retained but is entirely independent of rock-stratigraphic classification.

Type locality: NE¼NW¼ sec. 2, T. 9 N., R. 7 W., Macoupin County. Named for village of Womac approximately 3 miles northeast of type exposure.

Womack Gneiss[1]

Precambrian: Eastern Colorado.

Original reference: L. C. Graton, 1906, U.S. Geol. Survey Prof. Paper 54.

Named for Womack Hill, at east edge of town of Cripple Creek, Teller County.

**Womble Shale,**[1] **Schistose Sandstone,**[1] or **Formation**

Lower and Middle Ordovician: Southwestern Arkansas and southern Oklahoma.

Original reference: H. D. Miser, 1917, U.S. Geol. Survey Bull. 600, p. 67.

August Goldstein, Jr., and T. A. Hendricks, 1953, Geol. Soc. America Bull., v. 64, no. 4, p. 424 (fig. 2). Formation consists of shale, black to green, with thin layers of limestone and argillaceous sandstone in Arkansas. Predominantly schistose, micaceous, chloritic sandstone in McCurtain County, Okla. Thickness 250 to 1,000 feet. Underlies Bigfork formation; overlies Blakely formation.

W. D. Pitt, 1955, Oklahoma Geol. Survey Circ. 34, p. 23, 24–25. Womble shale, as defined in this report (core of Ouachita Mountains), includes stratigraphic interval between Mazarn shale below and Bigfork chert above. As originally defined, Blakely sandstone lies stratigraphically above Mazarn shale and below Womble shale. A series of beds distinct lithologically from Mazarn shale below and Womble siltstone above was noted at some localities. This [unit] could be designated as separate formation, but if it were designated in this way, it is recommended that it not be called Blakely because of findings of current field work in Blakely sandstone type area in Arkansas.

Type section: Crystal Mountain, Ark. Named for town of Womble (now called Norman).

Wompats limestone[1] (in Aubreyan series)

Carbonic: Northern Arizona.

Original reference: C. R. Keyes, 1922, Pan-Am. Geologist, v. 38, p. 251, 339.

Charles Keyes, 1936, Pan-Am. Geologist, v. 66, no. 3, p. 215 (chart), 223, Underlies Kanab limestones (new). Of Carbonic age. Spelled Wombats on page 223.

Named for Wompats Spring, northeast of great Shinumo Amphitheater, Grand Canyon.

Wonder Rhyolite[1]

Tertiary: Central western Nevada.

Original reference: J. A. Burgess, 1917, Econ. Geology, v. 12, no. 7, p. 589–593.

Quarried in Nevada Wonder mine, Wonder district, Churchill County.

**Wonder Lake Glaciation**

Pleistocene: South-central Alaska.

A. T. Fernald, 1960, U.S. Geol. Survey Bull. 1071–G, p. 232 (chart). Named on correlation chart. Correlated with Farewell, Riley Creek, and Donnelly glaciations. Younger than Slow Fork glaciation (new). Name credited to J. C. Reed, Jr.

In Mount McKinley area.

**Wood Shale Tongue** (of Ankareh Formation)

Wood Shale[1]

Upper Triassic: Southeastern Idaho, central northern Utah, and central western Wyoming.

Original references: G. R. Mansfield, 1915, Washington Acad. Sci. Jour., v. 5, p. 492; 1916, Washington Acad. Sci. Jour., v. 6, p. 41.

J. S. Williams, 1945, Am. Jour. Sci., v. 243, no. 9, p. 473, 476–477. Use of term Wood shale extended to Park City area, Utah, to replace upper part of Ankareh shale, latter being stratigraphically restricted. Upper Triassic.

G. R. Mansfield, 1952, U.S. Geol. Survey Prof. Paper 238, p. 17, 35, pl. 1. Type locality designated. Mapped in Ammon and Paradise Valley quadrangles where rock is primarily bright-red sandy shale or shaly sandstone. Locally contains purplish and green shale in addition to red beds.

Bernhard Kummel, 1954, U.S. Geol. Survey Prof. Paper 254–H, p. 180, 181, fig. 18. Unit considered to be westward extending tongue of Ankareh formation in western Wyoming and southeastern Idaho. Thickness approximately 250 feet at Spring Canyon, 40 feet at Cokesville, and 400 feet at Hot Springs. Upper Triassic.

Type locality: On Wood Creek, from which unit takes its name, in T. 3 S., R. 38 E., less than 2 miles west of Paradise Valley quadrangle, Idaho.

**Woodbine Sand,[1] Clay,[1] or Formation**

Woodbine Group

Upper Cretaceous (Gulf Series): Texas, southwestern Arkansas, western Louisiana, and central southern and southeastern Oklahoma.

Original reference: R. T. Hill, 1901, U.S. Geol. Survey 21st Ann. Rept., pt. 7, p. 293.

R. T. Hazzard, B. W. Blanpied, and W. C. Spooner, [1947], Shreveport Geol. Soc. 1945 Reference Rept., v. 2, p. 475, 476, 477, 480. Woodbine group comprises (ascending) Euless formation (new) with basal Dexter sand member, Lewisville formation with basal Pine Bluff tuffaceous gravelly member, and Eagle Ford formation with Tarrant member. Unconformably overlies South Tyler formation (new); unconformably underlies Austin chalk.

H. R. Bergquist, 1949, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 98. Formation crops out in belt a few miles wide to form Eastern Cross Timbers area between Black and Grand Prairies of northeastern Texas. Belt extends northward from Hill County nearly to the Red River, but from northeastern Cooke County, it trends southeast across Grayson County into northwestern part of Fannin County. Along this belt, formation consists of varied and interlensing sequence of nonmarine, brackish water, and marine beds of sand, shale, clay, and sandstone about 350 feet thick. Seemingly lies unconformably on Washita group and older beds of Comanche series. At some places, Grayson marl appears to grade upward into Woodbine and it is difficult to determine where unconformity occurs. At these places, Woodbine appears to be conformable with fossiliferous clay and shale younger than Grayson marl. Top of Woodbine of Red River area is about 40 or 50 feet below base of *Metoicoceras whitei* zone of lower Eagle Ford shale. Sequence exposed in Cooke, Grayson, and Fannin Counties is divided into (ascending) Dexter, Red Branch (new), Lewisville, and Templeton (new) members.

W. S. Adkins and F. E. Lozo *in* F. E. Lozo, 1951, Fondren Sci. Series, no. 4, p. 105–161, pls. Report is symposium on Woodbine group and adjacent strata. Relationships of Woodbine with Eagle Ford and Comanchean beds discussed in detail. Pepper shale is believed to be southward continuation of part of Woodbine group (Lewisville formation) in north-central Texas. In Dallas, McLennan, and Travis Counties, the Woodbine underlies Lake Waco formation (new).

L. W. Stephenson, 1952, U.S. Geol. Survey Prof. Paper 242, p. 1–226, pls. Woodbine formation, as originally defined, is made up of deposits laid down in fresh, brackish, and very shallow marine waters. Formation intervens between deeper marine facies of Comanche series below and Eagle Ford and younger formations above. Basal unit of Woodbine is Dexter member which consists chiefly of nonmarine sands interbedded with clays, but includes also important marine fossil-bearing zones in Tarrant and Denton Counties. Dexter is overlain in different areas by nearly contemporaneous nonmarine carbonaceous shales and tuffaceous sandstones of Red Branch member and marine shaly beds of Euless member. These in turn are overlain by marine sandy shales and sandstones of Lewisville member, and these by marine shales and minor sands of Templeton member. Hazzard, Blanpied, and Spooner's classification discussed and reasons cited for not accepting it. As used in present report, name Euless member is restricted to an upper shale unit between Dexter member and Lewisville member. So-called Pine Bluff member is part of Lewisville member and "Tarrant" unit is also considered part of Lewisville. Systematic description of larger invertebrate fossils.

L. W. Stephenson, 1953, U.S. Geol. Survey Prof. Paper 243–E, p. 57–66, pls. Includes Pepper shale member. Evidence afforded by assemblage of mulluscan fossils from Pepper shale confirms conclusion that the Pepper is southward extension of the Woodbine, and is probably extension of Lewisville member.

L. V. Davis, 1960, Oklahoma Geol. Survey Bull. 86, p. 39–42. Formation described in McCurtain County, where it is as much as 355 feet thick. Lower member is principally crossbedded dark tuffaceous sand, red clay, and gravel lentils. Upper member mostly gray to brown crossbedded quartz sand and sandy gravel. Unconformably underlies Tokio formation; unconformably overlies Washita group.

Named for exposures at Woodbine, Cooke County, Tex.

Woodbridge fire clay[1] (in Raritan Formation)

Cretaceous: Northeastern New Jersey.

Original reference: G. H. Cook and J. C. Smock, 1877, Map of clay district of Middlesex County. New Jersey Geol. Survey; G. H. Cook, 1878, New Jersey Geol. Survey Rept. on clays, p. 34.

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. 66, 103–104. Overlies Farrington sand member (new); underlies Sayreville sand member (new). Thickness 50 to 90 feet.

Named for occurrence at Woodbridge, Middlesex County.

**Woodburn Limestone Member** (of Cynthiana Formation)

Woodburn Limestone

Woodburn Phosphatic Member (of Brannon Limestone)

Woodburn Phosphatic Member (of Flanagan Limestone)[1]

Middle Ordovician: North-central Kentucky.

Original reference: A. M. Miller, 1913, Kentucky Geol. Survey, 4th ser., v. 1, pt. 1, p. 326.

D. K. Hamilton, 1948, Econ. Geology, v. 43, no. 1, p. 41 (fig. 2), 42. Woodburn limestone in Lexington area is about 40 feet thick and consists of coarsely crystalline phosphatic limestone. Overlies Brannon limestone; underlies Perryville limestone.

A. C. McFarlan, 1948, Am. Assoc. Petroleum Geologists Bull., v. 32, no. 8, p. 1636–1637. Referred to as phosphatic member of Brannon limestone.

D. K. Hamilton, 1950, Kentucky Geol. Survey, ser. 9, Bull. 5, p. 17, 18. Rank reduced to member status in Cynthiana formation.

Named for celebrated Alexander Estate in Woodford County.

**Woodbury Clay** (in Matawan Group)[1]

Woodbury 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, 26–28. Member of Matawan which is here reduced to formational rank. Underlies Marshalltown member; overlies and apparently grades into Merchantville member. Thickness about 50 feet.

J. P. Minard and J. P. Owens, 1960, U.S. Geol. Survey Prof. Paper 400–B, p. B184. Formation in Matawan group. Overlies Merchantville formation; underlies Englishtown formation. Average dip SE. 40 feet per mile. Thickness 50 feet.

Named for exposures in railway cut at Woodbury, Gloucester County.

Woodbury cyclothem (in McLeansboro Group)

Woodbury cyclothem (in Mattoon Formation)

Pennsylvanian: Southeastern Illinois.

W. A. Newton and J. M. Weller, 1937, Illinois Geol. Survey Rept. Inv. 45, p. 9, 28–30; J. M. Weller, 1942, Illinois Acad. Sci. Trans., v. 35, no. 2, p. 145 (table 1). Uppermost cyclothem exposed in area. Occurs above Greenup cyclothem (new) in Cumberland County and above the Gila cyclothem in Jasper County.

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 53 (table 2), pl. 1. In Mattoon formation (new). Above Gila cyclothem and below Newton cyclothem. Presentation of new rock-stratigraphic classification of Pennsylvanian strata in Illinois; cyclical classification is independent of rock-stratigraphic classification.

Type locality: Along Webster Creek just north of Jasper County line about 2 miles southwest of Woodbury, Cumberland County.

†Woodbury Formation[1]

Upper Cretaceous: Northwestern Iowa.

Original reference: C. A. White, 1870, Iowa Geol. Survey, v. 1, p. 26. 291–293.

Named for Woodbury County.

Woodbury Granite[1]

Devonian: Northeastern Vermont.

Original reference: C. H. Richardson, 1906, Vermont State Geologist 5th Rept.

Quarried in Woodbury Township, Washington County.

†Woodbury Granite

Devonian or post-Devonian: West-central Connecticut.

R. M. Gates, 1951, Connecticut Geol. Nat. History Survey Misc. Ser. 3, p. 3, 5, 11–12. Described as intrusive into Hartland formation. Texture varies from aplitic to pegmatitic.

R. M. Gates *in* R. M. Gates and W. C. Bradley, 1952, Connecticut Geol. Nat. History Survey Misc. Ser. 5, p. 12, 14. Both granite and associated granite gneisses were formerly termed Thomaston granite. Name Woodbury restricted to intrusive granite. Age tentatively designated Devonian or younger. Type occurrence given.

R. M. Gates, 1954, Connecticut Geol. Nat. History Survey Quad. Rept. 3, p. 3 (footnote). Name abandoned to avoid confusion with Woodbury granite in Vermont. Replaced by Nonewaug granite.

Type occurrence: Northern half of Woodbury quadrangle west of Watertown.

Woodbury Limestone Member (of Mattoon Formation)

Woodbury Limestone (in McLeansboro Group)

Pennsylvanian: Southeastern Illinois.

H. R. Wanless, 1939, Geol. Soc. America Spec. Paper 17, p. 108. Thin marine limestone in upper part of McLeansboro, between Shumway above and Gila coals.

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

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 40, 41, 51 (table 1), 78, pl. 1. Assigned member status in Mattoon formation (new). Above Gila limestone member and below Reisner limestone member (new). Thickness about 7 inches at type outcrop. Presentation of new rock-stratigraphic classification of Pennsylvanian strata in Illinois; cyclical classification independent of rock-stratigraphic classification.

Type locality: SE½SE¼ sec. 32, T. 9 N., R. 8 E., Cumberland County.

Woodbury Creek Member (of Esopus Formation)

Lower Devonian: Southeastern New York.

A. J. Boucot, 1959, Jour. Paleontology, v. 33, no. 5, p. 728, 731 (fig. 2), 734. Consists of interbedded brown-weathering medium- to fine-grained sandstone, blue gray where fresh. Fossiliferous. Thickness about 50 feet. Gradationally overlies unnamed middle member of formation; contact with overlying Kanouse sandstone not exposed, but strata on either side of contact are conformable.

Type section: Thruway cut at Highland Mills, Orange County. Unit known only from this area. Name derived from Woodbury Creek which is adjacent to exposures of member in railroad cut at Highland Mills. Section is located on eastern side of Green Pond-Schunemunk Mountain outlier.

**Wood Canyon Formation**[1]

Precambrian and Lower Cambrian: Southeastern Nevada and eastern California.

Original reference: T. B. Nolan, 1928, Am. Jour. Sci., 5th, v. 17, p. 461–472.

J. C. Hazzard, 1937, California Jour. Mines and Geology, v. 33, no. 4, p. 278 (fig. 3d), 307–312. Geographically extended into Nopah-Resting Springs area, Inyo County, Calif., where it is about 3,033 feet thick and includes Zabriskie quartzite member (new) in upper half. Overlies Stirling quartzite; underlies Cadiz formation.

R. H. Hopper, 1947, Geol. Soc. America Bull., v. 58, no. 5, p. 404 (fig. 1), 406–407. Formation, in Panamint Range, is about 2,600 feet thick and consists largely of quartzite, but with some limestone and shale in upper part. Includes Zabriskie quartzite member. Overlies Stirling(?) quartzite; underlies unnamed Cambrian and Lower Ordovician dolomite and limestone. Lower Cambrian.

H. E. Wheeler, 1948, Nevada Univ. Bull., Geology and Mining Ser., no. 47, p. 24 (fig. 3), 25–26, fig. 5. As defined in this report, includes strata above Prospect Mountain quartzite and below Zabriskie quartzite, here given formational rank. This restricts Hazzard's 1938 [1937] section both above and below. On basis of establishment of base of zone of *Olenellus* as base of Cambrian, basal 343 feet of Wood Canyon formation in Nopah Range appears to belong to latest Precambrian and upper 363 feet to Lower Cambrian. On the basis of lithology and fauna, formation is correlated with Lower Cambrian Wood Canyon formation of northwestern part of Spring Mountain, Nev. (Nolan, 1929 [1928]) although it includes more beds than were placed in formation by Nolan at type locality.

B. K. Johnston, 1957, California Univ. Pubs. Geol. Sci., v. 30, no. 5, p. 377–380, 381 (fig. 8), figs. 1 (geol. map), 2 (columnar section). Described in Manly Peak quadrangle, southern Panamint Range, Calif., where it is mostly quartzite and quartz-rich sandstone, with large amounts of siltstone and shale and some limestone and dolomite. Comprises two sections that are not in depositional contact and do not overlap. Lower section about 1,600 feet thick; upper section, about 700 feet thick, includes Zabriskie quartzite member. In fault contact with Archean gneiss; conformably underlies Lotus formation (new). Considered both Cambrian and Precambrian in age.

U.S. Geological Survey currently designates the age of the Wood Canyon as Precambrian and Lower Cambrian on the basis of a study now in progress.

Named for exposures in Wood Canyon, about 4 miles south of Crystal Springs, on west side of Spring Mountains, Clark County, Nev.

**Woodchopper Volcanics**[1]

Middle Devonian: Northeastern Alaska.

Original reference: J. B. Mertie, Jr., 1930, U.S. Geol. Survey Bull. 816, p. 75–80, 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.

Exposed on Woodchopper Creek at and below Woodchopper, Eagle-Circle district.

Woodcock Member (of Venango Formation)

Woodcock Sandstone[1]

Upper Devonian: Northwestern Pennsylvania.

Original reference: G. H. Chadwick, 1925, Geol. Soc. America Bull., v. 36, no. 3, p. 457–464.

Bradford Willard, 1937, Pennsylvania Acad. Sci. Proc., v. 11, p. 32. Shown on generalized succession of marine Upper Devonian as member of Venango formation above Saegerstown member and below Roystone member of Riceville formation.

G. A. Cooper and others, 1942, Geol. Soc. America Bull., v. 53, no. 12, pt. 1, chart 4. Woodcock sandstone shown on correlation chart above Saegerstown [formation] and below Oswayo formation. Upper Devonian.

Named for exposures along Woodcock Creek, Woodcock Township, Crawford County.

Wood Creek Beds[1]

Upper Ordovician: Northern New York.

Original reference: R. Ruedemann, 1925, New York State Mus. Bull. 258, p. 90–95, 137, 141, 149, 154.

Well exposed along Wood Creek, between Lee's Center and Stokes, 7 miles northwest of Rome, Oneida County, and in Lorraine Gulf.

**Woodford Chert[1] or Shale**

Devonian and Mississippian: Central southern and southeastern Oklahoma.

Original reference: J. A. Taff, 1902, U.S. Geol. Survey Geol. Atlas, Folio 79.

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.

S. P. Ellison, Jr., 1946, Am. Assoc. Petroleum Geologists Bull., v. 30, no. 1, p. 93–110. Discussion of conodonts as Paleozoic guide fossils and problem of correlation among beds containing upper Devonian conodonts and fossil wood. Woodford formation and Arkansas novaculite are part of this correlation problem. However, assignment of Devonian age to Woodford is not acceptable to many stratigraphers.

T. A. Hendricks, L. S. Gardner, and M. M. Knechtel, 1947, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 66. In western part of Ouachita Mountains in block southeast of Pine Mountain fault, Woodford chert unconformably overlies Pinetop chert. Basal 7 feet consist of white chert breccia or conglomerate containing some lenses of very fine grained crystalline limestone. Upper part consists of alternating beds of black papery shale that weather light gray, and black chert in beds 1 to 4 inches thick. Contains abundant round and discoidal phosphate nodules and conodonts. Thickness about 67 feet. Table shows Woodford chert separated from upper part of Arkansas novaculite. Upper Devonian(?). Correlated with Chattanooga shale, Woodford chert of Arbuckle Mountains, and upper part of Arkansas novaculite.

J. M. Weller and others, 1948, Geol. Soc. America Bull., v. 59, no. 2, p. 145, chart 5 (columns 55, 56). Woodford chert shown on correlation chart as Kinderhookian. Locally contains considerable black shale of Chattanooga type, and the two formations are known to be continuous in subsurface although beds of later Kinderhookian age have not been identified and are probably not represented in Chattanooga as it is developed in Ozark region. Woodford overlies older formations with conspicuous unconformity and in subsurface locally overlaps onto Arbuckle limestone.

H. D. Miser and others, 1954, Geologic map of Oklahoma (1:500,000): U.S. Geol. Survey. Woodford shale and Woodford chert mapped as Devonian and Mississippian.

T. W. Amsden, 1957, Oklahoma Geol. Survey Circ. 44, p. 6 (fig. 2), 48–49, fig. 3. Throughout Arbuckle region Hunton group is unconformably overlain by Woodford shale. Erosional interval separating Woodford from Hunton is considerable, so this shale may be in contact with any of Hunton formations or members, and in places Woodford rests directly on Sylvan shale.

J. D. Prestridge, 1959, *in* Petroleum geology in southern Oklahoma, v. 2: Tulsa, Am. Assoc. Petroleum Geologists, p. 158 (fig. 2), 161. Underlies Cornell Ranch member (new) of Sycamore formation. Uppermost Wooford is Kinderhookian.

Named for exposures about one-fourth mile north of Woodford, Carter County.

†Woodford Gneiss[1]

Precambrian: Southwestern Vermont.

Original reference: F. A. Burt, 1929, Vermont State Geologist 16th Rept., p. 68–69.

Probably named for Woodford village or Woodford Township, Bennington County.

Woodfordian Substage

Pleistocene (Wisconsinan): Illinois.

J. C. Frye and H. B. Willman, 1960, Illinois Geol. Survey Circ. 285, p. 1, 2 (fig. 1), 6–8. Wisconsinan stage of Lake Michigan lobe is subdivided into (ascending) Altonian, Farmdalian, Woodfordian, Twocreekan, and Valderan substages. Woodfordian is based on pre-Shelbyville Morton loess (new) that overlies Farmdale silt, and succession of progressively younger moraines extending from the Shelbyville to, but not including, the Valders. Stratigraphically terminated upward by Two Creeks forest bed of Wisconsin. From former classification Woodfordian includes Iowan substage of Illinois usage (but not of the type), the type Tazewell and Cary substages, it includes that part of the Cary that has recently been assigned to Mankato (Leighton, 1957). On the basis of numerous dates, the total time span of Woodfordian is less than 10,000 radiocarbon years. Includes Peoria loess and Richland loess (new). Also contains about 30 recognized end moraines.

Name derived from Woodford County which is just north of Shelbyville moraine and is crossed by Bloomington, Metamora, Normal, and Cropsey moraines.

Woodglen Limestone (in Washington Group)

Permian (Dunkard): Southeastern Pennsylvania.

W. O. Hickok 4th and F. T. Moyer, 1940, Pennsylvania Geol. Survey, ser. 4, Bull. C–26, p. 147–148. Name given to gray to dark fine-grained homogeneous nonfossiliferous limestone which breaks with conchoidal fracture. Maximum thickness 10 feet, average about 7 feet. Underlies Lower Mannington sandstone; commonly overlies clay shale or sandy shale below which is Colvin Run limestone. Included in lower part of Washington group.

Well exposed in Hugh Murphy quarry just northeast of Woodglen, Fayette County.

Woodhams Formation

Miocene (Relizian?) : Northern California.

R. M. Touring, 1959, Dissert. Abs., v. 20, no. 4, p. 1325. Name given to about 500 feet of siliceous mudstone and foraminiferal shales which conformably overlie Mindego formation (new) near east edge of La Honda quadrangle.

Area of report is in Santa Cruz Mountains, 30 to 40 miles south of San Francisco.

Woodhill Member (of Franconia Formation)

Upper Cambrian: Central Wisconsin and southeastern Minnesota.

R. R. Berg, 1951, Minnesota Geologist, v. 8, no. 4, p. 1. Proposed for basal member of Franconia. At type locality, consists of lower coarse-grained, poorly sorted sandstone 13 feet thick overlain by a medium-grained well-sorted sandstone 17 feet thick; in all outcrops, base of member is characterized by coarse-grained sandstone that overlies uniformly medium-grained Galesville sandstone member of Dresbach formation. Maximum thickness 44 feet in Houston County, Minn. Underlies Birkmose member (new).

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, 871. Term Ironton member had previously been applied to basal unit of Franconia; although defined as lithic unit (Ulrich, 1924, Wisconsin Acad. Sci. Trans., Arts, and Letters, v. 21), "Ironton member" came to mean all beds containing *Elvinia* fauna, and new name that did not carry faunal connotation became advisable.

Type locality: Roadcuts on State Highway 80 at Wood Hill, SE¼ sec. 3, T. 15 N., R. 2 E., Juneau County, Wis.

Woodhouse Clay (in Ogallala Formation)[1]

Woodhouse Formation

Miocene or Pliocene: Western Kansas.

Original reference: M. K. Elias, 1931, Kansas Geol. Survey Bull. 18, p. 155.

M. K. Elias, 1937, Kansas Geol. Survey Mineral Resources Circ. 7, p. 8. Woodhouse formation in Rawlins and Decatur Counties described as local clayey formation that is wedged in between sandy Ogallala beds above and Pierre shale below. Consists of silts and fine silty sands, with coarses sand to conglomerate at base, and chocolate to maroon plastic clays in upper part. Thickness as much as 60 feet.

Type locality: One mile west of Woodhouse Ranch, Wallace County.

**Woodhurst Limestone Member** (of Lodgepole Limestone)

Woodhurst Limestone Member (of Madison Limestone)[1]

Lower Mississippian: Central northern, central southern, and southwestern Montana.

Original reference: W. H. Weed, 1899, U.S. Geol. Survey Geol. Atlas, Folio 56.

L. L. Sloss and R. H. Hamblin, 1942, Am. Assoc. Petroleum Geologists Bull, v. 26, no. 3, p. 315, 317, 319, 320, 321–322, 324. Reallocated to member status in Lodgepole limestone; overlies Paine member; underlies Mission Canyon limestone. Thickness 240 to 570 feet.

First described in vicinity of Woodhurst Mountain, northeastern part Little Belt Mountains quadrangle.

**Woodland Gneiss**

Precambrian: Central western Georgia.

D. F. Hewett and G. W. Crickmay, 1937, U.S. Geol. Survey Water-Supply Paper 819, p. 29–30, pl. 1. Largely coarse-grained biotite augen gneiss. Persistently underlies basal bed of Hollis quartzite; 100 feet or more of gneiss immediately underneath quartzite is thinly laminated, locally schistose; progressively lower or deeper in the mass, the lamination is more widely spaced, and rock assumes common gneissic texture; because gneiss is most completely metamorphosed of the igneous rocks of the region, it is assumed to be the oldest. Intruded by Cunningham granite (new).

J. W. Clarke, 1952, Georgia Geol. Survey Bull. 59, p. 6 (table), 7–11. Precambrian(?).

Named for Woodland, Talbot County. Confined to belt that lies between Pine and Oak Mountains, south of Towaliga fault; also present in Thomaston quadrangle.

Woodland Trachyte[1]

Age(?) : Northeastern Maine.

Original reference: H. E. Gregory, 1900, U.S. Geol. Survey Bull. 165, p. 109, 110, 164.

Forms low hills along branch of Caribou Stream, in Woodland Township, Aroostook County.

**Woodman Formation**[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, chart 5 (column 30). Shown on correlation chart above Madison limestone and below Ochre Mountain limestone.

Named for the fact that it underlies Woodman Peak on south end of Dutch Mountain, Gold Hill region.

Woodmansie phase (of Bridgeton Formation)[1]

Pleistocene: New Jersey.

Original reference: R. D. Salisbury and G. N. Knapp, 1917, New Jersey Geol. Survey, v. 8, p. 11, 62.

Probably named for occurrence at or near Woodmansie, Burlington County.

**Woodmont Shale**

**Woodmont Shale Member** (of Jennings Formation)[1]

Upper Devonian: Western Maryland, southern Pennsylvania, and northern West Virginia.

Original reference: C. K. Swartz and others, 1913, Maryland Geol. Survey Lower Devonian volume, p. 26; 1913, Middle and Upper Devonian volume, p. 411, 412.

Ernst Cloos, 1951, Maryland Dept. Geology, Mines and Water Resources Washington County [Rept. 14], p. 90–91. In Washington County, Md., varies in thickness between 1,600 feet in eastern and 1,200 to 1,300 feet in western sections. Conformably overlies Genesee member or, where latter is lacking, rests on Romney shale; underlies Parkhead sandstone member.

Named from Woodmont Station, Washington County, Md., one-half mile east of which it is well exposed in cut of Western Maryland Railroad.

Woodpecker limestone[1]

Devonian: East-central Nevada.

Original references: C. R. Keyes, 1923, Pan-Am. Geologist, v. 40, p. 52; 1924, Pan-Am. Geologist, v. 41, p. 79.

Name derived from Woodpecker Peak, Eureka district.

**Woodpecker Limestone Member** (of Nevada Formation)

Middle Devonian: Central Nevada.

T. B. Nolan, C. W. Merriam, and J. S. Williams, 1956, U.S. Geol. Survey Prof. Paper 276, p. 41, 44–45, pl. 2. Made up of thin- to medium-bedded limestone not uncommonly sandy or argillaceous. Limestones fine grained to aphanitic or porcellaneous and light olive gray to dark gray. Weathering of shaly partings produces pinkish or yellowish colors. Thickness ranges from 220 through 450 feet. Lower boundary notably gradational with underlying Sentinel Mountain dolomite member (new) whereas contact with overlying Bay State dolomite member (new) is quite sharp being marked by varying thickness of light-gray dolomite sand at base of Bay State dolomite member. Calcareous nature of unit between the two dolomite members serves to distinguish it.

Type locality: In gulch draining south slope of Woodpeckers Peak, which is situated on north boundary of Oxyoke Canyon, in vicinity of Eureka.

**Wood River Formation**[1]

Pennsylvanian and Permian: Southern central Idaho.

Original reference: W. Lindgren, 1900, U.S. Geol. Survey 20th Ann. Rept., pt. 3, p. 89–90, 193–195, pl. 8.

D. A. Bostwick, 1955, Jour. Paleontology, v. 29, no. 6, p. 941–951. Formation, with exception of several hundred feet of conglomerates and limestones near base, is succession of calcareous sandstones and arenaceous limestones of 12,000 feet maximal thickness. Near Bellevue, contains fusulinids that compare closely with those of Desmoinesian, Virgilian, and Wolfcampian ages in rocks of Midcontinent and Southwest regions.

M. R. Thomasson, 1959, Dissert, Abs., v. 20, no. 3, p. 999. Subdivided into (ascending) Hailey, Slate Creek (Desmoinesian-Missourian), Lake Creek (Virgilian), and Wilson Creek (Wolfcampian) members. Overlies Muldoon formation (new). Wood River and Muldoon are time equivalents of Lemhi formation (new).

H. J. Bissell, 1960, Am. Assoc. Petroleum Geologists Bull., v. 44, no. 8, p. 1427 (fig. 3). Correlation chart shows that Wood River formation in Bellevue area comprises (ascending) Hailey member, unnamed lower sandy limestones, and upper calcareous sandstones and sandy limestones. Uncomformable above Milligen formation and below Phosphoria. Morrowan-Leonardian.

C. P. Ross, 1960, U.S. Geol. Survey Prof. Paper 400–B, p. B232. Discussion of interfingering Carboniferous strata in Mackay quadrangle, Idaho. Wood River where exposed west of Mackay quadrangle is lithologically diverse, but is characterized by abundant sandy beds, and, especially near base, by abundant conglomerate, part of it coarse and in thick layers. Formation has been regarded as of Pennsylvanian age, but microfossils (Bostwick, 1955), discovered since formation was defined, have shown that large thicknesses of beds assigned to it by Bostwick are of Permian age. These beds have nowhere been mapped separately. Formation west of Mackay quadrangle is probably at least 8,000 feet thick, and may be much thicker if beds containing Permian fossils are included in it. Beds definitely assignable to Wood River are now known to occur east of western part of Mackay quadrangle, but name has been used tentatively as far east as Montana boundary.

First described in vicinity of Hailey, Blaine County.

†Woods Bluff Group[1] or Series[1]

Eocene, lower: Southern Alabama and southeastern Mississippi.

Original reference: A. Heilprin, 1882, Philadelphia Acad. Nat. Sci. Proc. 1881, p. 158–159.

Named for exposures at Woods Bluff, on Tombigbee River, in northwestern part of Clarke County, Ala.

Woods Bluff Marl (in Bashi Formation)[1]

Eocene, lower: Southwestern Alabama.

Original reference: A. Heilprin, 1882, Philadelphia Acad. Nat. Sci. Proc. 1881, p. 157.

Named for exposures at Woods Bluff, on Tombigbee River, in northwestern part of Clarke County.

Woods Corners Group

Middle Cambrian: Northwestern Vermont.

A. B. Shaw, 1958, Geol. Soc. America Bull., v. 69, no. 5, p. 532 (fig. 5), 533 (fig. 6), 536. Proposed for entire succession between Rugg Brook dolomite below and Gorge formation above. Includes (ascending) St. Albans slate, Mill River conglomerate, Skeels Corners slate, Rockledge conglomerate, and its northern equivalent Saxe Brook dolomite, and Hungerford slate.

Name is taken from alternate local name for Skeels Corners, 5 miles north of St. Albans, St. Albans quadrangle.

Woods Hole Shale

Probably lapsus for **Woods Hollow shale.**

**Woods Hollow Shale**[1]

Middle Ordovician: Southwestern Texas.

Original reference: P. B. King, 1931, Am. Assoc. Petroleum Geologists Bull., v. 15, no. 9, p. 1066, 1071–1072.

W. B. N. Berry, 1960, Texas Univ. Bur. Econ. Geology Pub. 6005, p. 23–27, strat. sections. Graptolite fauna discussed. Underlies Maravillas chert; overlies Fort Pena formation.

Named for exposures in Woods Hollow Mountains between Woods Hollow and Little Woods Hollow, in anticlinal valley on former Louis Granger Ranch, Brewster County.

**Woodside Formation, Siltstone, or Redbeds**

Woodside Shale[1]

Lower Triassic: Northeastern Utah, southeastern Idaho, southwestern Montana, and southwestern Wyoming.

Original reference: J. M. Boutwell, 1907, Jour. Geology, v. 15, p. 439–458.

J. S. Williams, 1939, Am. Assoc. Petroleum Geologists Bull., v. 23, no. 1, p. 91–93. In Uinta Mountains, overlies Phosphoria formation (Rex member); Park City not considered valid term. Concomitantly with thinning of Rex member of Phosphoria, gray and red sandstones and shales appear between the calcareous sandstones and main body of Woodside shale; they are here named Mackentire redbeds tongue of Phosphoria.

H. D. Thomas, 1939, Am. Assoc. Petroleum Geologists Bull., v. 23, no. 8, p. 1249–1250. Discussion of Williams' paper. Proper designation should be Mackentire redbeds tongue of Woodside formation.

H. D. Thomas and M. L. Krueger, 1946, Am. Assoc. Petroleum Geologists Bull., v. 30, no. 8, pt. 1, p. 1268–1270, strat. sections. Along western part of Uinta Mountains, Woodside shale consists of 500 to 800 feet or red to maroon shales, siltstones, and very fine grained sandstones. Type Woodside rests directly above Phosphoria equivalent of Park City. Eastward along Uinta Mountains, it is impossible to separate redbeds of Park City age from true Woodside, and base of Woodside descends in section until at Skull Creek the entire upper Park City is represented by basal Woodside. Underlies Stanaker formation (new) at type section of Stanaker. Underlies Ankareh or Thaynes formations in some areas. Nomenclatural problems discussed.

N. D. Newell, 1948, Geol. Soc. America Bull., v. 59, no. 10, p. 1056 (fig. 2), 1057. Woodside formation in Confusion Range consists of several hundred feet of alternating red shales and sandy limestones. Overlies Phosphoria formation.

Bernhard Kummel, 1954, U.S. Geol. Survey Prof. Paper 254–H, p. 170–171. In type area, consists of approximately 1,000 feet of maroon and red, shaly siltstone; overlies Phosphoria formation and underlies Thaynes formation. Extends over wide area in northern Utah, western Wyoming, and southwestern Montana; tongues out westward in southeastern Idaho and southwestern Montana into Dinwoody formation. Areas of occurrence discussed.

V. E. McKelvey and others, 1956, Am. Assoc. Petroleum Geologists Bull., v. 40, no. 12 p. 2837 (fig. 2), 2842–2843. In central and southern Wasatch Mountains and western Uinta Mountains, overlies Franson member (new) of Phosphoria.

W. W. Rubey, 1958, U.S. Geol. Survey Geol. Quad. Map GQ–109. Referred to as Woodside redbeds in Bedford quadrangle, Wyoming.

R. K. Hose and C. A. Repenning, 1959, Am. Assoc. Petroleum Geologists Bull., v. 43, no. 9, p. 2185–2189. Term Thaynes extended into Confusion Range where it replaces term Woodside as used by Newell (1948).

Named for Woodside Gulch, Park City district, Utah.

**Wood Siding Formation** (in Wabaunsee Group)

Pennsylvanian (Virgil Series): Southeastern Nebraska and eastern Kansas.

G. E. Condra and E. C. Reed, 1943, Nebraska Geol. Survey Bull. 14, p. 41, 42, 43. Name applied to include section between base of the Brownville above and base of the Nebraska City below. This was done because (1) the Nebraska City limestone, with Lorton coal below it, is persistent recognizable marker; (2) nonpersistent Gray Horse limestone, named from Oklahoma, is not good boundary marker between so-called Caneyville formation and Pony Creek as restricted by Moore (1936, Kansas Geol. Survey Bull. 22); and (3) restricted Caneyville and Pony Creek are not good formations in Nebraska. Includes (ascending) Nebraska City limestone, 9 to 10 feet of greenish-gray sandy shale, 6 to 11 feet of gray to brownish limy sandstone, and Pony Creek shale; first three units are the Caneyville formation of Kansas Geological Survey.

G. E. Condra, 1949, Nebraska Geol. Survey Bull. 16, p. 13. Type locality and derivation of name stated.

R. C. Moore and M. R. Mudge, 1956, Am. Assoc. Petroleum Geologists Bull., v. 40, no. 9, p. 2273–2275. As originally defined, formation included approximately 20 feet of beds between former Nebraska City limestone and base of former Brownville limestone. As herein redefined, includes (ascending) Nebraska City limestone, Plumb shale (new), Grayhorse limestone, Pony Creek shale, and Brownville limestone members. Thickness 12 to 50 feet. Underlies Permian Onaga shale (new) ; overlies Root shale (new).

P. B. Greig, 1959, Oklahoma Geol. Survey Bull. 83, p. 62–71. Uppermost formation of Pennsylvanian system in Midcontinent area. As redefined by Moore and Mudge (1956), includes (ascending) Nebraska City limestone, Plumb shale, Grayhorse limestone, Pony Creek shale, and Brownville limestone members. Branson (1956, Oklahoma Geology Notes, v. 16) extended name into Oklahoma and modified Kansas definition to suit transitional sediments of Oklahoma section. As redefined, formation extends downward from top of Brownville limestone to base of lowest recognizable member unit. As result of southward pinchout of Nebraska City limestone member in Osage County, Okla., base of formation is defined by base of "Grayhorse" limestone. South of Pawnee County where "Grayhorse" limestone cannot be recognized, Brownville limestone member constitutes entire formation. In Pawnee County, formation comprises (ascending) "Grayhorse" limestone, Pony Creek shale, and Brownville limestone members. Average thickness in Pawnee County 75 feet. Overlies Gano shale; underlies Admire group.

Type locality: Missouri River bluffs south of Wood Siding Station, Nemaha County, Nebr.

**Woodson Mountain Granodiorite**

Cretaceous: South California.

F. S. Miller, 1937, Geol. Soc. America Bull., v. 48, no. 10, p. 1399. Incidental mention. Named credited to E. S. Larsen, Jr.

E. S. Larsen, Jr., 1948, Geol. Soc. America Mem. 29, p. 76–82, pl. 1. Light-colored rather coarse-grained granodiorite that contains biotite and a little hornblende. Intrudes Green Valley, Bonsall, and La Sierra tonalites, and Temescal Wash porphyry. Older than Roblar leucogranite (new) and Mount Hole granodiorite. Includes Steele Valley granodiorite and Cajalco quartz monzonite of Dudley (1935).

Named from its characteristic outcrops on Woodson Mountain, which is a few miles northeast of southeastern corner of San Luis Rey quadrangle and a few miles southwest of Ramona, San Diego County. Underlies area of about 220 square miles; among rocks of batholith, is exceeded in area only by Bonsall tonalite.

Woods Run Limestone (in Conemaugh Formation)[L]

Woods Run Limestone (in Conemaugh Group)

Pennsylvanian: Western Pennsylvania and western Maryland.

Original reference: P. E. Raymond, 1910, Carnegie Mus. Annals, v. 7, p. 147.

M. N. Shaffer, 1952, Pennsylvania Geol. Survey, 4th ser., Prog. Rept. 141, geol. map. This report considers Conemaugh a group.

J. J. Burke, 1958, Science, v. 128, no. 3319, p. 302. Original name Woods Run retained, without modification, for limestone described by Raymond (1910). Separated from overlying Carnahan Run shale (new) by 21½ feet of reddish-brown shale that carries plant fossils. Johnson (1929, Pennsylvania Geol. Survey Topog and Geol. Atlas 27) described a limestone which, in Pittsburgh region, occurs approximately 8 to 17 feet below the Woods Run; subsequent workers have referred to the two strata as Woods Run limestones or as Upper and Lower Woods Run limestones. Name Nadine limestone is here applied to this limestone described by Johnson.

Named for Woods Run within city of Allegheny, Pa. Allegheny is now incorporated in city of Pittsburgh.

Woods Run Shale (in Conemaugh Formation)[1]

Pennsylvanian: Western Pennsylvania and western Maryland.

Original reference: C. K. Swartz, 1922, Maryland Geol. Survey, v. 11, pl. 6.

R. R. Dutcher and others, 1959, Geol. Soc. America Guidebook Pittsburgh Mtg., p. 69 (fig. 4). Woods Run (Friendsville) shale shown on generalized columnar section for western Pennsylvania above Lower Bakerstown coal and below Ewing limestone.

Named derived from Woods Run, Pa.

**Woodstock Granite**[1] or **Granodiorite**

Carboniferous (?) : Northern Maryland.

Original reference: G. H. Williams and N. H. Darton, 1892, U.S. Geol. Survey map of Baltimore and vicinity to accompany "Guide to Baltimore," prepared for Baltimore meeting Am. Inst. Min. Engrs., Feb. 1892.

H. E. Vokes, 1957, Maryland Dept. Geology, Mines and Water Resources Bull. 19, p. 63. At least three periods of granite formation are recognized in Maryland. Granitic rocks of third period are represented by the Woodstock, Ellicott City, and at least part of the Sykesville.

Occurs in small elliptical area of less than 2 miles in diameter near Granite, close to junction of North and South Branches of Patapsco River. Woodstock is in Howard County, across river from Granite.

**Woodstock Greensand Marl Member** (of Nanjemoy Formation)[1]

Eocene, middle: Eastern Virginia and eastern Maryland.

Original reference: W. B. Clark, 1895, Johns Hopkins Univ. Circ., v. 15, no. 121, p. 3.

C. W. Cooke, Julia Gardner, and W. P. Woodring, 1943, Geol. Soc. America Bull., v. 54, no. 11, chart 12. Uppermost member of formation. Overlies Potapaco clay member. Middle Eocene (Claiborne).

Named for Woodstock, an old estate a short distance above Mathias Point on Virginia bank of the Potomac in King George County, Va.

Woodstock Quartz Schist[1]

Woodstock quartz schist phase (of Hebron Gneiss)

Pre-Triassic: Northwestern Connecticut.

Original reference: H. E. Gregory, 1906, Connecticut Geol. Nat. History Survey Bull. 6, p. 114, 128, and map.

John Rodgers and others, 1956, Preliminary geological map of Connecticut (1 :253,440) : Connecticut Geol. Nat. History Survey. Refers to Woodstock (Paxton) quartz schist phase of Hebron gneiss. Occurs chiefly in northeastern part of Hebron outcrop area. Further described as including fine-grained quartz-mica schist, quartzite, and quartzose gneiss. Also contains thin layers of greenish lime-silicate rock and impure limestone. Pre-Triassic.

Crops out in eastern part of Woodstock Township, Windham County.

Woodstock Schist[1]

Ordovician: Southeastern Vermont.

Original reference: C. H. Richardson, 1927, Vermont State Geologist 15th Rept., p. 127–158.

Crops out in Woodstock, Windsor County.

Woodville Marble

Pre-Triassic: Western Connecticut.

John Rodgers and others, 1956, Preliminary geological map of Connecticut (1:253,440): Connecticut Geol. Nat. History Survey. Described as grayish-white coarsely granular marble, generally calcitic but locally dolomitic.

Named for Woodville in town of Washington, Litchfield County.

**Woodville Sandstone Member** (of Saginaw Formation)

Woodville Sandstone[1]

Woodville Sandstone (in Grand River Group)

Pennsylvanian: Southern Michigan.

Original reference: A. Winchell, 1861, Michigan Geol. Survey 1st Ann. Rept. Prog., p. 126, 138, 153, 158.

W. A. Kelley, 1936, Michigan Dept. Conserv., Geol. Div. Pub. 40, Geol. Ser. 34, p. 206–207, 211. Included in Grand River group (new). Stratigraphic relation to Eaton sandstone (new) not determined. Not known certainly whether Woodville at type locality represents lentil of limited distribution which should be grouped with sandstones of Saginaw group or whether it is formation younger than any member of Saginaw group.

G. V. Cohee, Carol Mach, and Margery Holk, 1951, U.S. Geol. Survey Oil and Gas Inv. Chart 41, sheet 5. Recommended that name Woodville be restricted to sandstone member in lower part of Saginaw formation.

Type locality: Exposure in cut of side track from (Woodville) mine to Central Railroad. Name has no reference to village of Woodville, in Newaygo County, but to old Woodville mine in Jackson County.

†Woodward Group[1]

Permian: Southwestern Oklahoma and Texas.

Original reference: C. N. Gould, 1902, Oklahoma Geol. Survey 2d Bien. Rept., p. 42, 49.

C. C. Branson, 1957, Oklahoma Geology Notes, v. 17, no. 11, p. 103. Poorly understood sequence including Dog Creek, Whitehorse, and Day Creek. Abandoned by Oklahoma Geological Survey.

Named for Woodward County, Okla.

**Woodway Limestone**

Middle Ordovician: Southwestern Virginia.

R. L. Miller and W. P. Brosgé, 1950, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 104, (two sheets). Cryptocrystalline tan and gray limestone with interbeds and zones of medium-crystalline limestone; prominent zone of *Stromatocerium rugosum* at base. Thickness 256 to 288 feet. Overlies Hurricane Bridge limestone (new); underlies Ben Hur limestone (new). Same as platy 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, 51–56, pl. 1. Further described and type section given. Discussion of problems of correlation and summary of nomenclature of Middle Ordovician formations in Lee and Tazewell Counties.

Type section: On north slopes of Elk Knob, 1¾ miles east of Woodway, Lee County.

Wooleys Bluff Clays[1] (in McElroy Formation)

Eocene (Jackson): Western Louisiana and eastern Texas.

Original reference: A. C. Ellisor, 1936, Am. Assoc. Petroleum Geologists Bull., v. 17, no. 11, p. 1303.

D. H. Eargle, 1959, Am. Assoc. Petroleum Geologists Bull., v. 43, no. 11, p. 2627–2628, 2629. Incidental mention in discussion of Wellborn sandstone and McElroy formation.

Named for locality in sec. 4, T. 3 N., R. 12 W., Sabine Parish, La.

**Woolsey Member** (of Bloyd Shale)

Pennsylvanian (Morrow Series): Northwestern Arkansas.

L. G. Henbest, 1953, Am. Assoc. Petroleum Geologists Bull., v. 37, no. 8, p. 1943–1944, 1948 (fig. 2). Consists of a succession of terrestrial sediments up to 45 feet thick that intervene between Brentwood limestone member and unnamed upper division of Bloyd shale which includes Kessler limestone lentil. Member includes Baldwin or Zion Chapel coal. Disconformably overlies and (or) truncates uppermost beds of Brentwood member.

Named for its most complete and characteristic development in vicinity of Woolsey Station, Washington County.

**Woonasquatucket Formation**

Precambrian(?): North-central 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, 12, pl. 1. Comprises four distinct rock types: light-gray medium-grained feldspathic quartz-muscovite schist which is very weakly foliated, gray medium-grained quartz biotite schist with strong foliation, gray medium-grained feldspathic quartz biotite gneiss which is strongly foliated and thinly and irregularly layered, and conglomerate of granite and quartzite pebbles and cobbles in a quartz-muscovite schist matrix. Thickness 575 to 1,300 feet. Underlies Blackstone series; overlies Absalona formation (new); both contacts gradational.

Named from exposures on slopes northeast of Woonasquatucket Reservoir, Georgiaville quadrangle, Providence County.

†Woonsocket Conglomerate[1]

Carboniferous: Northeastern Rhode Island.

Original reference: G. R. Mansfield, 1906, Harvard Coll. Mus. Comp. Zoology Bull., v. 49, geol, ser., v. 8, p. 100.

Occurs in rather limited area around Woonsocket, Providence County.

†Woonsocket Basin Series[1]

Carboniferous: Northeastern Rhode Island.

Original reference: A. C. Hawkins, 1918, Am. Jour. Sci., 4th, v. 46, p. 437–472, map.

Occurs in Woonsocket Basin, Providence County.

Wooster Shale Member (of Cuyahoga Formation)

Lower Mississippian (Osagian): Northern Ohio.

E. J. Szmuc, 1957, Dissert. Abs., v. 18, no. 6, p. 2109. Used in place of name Black Hand shale since latter term is restricted to the pebbly sandstone. Intertongues with partly younger Black Hand sandstone, and in parts of Wayne, Medina, and Ashland Counties the sandstone is completely replaced by shale. Overlies Armstrong member.

Area investigated extends from vicinity of Meadville, Pa., to southern Ashland County, Ohio.

**Worcester Formation**

Worcester Phyllite[1]

Carboniferous: Eastern Massachusetts, northern Connecticut, and southern New Hampshire.

Original reference: B. K. Emerson, 1889, Geol. Soc. America Bull., v. 1, p. 560.

W. R. Hansen, 1956, U.S. Geol. Survey Bull. 1038, p. 20–31, pl. 1. Name Worcester formation proposed to include rocks of Carboniferous age formerly mapped in this area as Worcester phyllite and Brimfield schist and also a previously unmapped quartzite unit here named Vaughn Hills member. Worcester phyllite and Brimfield schist of previous reports dealing with this area are regarded as stratigraphically equivalent metamorphic facies, and terms "phyllite facies" and "mica schist facies" are suggested for use in this area. Also proposed that term "Brimfield schist" be restricted to those areas where the schist is not known to be equivalent to Worcester formation. Problematical whether or not Worcester formation of Hudson quadrangle and adjoining areas is to be correlated with Brimfield schist of Emerson's (1917) type locality; the two areas are separate and the schist is not exposed continuously between them; on the other hand, field evidence supports correlation of mica schist facies of this area with phyllite facies of Worcester formation. Includes Harvard conglomerate lentil. Mica schist facies grades upward into Nashoba formation (new).

John Rodgers and others, 1956, Preliminary geological map of Connecticut (1:253,400): Connecticut Geol. Nat. History Survey. Refers to Pomfret (Worcester) phyllite phase of Hebron gneiss; pre-Triassic.

Named for exposures in Worcester County, Mass.

†Worcester Quartzite[1]

Carboniferous: Eastern central Massachusetts, northern Connecticut, and central southern New Hampshire.

Original reference: B. K. Emerson, 1898, U.S. Geol. Survey Mon. 29, p. 17.

Exposed at Worcester, Mass., and over large area in northern part of Worcester County.

†Worcester County Gneiss[1]

Age(?): Massachusetts.

Original reference: E. Hitchcock, 1833, Rept. on geology, mineralogy, botany, and zoology of Massachusetts, p. 387–388.

Occurs along western margin of Worcester County gneiss range, in Northfield, Mass., and Winchester, N.H.

**Word Formation**[1]

Permian: 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. 654–662, pl. 2. In this report, the Vidrio is restricted to that part of former member which is believed to be middle Guadalupe in age and classed as member of Word formation. Includes four unnamed limestone members. Plate shows uppermost limestone member grades laterally into Vidrio limestone member. Overlies Leonard formation; underlies Altuda formation, Capitan limestone, and Gilliam limestone.

R. L. Clifton, 1945, Am. Assoc. Petroleum Geologists Bull., v. 29, no. 12, p. 1766–1768. Fauna and stratigraphic correlatives discussed. Word strata considered correlative with strata of Cherry Canyon and Brushy Canyon of Delaware Mountain group, San Andres group, and Blaine and Dog Creek formations.

E. R. Lloyd, 1947, West Texas, Geol. Soc [Guidebook] Spring Field Trip May 30–31, p. 5–6. Name Word should be restricted to local formation in Glass Mountains.

Named for Word's Ranch, Glass Mountains, Hess Canyon quadrangle, Brewster County.

Workman Hill Conglomerate

Miocene and Pliocene: Southern California.

G. J. Bellemin, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 4, p. 652 (fig. 1), 653–655. Named as one of five conglomerates interbedded in Miocene and Pliocene shales of Puente Hills, Los Angeles County.

Named for occurrence adjacent to Workman Hill.

Worland Limestone[1]

Worland Limestone (in Altamont Limestone Member of Oologah Formation)

Worland Limestone Member (of Altamont Limestone)

Pennsylvanian (Des Moines Series): Western Missouri, southern Iowa, southeastern Kansas, and northeastern Oklahoma.

Original reference: F. C. Greene, 1933, Missouri Bur. Geology and Mines 57th Bien. Rept., p. 14, 18, 37, App. 2, pl. 2.

L. M. Cline, 1941, Am. Assoc. Petroleum Geologists Bull., v. 25, no. 1, p. 29. Lower and upper Worland limestone of Greene (1933) have been traced across southwestern Missouri into southeastern Kansas and are equivalent to lower and upper Altamont limestones, respectively. Lower limestone of Altamont is herein named Tina, and name Worland retained for upper member of Altamont. Traced into Appanoose County, Iowa.

J. M. Jewett, 1941, Kansas Geol. Survey Bull. 38, p. 332–334. At type exposure, herein designated, consists of about 4½ feet of gray-brown-weathering massive limestone containing large fusulinids. Overlies Lake Neosho shale member (new).

R. D. Alexander, 1954, Oklahoma Geol. Survey Circ., 31, p. 14–15, 16 (fig. 5). In this report, Oologah is 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 limestone not yet subdivided in vicinity of Tulsa. In Nowata County, upper member of Oologah is Altamont limestone which is subdivided into Amoret limestone below and Worland limestone above, with shale interval between. The Worland is gray massive cherty limestone about 30 feet thick. Occurs below Nowata shale.

H. G. Hershey and others, 1960, Iowa Highway Research Board Bull. 15, p. 30–31, fig. 5. Uppermost member of Altamont limestone in southwestern Iowa. Consists of thin wavy beds separated by green-gray fossiliferous shale seams and occasional pockets of green shale. Thickness 2½ feet in Madison County; 6 feet in Appanoose County. Overlies Lake Neosho shale member; underlies Nowata shale.

Type exposure: Along Kansas City Southern Railway just north of grade crossing northeast of Worland, Bates County, Mo.

Worldbeater Granite Porphyry

World Beater Porphyry[1]

Precambrian(?): Southeastern California.

Original reference: F. M. Murphy, 1933, California State Div. Mines Rept. 28 of State Min., July-Oct. 1932, p. 339, map.

J. H. Maxson, 1950, Geol. Soc. America Bull., v. 61, no. 2, p. 111. Incidental mention of Worldbeater granite porphyry in discussion of physiographic features of Panamint Range.

Occurs in southern part of Panamint Range, Inyo County, between Pleasant Canyon and Happy Canyon. Probably named for Worldbeater mine.

**Worm Creek Quartzite member** (of St. Charles Limestone)[1]

Upper Cambrian: Southeastern Idaho and northeastern Utah.

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

J. S. Williams and G. B. Maxey, 1941, Am. Jour. Sci., v. 239, no. 4, p. 282, 283 (fig. 2); J. S. Williams, 1948, Geol. Soc. America Bull., v. 59, no. 11, p. 1135, pl. 1. Described in Logan quadrangle, Utah. Drab fine- to medium-grained medium-bedded quartzite; at base of formation. Thickness on High Creek 75 feet; at Calls Fort, west of quadrangle, 6 feet. Overlies Nounan formation. Deiss (1938, Geol. Soc. America Bull., v. 49, no. 7) erred in redefinition of St. Charles in Blacksmith Fork section, because he failed to locate Worm Creek quartzite, which is distinctly present there. Upper Cambrian.

G. B. Richardson, 1941, U.S. Geol. Survey Bull. 923, p. 13. In Randolph quadrangle, Utah, is massive gray quartzite about 300 feet thick.

W. H. Coulter, 1956, Idaho Bur. Mines and Geology Pamph. 107, p. 18. Thickness, east of Willow Flat, Idaho, 170 feet.

R. H. Olson, 1956, Utah Geol. Soc. Guidebook 11, p. 48–49. Area of report is Promontory Range. A 3,800-foot sequence of dolomites, limestones, and minor interbedded shales lying between Dunderberg shale (herein geographically extended into Utah) and Ordovician Garden City formation is referred to as Upper Cambrian (undifferentiated). A 60-foot quartzite member is present 1,160 feet below base of Garden City formation. This quartzite unit may be correlative of Worm Creek quartzite member of St. Charles formation.

C. B. Bentley, 1958, Bringham Young Univ. Research Studies Geology Ser., v. 5, no. 6, p. 22. Haynie (1957, unpub. thesis) affirmed Olson's (1956) Worm Creek designation in Promontory Range. Since Worm Creek is same age as Dunderberg shale of Eureka, Nev., Olson's Dunderberg shale is misnomer.

Named for exposures on Worm Creek, Bear Lake County, Idaho.

†Wortham Aragonite Lentil (in Wills Point Formation)[1]

Paleocene: Northeastern Texas.

Original reference: F. B. Plummer, 1933, Texas Univ. Bull. 3232, p. 530, 535, 537, 538, 559.

Mackenzie Gordon, Jr., J. I. Tracey, Jr., and M. W. Ellis, 1958, U.S. Geol. Survey Prof. Paper 299, p. 25. Lentil in Kerens member of Wills Point formation.

Named for occurrence in stream valley, 1 mile east of Wortham, Freestone County.

Worthey Member (of Sycamore Formation)

Mississippian: Central southern Oklahoma.

J. D. Prestridge, 1959, *in* Petroleum geology of southern Oklahoma, v. 2: Tulsa, Okla., Am. Assoc. Petroleum Geologists, p. 158 (fig. 2), 161–162, 163. Comprises approximately 310 feet of compact tough blocky blue slate, silty to sandy limestone which is massive at base becoming thick bedded near middle and thin bedded near top; also member becomes more shaly toward top. Eastward from type locality upper part gives way to lower Caney shale which becomes calcareous near base; contact gradational. Overlies Cornell Ranch member (new).

Type section: SE¼SE¼NE¼ sec. 33, T. 2 S., R. 1 E., Carter County. Named for Ed Worthey Farm. Massive part of member forms prominent Sycamore hogback.

**Worthington Sandstone Member** (of Allegheny Formation)[1]

Middle Pennsylvanian: Western Pennsylvania.

Original reference: J. P. Lesley, 1880, Pennsylvania 2d Geol. Survey Rept. $H_5$, p. xxi, 319.

Worthington is in Armstrong County.

Worthville Beds[1]

Upper Ordovician: Northern New York.

Original reference: R. Ruedemann, 1925, New York State Mus. Bull. 258, p. 137, 141, 149, 154.

Exposed along Sandy Creek about Worthville, Jefferson County.

**Wrangell Lava**[1]

Tertiary to Recent: Southeastern Alaska.

Original reference: W. C. Mendenhall, 1905, U.S. Geol. Survey Prof. Paper 41, p. 54, map.

F. H. Moffit, 1954, U.S. Geol. Survey Bull. 989-D, p. 165-167, pls. 6, 7. Proportion of fragmental beds, tuffs, and agglomerates much greater in western part of area (eastern part of Alaska Range and adjacent area), near the volcanic centers. The lava flows, particularly younger flows, are quite fresh and commonly black or dark gray in color; less commonly show colors of brick red, brown, and tan. Most lava is porphyritic and much is highly vesicular. Columnar structure well developed in many flows. Glassy phases of lava more numerous in upper part of section. Thickness varies with distance from vents; may be 12,000 feet or more in neighborhood of Mount Sanford, but because base of deposits is uneven surface, definite measurement applies to only one locality. Extrusion of Wrangell lava probably began in Eocene time and continued intermittently to Recent time. Mapped as Tertiary to Recent.

Forms entire western part of Wrangell group of mountains. Occupies an irregular elongated area extending from lower western slopes of Mount Drum to international boundary, a distance of about 130 miles.

Wray Channel Beds (in Ash Hollow Formation)

Pliocene: Northeastern Colorado.

M. K. Elias, 1942, Geol. Soc. America Spec. Paper 41, p. 143. Name applied to thin channel sandstone near base of Ash Hollow.

Occurs near Beecher Island Post Office about 15 miles south of Wray, Yuma County.

**Wreford Limestone** (in Chase Group)[1]

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

Original reference: R. Hay, 1893, Kansas State Bd. Agr. 8th Bien. Rept., p. 104.

R. C. Moore, J. C. Frye, and J. M. Jewett, 1944, Kansas Geol. Survey Bull. 52, pt. 4, p. 165. Includes (ascending) Threemile limestone, Havensville shale, and Schroyer limestone members. Average thickness 35 feet. Underlies Matfield shale; overlies Speiser shale. Wolfcamp series.

P. B. Greig, 1959, Oklahoma Geol. Survey Bull. 83, p. 105-109. Described in Pawnee County where it overlies Garrison shale in Council Grove group, and underlies Matfield shale. This is essentially usage of Prosser (1902). In Kansas, Wreford is divided into three members but these divisions have not been recognized in Oklahoma. Thickness 12 to 31 feet.

Named from exposures near Wreford, Geary County, Kans.

Wrightsville Conglomerate[1]

Devonian or Carboniferous: Northwestern Pennsylvania.

Original reference: J. F. Carll, 1883, Pennsylvania 2d Geol. Survey Rept. $L_4$, p. 180, 203-208, 230.

Forms several escarpments near Wrightsville, Warren County.

**Wupatki Member** (of Moenkopi Formation)

Lower Triassic: Northeastern Arizona.

E. D. McKee, 1951, New Mexico Geol. Soc. Guidebook 2d Field Conf., p. 86, 87 (fig. 1). Red beds—shaly siltstones and structureless mudstones—alternating with resistant thick-bedded sandstones. Thickness over 50 feet. Underlies Winslow member (new); overlies Kaibab limestone.

E. D. McKee, 1954, Geol. Soc. America Mem. 61, p. 18, 19. Thickness ranges from 70 to 119 feet. Underlies Moqui member (new) in Poverty Tank-Concho area. Units here called Wupatki and Moqui were referred to as Salt Creek by Hager (1922, Mining and Oil Bull., v. 8, no. 2, p. 73).

Named in Winslow-Holbrook area.

Wurtemburg Limestone (in Pottsville Formation)[1]

Pennsylvanian: Western Pennsylvania.

Original reference: J. P. Lesley, 1875, Pennsylvania 2d Geol. Survey Rept. J., p. 93–100.

Well exposed just east of Wurtemburg along Slippery Rock Creek, in Lawrence County.

Wurtemburg Sandstone (in Pottsville Formation)[1]

Pennsylvanian: Western Pennsylvania.

Original reference: J. P. Lesley, 1875, Pennsylvania 2d Geol. Survey Rept. J, p. 93–94.

Wurtemburg, Lawrence County.

**Wyandot 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 Wyandot mine, Houghton County.

**Wyandot 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 Wyandot mine, Houghton County.

**Wyandot No. 8 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).

Occurs in interval between conglomerate No. 6 above and Superior West amygdaloid below and is eight amygdaloids back from Wyandot shaft, Houghton County.

**Wyandot No. 8 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 Wyandot mine, Houghton County.

Wyandotte Group[1]

Pennsylvanian: Eastern Kansas.

Original reference: R. C. Moore, 1931, Kansas Geol. Soc. Guidebook 5th Ann. Field Conf., correlation chart.

**Wyandotte Limestone**[1] (in Kansas City Group)

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

Original reference: R. C. Moore, 1932, Kansas Geol. Soc. 6th Ann. Field Conf., Guidebook, p. 85, 91, 92, 97.

R. C. Moore, 1948, Am. Assoc. Petroleum Geologists Bull., v. 32, no. 11, p. 2031 (fig. 4). Formation includes (ascending) Frisbie limestone, Quindaro shale, Argentine limestone, Island Creek shale, and Farley limestone members. Underlies Bonner Springs shale; overlies Lane shale. 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. 34. Thickness of formation about 32 feet in Cass County, Nebr.

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 22 feet in Madison County, Iowa. Five members present.

Named from Wyandotte County, Kans.

†Wyckoff Limestone[1]

Pennsylvanian: Eastern Kansas.

Original reference: E. Haworth and M. Z. Kirk, 1894, Kansas Univ. Quart., v. 2, p. 111.

Named for Wyckoff, Lyon County.

Wykoff Beds[1]

Wykoff Member (of Maquoketa Formation)[1]

Upper Ordovician (Cincinnatian): Southeastern Minnesota and northeastern Iowa.

Original reference: C. W. Hall and F. W. Sardeson, 1892, Geol. Soc. America Bull., v. 3, p. 349, 359, 366.

C. R. Stauffer and G. A. Thiel, 1941, Minnesota Geol. Survey Bull. 29, p. 9, 92–93. Wykoff member of Maquoketa consists of about 30 to 45 feet of argillaceous gray limestone and weathered shale; fossiliferous. Occurs above Dubuque member and below Devonian Cedar Valley limestone. Name is satisfactory and should be retained in Minnesota classification.

Named for exposures at Wykoff, Fillmore County, Minn. Also well exposed 1 mile east of Spring Valley, along U.S. Highway 16.

**Wyman Formation[1]**

Precambrian(?): Southern California.

Original reference: J. H. Maxson, 1934, Pan-Am. Geologist, v. 61, no. 4, p. 311.

J. C. Hazzard, 1937, California Jour. Mines and Geology, v. 33, no. 4, p. 280 (fig. 4). Shown on columnar section above Roberts formation and below Reed dolomite. Thickness 3,700 feet.

U.S. Geological Survey currently designates the age of the Wyman as Precambrian(?) on the basis of a study now in progress.

In Wyman Canyon, Inyo Range.

Wyman[1] (formation)

Lower Cretaceous: Montana.

Original reference: C. R. Keyes, 1926, Pan-Am. Geologist, v. 46, p. 195–232.

†Wyman Sandstone[1]

Mississippian: Northern Arkansas and eastern Oklahoma.

Original reference: F. W. Simonds, 1891, Arkansas Geol. Survey Ann. Rept. 1888, v. 4, p. 26, 38–41.

Named for Wyman, Washington County, Ark.

Wymanian series

Precambrian (Protozoic): Eastern California.

C. R. Keyes, 1942, Pan-Am. Geologist, v. 77, no. 4, p. 307 (chart). Listed as lowermost series in section. Consists of 3,700 feet of schists. Unconformable below Reedian series.

Occurs in Death Valley region.

Wymer Beds[1]

*See* Wimer Beds.

**Wymore Shale Member** (of Matfield Shale)

Wymore 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. 37.

D. E. Hattin, 1957, Kansas Geol. Survey Bull. 124, p. 49–50, 122. Generally exhibits fourfold depositional sequence (ascending): (1) silty green shale; (2) silty red shale and red mudstone, (3) silty green shale, and (4) very silty shale, very calcareous mudstone, or hard very silty limestone. Thickness 9 to 26 feet. Underlies Kinney limestone member; overlies Schroyer limestone member of Wreford limestone. Wolfcamp series.

Type locality: Ravines on west side of creek 2½ miles east of south side of Wymore, Gage County, Nebr., in E½ sec. 27, T. 2 N., R. 4 E., about one-quarter mile north of where highway crosses Burlington and Union Pacific Railroads.

Wynn Limestone Member (of Palo Pinto Formation)

Pennsylvanian (Canyon Series): North-central Texas.

M. G. Cheney, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 1, p. 66 (fig. 1), 88. Name applied to lower limestone member of formation. Underlies Posideon shale member (here reallocated to redefined Palo Pinto).

Named from Wynn Mountain, 2½ miles east of Palo Pinto, Palo Pinto County.

Wynona Sandstone Group[1] or Series[1]

Pennsylvanian: Central northern Oklahoma.

Original reference: H. T. Beckwith, 1928, Oklahoma Geol. Survey Bull. 40T, p. 22–24.

Occurs in vicinity of Wynona, Osage County.

**Wynona Sandstone Member** (of Vamoosa Formation)

Wynona Sandstone Member (of Nelagoney Formation)[1]

Pennsylvanian (Virgil Series): Northeastern Oklahoma.

Original reference: C. F. Bowen, 1918, U.S. Geol. Survey Bull. 686–D, p. 17, 18.

W. F. Tanner, 1956, Oklahoma Geol. Survey Circ. 40, p. 12 (fig. 1), 50–52, fig. 14, pl. 1. Reallocated to Vamoosa formation. Described as sequence of beds about 70 feet thick; consists of at least two sandstones, each about 25 feet thick, separated by about 20 feet of shale and sandy shale. Beds are buff, very fine to coarse grained, thin bedded to massive; sandstones become thinner northward and split into many tongues. Lies stratigraphically above Cochahee sandstone member and below Oread limestone member.

P. B. Greig, 1959, Oklahoma Geol. Survey Bull. 83, p. 30. Lowest member of Vamoosa identified in Pawnee County. Thickness 15 feet. Occurs at top of complex 100-foot shale-sandstone sequence which comprises lower part of Vamoosa; underlies thick sequence of dark fossiliferous shales; occurs below Kanwaka shale member.

Named from exposures near Wynona, T. 24 N., R. 9 E., Osage County.

Wyo 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. 295–306, pl. 3.

Named for "well-known cattle brand (YO) used in Blue Mountain region along course of James River in adjoining parts of Mason and Kimble Counties."

†Wyoming Conglomerate[1]

Miocene(?): Northwestern Colorado, northeastern Utah, and southern Wyoming.

Original reference: C. King, 1876, U.S. Geol. Expl. 40th Par. Atlas, maps 1, 2; separate sheets were issued in 1875, but atlas bears 1876 imprint.

Occurs in region of Big Thompson, eastern Colorado, and east of Laramie Hills, Wyo.

†Wyoming Formation[1] or Group[1]

Pennsylvanian, Permian, and Triassic(?): Eastern Colorado.

Original reference: G. H. Eldridge, 1896, U.S. Geol. Survey Mon. 27.

T. S. Lovering and E. N. Goddard, 1950, U.S. Geol. Survey Prof. Paper 223, pl. 6; R. L. Langenheim, Jr., 1952, Am. Assoc. Petroleum Geologists Bull., v. 36, no. 4, p. 550 (fig. 2). Name appears on correlation charts citing history of nomenclature applied to Pennsylvanian and Permian rocks in Colorado.

Named for widespread development in Wyoming, but application of name in literature has been restricted to eastern Colorado.

Wyoming Valley Limestone Beds[1]

Pennsylvanian: Pennsylvania.

Original reference: C. A. Ashburner, 1886, Pennsylvania 2d Geol. Survey Rept. 1885, p. 437–450, map.

Occurs in Wyoming Valley, Luzerne County.

Wyopo Formation (in Chugwater Group)

Triassic: Northwestern Wyoming.

E. B. Branson and C. C. Branson, 1941, Am. Assoc. Petroleum Geologists Bull., v. 25, no. 1, p. 124 (table 1), 136. Cliff-forming series of white buff light-gray, and pink siltstone which is crossbedded in large part. In southern part of range, lower part of formation changes in short distances from light gray to light red. Thickness about 200 feet in Lander region and less than 100 feet near Dubois. Underlies Gypsum Spring formation; overlies Popo Agie formation.

Type locality: Wyopo, a loading spur on Northwestern Railway, 2 miles northeast of Lander, Fremont County.

Wyota 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. 24, figs. 3, 12. Dolomite, argillaceous and dense at top; pure, coarsely crystalline and porous below; medium- to thick-bedded. Thickness about 19 feet. Shown on columnar section as underlying Sinsinawa member (new) of Wise Lake formation and overlying Wall member (new) of Dunleith formation.

Occurs in Dixon-Oregon area.

XI Member (of Rexroad Formation)

Pliocene, upper: Southwestern Kansas.

C. W. Hibbard, 1949, Michigan Univ. Mus. Paleontology Contr., v. 7, no. 5, p. 93–94, 96–97. Consists of about 25 feet of sand, caliche, and clay beds in basal part of formation. Overlies Laverne formation with angular unconformity. Contains vertebrate fauna.

C. W. Hibbard, 1953, Michigan Acad. Sci., Arts, and Letters, Papers, v. 38, p. 389, 408. Contains Saw Rock Canyon fauna considered to be lower upper Pliocene in age.

Type locality: Near center of west line of sec. 36, T. 34 S., R. 31 W., Seward County. Name derived from XI ranch on which exposures occur.

Yaak Quartzite[1]

Precambrian: Northwestern Montana, and British Columbia, Canada.

Original reference: R. A. Daly, 1905, Canada Geol. Survey Summ. Rept. 1904, p. 96–100.

Probably named for Yaak River, Montana-British Columbia.

Yabucoa Granite[1]

Age(?): Puerto Rico.

Original reference: C. R. Fettke, 1924, New York Acad. Sci. Scientific survey of Porto Rico and Virgin Islands, v. 2, pt. 2, p. 159.

Yaeger Greenstone (in Yavapai Group)

Precambrian: Central Arizona.

E. D. Wilson, 1937, (abs.) Geol. Soc. America Proc. 1936, p. 112; 1939, Geol. Soc. America Bull., v. 50, no. 7, p. 1118 (table 1), 1120, pl. 10. Largely of intermediate to mafic flows and small intrusives, tuff, and agglomerate, together with some sedimentary material. Rocks show extensive alteration to greenish-black and grayish-green aggregates and fine-grained chlorite, sericite, and quartz, with local rude schistosity. Thickness appears to exceed 2,000 feet; base not exposed. Probably oldest member of Yavapai group. In fault contact with Red Rock rhyolite (new) above. Yaeger greenstone is equivalent to "greenstone complex" of earlier authors, especially Lausen (1930, Jour. Geology, v. 38, no. 2, p. 174).

Gordon Gastil, 1958, Geol. Soc. America Bull., v. 69, no. 12, pt. 1, p. 1496. In Gila County, basic volcanic rocks belong not to a single unit, the Yaeger greenstone, placed at base of stratigraphic sequence, but to at least three stratigraphically separate units—Flying W, Board Cabin, and Haigler formations (new).

Named for typical occurrence east of Yaeger mine, in southwestern part of Black Hills. Also crops out in Mazatzal Mountains and eastern Tonto Basin areas.

Yager Formation

Upper Jurassic to Lower Cretaceous: Northwestern California.

B. A. Ogle, 1953, California Div. Mines Bull. 164, p. 13 (fig. 3), 16–22, pls. 1, 2. Series of dark-gray indurated mudstone, shale, graywacke, and conglomerate. Thickness about 10,000 feet. In fault contact with Franciscan in northeastern part of Fortuna quadrangle and with rocks of False Cape shear zone along Russ fault in southern part of quadrangle; in southern area, unconformably underlies Pullen formation (new) and farther north undifferentiated Wildcat group; along Yager fault is faulted against Rio Dell formation (new) and Eel River formation (new). It is possible that rocks included in formation range from Upper Jurassic to Upper Cretaceous; most evidence points to Cretaceous age. Columnar section shows Upper Jurassic to Lower Cretaceous.

Exposed in Yager Creek in Fortuna quadrangle, Eel River valley area, Humboldt County.

**Yakataga Formation**[1]

Miocene and Pliocene(?): Southeastern Alaska.

Original reference: N. L. Taliaferro, 1932, Geol. Soc. America Bull., v. 43, no. 3, p. 756.

D. J. Miller, 1951, Preliminary report on the geology and oil possibilities of the Yakataga district, Alaska: U.S. Geol. Survey, p. 35, fig. 1. Horizon of Yakataga-Poul Creek contact in area between Twomile Creek and White River found to lie several hundred feet stratigraphically above sandstone cited by Taliaferro as marking base of Yakataga formation. Formation includes entire sequence of Tertiary strata overlying Poul Creek formation in Yakataga district. Upper Oligocene(?), Miocene and Pliocene(?).

D. J. Miller, 1957, U.S. Geol. Survey Oil and Gas Inv. Map OM–187, sheets 1 and 2. In southeastern part of Robinson Mountains, formation comprises minimum of 10,000 feet, possibly 15,000 feet or more, of sedimentary rocks, chiefly siltstone, sandstone, and unsorted coarse ice-transported debris, called conglomeratic sandy mudstone. Lower part of Yakataga Reef section reassigned to Poul Creek formation. Considerable diversity of opinion as to age of formation. Mapped as Miocene and Pliocene(?).

Well exposed at Yakataga Reef and on both flanks of "Yakataga" anticline (Sullivan anticline in report of Miller, 1957), Yakataga district, Controller Bay region.

**Yakima Basalt**[1]

Miocene, upper, and Pliocene, lower: Eastern Washington.

Original reference: G. O. Smith, 1901, U.S. Geol. Survey Water-Supply Paper 55.

W. C. Warren, 1940, (abs.) Geol. Soc. America Bull., v. 51, no. 12, pt. 2, p. 2034–2035; 1941, Jour. Geology, v. 49, no. 8, p. 795–814. Yakima basalt is typical plateau basalt which is associated toward west in Cascade Mountains with different type of volcanic formation, the Keechelus andesitic series. Latter has commonly been regarded as younger. In Mount Aix quadrangle, upper part of Keechelus andesitic series, which has long been known to be unconformable on lower part, has been split off as separate unit and is here named Fifes Peak andesite. Marginal flows of Yakima overlap Fifes Peak andesite. In some areas, overlies Taneum andesite. Yakima commonly regarded as middle Miocene but may be upper Miocene.

J. H. Mackin, 1947, Northwest Sci., v. 21, no. 1, p. 33. In Yakima-Ellensburg area, Yakima basalt with Squaw Creek diatomite member (new) one flow below top, is overlain in ascending order by Selah tuff (new), Wenas basalt, and main body of Ellensburg formation.

A. C. Waters, 1955, Geol. Soc. America Bull., v. 66, no. 6, p. 669–672, pl. 1. Described and mapped in Yakima East quadrangle where it is exposed in four southeast-trending strips that coincide with crestal portions of four anticlinal axes. Interfingers with overlying Ellensburg formation. Thickness as much as 1,500 feet; base not exposed. Lenses of micaceous silt, sandstone, and clay, with occasional conglomerate beds, occur between flows at many localities in upper part of section. Layer of fresh-water diatomite, 6 to 10 feet thick, together with 150-foot basalt on which it rests, forms good horizon marker. Top of flow that overlies the diatomite was apparently selected by Smith as top of Yakima basalt and base of Ellensburg where he mapped Ellensburg quadrangle. Present mapping indicates that contact between any one basalt flow and an overlying sedimentary bed cannot serve as workable horizon for defining top of Yakima basalt and base of Ellensburg; in general, sedimentary parts of the section thin and pinch out between successively younger flows when traced eastward; in some areas, exact position of contact is a matter of arbitrary choice; at one locality, Ellensburg pinches out and Wenas basalt rests directly on Yakima. In a broad sense, entire lower part of Ellensburg can be considered marginal sedimentary facies of Yakima basalt flows.

Named for occurrence in Yakima area.

Yakima Group[1]

Pliocene: Central northern Oregon.

Original reference: T. Condon, 1902, The two Islands: Portland, Oreg., The J. K. Gill Co.

Yakinikak Limestone[1]

Upper Mississippian: Northwestern Montana.

Original reference: Bailey Willis, 1902, Geol. Soc. America Bull., v. 13, p. 316, 324.

L. L. Sloss, 1945, Jour. Paleontology, v. 19, no. 3, p. 309. Represents remnant of an imbricate thrust sheet that has been thrust over subjacent Pennsylvanian(?) quartzite.

Type locality: On Yakinikak Creek, 4 miles west of North Fork of Flathead River, Glacier National Park.

**Yakutat Group**[1]

Upper(?) Cretaceous: Southeastern Alaska.

Original reference: I. C. Russell, 1891, Nat. Geog. Mag., v. 3, p. 167–175.

George Plafker and D. J. Miller, 1957, U.S. Geol. Survey Oil and Gas Inv. Map OM–189. Sedimentary sequence in Malaspina district assigned to Yakutat group probably thousands of feet thick. Paleontological evidence indicates Upper (?) Cretaceous age. Underlies Tertiary(?) siltstone sequence and overlies Cretaceous or older crystalline complex with unconformable contacts.

Exposed about Yakutat Bay and westward along foot of St. Elias Mountain to Icy Bay. Also forms major part of coastal mountains between Disenchantment Bay and Dry Bay.

**Yale 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, 503.

N. K. Huber, 1959, Econ. Geology, v. 54, no. 1, p. 104 (table 10), 106 (table 11), 107 (fig. 6). Underlies Norrie member; overlies Plymouth member. Thicknesses (taken from drill holes) 48½ and 67½ feet.

Named for Yale mine, near Bessemer, Gogebic County, Mich.

**Yale Point Sandstone** (in Mesaverde Group)

Upper Cretaceous: Northeastern Arizona.

G. A. Kiersch, 1955 Mineral Resources Navajo-Hopi Indian Reservations, Arizona-Utah, v. 2: Tucson, Ariz., Univ. Arizona Press, p. 4 (fig. 1), 7. Prominent cliff-forming sandstone capping group along eastern margin of Black Mesa. Overlies Wepo formation (new). Name credited to Repenning and Page.

C. A. Repenning and H. G. Page, 1956, Am. Assoc. Petroleum Geologists Bull., v. 40, no. 2, p. 271, 279–281. Yellowish-gray massive sandstone, weathering grayish orange, and composed of coarse- to medium-grained subrounded to subangular clear quartz. Bedding is lenticular, individual units crossbedded. Thin silty units present at widely spaced intervals. Minor amounts of coal present. Thickness at Yale Point 204 feet, maximum of 300 feet at north end of Marsh Pass. Caps Black Mesa; no younger sediments overlie formation; and its upper limit is surface of recent erosion. Intertongues with underlying Wepo formation to south. Type section designated.

Type locality: Three-fourths mile west of Yale Point of Black Mesa, from which it is named, Apache County.

**Yamhill Formation**

Eocene, upper: Western Oregon.

E. M. Baldwin and others, 1955, U.S. Geol. Survey Oil and Gas Inv. Map OM–155. Name proposed for thick sequence of marine sedimentary rocks that overlie Siletz River volcanic series. These sedimentary rocks have been known locally as Mill Creek beds. At Mill Creek, sedimentary rocks that compose lower 500 feet of formation are predominantly dark-gray shale and siltstone with occasional beds of lime-cemented sandstone. The siltstone and shale sequence along Mill Creek is overlain by sequence of massive sandstone beds. The sandstone is medium to greenish gray, thick bedded, and fossilferous. This sandstone is about 500 feet thick and grades upward into more argillaceous rock. Greenish-gray sand beds of the Yamhill are in turn overlain along Mill Creek by approximately 4,000 feet of finely micaceous siltstone and mudstone. Unconformably overlain by Nestucca formation. Yamhill and Burpee formations occupy same general stratigraphic position and are probably equivalent in age. Eocene.

E. M. Baldwin, 1959, Geology of Oregon: Ann Arbor, Mich., Edwards Bros., Inc., p. 13–14. Formation is exposed along south slope of Yamhill Valley and southward through the Dallas area to Luckiamute River where it appears to interfinger with beds of Tyee formation. Near Dallas, limestone at base of formation is referred to as Dallas limestone member.

Type section: Exposures along Mill Creek from a point 0.6 mile south of Sheridan quadrangle to point 0.1 mile southeast of Mill Creek School. Formation best preserved within Yamhill Valley downwarp, which occupies broad area along South Yamhill River in Sheridan quadrangle.

**Yampa Limestone Lentil** (of Bingham Quartzite)[1]

Pennsylvanian: Central northern Utah.

Original reference: A. Keith, 1905, U.S. Geol. Survey Prof. Paper 38, p. 43, map, sections.

Named for Yampa mine, Bingham district.

†Yampa Sandstone[1]

Pennsylvanian: Northeastern Utah.

Original reference: J. W. Powell, 1876, Geology of eastern portion of Uinta Mountains, p. 41, 55.

Occurs along Yampa River and on Yampa Plateau.

Yampai sandstone[1]

Yampai shales (in Tusayan series)

Permian: Northwestern Arizona.

Original reference: C. R. Keyes, 1922, Pan-Am. Geologist, v. 38, no. 3, p. 251, 339.

Charles Keyes, 1936, Pan-Am. Geologist, v. 66, no. 3, p. 215 (table). Underlies Shiwits sandstones; overlies Seligman limestones. In Tusayan series (new) of Carbonic age.

In Grand Canyon region.

**Yankee Fork Rhyolite 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.

C. P. Ross and J. D. Forrester, 1958, Idaho Bur. Mines and Geology Bull. 15, p. 13. In Bayhorse region, Challis volcanics have been divided into five members: latite-andesite, Germer tuffaceous, basalt and related flows, Yankee Fork rhyolite, and travertine. Rhyolitic member has three subdivisions that have been distinguished in mapping on the basis of differences in lithology.

Type locality: Head of Yankee Fork Creek, southeast corner of Casto quadrangle.

**Yankeetown Chert**[1]

Yankeetown Chert (in New Design Group)

Upper Mississippian (Chester Series): Southwestern Illinois and eastern Missouri.

Original reference: S. Weller, 1913, Illinois Acad. Sci. Trans., v. 6, p. 120, 124.

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. 826. Assigned to New Design group (new).

Named for Yankeetown School, southeastern corner Monroe County, Ill.

Yanktonian series

Cretaceous: Iowa.

C. R. Keyes, 1936, Pan-Am. Geologist, v. 66, no. 2, p. 154–156. Term used for so-called Benton shales of Iowa. Comprises (ascending) Woodbury shales, Dixon chalk, Hawarden shales, and Niobrara chalk.

Yap Beds or Formation

Pre-Tertiary(?): Caroline Islands (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. 36–38 [English translation in library of U.S. Geol. Survey, p. 32–33]; 1952, Coral reefs in the South Seas: Japan Hydrog. Office Bull., v. 11, p. 60–61, table 4 [English translation in library of U.S. Geol. Survey, p. 71–72]. Group of green rocks composed chiefly of massive amphibolite, granular amphibolite, platy amphibolite, and green schist. Dips at high angles. Unconformably underlies Map beds. Pre-Tertiary(?).

C. G. Johnson, R. J. Alvis, and R. L. Hetzler, 1960, Military geology of Yap Islands, Caroline Islands: U.S. Army Far East Command, p. 63–65. Pre-Miocene, possibly Mesozoic.

Occurs in Yap proper, Yap Island group.

Yapoah Flows, Basalt

Recent: Southwestern Oregon.

Howel Williams, 1944, California Univ. Pub., Dept. Geol. Sci. Bull. 27, no. 3, p. 55, 62, pl. 9. Discussion of volcanoes of Three Sisters region. Name is applied to flows from Yapoah Cone.

Yapoah Cone is north of North Sister Mountain.

Yaquian series

Cambrian (Mid-Cambric): Northern Arizona.

Charles Keyes, 1940, Pan-Am. Geologist, v. 74, no. 2, p. 154–156. Name proposed for beds of Mid-Cambric age in the Grand Canyon which were previously called Tonto group and correlated with the type Tonto series section (of Protozoic age) near Fort Apache.

In the Grand Canyon region.

**Yaquina Formation[1] or Sandstone**

Oligocene, upper: Northwestern Oregon.

Original reference: Harrison and Eaton [consulting firm], 1920, Report on investigation of oil and gas possibilities of western Oregon: Oregon Bur. Mines and Geology, Mineral Resources Oregon, v. 3, no. 1, p. 3–40.

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-Waldport area as approximately 2,700 feet of shallow-water deposits, predominantly light-gray to brown tuffaceous and usually carbonaceous poorly consolidated sandstones, sandy tuffs, and interbedded or alternating tuffs and sandstones. Disconformably overlies Toledo formation; disconformably underlies Nye mudstone.

P. D. Snavely, Jr., and H. E. Vokes, 1949, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 97. Described in coastal area near Cape Foulweather as 2,500 to 3,000 feet of arenaceous sedimentary rocks, unconformably overlying Nestucca formation. Outcrop belt narrows northward as dip steepens and the Yaquina is progressively overlapped by Astoria formation.

Type locality not designated in original description. Schenck (1928) interpreted type locality to be near village of Yaquina, near Newport, Lincoln County.

**Yarmouth Interglaciation**

Yarmouth (Yarmouthian) Stage, Age

Yarmouth stage of deglaciation[1]

Pleistocene: Mississippi Valley.

Original reference: F. Leverett, 1898, Jour. Geology, v. 6, p. 176, 238–243.

J. C. Frye and A. B. Leonard, 1952, Kansas Geol. Survey Bull. 99, p. 24, 31, 35, 38, 52, 55, 104, 118, 156. Discussion of Yarmouth soil, Yarmouthian age, and stage. The Yarmouthian follows the Kansan and precedes the Illinoian.

Name amended to Yarmouth Interglaciation to comply with Stratigraphic Code adopted 1961.

Name derived from Yarmouth, Des Moines County, Iowa.

**Yates Formation** (in Artesia Group)

**Yates Sandstone** (in Whitehorse Group)

Permian: Subsurface in Texas and subsurface and surface in New Mexico.

G. C. Gester and H. J. Hawley, 1929, Structure of typical American oil fields: Tulsa, Okla., Am. Assoc. Petroleum Geologists, v. 2, p. 487, 488. In Yates field, upper division of Permian is known as "Anhydrite series" and ranges in thickness from 650 to 750 feet. Yates is 50-foot sandstone that occurs 100 to 150 feet below top of Anhydrite series and from 500 to 550 feet above top of "brown lime," topmost member of "Big lime" in this field.

R. K. DeFord, G. D. Riggs, and N. H. Wills, 1938, (abs.) Am. Assoc. Petroleum Geologists Bull., v. 22, no. 12, p. 1706. Yates sand has been traced from subsurface to surface outcrop and top of Yates mapped from Carlsbad to McKittrick Canyon. Subdivision of Whitehorse-Capitan is simplified. From top downward, it is subdivided into Carlsbad, Yates, Seven Rivers, and Queen. This involves redefinition of the Carlsbad.

P. T. Hayes, 1957, U.S. Geol. Survey Geol. Quad. Map GQ–98. Formation included in Carlsbad group. Overlies Seven Rivers formation; underlies Tansill formation.

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.

Named from subsurface sections in Yates field in Pecos County, Tex.

Yauco Mudstone (in Mayagüez Group)

Upper Cretaceous: Southwestern Puerto Rico.

P. H. Mattson, 1958, Dissert. Abs., v. 18, no. 1, p. 197. Group comprises seven units. The Yauco is fourth in sequence [ascending]; overlies Melones limestone and underlies Maricao basalt (both new). Group ranges in age from Santonian or Campanian to early Maestrichtian.

P. H. Mattson, 1960, Geol. Soc. America Bull., v. 71, no. 3, p. 330 (fig. 3), 331–333, pl. 1. Mudstone, minor tuff, and rare conglomerate are herein named Yauco mudstone. These are rocks called strongly bedded shale by Mitchell (1922) who named them Río Yauco shale. Hubbard (1923, New York Acad. Sci. Scientific survey of Porto Rico and Virgin Islands, v. 2, pt. 1) named them Río Yauco series. Río has been dropped to avoid confusion with other Puerto Rican formational names. Consists of foraminiferal tuffaceous mudstone with minor amount of tuff, wacke, conglomerate, and bedded chert. Bedded tuff forms 20 to 60 percent of Yauco mudstone; the larger tuff and flow units have been separated as Maricao basalt (new). Mudstone forms narrow belts on limbs of Hormigueros syncline; it averages 250 meters in north limb and ranges from 0 to 30 meters in south limb. Bedding in Yauco mudstone generally parallels contact with Rio Loco lava, but locally exposures show bedding truncated at contact. Relationships with Río Blanco formation not definitely known. Gradational contact with Sabana Grande andesite.

Report discusses Mayagüez area, about 250 square miles, in southwest Puerto Rico. Area contains large alluvium-filled valleys and part of the Cordillera Central in its southern foothills.

**Yavapai Series**

Yavapai Group

Yavapai Schist[1]

Precambrian: Central Arizona.

Original reference: T. A. Jaggar, Jr., and C. Palache, 1905, U.S. Geol. Survey Geol. Atlas, Folio 126.

E. D. Wilson, 1937, (abs.) Geol. Soc. America Proc. 1936, p. 112; 1939, Geol. Soc. America Bull., v. 50, no. 7, p. 1119–1120, table 1. Precambrian schists in central Arizona, which show recrystallization only in vicinity of intrusive bodies, collectively termed Yavapai group and subdivided into (ascending) Yaeger greenstone (new), Red Rock rhyolite (new), and Adler [Alder] sedimentary series (new). Term Yavapai group preferred because Yavapai formation is only locally schistose.

C. A. Anderson, E. A. Scholz, and J. D. Strobell, Jr., 1955, U.S. Geol. Survey Prof. Paper 278, p. 7, pl. 3. Series composed of many formations in Jerome area and divided into two groups. In Bagdad area, series comprises three formations (ascending): Bridle formation (new), Butte Falls tuff (new), and Hillside mica schist (new).

C. A. Anderson and S. C. Creasey, 1958, U.S. Geol. Survey Prof. Paper 308, p. 8–9, pl. 1. Series includes all older Precambrian volcanic and sedimentary rocks in Prescott-Jerome area. Separated into two major subdivisions: eastern Ash Creek group (new) of seven formations and western Alder group of six formations. The two groups separated by the Shylock fault. Wilson (1939) suggested that Yavapai schist be modified to Yavapai group. Yavapai series is used in this report to replace Yavapai schist.

Named for extensive development in Yavapai County.

**Yazoo Clay** (in Jackson Group)

Yazoo Clay Member (of Jackson Formation)[1]

Yazoo Group

Eocene, upper: Mississippi, southwestern Alabama, and central northern Louisiana.

Original reference: E. N. Lowe, 1915, Mississippi Geol. Survey Bull. 12, p. 79.

H. N. Fisk, 1938, Louisiana Dept. Conserv. Geol. Bull. 10, p. 98–105. Yazoo clay, as used in this report [Grant and La Salle Parishes], includes all materials between Danville Landing beds above and Moodys Branch marl below. Includes Tullus clay member (new) below and Verda member (new). Thickness 275 to 375 feet. Jackson group.

F. F. Mellen, 1940, Mississippi Geol. Survey Bull. 39, p. 12 (table), 18–22. Member of Jackson formation. Conformably overlies Moodys Branch marl member; conformably underlies Forest Hill sand member. Thickness about 500 feet.

U. B. Hughes and others, 1940, Mississippi Geol. Soc. [Guidebook 1] Field Trip Feb. 10, 11, 2d day's field trip, p. 2, columnar section. Yazoo clay in Jackson group. Massively bedded yellow to green calcareous clay. Interbedded lignitic clay in western Mississippi. Bentonitic zone near base. Thickness 90 to 600 feet. Underlies Forest Hill sand; overlies Moodys marl. Contains Cocoa sand member.

H. A. Tourtelot, 1944, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 6. Yazoo clay, in Quitman fault zone area, is divided into two tongues by Cocoa sand member. Estimated thickness 125 feet in southeastern part of area; thickens northwest to 250 feet in Jasper County, Miss. Overlies Moodys marl; underlies Red Bluff clay.

G. E. Murray, 1947, Am. Assoc. Petroleum Geologists Bull., v. 31, no. 10, p. 1838 (fig. 6), 1839. Yazoo clay, in Mississippi and Alabama, divided into (ascending) North Creek clay (new), Cocoa sand, Pachuta clay (new), and Shubuta clay (new) members.

Alan Cheetham, 1957, Gulf Coast Assoc. Geol. Soc. Trans., v. 7, p. 97 (fig. 5). Chart shows Yazoo group, consisting of North Creek clay, Cocoa sand, Pachuta marl, and Shubuta clay, as Eocene–Oligocene.

H. V. Andersen, 1960, Louisiana Geol. Survey Geol. Bull. 34, p. 96–99. Most continuous section of Yazoo formation in Sabine Parish extends from bottom of Caney Creek (SW¼SE¼ sec. 34, T. 4 N., R. 12 W.) approximately 100 yards south of bridge and thence eastward in ditches along Clare-Toro ward road. At this locality, about 65 feet of Yazoo clay is exposed. Included in this section is a 5.8–foot bed of highly fossiliferous, glauconitic, sandy marl, which is equivalent to basal sediment of Wooleys Bluff clays (member?) of Wellborn formation of Texas, and a 7-foot fossiliferous sand, which is probably equivalent to some part of sands reported overlying Wooleys Bluff clays at Sabine River in Texas. Overlies Moodys Branch marl with contact transitional; underlies Danville Landing beds. Jackson group.

Named for exposures in bluff of Yazoo River at Yazoo City, Yazoo County, Miss.

†Yeager Clay[1]

Oligocene(?): Southern Texas.

Original reference: Julia Gardner and A. C. Trowbridge, 1931, Am. Assoc. Petroleum Geologists Bull., v. 15, no. 4, p. 470.

Named from Yeager Ranch, on Cotulla-Sandiego Road, in northeast Webb County.

Yeager Greenstone

*See* Yaeger Greenstone.

Yearwood Formation

Cretaceous (Comanche Series) : Southwestern Texas.

J. P. Brand and R. K. DeFord, 1958, Am. Assoc. Petroleum Geologists Bull., v. 42, no. 2, p. 373–376. Name proposed for lowermost Cretaceous formation in Kent quadrangle. Formation consists of up to 160 feet of limestone and a sporadically distributed basal conglomerate. Basal clastic part is restricted to vicinity of type locality where maximum section of about 55 feet is recorded; elsewhere, basal conglomerate is absent or exemplified by scattered quartz pebbles in basal few feet of the limestone. Upper member consists of up to 110 feet of light-gray to grayish-orange-pink thin bedded to massive micrograined limestone with thin light-gray calcareous shale interbeds. Yearwood rests unconformably on Permian formations; at type locality, on Permian red beds; in escarpment northeast of Kent and between Kent and Boracho Station, on Tansill (Guadalupian) limestone; underlies Cox sandstone with contact disconformable.

P. C. Twiss, 1959, Texas Univ. Bur. Econ. Geology Quad. Map 23. Crops out in four isolated localities in northern third of Van Horn Mountains area. Average thickness about 225 feet. At all exposures, overlies Permian limestone unconformably and slightly discordantly. Regional stratigraphy indicates the Yearwood is correlative with Bluff formation.

Type locality: West slope of prominent hill in NW¼ sec. 7, Blk. 59, Texas and Pacific Railroad Co., Kent quadrangle. Name derived from Yearwood (Drake) Ranch about 5 miles north-northeast of Kent, Culberson County.

**Yegua Formation** (in Claiborne Group)[1]

Yegua Group

Yegua Member (of Lisbon Formation)

Eocene, middle: Eastern and southern Texas, northwestern Louisiana, and western and southern Mississippi.

Original reference: E. T. Dumble, 1892, Brown coal and lignite of Texas, p. 124, 148–154.

H. B. Stenzel, 1940, Texas Univ. Bur. Econ. Geology Pub. 3945, p. 847–904. Comprehensive report on Yegua problem. Terms Lufkin, Yegua, and Cockfield have been used for beds in question in the past. All three terms have their advocates. Writer [Stenzel] would have preferred Lufkin but consensus was decidedly against it and for retention of name Yegua; hence, term Yegua is retained in this report. Type localities of Yegua as given by Dumble and other authors following him are declared invalid and are abandoned. However, new type locality is not designated. Formation is divided into an upper, partly marine member Creola (new), and lower, nonmarine member, Lufkin. Lower boundary of Yegua lies at top of Mount Tabor member of Crockett formation and at base of Bryan sand, which is local sand lentil in Yegua; upper boundary is defined by disconformity with which sediments of Jackson group begin.

F. F. Mellen, 1940, Mississippi Geol. Survey Bull. 39, p. 12 (table), 13–16. Referred to as member of Lisbon formation. In Yazoo County, consists of about 100 feet of silty lignitic clays, argillaceous lignitic silts, and fine-grained argillaceous sands of nonmarine or estuarine origin. Disconformably underlies Moodys Branch member of Jackson formation; base not exposed.

J. M. Patterson, 1942, Am. Assoc. Petroleum Geologists Bull., v. 26, no. 2, p. 259 (fig. 2), 263–266. Formation described in south Texas. In Starr and Zapata Counties, consists of two marine sandstones and three marginal shale members. Northward, in southern Webb County, these sand members wedge out and entire Yegua section becomes a series of red and green bentonitic shales with interbedded tuff and ash beds. Includes (ascending) La Perla shale member (new), Mier sandstone tongue, Jose shale member (new), Loma Blanca tongue, and Los Arrieros shale member (new). Thickness about 800 feet. Overlies Falcon sandstone member (new) of Cook Mountain formation; underlies Fayette formation.

A. A. L. Mathews, 1950, Texas Eng. Expt. Sta. Research Rept. 14, p. 1–4. Rank raised to group. Includes (ascending) Smetana sandstone (new), Bryan sandstone, Easterwood shales (new), and Cockfield formation. Estimated thickness about 1,700 feet. Unconformably underlies Rock Prairie sandstone (new) of Jackson group. Unconformably overlies Mount Tabor shales.

U.S. Geological Survey has restricted the term Yegua to Texas and restored the term Cockfield Formation for use in Mississippi, Louisiana, and Arkansas.

Type locality: Near mouth of Elm Creek, on [West] Yegua River [Creek], Lee County, Tex.

Yegua River Conglomerate (in Yegua Formation)[1]

Eocene: Eastern Texas.

Original reference: L. C. Reed and O. M. Longnecker, Jr., 1929, Texas Univ. Bull. 2901, p. 163–174.

A. A. L. Mathews, 1950, Texas Eng. Expt. Sta. Research Rept. 14, p. 2. Reed and Longnecker described Yegua River conglomerate with thickness of 40 feet and stated that it gouges both the Turkey and upper Turkey Creeks beds. Since its position in Yegua group is not clear or determinable, nor location of Turkey Creek definite, and since only conglomerate of Yegua age observed in Brazos County is at base of Smetana sandstone (new), name Yegua River conglomerate cannot be used.

Derivation of name not stated.

Yellian series[1]

Pennsylvanian: Western Arkansas.

Original reference: C. R. Keyes, 1928, Pan-Am. Geologist, v. 49, p. 287; 1932, Pan-Am. Geologist, v. 57, p. 344.

Named for Yell County.

Yellow Branch Member (of Poteet Formation)

Middle Ordovician (Mohawkian): Southwestern Virginia.

G. A. Cooper, 1956, Smithsonian Misc. Colln., v. 127, pt. 1, p. 99, pl. 1 (facing p. 130). Gray thick-bedded calcarenite. Thickness about 8 or 9 feet. Chart shows unit in lower part of Poteet formation. Corresponds to "9-foot limestone bed" in much discussed Yellow Branch section. Name attributed to B. N. Cooper and G. A. Cooper.

Occurs in section along Yellow Branch (so called locally, but Yellow Creek on Rose Hill quad. map), 5¼ miles south of Hagan and 2 miles north of Tennessee line, Rose Hill quadrangle, Lee County.

**Yellow Breeches Member** (of Wilhite Formation)

Precambrian (Ocoee Series): Southeastern Tennessee.

P. B. King and others, 1958, Geol. Soc. America Bull., v. 69, no. 8, p. 55 (table 1), 962. Characterized by limestone and dolomite which in places form units more than 100 feet thick, many of which are sandy and conglomeratic; these are interbedded with various argillaceous, silty, and sandy rocks. Thickness about 2,000 feet. Upper member of formation; overlies Dixon Mountain member (new).

Named for Yellow Breeches Creek east of Jones Cove, Sevier County.

†Yellow Creek Beds[1]

Devonian and Lower Mississippian: Northeastern Mississippi.

Original reference: E. N. Lowe, 1915, Mississippi Geol. Survey Bull. 12, p. 51.

Named for exposures on Yellow Creek, a branch of Tennessee River in Tishomingo County.

**Yellow Creek Sandstone Member** (of Hance 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, 38, 119.

H. R. Wanless, 1946, Geol. Soc. America Mem. 13, p. 65, 66, 67, 154. In Hance formation about 100 feet above Naese sandstone, the top member of Lee formation.

Named for Yellow Creek, Bell County, Ky.

**Yellow Hill Limestone**[1]

Yellow Hill Limestone (in Pogonip Group)

Lower Ordovician: Eastern Nevada.

Original reference: L. G. Westgate and A. Knopf, 1932, U.S. Geol. Survey Prof. Paper 171.

L. F. Hintze, 1952, Utah Geol. and Mineralog. Survey Bull. 48, p. 48–50, 51–52. In Ely Springs Range, Pogonip group includes Yellow Hill limestone and Tank Hill limestone (top of Ordovician sequence). Inasmuch as both upper and lower limits of Yellow Hill are fault bounded as is lower limit of Tank Hill, it is not considered advisable to carry these formations as stratigraphic units into other areas.

W. H. Easton and others, 1953, Am. Assoc. Petroleum Geologists Bull., v. 37, no. 1, p. 147 (fig. 2). Shown on correlation chart of Pioche district above Mendha limestone and below Tank Hill limestone. Pioche district as used in this report extends to Dutch John Mountain, approximately 40 miles north of Pioche.

Well exposed on Yellow Hill, near center of Ely Springs Range, Pioche region.

**Yellowjacket Formation**[1]

Precambrian (Belt Series) : Southern central Idaho.

Original reference: C. P. Ross, 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.

Named for exposures at town of Yellowjacket, Casto quadrangle.

**Yellow Leaf Quartz Schist**[1]

Devonian (possibly post-Lower Devonian) : Eastern Alabama.

Original reference: C. Butts, 1926, Alabama Geol. Survey Spec. Rept. 14, p. 57, 147–148, map.

Named for exposures on headwaters of Yellow Leaf Creek, 1½ miles east of Jemison, Chilton County.

**Yellowpine Limestone Member** (of Monte Cristo Limestone)

Upper Mississippian: Southeastern Nevada and southeastern California.

Original reference: D. F. Hewett, 1931, U.S. Geol. Survey Prof. Paper 162, p. 9, 18.

J. M. Weller and others, 1948, Geol. Soc. America Bull., v. 59, no. 2, chart 5 (column 23). Age shown on correlation chart as Mississippian (Meramecian).

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. 881, 883 (fig. 2), Geographically extended into Nopah Range, Inyo County, Calif., where it is 100 feet thick, and overlies Bullion limestone member (Arrowhead limestone member not recognized in area). Underlies Bird Springs formation.

D. F. Hewett, 1956, U.S. Geol. Survey Prof. Paper 275, p. 42. Described in Ivanpah quadrangle (California-Nevada). About 120 feet thick in Goodsprings quadrangle, generally thinner westward and southward. Overlies Arrowhead limestone member; underlies Bird Spring formation.

Contains productive ore bodies of Yellow Pine, Potosi, Ingomar, and other mines, Good Springs region, Nevada.

†Yellowstone Formation[1]

Jurassic(?) and Lower and Upper Cretaceous: Central southern Montana.

Original reference: G. D. Harris, 1845, Philadelphia Acad. Nat. Sci. Proc., v. 2, p. 235–237.

Occurs on east flank of Little Belt Mountains, in southwestern part of Little Belt quadrangle, Little Belt Mountains region.

†Yellowstone Lake Group[1]

Pliocene: Northwestern Wyoming.

Original reference: T. B. Comstock, 1874, Rept. of reconn. of northwestern Wyoming made in 1873 by Wm. A. Jones, table facing p. 103.

†Yellville Limestone[1]

Lower Ordovician: Northern Arkansas and southern Missouri.

Original reference: G. I. Adams and E. O. Ulrich, 1904, U.S. Geol. Survey Prof. Paper 24, p. 18, 32 (fig. 1), 90, 93.

Named for exposures at Yellville, Marion County, Ark.

†Yentna Beds[1]

Tertiary: Southern Alaska.

Original reference: J. E. Spurr, 1900, U.S. Geol. Survey 20th Ann. Rept., pt. 7, p. 172, 183.

Crops out opposite Sushitna trading post, on Sushitna River, below mouth of the Yentna.

Yeoman Beds

Ordovician: Subsurface in north-central North Dakota, and southern Saskatchewan, Canada.

Saskatchewan Geological Society, 1958, Report of the Lower Palaeozoic names and correlations committee: Saskatchewan Geol. Soc., p. 4, 5, charts A and B [p. 18, 19]. Largely composed of mottled fossiliferous-fragmental brown dolomitic limestone; dense brown dolomites abundant in outlying areas of the Williston Basin. Thin but very widespread argillaceous section marks top of unit. Reach maximum known thickness of 600 feet in north-central North Dakota. Underlies Herald beds (new) and overlies Winnipeg formation with conformable contacts.

Type locality: Shell Yeoman No. 6–32 (Lsd. 6, sec. 32, T. 8, R. 16, W. 2nd Mer., Saskatchewan) between 8,008 and 8,281 feet; Williston Basin.

**Yeso Formation**

Yeso Member (of Chupadero Formation)[1]

Permian: Northern, central, and southern New Mexico.

Original reference: W. T. Lee, 1909, U.S. Geol. Survey Bull. 389.

C. E. Needham and R. L. Bates, 1943, Geol. Soc. America Bull., v. 54, no. 11, p. 1655 (fig. 1), 1657–1661. Lee (1909) named the Yeso as middle formation of Manzano group. Name is derived from Mesa del Yeso, a small tableland 12 miles northeast of Socorro. Lee stated that Yeso beds were typically exposed on this mesa. However section he described in text, columnar section, and faunal list lies 2 miles southeast of this Mesa del Yeso. Section given in present report was measured in immediate vicinity of Lee's section and some parts are no doubt identical with his. Lee's description of Yeso is unsatisfactory because: (1) type locality is not completely designated; (2) section is measured in such general terms that it is not suitable for present stratigraphic needs; (3) at top of Lee's section, and included by him in Yeso, is a 75-foot limestone, top of which is an exposed erosion surface. This limestone is now known to be basal San Andres; (4) below this bed, Lee also included in Yeso 200 feet of sandstone, part of which is now separated as Glorieta sandstone; and (5) a limestone layer at base of Yeso is described as highly fossiliferous and 50 feet thick. Such a layer is not believed to occur at or near base of formation. In present report, base of Yeso is placed at base of a limestone bed, this bed is only 7 to 10 feet thick and is barren of fossils. Prominent exposure of San Andres limestone is present three-eighths mile west of base of Yeso type section as herein described, the position of which is result of faulting. Because this stratum is about 50 feet thick and contains many fossils, it is thought that Lee may have mistakenly included it in basal Yeso. As redescribed herein, Yeso consists of at least four units. Lowest is general zone of clastic material, characterized by pink and orange sandstone; middle evaporites; Canas member (new); Joyita member (new) Thickness 592.7 feet at type section; thickens toward both northwest and southeast from type section. Overlies Abo formation; underlies Glorieta sandstone. Darton (1922, U.S. Geol. Survey Bull. 726) reduced Yeso to member status in Chupadero formation, a term he introduced to include beds of Yeso and San Andres age. Term Chupadero has been abandoned by U.S. Geological Survey, and Yeso is now considered formation in Manzano group.

G. H. Wood and S. A. Northrop, 1946, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 57. In Sandoval and Rio Arriba Counties, subdivided into Meseta Blanca member at base and San Ysidro member above (both new). Overlies Abo formation; underlies Glorieta sandstone member of San Andres.

V. C. Kelley and G. H. Wood, 1946, U. S. Geol. Survey Oil and Gas Inv. Prelim. Map 47. Formation, in Lucero uplift, Valencia, Socorro, and Bernalillo Counties, subdivided into (ascending) Meseta Blanca member, 0 to 20 feet, and Los Vallos member (new), 820 to 1,020 feet. Overlies Abo formation; underlies San Andres formation.

R. H. Wilpolt and others, 1946, U.S. Geol. Survey Oil and Gas Prelim. Map 61. In La Joya area, Los Pinos Mountains, and northern Chupadera Mesa, subdivided into (ascending) Meseta Blanca, Torres (new), Canas gypsum, and Joyita sandstone members. Thickness as much as 1,015 feet.

G. O. Bachman and P. T. Hayes, 1958, Geol. Soc. America Bull., v. 69, no. 6, p. 696 (fig. 4), 697. In Otero County, includes Otero Mesa member (new). Overlies Lee Ranch tongue (new) of Abo sandstone; west of Otero Mesa overlies Hueco limestone.

Type section (Needham and Bates): Base of section is 11.2 miles N. 46° E. of Socorro at point on Socorro quadrangle where its eastern edge is intersected by the 34° 10′ parallel. Section measured northeast from this point, in canyons and cuesta escarpments in secs. 4 and 5, T. 2 S., R. 2 E., and in sec. 33, T. 1 S., R. 2 E., Socorro County. Top of section is 2¼ miles southeast of Mesa del Yeso on high isolated butte. Named for exposures on Mesa del Yeso, small tableland, 12 miles northeast of Socorro.

Ynezian Stage

Paleocene: California.

V. S. Mallory, 1953, (abs.) Jour. Paleontology, v. 27, no. 6, p. 903. Named as lowermost of six stages, based on foraminiferal assemblages, in lower Tertiary of California. Occurs below Bulitan [Bulitian] stage.

V. S. Mallory, 1959, Lower Tertiary biostratigraphy of the California Coast Ranges: Tulsa, Okla., Am. Assoc. Petroleum Geologists, p. 22–27, 74, 91, fig. 7, tables. Lowest of Tertiary stages. Divisible into two zones, *Silicosigmoilina californica* below and *Bulimina excavata* above. Stage is generally correlative with Laiming's (1939, 6th Pacific Cong. Proc., v. 2) "E-Zone." Base of chronologic-biostratigraphic classification presented is taken as being horizon at which "Martinez" megafossils or associated Foraminifera first occur as distinguished from those horizons generally understood to be Upper Cretaceous. Base of Paleocene, as established here, would be at horizons immediately superjacent to European Danian stage; base of Ynezian may not represent lowest Tertiary in California region. Type section of stage in lower Anita formation rests conformably on strata referred to Jalama formation by Dibblee (1950).

Type area: Canada el Bulito, Santa Barbara County.

Yoakum Dolomite Member (of Queen Formation)

Permian: Subsurface in Texas and New Mexico.

W. C. Fritz and James Fitzgerald, Jr., 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 1, p. 24–25. Name applied to brown dolomite in Queen formation. Occurs between depths of 4,180 feet and 4,215 feet in type well.

Type well: Well No. 30, formerly Davidson, now Honolulu-Cascade, Bennett No. 1, center NE¼ sec. 678, Block D, John H. Gibson Survey, Yoakum County, Tex.

Yoder Formation[1]

Oligocene, lower: Southwestern Wyoming.

Original reference: E. M. Schlaikjer, 1935, Harvard Coll. Mus. Comp. Zool., v. 76, no. 3, p. 71–75.

C. B. Schultz and T. M. Stout, 1955, Nebraska Univ. State Mus. Bull., v. 4, no. 2, p. 31, 34, table 1. Lower Chadron, or Chadron A of this report, is essentially the Yoder of Schlaikjer (1935) and the Ahearn of Clark (1954), which may prove to be a synonym of the former.

Type locality: SE¼ sec. 29, T. 23 N., R. 62 W., Goshen County. Named for town of Yoder, 1½ miles southeast of type locality.

**Yogo Limestone**[1]

Upper Cambrian: Central northern and central southern Montana.

Original references: W. H. Weed, 1899, U.S. Geol. Survey Geol. Atlas, Folio 55; 1899, Folio 56; 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. 1272, 1282, 1285, 1336, 1337. Original description of Yogo limestone has no meaning because Cambrian rocks could not be found in any section in Montana or Yellowstone Park between Dry Creek shale and overlying Devonian limestone or dolomites. Name Yogo has no basis in observable fact and must be discarded.

L. L. Sloss and W. M. Laird, 1947, Am. Assoc. Petroleum Geologists Bull., v. 31, no. 8, p. 1413–1415. In work on Little Belt Mountains, Weed (1900) described thin-bedded limestones interbedded with gray or greenish shale and grading into rather pure thick-bedded limestone. To these beds, he gave name Yogo limestone and assigned them to Cambrian. It is evident that Weed considered Yogo limestone equivalent to Peale's (1893, U.S. Geol. Survey Bull. 110) pebbly limestones of Three Forks area. It now seems clear that Weed's Yogo limestone is equivalent to basal Devonian of this paper, plus a variable part of the base of limestone member of Jefferson formation. If the basal Devonian unit is proved to be a cartographic unit, Yogo, suitably revised, would have priority as formational name. Deiss (1936) found no Cambrian fossils above Dry Creek shale in Belt Creek section; hence, no Yogo in the section. He believed that name Yogo should be discarded. Present authors agree that there may be no Cambrian above Dry Creek shale in central Montana, but this fact does not invalidate term Yogo. If formation is a lithologic unit, its identity is not destroyed because it was first assigned to wrong geologic age.

Christina Lochman,. 1950, Am. Assoc. Petroleum Geologists Bull., v. 34, no. 11, p. 2212. Yogo limestone, if used as originally defined by Weed does not exist. Even if used in restricted sense as indicated by Sloss and Laird, Yogo can only be lithologic and stratigraphic equivalent of beds in upper part of their basal Devonian unit—beds which because of their transitional character are more difficult to separate from overlying Jefferson than the prominent red and yellow dolomites and mudstones of lower part of basal Devonian unit.

Derivation of name not stated. Unit was mapped by Weed in vicinity of village of Yogo and along Yogo Creek, Little Belt Mountains quadrangle.

Yokohl Amphibolite (in Kaweah Series)

Triassic(?): Southern California.

Cordell Durrell, 1940, California Univ. Dept. Geol. Sci. Bull., v. 25, no. 1, p. 13–14, 116, fig. 29, geol. map. Oldest in sequence (ascending) of four units in series. Most important original lithologic types are basic volcanic rocks, both flows and tuffs; bedded cherts of radiolarian type; acid volcanic rocks; argillaceous sediments; and limestone. Approximate thickness in Woodlake Mountain 8,000 feet, base not exposed; older than Lemon Cove schist (new).

Occurs in the southern Sierra Nevada in north-central Tulare County.

Yokut Sandstone

Eocene: East-central California.

R. T. White, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 10, p. 1726–1727 (fig. 1), 1744 (fig. 5), 1745–1747. Massive sandstone, fine-grained, white, brown, and gray. Thickness varies from 0 to 305 feet; at type locality 45 feet. Underlies Domengine formation (as restricted by Clark, 1926, California Univ. Pub. Bull., Geology Dept., v. 16, no. 5); overlapped by Domengine at axis of Coalinga anticline on south, and approximately 1 mile northwest of Tumey Gulch on north; overlies Arroyo Hondo member of Lodo formation with contact gradational. This unit was lower part of "Tejon" of Anderson and Pack (1915, U.S. Geol. Survey Bull. 603); referred to "Meganos" group by some authors. Incorrectly included in Domengine by White (1938, Geol. Soc. America Proc. 1937) and erroneously included in Arroyo Hondo by Vokes (1939).

I. F. Wilson, 1943, California Jour. Mines and Geology, v. 39, no. 2, p. 208–209. Described in San Benito quadrangle where it is exposed along southwest flank of Butts Ranch syncline. Thickness varied between 800 to 1,200 feet. Overlies Lodo formation; unconformably overlain by Domengine sandstone.

M. B. Payne, 1951, California Div. Mines Spec. Rept. 9, p. 15. North of Cantua Creek in Panoche Hills [Fresno County], Yokut sand underlies basal Kreyenhagen glauconitic sand, Domengine formation missing.

Type locality: Near west boundary of SE¼ sec. 29, T. 18 S., R. 15 E., in Domengine Creek. No geographic names were available. Yokut was named after Yokut Indians who inhabited San Joaquin Valley.

**Yolo Formation**

Upper Cretaceous (Chico Series) : Northern California.

J. M. Kirby, 1943, Am. Assoc. Petroleum Geologists Bull., v. 27, no. 3, p. 282, 285–287, 291, 293. Consists of well-bedded greenish-gray or light drab siltstones with numerous thin layers of fine flaggy sandstone. Thickness 500 to 1,100 feet. Underlies Sites formation; overlies Venado formation (new). Replaces preoccupied name Mills formation (Kirby, 1942).

Named because of widespread distribution along west side of Sacramento Valley in Yolo County. Well exposed at Cache Creek, immediately downstream from concrete bridge on Rumsey-Lake County highway.

**Yonkers Granite**[1]

Precambrian : Southeastern New York.

Original reference: F. J. H. Merrill, 1890, Am. Jour. Sci., 3d ser., v. 39, p. 388.

T. W. Fluhr, 1948, Rocks and Minerals Mag., v. 23, no. 8, p. 699. Age shown in map legend as probable Upper Ordovician.

Occurs in hills in Yonkers, Westchester County.

**Yonna Formation**

Pliocene: Southwestern Oregon.

R. C. Newcomb, 1958, Northwest Sci., v. 32, no. 2, p. 41–48. In type area, consists of (1) a lower sedimentary (lacustrine) section consisting of ashy diatomite, stratified sandstone, laminated siltstone, waterlaid volcanic ash, pumice, and semiconsolidated gravel, and (2) a rather thick upper unit of basaltic lapilli tuff, part of which was deposited in water. Outside type area, there is much diatomite, waterlaid volcanic ash, and other sedimentary material in upper part of formation, and relation of a sedimentary lower unit and a tuffaceous upper unit is not clearly established. As much as 2,000 feet thick. Formation is cut by dikes and sills of generally basaltic composition and is broken by an intricate system of block faulting; breakage and displacement are greatest in the Klamath and Langell grabens, here strata of the Yonna have dips as high as 30° or 40°. Overlies unnamed lava rocks; underlies with minor erosional unconformity, lava rocks (Pliocene?), Quaternary lava or alluvium.

Type locality: Along west side of Yonna Valley in T. 38 S., R. 11½ E., Willamette meridian and baseline, Klamath County. Crops out in large areas in Yonna, Swan Lake, Sprague River, Williamson River, Poe and Klamath Valleys, and adjacent Lost River basin.

**Yorba 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. Thin-bedded gray siltstone with lesser amounts of thin-bedded fine-grained sandstone. Maximum exposed thickness about 2,500 feet. Underlies Sycamore Canyon member, contact gradational; overlies Soquel member (new), contact gradational.

Named for Yorba Bridge across Santa Ana River, 2½ miles east of Atwood, Orange County. Exposed in Puente Hills north of Yorba Bridge and in northwestern Santa Ana Mountains to south of bridge.

†York Limestone[1]

Cambrian and Ordovician: Southeastern Pennsylvania.

Original reference: P. Frazer, Jr., 1876, Pennsylvania 2d Geol. Survey Rept. C, p. 130.

In York County.

†York Schist[1]

Lower Cambrian: Southeastern Pennsylvania.

Original reference: P. Frazer, Jr., 1876, Pennsylvania 2d Geol. Survey Rept. C, p. 130–143.

Composes greater part of Chikis Ridge and Chestnut Hill in York County.

†York Shale[1]

Lower Cambrian: Southeastern Pennsylvania.

Original reference: C. D. Walcott, 1896, U.S. Geol. Survey Bull. 134, p. 14–15, 26, 36–37.

Well exposed in York County.

†York County Hydromica Slates[1]

Lower Cambrian: Southeastern Pennsylvania.

Original reference: J. P. Lesley, 1892, Pennsylvania 2d Geol. Survey Summ. Final Rept., v. 1, p. 203.

Composes greater part of Chikis Ridge and Chestnut Hill in York County.

York Harbor Biotite Granite[1]

Devonian(?): Southwestern Maine.

Original reference: A. Wandke, 1922, Am. Jour. Sci., 5th, v. 4, p. 148, 149.

Exposed along south side of York Harbor, York County.

Yorkian[1] or Yorkic period[1]

Silurian and Devonian: New York.

Original reference: C. R. Keyes, 1922, Pan-Am. Geologist, v. 37, p. 234, 243–244.

York-Petro Limestone[1]

Pennsylvanian: Utah.

Original reference: R. N. Hunt and O. P. Peterson, 1924, Am. Inst. Mining Metall. Engineers Trans., v. 70, p. 859–883, 908–926.

Occurs in Bingham district.

†Yorktown Epoch[1]

Miocene: Atlantic coast.

Original reference: J. D. Dana, 1863, Manuel geology, p. 506, 510, 521, 522.

Occurs at Gay Head on Martha's Yineyard; in New Jersey; in Maryland, on both sides of the Chesapeake Bay for a great distance; and in Virginia, at Yorktown, Suffolk, Smithfield, and through larger part of Tertiary region.

**Yorktown Formation** (in Chesapeake Group)[1]

Miocene, upper: Eastern Virginia, eastern Maryland, and North Carolina.

Original reference: W. B. Clark and B. L. Miller, 1906, Virginia Geol. Survey Bull. 2, pt. 1, p. 19.

L. W. Stephenson and F. S. MacNeil, 1954, Geol. Soc. America Bull., v. 65, no. 8, p. 733–738. Geographically extended into eastern Maryland where it reaches Chesapeake Bay in the Calvert Cliffs. Overlies St. Marys formation.

H. E. LeGrand and P. M. Brown, 1955, Carolina Geol. Soc. Guidebook of Excursion in Coastal Plain of North Carolina, Oct. 8–9, p. 11–12. Formation, as extended into North Carolina, may include elements of St. Marys formation as mapped elsewhere. In this report, Duplin marl is considered to be a shallow-water facies of the Yorktown; Waccamaw formation, considered as contemporaneous with Duplin, is also included in Yorktown.

J. L. Stuckey and S. G. Conrad, 1958, North Carolina Div. Mineral Resources Bull. 71, p. 45; J. L. Stuckey, 1958, Geologic map of North Carolina (1:500,000): North Carolina Div. Mineral Resources. As mapped, includes Duplin marl.

First described at Yorktown on James River, Va.

Yorktownian Substage

Miocene, upper: Maryland, New Jersey, and Virginia.

D. S. Malkin, 1953, Jour. Paleontology, v. 27, no. 6, p. 767, 768. A substage based on microfaunal assemblages; includes all sediments deposited in central Atlantic Coastal Plain province during time of accumulation of Yorktown formation, type exposure of which is considered exemplary of the substage. In sequence, the Yorktownian succeeds St. Marysan substage.

**Yorkville Quartz Monzonite**

Yorkville Granite[1]

Permian: Northwestern South Carolina and southern North Carolina.

Original reference: A. Keith, 1931, U.S. Geol. Survey Geol. Atlas, Folio 222.

L. L. Smith and Roy Newcome, Jr., 1951, Econ. Geology, v. 46, no. 7, p. 759–760. Granite exposed over large area south and southeast of Henry Knob, which is 3 miles west of Clover, S. C.

Named for exposures at Yorkville (also called York), York County, S.C.

Yosemite Glacial Epoch[1]

Pleistocene: California.

Original reference: E. Blackwelder, 1930, Geol. Soc. America Bull., v. 41, p. 91–92.

Youghall Formation

Youghall Member (of Morgan Formation)

Pennsylvanian: Northwestern Colorado and northeastern Utah.

M. L. Thompson, 1945, Kansas Geol. Survey Bull. 60, pt. 2, p. 29, 30, 34–39, geol. sections. Proposed for the fossiliferous limestones, thin shales, and thick interbedded highly crossbedded sandstones stratigraphically between Hells Canyon formation (new) and Weber sandstone (redefined). Type section, approximately 625 feet thick, composed of crossbedded to massive buff to reddish-brown sandstone and interbedded highly fossiliferous limestone. Thickness at Juniper Mountain 650 feet, contact with overlying Weber not observed; 500 feet at Split Mountain; 600 feet at White Rock Canyon; 530 feet at Sheep Mountain Canyon. Overlies Hells Canyon formation on south and southeast margins of Uinta Mountains; on southwest margin, overlies Morgan formation (as defined by Williams); on north margin, overlies Belden formation.

D. O. Peterson, 1960, Dissert. Abs., v. 20, no. 7, p. 2757. Redefined as upper member of Morgan formation and restricted to upper tan and buff sandstones and interbedded limestones; balance of formation which is red sandstone and interbedded limestone is designated "Red Morgan" member.

Type locality: Exposures on west side of Hells Canyon in sec. 31, T. 6 N., R. 102 W., and along east side of head of Hells Canyon in W½ sec. 7, T. 5 N., R. 102 W., Moffat County, Colo. Name derived from old stage station of Youghall, east of Hells Canyon.

Youghiogheny Sandstone

Upper Devonian (Conewango): Southwestern Pennsylvania.

W. M. Laird, 1941, Pennsylvania Topog. and Geol. Survey Progress Rept. 126, p. 9–11. Name will probably be used. following more definitive study of area, for unit here termed Sandstone B and described as alternating red sandstone and brick-red shales interbedded with some massive green sandstones and green shales. Red beds show rapid lateral change to green. A tongue like expression of Catskill magnifacies into a marine magnafacies represented by Shale C above (Watering Trough shale) and Sandstone A below (Maple Summit sandstone). Thickness 422 feet in Youghiogheny Gorge through Laurel Hill. Conformable contacts with overlying and underlying units.

Type exposure along tracks of Western Maryland Railroad on south bank of Youghiogheny River opposite settlement of Victoria, Fayette County.

Youngman Formation (in Maquam Group)

Middle Ordovician (Chazyan): Northwestern Vermont, and southeastern Quebec, Canada.

Marshall Kay, 1945, (abs.) Geol. Soc. America Bull., v. 56, no. 12, pt. 2, p. 1172. Typically argillaceous limestone grading up into dark slate having limestone interbeds. Thickness 300 feet at type locality. Underlies Isle la Motte limestone disconformably; overlies Carman quartzite.

Marshall Kay and W. M. Cady, 1947, Science, v. 105, no. 2736, p. 601. Upper formation of Maquam group (new).

Marshall Kay, 1958, Am. Jour. Sci., v. 256, no. 2, p. 81–82, 83–85. Type Youngman contains some fossils known in the Chazy limestones to west along Lake Champlain, but others that are unknown there and have been thought diagnostic of later age. Stratigraphic relations of Carman and Youngman seem to preclude their being other than Chazyan. It is concluded that the Carman-Youngman is Chazyan of facies different from typical Chazyan group and from St. Dominique [in Quebec] and that presence of *Christiania*, *Sowerbyella*, and *Platymena* and other forms in formation must be accepted as showing that ranges of these genera are somewhat greater than had been recognized, and that their sensitivity in correlation is reduced.

Type locality: Mississquoi Park, Highgate Springs, Franklin County, Vt.

**Young Peak Dolomite**[1]

Middle Cambrian: Western Utah.

Original reference: T. B. Nolan, 1930, Washington Acad. Sci. Jour., v. 20, no. 17, p. 421–432.

W. H. Easton and others, 1953, Am. Assoc. Petroleum Geologists Bull., v. 37, no. 1, p. 147 (fig. 2). Listed on correlation chart of recommended revision of stratigraphic units in Great Basin. Above Abercrombie formation and below Trippe limestone.

Well exposed on Young Peak, on south side of Dry Canyon, Gold Hill district.

Youngs Bluff Bed[1]

Eocene (Jackson): Northwestern Louisiana.

Original reference: T. L. Casey, 1902, Science, new ser., v. 15, p. 716.

Named for outcrops on estate of John Young, south of Montgomery, Grant County.

Ysidro shale[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, 12.

Well exposed in sharp truncated arch in Tijeras Canyon between Sandia and Manzano Ranges. Derivation of name not given.

**Yucca Formation**

Yucca Bed[1]

Lower Cretaceous: Western Texas.

Original reference: J. A. Taff, 1891, Texas Geol. Survey 2d Ann. Rept., p. 725, 736.

R. M. Huffington, 1943, Geol. Soc. America Bull., v. 54, no. 7, p. 992 (fig. 2), 997–1000. Formation, in northern Quitman Mountains, is predominantly gray, buff, and red limestone, arenaceous limestone, maroon shale, sandstone, and limestone-, chert-, and quartz-pebble conglomerate. Thickness 1,117 to 5,518 feet. Overlies Torcer formation (emended) with contact not exposed; underlies Bluff formation with contact arbitrarily chosen. Beds correlative with parts or all of Yucca formation have previously been mapped or designated by other names in parts of Quitman area. Baker (1927, Texas Univ. Bull. 2745) erroneously mapped Yucca as Cox. Las Vigas(?) in Malone Mountains is evidently same as the Yucca. Recommended that earlier and diverse terminology for all, or parts, of the same formation be abandoned in favor of name Yucca.

Elliot Gillerman, 1953, U.S. Geol. Survey Bull. 987, p. 12 (table 1), 15–16, pl. 1. In Eagle Mountains, formation consists chiefly of red shales and limestones; brown limestones, red and brown sandstones, and limestone pebble conglomerate. Thickness as much as 330 feet. Overlies Wolfcamp(?); underlies Bluff Mesa formation (name replaces preoccupied Bluff formation).

D. L. Amsbury, 1958, Texas Univ. Bur. Econ. Geology Geol. Quad. Map 22. In Presidio County, overlies Pinto Canyon formation (new); underlies Bluff formation.

R. K. DeFord and L. W. Bridges, 1959, Texas Jour. Sci., v. 11, no. 3, p. 291. In northern Rim Rock country, locally underlies Tarantula gravel (new).

Named for Yucca Mesa, El Paso County.

†Yucca Flat Formation

Middle to Upper Cambrian: Southern Nevada.

M. S. Johnson and D. E. Hibbard, 1957, U.S. Geol. Survey Bull. 1021–K, p. 340–342, pls. 32, 33. Consists of two parts: lower part of generally light- to medium-gray massive calcitic limestone which weathers a mottled buff to gray, thickness 395 feet; upper part contains four recognizable units, (ascending) A through D, and consists of dark- and light-colored, well-bedded, and generally thin-bedded limestone and dolomite; thickness more than 2,420 feet. Underlies Dunderberg shale and overlies Jangle limestone (new) with contacts conformable.

Named for exposures on east side of Yucca Flat in the Atomic Energy Commission Nevada proving grounds area, Nye County. Occupies hills and valleys of great relief. Banded Mountain obtains its name from alternating bands of dark- and light-colored limestone and dolomite characteristic of parts of formation. Mose complete section exposed from Jangle Ridge to Banded Mountain but section incomplete due to faulting.

Yukon Group[1]

Precambrian: Northeastern Alaska, and northwestern Yukon, Canada.

Original references: D. D. Cairnes, 1914, Geol. Soc. America Bull., v. 25, p. 184; 1914, Canada Geol. Survey Summ. Rept. 1912, p. 11; 1914, Canada Geol. Survey Mem. 67, p. 40.

Yukon Silts[1]

Pleistocene: Northeastern Alaska.

Original reference: J. E. Spurr, 1898, U.S. Geol. Survey 18th Ann. Rept., pt. 3, p. 200–220.

A. J. Eardley, 1938, Geol. Soc. America Bull., v. 49, no. 2, p. 317–336. Divided into six groups of unconsolidated deposits.

Form lower terraces of Yukon River.

†Yule Limestone[1]

Ordovician: Western and central Colorado.

Original reference: G. H. Eldridge, 1894. U.S. Geol. Survey Geol. Atlas, Folio 9.

J. H. Johnson, 1955, Geol. Soc. America Bull., v. 55, no. 3, p. 315, 320, 322. Mentioned in report on Paleozoic stratigraphy of Sawatch Range. Yule limestone of various authors is now included in Manitou dolomite, Harding sandstone, and Fremont limestone of this report.

Named for development at head of Yule Creek, Anthracite-Crested Butte area.

†Yulean series[1]

Cambrian to Upper Devonian: Western Colorado.

Original reference: C. R. Keyes, 1924, Pan-Am. Geologist, v. 41, p. 281, 289.

Yuma Sandstone Member[1] (of Manning Formation)

Eocene, upper: Southeastern Texas.

Original reference: B. C. Renick, 1936, Texas Univ. Bull. 3619, p. 36–39, table opp. p. 17.

D. H. Eargle, 1959, Am. Assoc. Petroleum Geologists Bull., v. 43, no. 11, p. 2630. Tentatively considered equivalent to Stones Switch sandstone member of Whitsett formation.

Exposed in vicinity of Yuma.

**Zabriskie Quartzite**

Zabriskie Formation

Zabriskie Quartzite Member (of Wood Canyon Formation)

Lower Cambrian: Southeastern California and western Nevada.

J. C. Hazzard, 1937, California Jour. Mines and Geology, v. 33, no. 4, p. 278 (fig. 3d), 309–310. Discussion of Paleozoic section in Nopah and Resting Springs Mountains, Inyo County. Zabriskie quartzite member is 160-foot unit, upper 100 feet of which consists of massive indistinctly crossbedded fine- to medium-grained fairly well-sorted pinkish to light-gray quartzite in beds 1 to 6 feet thick; weathered surface is characteristically salmon pink to rusty brown; below 100-foot massive part unit grades into reddish-brown sandy shale and medium- to coarse-grained shaly quartzite and sandstone, locally conglomeratic. Basal 10 feet is light-gray to nearly white reddish-brown weathering massive quartzite. Basal part contains vertical tubelike structures assumed to be sand-filled burrows of forms like *Scolithus;* these are characteristics of base of Zabriskie both in the Nopah and Resting Springs Ranges; in Emigrant Pass, upper beds of Zabriskie show horizontal worm(?) castings and ripple marks. Top of Zabriskie is 630 feet below top of Wood Canyon formation; overlies unnamed micaceous shale interval of Wood Canyon; upper 630 feet of Wood Canyon unnamed.

R. H. Hooper, 1947, Geol. Soc. America Bull., v. 58, no. 5, p. 404 (fig. 1), 406. Member, in Panamint Range, is about 70 feet thick and consists of light-pink cross-laminated saccharoidal quartzite.

H. E. Wheeler, 1948, Nevada Univ. Bull., Geology and Mining Ser., no. 47, p. 24 (fig. 3), 26–27, fig. 5 facing p. 32. Rank raised to formation. Underlies Tecopa formation (new); overlies Wood Canyon formation. Thins to about 20 feet at Spring Mountain and apparently grades out completely toward the east. By inference, the Zabriskie is a tongue extending northwestward from the time-transgressing top surface of Prospect Mountain quartzite and thus should become part of the Prospect Mountain as the Wood Canyon thins out on border of geosyncline. Geographically extended into southwestern Nevada.

Name derived from Zabriskie Station on Tonopah and Tidewater Railroad in Amargosa Valley west of Resting Springs Range, Inyo County, Calif.

Zadoc Member (of McNairy Formation)

Cretaceous (Gulf Series): Southeastern Missouri.

H. S. McQueen and others, 1939, *in* Kansas Geol. Soc. Guidebook 13th Ann. Field Conf., p. 70 (fig. 25), 71. Light-gray to dark-brown sandy, ferruginous clay about 29 feet thick. Occurs about 10 feet above base of formation and 22 feet below top.

Present in Ardeola Hill section, center NW¼ sec. 10, T. 27 N., R. 11 E., Ardeola, Stoddard County. This is stop 33 on road log.

Zaleski Flint (in Allegheny Formation)[1]

Zaleski marine member

Pennsylvanian (Allegheny Series): Southeastern Ohio.

Original reference: Wilber Stout, 1927, Ohio Geol. Survey, 4th ser., Bull. 31, p. 181.

M. T. Sturgeon and others, 1958, Ohio Geol. Survey Bull. 57, p. 49 (table 7), 55–56. Member of Ogan cyclothem in report on Athens County. In its type area, this bed is normally a flint but locally in type area is also represented by calcareous flint, siliceous limestone, calcareous shale, and iron ore. Nodular fossiliferous marine limestone and shale has been observed in Sandy Township, Tuscarawas County, at horizon of Zaleski member. Thickness about 8 inches. Overlies Ogan coal and underclay members; underlies members of Winters(?) cyclothem. Allegheny series.

Exposed near Zaleski, Vinton County.

**Zanzibar Limestone**[1]

Ordovician(?): Central Nevada.

Original reference: H. G. Ferguson, 1924, U.S. Geol. Survey Bull. 723.

W. H. Easton and others, 1953, Am. Assoc. Petroleum Geologists Bull., v. 37, no. 1, p. 148. Listed with names not included on chart of recommended revision of stratigraphic units in Great Basin. Reasons for omission usually are that names are incapable of being interpreted or are rejected synonyms. [Toquima formation and Mayflower schist, noted by Ferguson, 1924, as overlying and underlying Zanzibar are also omitted from chart.]

Prominently developed on Zanzibar claim, about 1½ miles east of Manhattan, Nye County.

Zarah Subgroup (of Kansas City Group)

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

R. C. Moore, 1948, Am. Assoc. Petroleum Geologists Bull., v. 32, no. 11, p. 2031 (fig. 4), 2033. Name applied to upper part of Kansas City group. Includes beds between top of Iola formation and base of Plattsburg formation of Lansing group. As thus defined, subgroup comprises (ascending) Lane shale, Wyandotte formation, and Bonner Springs shale. Thickness of subdivisions varies from place to place. Occurs above Linn subgroup (new).

R. C. Moore and others, 1951, Kansas Geol. Survey Bull. 89, p. 81. Thickness in Kansas about 100 feet.

Named for village of Zarah on Kansas Highway 10 at Santa Fe Railway crossing in western Johnson County, Kans.

**Zeandale Limestone** (in Wabaunsee Group)

Pennsylvanian (Virgil Series): Northeastern Kansas.

R. C. Moore and M. R. Mudge, 1956, Am. Assoc. Petroleum Geologists Bull., 40, no. 9, p. 2274 (fig. 1), 2276. Defined to include strata between Pillsbury shale (new) above and Willard shale below. Thickness ranges from 19 to 53 feet and averages about 25 feet. Comprises (ascending) Tarkio limestone, Wamego shale, and Maple Hill limestone members.

Type section: In SE¼NE¼NE¼ sec. 28, T. 10 S., R. 9 E., along north-south farm access road south of Deep Creek, about 1 mile east and one-quarter mile south of Zeandale, Riley County. Name derived from town of Zeandale on south side of Kansas River.

Zell Limestone Member (of Macy Formation)

Middle Ordovician: Southeastern Missouri.

E. R. Larson, 1951, Am. Assoc. Petroleum Geologists, v. 35, no. 9, p. 2061–2064. Name applied to upper member of formation. Consists of fine-textured well-bedded calcitite with green shale partings and thin layers of intraformational conglomerate and shell beds; contains thin bed of metabentonite near top. Thickness at type locality 32 feet; thickens southward to 69 feet in southeastern Perry County. Overlies Hook member (new); underlies Decorah formation.

Type exposure: At type exposure of Macy formation, along Missouri Highway 25 in SE¼ NW¼ sec. 27, T. 38 N., R. 8 E., 1 mile north of Zell, Ste. Genevieve County.

Zemorrian Stage[1]

Miocene, lower: 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. 103–113, figs. 4, 14 (correlation chart). Superjacent to Refugian stage; subjacent to Saucesion stage. Includes two zones: *Uvigerina gallowayi* and *Uvigerinella sparsicostata*. Systematic catalogue.

Type locality: Zemorra Creek, head of which is in SW¼ sec. 17, T. 29 S., R. 20 E., western Kern County. Creek runs northeast cutting the northwestern tip of sec. 16 and thence across SW¼ sec. 9, turns east-northeast and joins Chico Martinez Creek near center NW¼ sec. 10.

Zenoria 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), 104–105. Consists of series of fossiliferous blue-gray clays and sands; clays are fine, very plastic, contain considerable glauconite and lack lignitic particles of the typical Verda. Occurs in upper part of member at about the same stratigraphic position as the Mossy Ridge lentil (new). Thickness in wells about 50 feet.

Named from exposure along a creek bank 1 mile northeast of Zenoria, La Salle Parish.

†Zesch Formation

Upper(?) Devonian: Central Texas.

V. E. Barnes, P. E. Cloud, Jr., and L. E. Warren, 1947, Geol. Soc. America Bull., v. 58, no. 2, p. 128 (fig. 2), 137 (fig. 7), 138–139. Thin highly siliceous limestone and leached silica rock containing a few species of brachiopods; brownish to yellowish and contains angular fragments of chert. About 18 to 24 inches thick; thins to feather edge. Rests on older Devonian strata (Bear Spring formation) and is collapsed into middle Ellenburger strata (Gorman formation); appears to grade upward into chert breccia here assigned to Ives breccia.

P. E. Cloud, Jr., V. E. Barnes, and W. H. Hass, 1957, Geol. Soc. America Bull., v. 68, no. 7, p. 811. Term abandoned. Partial synonym for Ives breccia member of Houy formation (new).

Type locality: On Ray Zesch Ranch, Mason County.

Zeta Lake granite porphyry facies (of Ogishke 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), 1034, 1035. Black granite porphyry pebble conglomerate at top of Ogishke conglomerate. Thickness 1,000 feet. Conformably underlies and interbeds with Knife Lake slates; overlies West Gull jasper facies of Ogishke conglomerate.

Occurs in vicinity of Zeta Lake in Vermilion district.

**Zeto Point Basalt Porphyry**

Tertiary: Southwestern Alaska.

R. R. Coats, 1947, U.S. Geol. Survey Alaskan Volcano Inv. Rept. 2, pt. 5, p. 77, pl. 6. Constitues five domical masses of basalt porphyry. Largest of the masses, about 230 feet thick, lies north of entrance to Sweeper Cove. All rocks have abundant calcic plagioclase phenocrysts, as much as 1 centimeter long, in medium- to light-gray groundmass. Basalt porphyry is younger than Finger Bay volcanics (new) which it intrudes; older than Andrew Bay volcanics (new).

Five domical masses which crop out on and near shore line of Kuluk Bay from Zeto Point northward (two of the domes mapped along Kuluk Bay south of Zeto Point), northern Adak Island, in central part of Aleutian Islands.

Zia Marl[1]

Eocene(?): Central northern New Mexico.

Original reference: A. B. Reagan, 1903, Am. Geologist, v. 31, p. 67–111.

Probably named for village of Zia, near Jemez, Sandoval County.

Zilhlejini Formation[1]

Upper Cretaceous: Northeastern Arizona.

Original reference: A. B. Reagan, 1925, Pan-Am. Geologist, v. 44, p. 287, 291.

Probably named for exposures on Ziltahjina Peak [as spelled on 1924 geologic map of Arizona], in Black Mesa.

**Zilpha Clay** (in Claiborne Group)

Zilpha Clay Member (of Lisbon Formation)

Eocene, middle: Western Mississippi.

U. B. Hughes and others, 1940, Mississippi Geol. Soc. [Guidebook 2] Field Trip, Mar. 9–10, p. 3, 11–12, column section. Gray-white to chocolate-brown clay; sandy at top and glauconitic at base. Thickness about 60 feet in Lisbon formation; underlies Kosciusko sand member; overlies Winona sand member. Name credited to Raymond Moore.

E. P. Thomas, 1942, Mississippi Geol. Survey Bull. 48, p. 33–40, fig. 1, pls. 1, 2, profiles A, B, C. Rank raised to formation in Claiborne group. Thickness at designated type locality 54 feet; upper contact not exposed. Overlies Winona greensand and underlies Kosciusko formation.

Type locality: Along county road at Bucksnort Hill 1½ miles north of Zilpha Creek and near center sec. 8, T. 16 N., R. 6 E., northwestern Attala County.

**Zion Hill Member (of Bull Formation)**

**Zion Hill Quartzite**[1]

**Zion Hill Quartzite Member (of Schodack Formation)**

Lower Cambrian: Southwestern Vermont and eastern New York.

Original reference: R. Ruedemann, 1914, New York State Mus. Bull. 169, p. 69–70.

D. M. Larrabee, 1939, Eng. Mining Jour., v. 140, no. 12, p. 47–48, 49 (fig. 3), 51. In area studied [near Rutland, Vt.], Cambrian grits, quartzites, slates, limestone, and shales are separated from overlying Ordovician quartzites, graywackes, slates, and cherts by angular unconformity, exposed in road cut at Hampton, N.Y., where at a near contact, Cambrian Schodack shales dip 78° E., and Ordovician Zion Hill quartzite dips 48° E. Thickness about 70 feet. Underlies Normanskill.

Rudolf Ruedemann, J. H. Cook, and D. H. Newland, 1942, New York State Mus. Bull. 331, p. 65–67. Member of Schodack formation. Exposed as deep iron-red quartzitic sandstone in many localities in Catskill quadrangle. At top of formation.

E. P. Kaiser, 1945, Geol. Soc. America Bull., v. 56, no. 12, pt. 1, p. 1084 (table 1), 1089, 1090, 1091, pl. 1. Discussion of Taconic thrust sheet in Vermont. Zion Hill formation is chiefly massive gray medium- or coarse-grained quartzite. Thickness at Zion Hill and Wallace Ledge about 80 feet. Formation varies in details of lithology and thickness. In Zion Hill district, composed of two massive beds of quartzite separated by thin layer of sandy shale. In slate belt, overlies Schodack slate; in Zion Hill district, overlies Wallace Ledge formation (new); underlies Normanskill formation. Keith's (1932, Washington Acad. Sci. Jour., v. 22; 1933, 16th Internat. Geol. Cong. Guidebook 1 [eastern New York and western New England]) sequence and the sequence used in this report are incompatible. Keith's Barker quartzite (which must be that exposed on Barker Hill) is Zion Hill quartzite. Bird Mountain grit is thick facies of Zion Hill formation.

Phillip Fowler, 1950, Vermont Geol. Survey Bull. 2, p. 53–54. Zion Hill quartzite described in Castleton area. Lower Cambrian, not Ordovician as believed by Larrabee (1939). Cambro-Ordovician boundary is placed between Zion Hill quartzite and overlying banded slate which is arbitrarily mapped as Normanskill. Kaiser (1945) suggested that Bird Mountain grit was phase of Zion Hill. This is not unlikely as long as Berkshire schist surrounding Bird Mountain was considered to be metamorphosed Mettawee and Schodack. Inasmuch as bulk of Berkshire is here assigned to Nassau formation, Bird Mountain grit cannot be facies of Zion Hill quartzite. Overlies Schodack formation.

P. H. Osberg, 1952, Vermont Geol. Survey Bull. 5, p. 116 (fig. 16). Correlation chart for Taconic sequence, Vermont, shows Zion Hill quartzite above Wallace Ledge slate and below Schaghticoke shale.

E-an Zen, 1959, New England Intercollegiate Geol. Conf. Guidebook 51st Ann. Mtg., p. 1. Member of Bull formation. Massive greywacke or subgreywacke, ranging in thickness from 0 to 100 feet. Rapid variation in thickness suggests that it may be a shoestring sand and it occurs as discontinuous beds in general in middle part of formation. Base of rock may be pebble conglomerate, with load-casting features, whereas top may be mudstone. Overlies Bomoseen graywacke member; underlies Mudd Pond member (new).

George Theokritoff, 1959, New England Intercollegiate Geol. Conf. Guidebook 51st Ann. Mtg., p. 54. In Washington County, N.Y., a fine greenish to brownish quartzite weathering whitish to light gray occurs in Bull formation. It is correlated with Zion Hill quartzite in Vermont on basis of lithological similarity and stratigraphical position. Dale (1899, U.S. Geol. Survey Ann. Rept. 19, pt. 3) correlated quartzite of Zion Hill with quartzites "between Cambrian black shales (Horizon D) and the Ordovician black shales (Horizon G)." He named this unit "Ferruginous quartzite" and included in it the quartzite at Zion Hill as well as quartzites developed at higher horizons. Ruedemann (1914) named Dale's Ferruginous quartzite "Zion Hill quartzite," but quartzites included in this unit which occur at higher horizons are here referred to higher unit assigned to Upper Cambrian and named Hatch Hill formation.

Named for Zion Hill, Hubbardtown, Castleton quadrangle, Vt.

Zoar Limestone (in Pottsville Formation)[1]

Pennsylvanian: Eastern Ohio.

Original reference: J. S. Newberry, 1874, Ohio Geol. Survey, v. 2, p. 133, 134, pl. facing p. 31.

Named for Zoar, Tuscarawas County.

Zopilote Breccia (in Garren Group)

Tertiary: Western Texas:

Hugh Hay-Roe, 1957, Texas Univ. Bur. Econ. Geology, Geol. Quad. Map 21. Named proposed for alkali-feldspar trachyte flow-breccia that forms larger part of Zopilote Hills. Type section, measured from base, includes 148 feet of hard grayish-red massive lithic breccia. Unit is evidently the basal flow breccia of thick sequence, which crops out in hills south of area and is overlain by vesicular andesite correlative with Bell Valley andesite; thus the Zopilote is homotaxially equivalent to Means trachyte. Overlies Moon trachyte.

Type section: Zopilote Hills, Wylie Mountain area, Jeff Davis County.

Zoroaster Granite

Precambrian (Archean): Northern Arizona.

Ian Campbell and J. H. Maxson, 1936, Carnegie Inst. Washington Year Book 35, p. 330, 331. Granite cuts across, at steep angle, the nearly vertical schistosity of the country rocks. Contact best exposed on south side of Colorado gorge.

Well exposed by narrow canyon of Zoroaster Creek, Grand Canyon region.

Zuckerman Limestone Member (of Hoxbar Formation)[1]

Zuckerman (Zuckermann) Sandstone or Beds (in Hoxbar Group)

Pennsylvanian (Virgil Series): South-central Oklahoma.

Original reference: C. W. Tomlinson, 1928, Oklahoma Geol. Survey Bull. 40Z, p. 16.

R. C. Moore and others, 1944, Geol. Soc. America Bull., v. 55, no. 6, p. 697. Upper Hoxbar deposits, including Zuckerman sandstone, 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), 43–44. Zuckermann beds or member (of Hoxbar group) lies about 500 feet above Daube limestone member. Includes 30 feet or more of strata, chiefly white to buff coarsely crystalline calcareous sandstone, with finer grained layer at top and local development (intraformational?) conglomerate of gray limestone pebbles calcareous matrix. Crops out only in northern part of Lake Murray State Park and around north end of Criner Hills. Elsewhere (if present) it is hidden beneath unconformably overlying sediments.

Named for occurrence at abandoned coal mine of Daube, Westheimer, Munzeheimer, and Zuckerman, SE¼ sec. 8, T. 5 S., R. 2 E., Carter County.

Zuni pebble zone

Tertiary [Oligocene or Miocene]: Northeastern Arizona and northwestern New Mexico.

P. W. Howell, 1959, Dissert. Abs., v. 20, no. 2, p. 641. Younger than Zuni erosion surface, which may extend back to Oligocene time; older than late Miocene-early Pliocene Chetoh formation (new).

In Cheton country, a section of Colorado Plateau north of Little Colorado River, extending from Zuni Uplift west to Painted Desert.

**Zuni Sandstone**[1]

Upper Jurassic: Northwestern New Mexico and northeastern Arizona.

Original reference: C. E. Dutton, 1885, U.S. Geol. Survey 6th Ann. Rept., p. 137, pl. 16.

U.S. Geological Survey has restored the term Zuni Sandstone for use in Gallup-Zuni and Ackomas Basins.

Named for occurrence in Zuni Plateau, N. Mex.

†Zuni shale[1]

Upper Jurassic: Western New Mexico.

Original reference: C. R. Keyes, 1905, Am. Jour. Sci., 4th, v. 20, p. 424.

Derivation of name not stated.

†Zunian series[1]

Triassic(?) and Jurassic: Northeastern Arizona and northwestern 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.

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